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BEHAVIORAL ANTECEDENTS OF HYPERACTIVITY

BY

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Behavioral Antecedents of Hyperactivity" submitted by Olive June Yonge in partial fulfilment of the requirements for the degree of Master of Education.

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Supervisor

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Date May 2 1978

ABSTRACT

The research project attempted to discern (a) whether there was a difference between the environmental, birth, growth and developmental histories of hyperactive and non-hyperactive boys, and (b) whether hyperactive boys differed from nonhyperactive boys in regard to certain cognitive functions such as, planning ability and use of successive and simultaneous modes of information integration.

To examine the differences in the histories of the hyperactive and nonhyperactive boys, a parental questionnaire was designed and administered to 25 mothers of non-hyperactive boys and 25 mothers of hyperactive boys. The results obtained on the questionnaire were analyzed using chi square and content analysis. The statistical analysis showed that a greater number of hyperactive boys had only their biological mother living at home (not precluding the fact that the mother may have remarried), mothers of non-hyperactive children utilized Community Health Clinics more frequently, hyperactive boys required discipline more frequently, hyperactive boys had difficulty interacting with their peers and siblings prior to going to school and with their peers after they were going to school and second degree relatives of hyperactive boys had characteristics related to hyperactivity. The results failed to demonstrate a relationship between hyperactivity and organic factors.

The examination of the cognitive functions of the hyperactive and nonhyperactive boys were measured through the use of the Porteus Maze Test (1959) and Reitan's Trail Making Test. Both groups were compared using the t-ratio. The Porteus Maze, is a test designed to measure planning abilities. No difference was found between the hyperactive and nonhyperactive groups. Reitan's Trail Making Test, requiring successive information integration through sequencing of numbers on the first part and sequencing alternating numbers and letters on the second part, showed that the hyperactive boys required a significantly longer time to complete the task.

General implications, based on the results obtained on the parental questionnaire are discussed. Also, further research questions are offered.

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CHAPTER I

INTRODUCTION

The study of hyperactivity has become increasingly popular in the last two decades. Although high activity levels of children were observed and documented by Eric Hoffman in the late eighteen hundreds, the interest in and consequent research of hyperactivity is relatively recent (Conrad, 1976; Arnold, 1976).

At present the exact cause of hyperactivity is unknown. However, professionals offer management strategies and counselling to affected children and parents without any understanding of the possible complex psychological or physiological etiologies underlying the disorder (Weithorn, 1973). This practice in modern day medicine is comparable to the use of blood letting to alleviate fever; in which lack of knowledge of the fever's cause did not deter professional use of that practise in treating patients in the eighteen hundreds (Coleman, 1972).

The research project was designed around the general question, "Is there a difference between the environmental, birth, growth and developmental histories of hyperactive and nonhyperactive children?" Prior to the question being refined and broken into subquestions, a difficulty arose regarding the definition of hyperactivity. Hyperactivity

has been referred to as hyperkinesis (Millichap, 1975; Conrad, 1976), brain damage syndrome (Strauss and Lehtinen, 1947), minimal brain dysfunction (Clements, 1966) and developmental hyperactivity (Safer and Allen, 1976). Therefore it is not surprizing that the prevalence of this nebulous behavior has been estimated to vary from 2 to 40 per cent (Safer and Allen, 1976). Furthermore, Cantwell (1975) states that the prevalence percentages have varied depending on the populations studied (clinical referrals versus normal non-referred children), method of investigation (retrospective, longitudinal) and diagnostic criteria used to assess hyperactivity (rating scale, mechanical instruments, questionnaire).

Another problem regarding hyperactivity, aside from definition, referred to the nature of the disorder. Specifically, there has been dissension among researchers whether to regard hyperactivity as a syndrome (Cantwell, 1975; Sykel et al., 1973) or as a symptom (Stewart and Olds, 1973; Ross and Ross, 1976). A syndrome implies a number of co-existing symptoms which have a common basis, an example being measles (Safer and Allen, 1976; Ross and Ross, 1976). However, to date there has been no empirical evidence proving the existence of a common etiology. Researchers have identified a specific number of coexisting symptoms, an example being the Child Rating Scale for Hyperkinesis (Davids, 1971). If hyperactivity is viewed as a symptom, its signifi-

cance then depends on a number of factors, including the following: age, sex, occurrence of high activity levels in appropriate situations, ability to voluntarily control activity level and the presence of other behavioral or physiological disturbances (Ross and Ross, 1976). Other behavioral signs and symptoms such as short attention span, impulsivity, and so forth, may or may not occur concurrently with high activity levels (Stewart and Olds, 1973). Hyperactivity viewed as a symptom becomes a broad, complex area of study due to the many possible etiologies in reference to the symptom itself and to related disorders and/or symptoms.

In an attempt to simplify the syndrome-symptom dichotomy, researchers have approached the question of etiology of hyperactivity from either a unitary or multiple framework. A unitary framework implies a standard cause with unique expressions (Wender, 1973; Waldrop, 1971; Weiss, 1971), whereas a multiple framework indicates many causes and an interaction of causes (Ney, 1974; Ross and Ross, 1976; Arnold, 1976). The present research project has been designed with deference to a multiple framework.

The problem regarding a definition of hyperactivity was reduced by accepting an operational measure of hyperactivity rather than a theoretical definition. The operational measure decreases the difficulty of semantic problems in the definition. Also this measure has to be a

reliable indicator of hyperactive behavior in the hyperactive group. The measure meeting this criteria was the Child Rating Scale of Hyperkinesis (Davids, 1971). This Scale has been shown to have adequate reliability as evidenced by Burns and Lehman's (1974) report of a .922 correlation between test-retest administrations.

The examination of the birth, growth and developmental histories of hyperactive and nonhyperactive children, indicated a need to differentiate a number of specific behavioral antecedents of hyperactivity, which were drawn from genetic, organic, environmental and psychogenic areas of study. Whether a behavioral antecedent was chosen or not depended on whether it had been researched in the past or if the review of the literature indicated that a specific behavior appeared to be significant.

The original question addressed itself to hyperactive and nonhyperactive children. For the research project, males rather than females were chosen as the subjects due to the higher incidence of hyperactivity in males than in females (Safer and Allen, 1976; Ross and Ross, 1976), and due to the availability of hyperactive male subjects (King, 1978).

Mothers were to be interviewed in order to obtain information regarding the birth, growth and development of the subjects, and therefore the researcher could arrange to be in contact with the subjects. Given this opportunity,

a second general question was formulated, "Did hyperactive boys differ from nonhyperactive boys in regard to certain cognitive functions such as, planning ability and use of successive and simultaneous modes of information integration?" Two standardized instruments, the Porteus Maze Test and Reitan's Trail Making Test, were chosen to measure the cognitive functions.

In summary, the specific objectives of this research project are:

1. To examine if the occurrence of hyperactive behavior is influenced by birth order, family size, race, religion; and, age, occupation, education and marital status of the parents.
2. To determine if there is a significant difference between the mothers of the hyperactive boys and the nonhyperactive boys in regard to previous maternal difficulties and the pregnancy and delivery of the boy being studied.
3. To determine if there is a significant difference between the hyperactive and nonhyperactive boys in regard to the neonatal and infancy periods, presence of anomalies, achievement of developmental milestones, illnesses, accidents, need of discipline, enuresis and ability to form interpersonal relationships.
4. To ascertain if there is a significant difference be-

tween male and female first and second degree relatives of the hyperactive and nonhyperactive boys in regard to school based learning behavior, temperamental characteristics (irritability, impulsivity, anger and unpredictability), high activity levels, history of psychiatric or physical illness, antisocial behavior as evidenced by a prison record and the abuse of alcohol.

5. To determine whether boys displaying hyperactive behavior have signs of organic brain damage as measured by Reitan's Trail Making Test.

6. To examine if there is a significant difference between the hyperactive and nonhyperactive boys in regard to the utilization of planning behaviors as measured by the Porteus Maze Test.

7. To examine whether hyperactive boys have a preference for either a successive or simultaneous mode of information integration.

CHAPTER II

REVIEW OF LITERATURE

According to Ross and Ross (1976) researchers have theoretically acknowledged the presence of etiological subgroups as the basis for hyperactivity, but prior to 1970 the major thrust of research was confined to an organic versus a nonorganic etiology, a finding reinforced by Werry (1968) in his review of the literature. Using different terminology, he was able to delineate the hard neurological orientation (organic), the soft orientation (psychogenic or environmental) and the middle position expounded by researchers such as Eisenberg and Chess, which is a mixture of the other orientations. Werry concludes by stating

> it seems best to view hyperactivity as a sign and symptom which may be due to a variety of factors such as brain dysfunction, biological variation, developmental disorder, emotional disturbance (that is, anxiety motivated or deficient socialization) (p. 175).

Following from this statement, a variety of factors will be examined in this section. The factors, for the sake of clarity and organization, have been grouped into four categories based on the Ross and Ross (1976) etiological model. It should be noted that researchers have developed anywhere from two (Strauss and Lehtinen, 1947) to twelve etiological subgroup categories (McMahon, Deem and Greenberg, 1970) and that the grouping of four categories

was arbitrarily chosen.

Genetic Factors

Prior to the 1970's, there was very little genetical research done as it related to hyperactivity. Ross and Ross (1976) state that this was due to the assumption of an organic-nonorganic basis as the cause of hyperactivity, as evidenced by clinical descriptions and experimental studies. Also, etiological classifications devised prior to 1970 primarily contained the organic-nonorganic categories. However, recently through the study of first-degree relatives of hyperactive children, twin studies and adoption studies, researchers have discovered that an important relationship appears to exist between hyperactivity and genetic factors. The specific nature and characteristics of this relationship are still unclear due to the difficulties of discerning environmental from inherited factors. Furthermore, Omenn (1973) points out that the behavioral phenotypes are highly variable and maybe quite "removed from the direct effects of single genes and enzymes" (p. 5). Also, this phenotype maybe a result of differing genetic inputs, making it difficult to determine whether behavior is primarily influenced by genetic or environmental factors.

Mechanism of Genetic Transmission

Cantwell (1975) acknowledges that the mechanism of genetic transmission is unknown; but suggests certain gen-

etic models which can be hypothetically considered. As he lists them, they are: chromosome anomaly, simple autosomal dominant and simple autosomal recessive transmission, sex linkage and polygenic inheritance.

In regard to chromosome anomaly, an XYY and XXY chromosome combination have previously been linked to personality disturbance. Warren et al., (1971) studied 96 children who were previously diagnosed as hyperactive. He found no evidence of an abnormal number of X chromosomes nor of any abnormality of chromosome number or morphology.

If hyperactivity is transmitted by a simple autosomal dominant gene, then one parent would have to be hyperactive, there would be no sex differences, and it would occur in every generation (Cantwell, 1975). Based on these conditions this model is not viable because parents do not always show hyperactive behavior, males are more frequently affected than females (Safer and Allen, 1976) and the condition does not consistently appear in every generation.

To fit the criteria for a simple autosomal recessive model, both parents would be carriers but neither of them would be hyperactive. Also, approximately 25 per cent of the full siblings of the affected child would be hyperactive (Cantwell, 1975; Ross and Ross, 1976).

Wender (1971) found that siblings of hyperactive

children may also be hyperactive but at present it is not known whether the number of siblings comprises 25 per cent, or more or less. Concerning the parents, Morrison and Stewart (1971) rated a parent as a "probably hyperactive child" if they were aggressive, reckless, extremely active, suffered from distractibility, had poor concentration, had difficulty learning and demonstrated antisocial behavior as children. They found 20 per cent of parents of hyperactive children exhibited these behaviors. Consequently, the simple autosomal recessive gene model is not fully supported.

The sex-linked model was proposed due to the greater number of affected males than females. However, this model also appears unlikely due to the apparent transmission of hyperactivity from father to son (Cantwell, 1975; Ross and Ross, 1976; Omenn, 1973).

The last model of genetic transmission suggested by Cantwell is the polygenetic inheritance model. Essentially, the model implies that there is more than one gene locus responsible for the transmission of hyperactivity. Instead, a number or combination of certain genes when influenced by specific environmental factors, will cause hyperactivity. Morrison and Stewart (1973) have been able to support this model by showing a greater risk factor in families who have a larger number of members displaying hyperactive behaviors, and a greater incidence of second degree relatives affected

by the disorder when the hyperactive child had a first degree relative who was hyperactive. Concerning the risk factor, Morrison and Stewart had earlier noted in their research a relationship between alcoholism and hyperactivity. Therefore, taking alcoholism as a risk factor, they attempted to find out if there was a greater incidence of alcoholism in families of hyperactive children, and found the incidence to be twice as high. The only problem with their research was the use of a small sample, which makes it difficult to generalize their findings to other hyperactive families.

To this point, Cantwell's genetic models have been discussed. The following section will examine the research done on first degree relatives, twins and adopted children.

First Degree Relatives

First degree relatives (parents, siblings and children) of a person affected with a disorder have a higher risk of developing the particular disorder than the general population, a fact that has been proven to be true for epilepsy, depression, schizophrenia and alcoholism (Omenn, 1973). A number of researchers, based on clinical observation, have suggested that an increased prevalence of psychiatric illnesses and social problems is manifested by first degree relatives of hyperactive children (Wender, 1971; Satterfield, 1974; Mendelson et al., 1971).

The two most systematic studies of first degree relatives were carried out by Morrison and Stewart (1971) and

Cantwell (1972). Morrison and Stewart interviewed parents of 59 hyperactive and 41 normal children, and found a greater prevalence of alcoholism, sociopathy and hysteria in the parents of the hyperactive children (33 per cent compared to 17 per cent). Cantwell generally supported Morrison and Stewart's findings, but he found the prevalence of alcohol to be fairly high for both groups of parents. However, he attributed this finding to the nature of the sample, as all of the parents in the sample were military people whom, he hypothesized, probably resorted to alcohol as a leisure activity or as a means of dealing with high controls in their lives.

Twin Studies

The use of twin studies involves a comparison of identical monozygotic twins with fraternal dizygotic same-sex twins, where at least one member of each pair is affected with the disorder. Genetic factors are assumed if there is a higher incidence of the disorder in the monozygotic co-twins than in the dizygotic co-twins. However, if there is no significant difference in the incidence of the disorder in the twins, environmental factors are assumed.

Lopez (1965) studied 10 pairs of twins of which 4 pairs were monozygotic and 6 were dizygotic. He found all of the monozygotic and only 1 set of the dizygotic twins to be hyperactive. Unfortunately, Lopez did not take sex into account, and since all of the monozygotic and only two-thirds

of the dizygotic twins were males, it is not obvious whether the findings were due to a genetic or a masculinity factor.

Willerman (1973) studied 93 sets of same sexed twins: 28 monozygotic and 28 dizygotic male pairs and 26 monozygotic and 11 dizygotic female pairs. Using the Werry-Weiss-Peter's Activity Scale, he labeled all children who scored in the top 20 per cent of the scale as hyperactive. He found that the monozygotic twins showed a significant higher correlation for activity level, whereas the dizygotic twins showed no correlation at all. Therefore, he was able to conclude that genetic factors must be considered in the etiology of high activity levels.

Scarr (1966) had previously found similar results to Willerman, although she had only studied 61 pairs of female twins. Concerned with activity motivation, she used rating scales, experimental tasks and interviews to obtain her data. She found a higher correlation for activity motivation between monozygotic twins than dizygotic twins.

Adopted Children

This method studies the adopted or foster hyperactive children and their adoptive and biological parents. If hyperactivity is transmitted genetically, then the biological parents should have a greater incidence of psychiatric disorders associated with hyperactivity and a history of hyperactivity.

Cantwell (1972), and a year later Morrison and Stewart

(1973), did find a higher prevalence of hyperactivity in the first and second degree relatives of the biological parents. Also, in this group, they found a higher prevalence of sociopathy, hysteria and alcoholism. However, both research groups were unable to interview the biological parents of the adopted children and had to interview the biological parents of another group of hyperactive children, thereby weakening their results (Ross and Ross, 1976).

Safer (1973) studied the siblings and half siblings of 17 children who were diagnosed as having minimal brain damage, all of whom had been placed under foster care at an early age. He found that 10 of the 19 full siblings, and only 2 of the 22 half siblings, manifested signs and symptoms of minimal brain damage; and that the full siblings tended to have a shorter attention span and a higher frequency of childhood antisocial behaviors. The findings support a genetic factor in the etiology of minimal brain damage.

Summary Statement

Cantwell (1975) and Morrison and Stewart (1973) have initiated the majority of research in this area. Of all of the proposed mechanisms of genetic transmission, the polygenetic inheritance model appears to be the most viable. The study of first degree relatives, twins and adopted children have all supported a genetic etiology hypothesis.

Organic Factors

Historically, hyperactivity was the most pronounced sign and symptom of brain injury or damage due to accident, trauma or disease, and as a greater prevalence of hyperactivity was observed, a causal relationship between hyperactivity and brain damage was assumed. Strauss and Lehtinen (1947) contributed to this view by identifying hyperactivity as the distinctive behavior of children sustaining an external insult to their central nervous system which resulted in brain damage, the external insult being distinguished from an internal problem by the terms exogenous and endogenous. Furthermore, they contended that the brain injury occurred prenatally, during birth or neonatally (See Table I). Although they were unable to specify the location, extent or site of damage, they hypothesized that the damaging external events produced structural brain changes due to lack of oxygen, hemorrhage or inflammation of the brain tissue.

Pasamanick, et al. (1956) having earlier discovered a relationship between mental retardation and factors in pregnancy, attempted to find out if there was a relationship between behavioral disorders and factors in pregnancy. Behavioral disorders, according to Pasamanick et al., meant children who were confused, disorganized and hyperactive. They found toxemia and hypertension occurring during pregnancy to be highly correlated with behavior disorders in

TABLE I

Factors Producing Brain Injury During the Prenatal Period, Birth and After Birth

Factors Producing Brain Injury During the Prenatal Period

Any accident the mother may have suffered with particular damage to the abdomen may very probably result in injury to the fetus. Factors, the operation of which is less well known but which must be evaluated as possibilities, include any infectious diseases of the mother during pregnancy, particlarly German measles and measles, X-ray treatment of the pregnant mother, serious heart and kidney diseases, serious intoxications, and extreme vitamin deficiencies. It is still within the province of research whether these latter factors produce injuries or whether they act rather to produce malformations or degeneration of the brain.

Factors Producing Brain Injury During Birth

Prebirth Conditions	Birth Conditions
Premature birth	Long and difficult birth
Cesarean birth	Dry birth
Prolonged pregnancy	Precipitate delivery
Maternal Conditions	**Fetal Conditions**
Eclampsia	Anomalies in presentation
Pelvic malformation	Twisting of the umbilical cord
Antepartum hemorrhage	
	Medical Conditions
	Use of forceps
	Improper use of anesthetic or drugs

Factors Producing Brain Injury After Birth

Infectious diseases during the first months, particularly whooping cough, measles, scarlet fever, pneumonia
Encephalitis and meningitis
Traumata to the head: falls or blows resulting in concussions or skull fracture
Sequelae of the newly discovered Rh factor

Note. Obtained from A.A. Strauss and L.E. Lehtinen, Psychopathology and Education of the Brain-Injured Child. New York: Grune and Stratton, 1947, pp. 106-107.

children. Other significant factors that were found to be correlated with behavior disorders included: bleeding during pregnancy and labour, non-puerperal complications, dystocia owing to an abnormal pelvis, miscellaneous puerperal complications, premature separation of placenta, placenta praevia, malpresentations other than breech and low birth weight. No significant difference was found regarding operative procedures such as use of forceps or caesarian section.

In the summary of the article, Pasamanick et al., notes that the above complications of pregnancy and birth are not only associated with behavioral disorders, but also with stillbirths, neonatal deaths, cerebral palsy, epilepsy and mental deficiency. Therefore, they proposed that there may exist a neuropsychiatric continuum of reproductive casualty composed of lethal and sublethal components. The child's placement on the continuum would depend on the severity, type and location of brain damage resulting from the reproductive casaulty factor.

Pasamanick's et al., findings have received support from Laufer and Denhoff (1957), Anderson (1963), Wender (1971), Lopez (1965) and Safer and Allen (1976), but has been contradicted by the research of Minde, Webb and Sykes (1968). Using a retrospective approach, they studied the birth histories of 56 hyperactive and 56 normal children, and through examination of 23 prenatal and perinatal complications, they

found only an unusual length of labour when associated with instrumentation to be a significant finding. Yet, as Montagu (1962) cites that a significant relationship exists between the length of labour and all types of central nervous system damage, this variable alone may support an organic hypothesis. Nevertheless, Minde, Webb and Sykes also cite other researchers such as Fraser and Wilkes (1959), Pond (1961), Graham et al. (1962) and Ernhart et al.; (1963) who have also been unable to support Pasamanick's et al., findings.

Minor Physical Anomalies

Waldrop, Pedersen and Bell (1968) observed a relationship between hyperactivity and an increased incidence of minor physical anomalies in the child, which included: increased head circumference, an epicanthus which was deeply covered, low-set ears (bottom of ears in line with mouth or lower), fifth finger of hand markedly curved inward toward other fingers and the third toe longer than the second toe. These findings were confirmed by Rapoport, Quinn and Lemprecht (1974), who, using a sample of 76 boys who were rated as hyperactive through the use of a teacher rating scale, found a relationship between the presence of minor physical anomalies and obstetrical complications. The obstetrical complications included bleeding, toxemia, premature birth, caesarian section, placenta praevia and fetal distress. The only explanation the researchers could give for the findings,

was that a genetic disorder may be phenocopied by a traumatic event early in the pregnancy; an explanation which however, does not take into account the obstetrical complications that occur later in pregnancy such as premature birth.

Hyperactive Profile

Up until the late 1950's, only observable behavior of hyperactivity such as restlessness and distractibility was used as the main criteria on which to base a diagnosis of hyperactivity, and consequently an organic etiology was inferred on the basis of observable behavior. Through the realization of the need for objective measures and discovery of the complexity and varying nature of the disorder, researchers such as Anderson and Plymate (1962) and Clements and Peters (1962) suggested a more comprehensive evaluation of the child displaying the disorder, which included clinical, psychological, neurological (including EEG) assessment. Consequently a hyperactive profile was established and included prenatal and perinatal complications, prematurity, soft neurological signs and abnormal EEG's.

Inclusion of soft neurological signs and abnormal EEG's in the profile, stimulated a great deal of research on these two variables. The findings have generally shown that although quite a few hyperactive children have a greater percentage of soft neurological signs and/or abnormal EEG's, the difference between the hyperactive and normal children

concerning these two variables, is not significant (Satterfield, 1973; Werry, 1968).

Central Nervous System Dysfunction

Pavlov (1927) suggested the earliest theory of central nervous system dysfunction which focused on cyclical reciprocal excitation and inhibition. Essentially this model viewed cerebral excitation occurring as a result of stimulation which was then countered by inhibition in the same and in the surrounding areas of the brain.

Luria found this Pavlovian model to be workable in terms of his research with hyperactive children (Weithorn, 1973). He proposed that children could be classified in terms of three nervous processes: strength, balance and lability. If any of the three processes became impeded, the inhibition-excitation balance would change and consequently there would be a behavioral change. The observable behavior would vary from listlessness to restlessness, depending on which nervous process was affected (Williams, 1976).

Another theory of central nervous system dysfunction, based on an equilibrium concept pertaining to the arousal state, views the hyperactive child as overaroused: the child, through stimulation-seeking behavior, attempts to induce cortical inhibition in order to achieve equilibrium. This theory has received support through the clinical observation of hyperactive children watching television for pro-

longed periods of time, the stimulation of which in some way induces cortical inhibition (Weithorn, 1973).

Delayed and/or Irregular Maturation

The maturation model developed from the clinical observation of delayed physical and psychological development in the hyperactive child. It was originally thought that the delay in development was corrected at puberty (Werry, 1968), but recent research findings have shown that a significant proportion of hyperactive children, when adolescent, engage in antisocial behaviors, suffer from depression, may have serious academic retardation, have a poor self image (Cantwell, 1975), lack ambition (Weiss, 1971), are more active than their peers, are impulsive, rebellious and have difficulties concentrating (Mendleson et al. 1971). Also, developmental differences between hyperactive and age related normals has been empirically documented by Oettinger, Majovski, Limbeck and Gauch (1974), who found that the bone age of minimal brain damaged subjects compared to normal elementary school age children was significantly retarded. Researching psychological development, Buttor and Lapierre (1974) found that hyperactive children, aged six to twelve, were 18 to 24 months less mature than matched controls as measured by the Illinois Test of Psycholinguistic Abilities.

The cause of delayed maturation is generally attributed to some type of organic central nervous dysfunction. Laufer and Denhoff (1957) have suggested that hyperactivity

is the result of subcortical dysfunction. Specifically, subcortical dysfunction could be caused by anything (anoxia, brain injury), "that produced dysfunction of the diencephalon and the diencephalocortical interactions" (p. 467), and could occur any time between prebirth to 5 years of age. The effect of the dysfunction in the diencephalon results in the child being flooded with peripheral and viseral stimulation. However, as the child grows and develops, the cortex also develops and plays a greater role in inhibiting the stimulation and consequently the maturational lag begins to diminish.

Information Processing

The research project has objectives which attempt to ascertain if hyperactive boys use a different method of information processing than nonhyperactive boys. Information processing is a term which refers to input, storage, retrieval and output of information (Kirby, 1976). Since the term represents many constructs, only the following selected constructs were examined: planning behavior, and the use of simultaneous and successive modes of information integration. The review of the literature focusing on these constructs will examine Luria's model of information processing, which in part gives an historical perspective, followed by the more recent contributions Das, Kirby and Jarman (1975) have made in this field.

Simultaneous and Successive Syntheses

Luria (1973), through observation of brain damaged patients, proposed that the human brain was composed of three functional systems. The first system includes the reticular formation, upper brain stem, limbic cortex and hippocampus, and is responsible for arousal and maintaining wakefulness. The second system includes the occipital, parietal and frontal temporal lobes and is responsible for input, recording and storage of information. The third system located in the frontal lobes is responsible for planning and executing behavior.

Cognitive content is synthesized through the use of interoceptive, proprioceptive and exteroceptive analyzers which are located throughout the brain but work collectively to synthesize the input. The synthesis, according to Luria, has two modes of operation: simultaneous and successive. Also, the synthesis takes place at the perceptual, memory and complex intellectual levels of functioning.

Simultaneous processing involves the synthesis of separate elements into groups which usually have spatial overtones, any part of the synthesis, regardless of position, being surveyable. Successive processing involves the grouping of separate elements into a serial order, and unlike simultaneous processing, only select portions are surveyable and these portions are dependent on elements which precede them.

Das, Kirby and Jarman's Simultaneous and Successive Processing Model of Information Integration

Drawing from Luria's work, Das, Kirby and Jarman (1975), developed a composite model of information processing which is illustrated in Figure 1. The model consists of four units: input, sensory register, central processing and output. Input, presented in a simultaneous or successive manner, is registered by the sensory register, and if not processed further rapidly decays. The sensory register processes the input in parallel form and the central processing unit, the equivalent to Luria's second and third systems, interprets it serially. Here the input is processed through encoding, recording and storage mechanisms according to the third system of planning and decision making, and no matter what form the input is in, the processing will take place simultaneously or successively at the perceptual, memory or complex intellectual levels. The use of either form of processing is dependent on the nature of the input, and the individual's habitual method of processing input, which is mediated by environmental and genetic factors. The output unit organizes a response which is consistent to the nature of the input (Das, Kirby and Jarman, 1975).

Relevancy of Information Processing to Hyperactivity

Using Luria's three functional brain systems as a reference point, hyperactivity may be understood in terms

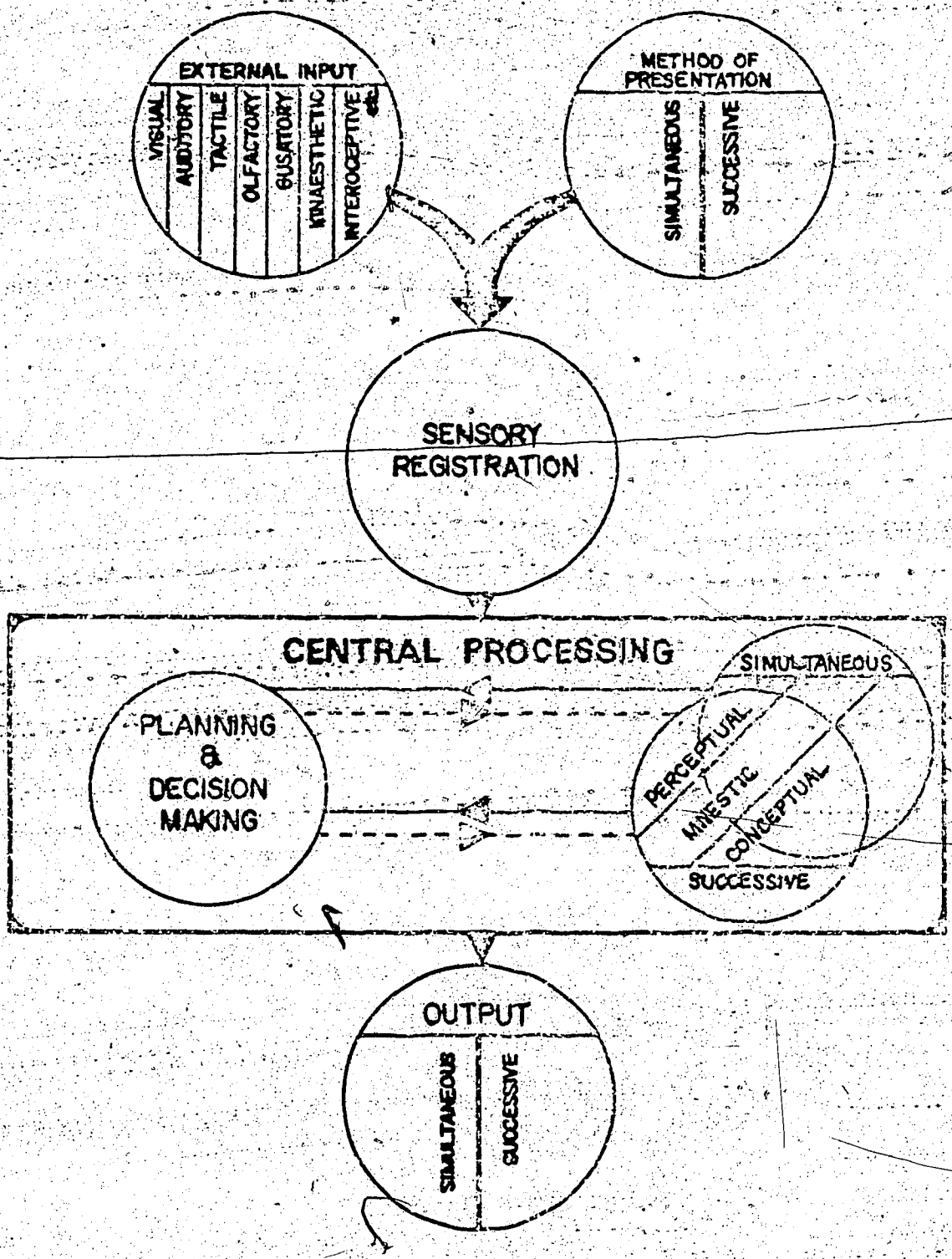

Figure 1. The simultaneous and successive processing model of information integration (from Das, Kirby and Jarman, 1975, p. 90)

of the first system, which is responsible for arousal and wakefulness, and the third system, which is responsible for planning and executing behavior. In regard to arousal, the structures controlling this function may be defective, and consequently the child, in response to the defect, maybe overaroused or underaroused. An overaroused child may show excessive excitement when no situation warrants such behavior, whereas an underaroused child may show minimal excitement when much more emotional reaction is appropriate (Das, 1975-1976).

Williams (1976) using a physiological measure, tested normal and hyperactive children in a controlled laboratory setting, finding children who had been rated as hyperactive in the classroom were underaroused physiologically. Therefore it could be argued that the hyperactive child is merely seeking stimulation in order to raise his arousal level.

Little is known about the system responsible for planning and executing behavior. Hyperactive children may have a dysfunction in this system as evidenced by certain characteristic behaviors, since they have difficulty delaying gratification, lack impulse control, are only able to concentrate for short periods of time and are unpredictable (Davids, 1971).

The two systems are interdependent since the arousal system is regulated by the third system, which is responsible for planning and executing behavior. Therefore hyper-

activity should not only be viewed as a result of a dysfunction of either system, but as being the result of an interaction between the two systems.

In regard to simultaneous and successive information integration, a child may use either mode when engaging in cognitive tasks. It has been documented that an overaroused child has difficulty using simultaneous processing (Das, 1975). Also, Williams (1976) found that hyperkinetic children had difficulty on two tasks which required a successive mode of information integration.

Presently, all the ramifications of whether a hyperactive child uses a simultaneous or a successive mode of information integration, is unknown. Hypothetically, knowledge that a hyperactive child characteristically prefers one mode of information integration over the other, may prove to be a valid diagnostic tool; and secondly, remedial instruction for the child would be dependent and organized in terms of his preferred or "developed" mode of information integration.

Summary Statement

This section examined research related to an organic basis of hyperactivity. The approaches used by researchers varied from the examination of specific physiological changes, such as toxemia in pregnancy, to the use of a hyperactive profile in determining the cause of hyperactivity. The latter part of the section discussed a few pertinent theories

of information processing and how they were relevant to the study of hyperactivity.

External Factors

It is feasible that hyperactivity could be caused, or at least be facilitated, by certain external factors. The following section will examine the role of lead poisoning, radiation stress, hypersensitivity, maternal behaviors and environmental constraints as they relate to the etiology of hyperactivity.

Lead Poisoning

Lead is a trace element which was recognized as a toxin as early as the second century B.C. by Nirander, a Greek poet-physician, who noticed that colic and paralysis resulted from ingestion of liquor made in lead pots (Needleman, 1973). At present, lead occurs so widely in the environment, that "exposure to it is almost inevitable, even for fetuses" (Ross and Ross, 1976, p. 82).

Most children develop lead poisoning from the ingestion of two nonfood substances: lead-pigmented paint and roadside dust or snow contaminated with high octane leaded gasoline. After World War II, the lead in paint was replaced by titanium oxide, but concentrations of lead up to 40 per cent by weight have been found in the paint of inner city and older homes built in the United States of America prior to or during the Second World War. New paint

is usually placed over old paint and since certain constituents of paint volatize over a period of time (with the exception of lead), it is therefore possible to predict the presence of lead in any home painted prior to World War II (Needleman, 1973).

The onset of lead poisoning is insidious: the child may initially be tired, anorexic and irritable. Later he may complain of abdominal pain, headache and show motor unsteadiness (Needleman, 1973), and as the lead concentration increases, changes occur in renal function and the central nervous system. The following behaviors and physiological changes have been noted to occur as a sequelae to lead poisoning: permanent neurological damage, cerebral palsy, nerve lesion, intellectual impairment, visual impairment, increased sensitivity to convulsive disorders and behavioral disturbances such as hyperactivity and negativism. Many of the physiological changes have been confirmed through autopsy (Barltrop, 1973).

David, Clark and Voeller (1972) examined the relationship between lead poisoning and hyperactivity. They compared the urine and blood lead levels of hyperactive (N=82) and nonhyperactive (N=37) children and found over half of the hyperactive sample had raised, but not toxic, blood lead levels, and 60 per cent had toxic urine lead levels. The results of the research permitted them to conclude that a positive relationship existed between the presence of lead

in the body and hyperactivity. Further, the researchers questioned the validity of the present serum value which theoretically denotes toxicity, and instead preferred to view any lead elevation as significant in relation to the etiology of hyperactivity.

An important observation was also made in regard to the treatment of lead poisoning. After a toxic serum level is confirmed through laboratory testing, a chelating agent is administered to the child. The chelating agent combines with the lead atoms, and then both are excreted through the kidneys. The treatment works rapidly and is highly effective (Ross and Ross, 1976), but a problem arises when the child is returned to the same lead contaminated environment: either he is treated repeatedly, or he develops the previously mentioned seqeulae to lead poisoning.

If David, Clark and Boeller's research is confirmed to be valid and reliable, it will have a considerable impact on the health care of children, since it is estimated that over 20 per cent of all children in certain cities in the United States of America have excessive blood lead levels (Barltrop, 1973).

Radiation Stress

Television, X-ray machines and fluorescent lights are a few of the many electrical devices which produce radiation. Individually, one electrical device may produce an insignificant amount of radiation, but exposure to a number of

electrical devices may produce biological changes in man (Ott, 1976). Radiation is not always man-generated but is found in natural materials such as rocks which contain varying levels of radioactivity. Joffe (1969) cites a research study done by Gentry, Parkhurst and Zulin in 1959, who found a direct relationship between the incidence of infant malformations and the amount of radioactivity present in the natural environment.

John Ott (1976), a photobiologist, has noted a relationship between radiation stress produced by fluorescent lighting and certain television frequencies, and hyperactivity. On Ott's instigation, the Environmental Health and Light Research Institute (U.S.A.) monitored two control and experimental first grade classrooms by means of time-lapse photography for five months. In the experimental classrooms, the standard fluorescent lights were replaced with specially designed fluorescent lights which more nearly simulated natural daylight, whereas the control classrooms were lighted with the usual fluorescent lights. A week after the start of the experiment, changes were noted in the experimental group: the students became more manageable, attentive and interested in their work; in the control classroom, students continued to fidget, move from their seats and flail their arms. However, when discussing this study in his book, Health and Light, Ott makes no reference to the number of children observed in each group, whether an

objective measuring instrument was employed to measure the observed differences between the classrooms or pre and post behaviors, and gives no explanation of what he considers hyperactive behavior to be. Nevertheless, Ott's research is certain to stimulate further research in this area, and suggests the possibility that hyperactivity could be a byproduct of radiation stress.

Hypersensitivity

A relationship between hyperactivity and hypersensitivity to certain food additive and/or allergies to certain foods has been hypothesized. This hypothesis is based in part on the observations that hyperactive children seem to have more allergies than normal children, and some children who experience seasonal allergies exhibit more behavioral signs and symptoms during their allergy related season (Arnold, 1976).

The physiological basis of allergy-induced hyperactivity is unknown. Moyer (1975), quoted by Ross and Ross (1976), has postulated that the central nervous system is directly affected by certain allergens, causing a noninflammatory swelling among the neural connections responsible for aggression, which in turn would result in increased sensitivity to stimulation in that area.

Feingold (1976), a specialist in child allergies, has proposed that certain children are unable to tolerate synthetic chemicals due to possible genetic variations, and

specifically refers to artificial food colors and flavors as being the undesirable synthetic chemical. Also, he has noted that artificial food colors and flavors and certain drugs used as medications are both low molecular weight compounds. Therefore, acknowledging that certain drugs are behavior modifiers, he argues that additives also have this property. In relation to hyperactivity, the additive maybe the sole cause of the disorder, or may be an irritant ingested prenatally or during extrauterine life.

Feingold's theory has evoked a great deal of research and criticism. Spring and Sandoval (1976) reviewed Feingold's work and concluded that there is no scientific evidence that a positive relationship exists between increased additives in food and an increase in hyperactivity, and that there is a discernable placebo effect in many of the studies: for example, the constant attention given to the child, generated by the additive free diet, would affect the child's behavior. Lastly, they concluded that none of the earlier studies used control groups, yet Feingold promoted a great deal of publicity from his limited, nonvalidated findings. Public promotion becomes an unproven panacea and consequently children who need intervention other than an additive free diet may never receive what they really require.

Maternal Behaviors

The prenatal environment which is controlled and monitored by certain maternal behaviors, is as important to the

normal development of the fetus as is the extrauterine environment to the normal development of the child. The following section will briefly examine a few of the most important maternal behaviors.

Nutrition

Maternal health and fetal growth, development and viability are dependent on adequate maternal nutrition. If the mother is malnourished, the incidence of disorders of pregnancy increase (Joffe, 1969), and earlier in the discussion of organic factors, disorders of pregnancy were linked to neuropsychiatric disorders, including hyperactivity (Pasamanick et al., 1956).

Disease

Aside from toxemia, which is considered a disorder of pregnancy by Pasamanick et al (1956) Laufer (1957) and Anderson (1963), Montagu (1962) states that disturbed metabolism, cancer (specifically choriocarcinoma and malignant melanoma), and viral and bacterial diseases directly or indirectly affect the growth and development of the fetus. However, Montagu does not cite the specific mechanism of biological interference, nor does he differentiate the exact fetal behavioral effects caused by the mentioned maternal illnesses.

There is little support to prove a cause-effect relationship between maternal illnesses and hyperactivity in the fetus. Even when a child has gross neurological defects

caused by a virus such as rubella, there may be no evidence of behavioral disturbance (Joffe, 1969).

X-ray

X-ray can affect prenatal development prior to and/or during pregnancy. Prior to pregnancy, the ionizing radiation in the X-ray can alter the chromosomes of the ovaries or sperm cells, thereby producing inheritable anomalies. During pregnancy, the ionizing radiation has the same action but the effect is greater because fetal tissue has a greater susceptibility to exogenous stimuli than adult tissue (Joffe, 1969).

A significant number of anomalies, including ones of the central nervous system, have been found in the offspring of mothers exposed to X-ray (Joffe, 1969).

Drugs

Joffe (1969) and Montagu (1962) both state that the majority of drugs and hormones adversely affect the fetus in producing congenital or developmental anomalies, much less death, and behavioral effects from prenatal drug administration have been repeatedly documented through animal experimentation (Joffe, 1969).

Alcohol, a very common drug, was studied in terms of its effect on the offspring of chronic alcoholic women by Jones et al., (1974). The researchers studied 23 offspring and found a perinatal mortality rate of 17 per cent, varying degrees of mental deficiency in 44 per cent, and abnormal

features such as short palpebral fissures and cardiac murmur in 32 per cent. The researchers were so appalled by the findings that they suggested early termination of pregnancy for any chronic alcoholic woman. Jones's research therefore suppots the hypothesis that hyperactivity maybe caused by brain damage.

Smoking

High levels of carbon monoxide in the fetal blood stream can interfere with oxygenation during delivery. Also, heavy cigarette smoking has been associated with obstetrical complications which in turn could produce fetal anoxia (Ross and Ross, 1976).

Denson, Nanson and McWalters (1975) researched the relationship between heavy maternal smoking during pregnancy and hyperactivity, interviewing 60 mothers of whom 20 had hyperactive children, 20 had dyslexic children, and the remainder had normal children. They found that the mean cigarette consumption of the mothers of the hyperactive children was more than three times the average consumption of the other two groups of mothers, and that the majority of the hyperactive children were first born. This is significant because a difficult and prolonged labour can reduce oxygenation, and such a labour is more likely to occur with first borns (Ross and Ross, 1976). This occurrence, coupled with the high level of carbon monoxide caused by smoker inhalation, could produce fetal anoxia.

Emotions

Joffe (1969) in his book, Prenatal Determinants of Behavior reviews a large number of research studies in regard to emotional status and reproductive problems, and maternal emotions and fetal and infant behavior. He states that it is quite likely that the emotional state of the mother during pregnancy will affect the child's behavior, but no research study is able to effectively delineate the specific effect of the emotional state. At present the emotional state can be viewed as one of many prenatal variables and can be either environmental or constitutional in nature.

Environmental Constraints

In certain circumstances it is possible to view the cause of hyperactivity in terms of a confining environment. Children engage in a variety of activity related behaviors when playing, and when they are not allowed to be active in certain environments, they may compensate and be overactive in other environments--ones that may not welcome overactivity, such as school. McNamara (1972) illustrated this phenomena when he described his work with Puerto Ricans in New York city, who live in high density, deteriorated slum conditions with few recreational areas for the children. The crime rate is very high and the majority of the parents fear for the safety of their children, and consequently the child spends the major part of his time indoors watching

television. When the child is at school or apartment bound without a television he becomes "hyperactive". McNamara concludes his article by stating that the treatment of this behavior would simply consist of building safe recreational areas.

Summary Statement

Various external factors have been examined as they relate to the etiology of hyperactivity. Some of the factors are speculative, such as maternal behaviors, and others, such as lead poisoning, have been directly linked to the etiology of hyperactivity.

Psychogenic Factors

Any child, whether is is hyperactive or normal, can not be studied in isolation, since children interact with others, affect, and are affected by the nature of the relationship. To simplify the examination of these interactions and related behaviors, three different models of human behavior that pertain to hyperactivity will be discussed: they are the behavioral, psychological and sociological models.

Behavioral Model

The behavioral model views hyperactivity as a "bad habit" (Conrad, 1976) with the child learning to be hyperactive through positive reinforcement and observational

learning. For example, parents may value high activity levels and give a great deal of attention to a child when he is active rather than passive. Also, through parental modeling, the child may observe hyperactive type behaviors in his parent(s) and attempt to imitate them, as suggested in part by the findings of Cantwell (1972) and Morrison and Stewart (1971), who noted that first degree relatives were often hyperactive. Although the researchers were pursuing a genetical hypothesis, the role of observational learning can not be discounted.

Psychological Model

The psychological model hypothesizes that hyperactivity is a byproduct of a negative emotion such as anxiety and/or the result of some unconscious conflict (Conrad, 1976), the exact source of which maybe unknown. Researchers have examined mother-child relationships, child rearing practices and temperament patterns in an attempt to discern the cause of hyperactivity, but a difficulty arises in separating the mother's behavior from the child's, and vice versa (Ross and Ross, 1976).

Sociological Model

The sociological model states that hyperactivity is meaningful within the situation (Conrad, 1976), so that the problem may not be the child but lies within the social system. For example, a child may be hyperactive in a classroom that seeks order, student compliance and control, and yet

be very manageable in a less restrictive environment. Conrad also argues that hyperactivity is an ascribed status conferred informally or formally upon the child by parent, relatives, doctors or other related helping professions, and that it is a relative rather than absolute phenomena, changing as levels of tolerance vary and as the child encounters different societal systems.

Summary Statement

Three models of human behavior as they pertain to hyperactivity have briefly been examined. Each model is unique in its view of human behavior and consequently as a total initiate many possible causes of hyperactivity.

CHAPTER III

RESEARCH DESIGN, INSTRUMENTS AND PROCEDURES

The research project focused on the growth and development of 25 hyperactive and 25 nonhyperactive boys, from the prenatal period to their present age, with related information regarding the subject's siblings, parents, aunts and uncles and grandparents also being obtained. Measures of each subject's present mental functions in terms of planning abilities, use of simultaneous or successive modes of information integration, plus any indications of brain damage were obtained through two separate instruments.

The research project was designed to answer the following questions:

1. Is the occurrence of hyperactivity influenced by birth order, family size, race, religion or occupation, education and marital status of the parents?
2. Is there a significant difference between the mothers of the hyperactive boys and mothers of the nonhyperactive boys in regard to previous maternal difficulties and the pregnancy and delivery of the boy being studied?
3. Do hyperactive boys differ from nonhyperactive boys in regard to the neonatal and infancy periods, presence of anomalies, achievement of developmental milestones,

illnesses, accidents, need of discipline, enuresis and ability to form interpersonal relationships?

4. In regard to the siblings, parents, aunts, uncles and grandparents of the hyperactive and nonhyperactive boys, is there a difference between the two groups in regard to school based learning behavior, temperamental characteristics (irritability, impulsivity, anger and unpredictability), activity levels, history of psychiatric or physical illness and antisocial behavior, as evidenced by a prison record or the abuse of alcohol.
   (a) Do male relatives of the hyperactive boys display more of the above behaviors than the male relatives of the nonhyperactive boys?
   (b) Is there a difference in terms of the incidence of these behaviors between the first degree and second degree relatives of the nonhyperactive and hyperactive boys?
5. Do hyperactive boys have brain damage?
6. Is there a difference between the planning abilities of hyperactive and nonhyperactive boys?
7. Do hyperactive boys differ from nonhyperactive boys in terms of a preference for either the simultaneous or the successive modes of information integration?

Sample

The total sample consisted of 50 boys and their mothers.

25 each in the hyperactive and the nonhyperactive group. Members of the hyperactive group were selected from a previous research project coordinated by Dr. Clement King, in which he assessed 200 boys in the City of Edmonton using a Child Rating Scale for Hyperkinesis (Davids, 1971) which was administered to the boys by their teachers.

The scale measures the following six characteristics: hyperactivity, short attention span and powers of concentration, variability, impulsiveness and ability to delay gratification, irritability and explosiveness. Each characteristic is treated as an ordinal variable and has a corresponding rating scale consisting of six positions, ranging from the initial position of "much less than most children" to the final position of "much more than most children". The initial position is allotted 1 point and 1 point is added successively for each of the following positions, therefore giving the final position a value of 6 points, with the total points for the six characteristics possibly ranging from 6 to 26. If a child obtains a score over 24 the presence of hyperkinesis is indicated; if the score falls between 19 and 23, there is a suspicion of hyperkinesis; and if the score is 18 or less, there is little evidence of the presence of hyperkinesis (Davids, 1971, pp. 501).

Dr. King made available the names of the boys who had scored 24 or more points on the Child Rating Scale for

Hyperkinesis, plus a list of boys who had had difficulty in school as evidenced by a history of medical or psychological intervention documented on the cumulative records. The total number of boys meeting this criteria was 60. The various schools which the boys attended were then contacted by telephone for the home telephone number and the father's occupation, and that information was released for 46 of the 60 boys. Thirty-eight mothers were then contacted by telephone, of which 25 consented to be interviewed and allowed their sons to be tested.

The nonhyperactive group consisted of 54 boys from Mount Royal and Father Lacombe Schools who were in regular classrooms. Both schools allowed the researcher to go through the cumulative records in order to obtain the home telephone numbers and father's occupations of the 54 boys, and thirty-four mothers were then contacted by telephone, of which 25 consented to be interviewed and allowed their sons to be tested.

The groups were matched for socioeconomic status based on the Blishen Scale (1958). The Blishen Scale is divided into 7 class categories, each one containing a number of occupations applicable to the level of the class, and the scale contains a total listing of 343 occupations. Class 1 contains occupations which tend to require a minimum of 4 years of formal post secondary education, and ones that give high financial renumeration. Each succeeding class, after

Class 1, contains occupations which correspondingly require less educational preparation and decreasing financial remuneration.

The sample consisted only of the mothers and their natural sons, the boys ranging from 8 to 13 years of age. Age, I.Q. and the Occupational Class Rating for the hyperactive and nonhyperactive groups are represented in Table II.

Instrumentation

Three instruments were used to answer the research questions listed at the beginning of this chapter. A specially designed Parental Questionnaire was used to answer questions 1 to 4; Reitan's Trail Making Test was used to answer questions 5 and 7; and the Porteus Maze Test was used to answer questions 6 and 7.

Parental Questionnaire

The parental Questionnaire presented on pages 55 to 63 consists of 67 questions taken in part from other scales, check lists or questionnaires. The specific questions taken from these sources are outlined as follows:

(a) Question numbers 48 and 61 were obtained from the Werry-Weiss-Peter's Activity Scale (1968).

(b) Question numbers 28, 31, 38, 39, 53, 54, 55 and 63 were obtained from Safer and Allen's Developmental and Medical History Check List (1976).

TABLE II

Sample Characteristics of the Hyperactive and Nonhyperactive Subjects in Regard to Occupational Class, I.Q. and Age

Blishen's Occupational Class Scale	Hyperactive Group I.Q.	Hyperactive Group Age	Nonhyperactive Group I.Q.	Nonhyperactive Group Age
Class 1	0	0	0	0
Class 2	95	13	120	11
	100	10	122	10
	104	9	104	11
Class 3	81	10	92	11
	91	12	119	12
Class 4	122	8	125	12
	113	12	128	9
Class 5	96	12	104	12
	90	9	84	10
	103	10	104	11
	89	11	91	11
	105	9	105	12
	92	10	107	12
	86	13	72	13
	100	10	115	11
	101	11	88	10
Class 6	100	11	122	12
	93	9	107	10
	85	9	106	11
	89	11	96	9
	72	11	104	10

(continued on next page)

Continuation of TABLE II

Blishen's Occupational Class Scale	Hyperactive Group		Nonhyperactive Group	
	I.Q.	Age	I.Q.	Age
Class 6	95	12	115	11
Class 7	85	11	102	10
	94	12	105	10
	92	10	91	10

(c) Question numbers 4, 12, 13 and 27 were obtained from Bowen's Parental Questionnaire for the Assessment of Genetic Disorders (1977).

(d) Question numbers 19, 26, 43, 44, 49, 51, 52, 58, 59, 64, 65 and 66 were obtained from Cantwell's Outline for Interviews with Parents (1975).

(e) Question number 41 was obtained from Rapoport's Stigmata Check List (1974).

(f) Question numbers 21, 22, 23, 24, 50 and 57 were obtained from Stewart and Pitt's Mothers Questionnaire (1966).

(g) Question numbers 48, 56, 60 and 61 were taken from Conner's Rating Scale (1970).

(h) Question number 5 was adapted from the Blishen Occupational Rating Scale (1958).

(i) Question numbers 29, 42, 62 and 67 were inserted under the heading of "other" in case the mother wanted to give any information not specifically asked for.

(j) Question numbers 1, 2, 3, 6, 7, 8, 9, 10, 11 and 14 obtained demographic data which in content is fairly standard to all questionnaries.

(k) Question numbers 15, 16, 17, 18, 20, 30, 25, 32, 33, 34, 35, 36, 37, 40, 45, 46 and 47 were deemed as important after completing the review of the literature.

Although the content of the questions were obtained from other sources, they had to be adapted to the format of the present questionnaire. For example Safer and Allen (1976), using a yes/no format, asked mothers whether they had any vaginal bleeding in the first or last 3 months of pregnancy. This question in the present questionnaire was divided into two separate questions: one pertaining to the first 3 months, and the other to the last 3 months of pregnancy. Furthermore, the mothers in the present questionnaire were asked to state if the bleeding had been profuse, moderate, spotting or nil, in order to obtain more specific information.

Also, it should be noted that more than one reference questionnaire, scale or check list referred to a similar question. In documenting the source of the question used in the newly devised parental questionnaire, only one source has been credited in an attempt to avoid unnecessary repetition.

The choice of questions were determined in order to research as many behavioral antecedents of hyperactivity as possible. One important consideration was the time factor, since too many questions would fatigue the mother.

The entire questionnaire consisted of four sections; the first section obtained demographic data and general information; the second section attempted to find out the history of previous maternal difficulties and characteristics of the pregnancy of the subject being studied, includ-

ing the labour and delivery; section three referred to the subject's development and his ability to form interpersonal relationships; and the last section attempted to find out the characteristics of the relatives of the subject.

The questionnaire has been put together for the first time. In order to check whether the questions were clearly intelligible, the questionnaire was administered to three fellow graduate students. The following changes were made as a result of the peer evaluation:

(a) Question number 34 was added to the list of questions.

(b) Question numbers 49 and 50 were changed to include a set number of responses rather than just requiring the mother to name the specified behaviors.

(c) Question number 60 was changed to include response (a) which had formerly been omitted.

A retrospective approach was used in gathering information for the questionnaire. It should be noted that problems inherent in doing a retrospective study were documented by Thomas, Chess and Birch (1968), who contended that parents were unable to recall pertinent past behaviors, had a tendency to deny or minimize the child's problem in retrospect, and revised sequences of events to conform to theories of causality. Goddar, Broder and Wenar (1961) also noted an inaccurate recall of time related events such as the length of labour, as well as a tendency of mothers to exaggerate the abilities of first born children.

Another difficulty arose since only the mother was asked to give information about the first and second degree relatives of her child. Her knowledge about her husband's relatives may have been limited, inaccurate and/or biased.

Porteus Maze Test

The Porteus Maze Test was designed by Porteus in 1913 in order to assist him in differentiating "feeble minded" children from normal children. It is a nonverbal intelligence test consisting of a series of mazes which progress from simple (Age level; 3 years) to complex (Adult level; older than 14 years). The essential quality needed to successfully complete the maze is planning ability, which is a skill mediated by the frontal lobes.

The test gives a mental age score determined by the number of successfully completed mazes and a Q-score. The Q-score measures temperamental characteristics inferred by (a) neatness (b) care in doing a job (c) persistence in the face of difficulties (d) resistence to fatigue and distraction (e) control of emotions, and (f) sustained attention (Porteus, 1965). To obtain a Q-score, each maze is analyzed and given a weighted score. For more information refer to Appendix A.

Porteus's Maze Test has been standardized and has correlated highly with the Standford-Binet and Wechsler's Intelligence Scale for Children. It has also shown to be sensitive to psychosurgery, the influence of medications,

psychiatric illness and juvenile delinquency (Porteus, 1965).

Reitan's Trail Making Test

The Trail Making Test was originally part of the Army Individual Test of General Mental Ability and was first used by Reitan for neuropsychological testing in 1955. It is a quickly administered, timed test which requires the subject to understand and sequence number and letter concepts, plus exhibit ability to maintain flexibility while mentally shifting from numbers to letters in the second part of the test. To successfully complete the first part of the test, the subject must continuously scan the page and draw a line connecting 15 numbers. In the second part of the test, the subject again must scan the page and this time draw a line connecting first a number and then a letter in a certain order.

The test has proven to be a sensitive measure of organic brain damage (Reitan, 1955). It has been standardized and norms in terms of average number of seconds required to complete the test are available for males and females ranging from 8 to 13 years of age.

Procedure

Since fathers' occupations were known, mothers were drawn randomly from the hyperactive and nonhyperactive groups and contacted by telephone. After the mothers gave a telephone consent to be interviewed and to have their sons

tested, an interview time consisting of one and one half hours was arranged. When possible, the interview was scheduled at a time that the son would be available for testing, but this was not always possible, and 19 separate sessions had to be arranged to test the sons.

All of the instruments were administered in the mother's home. Prior to the administration of the Parental Questionnaire, the mother was informed that: the answers given in the interview were considered confidential and would be used for research purposes only; every word she said would be written down; and, certain questions would ask her to recall behavior that had occurred many years ago. In reference to these particular questions, she was instructed not to rush her answers but to take her time. Any questions the mothers had during the interview were answered as they arose, and a few times the mother was asked to expand or clarify a response.

The family history section asked for a great deal of information in a limited space, and in order to accomodate all the available information, a number was applied to each of the kinship groups. Furthermore the number was preceeded with an "m" or a "p" to denote a maternal or a paternal relationship, a method that was especially useful when a mother came from a large family or had a husband who did, and consequently recalled pertinent family history in terms of groups of relatives.

The Porteus Maze Test and Reitan's Trail Making Test were administered to the subjects on the kitchen table or in a bedroom. If the Trail Making Test was administered initially to a subject in one home, the test would be the second one administered in the next home. Each subject was provided with a pencil and the test materials, given standard instructions, instructed to begin and observed continuously by the researcher.

Testing conditions were not always ideal due to interruptions from other family members, the television set, telephone or household pets. Although the average time of administration for the three instruments was one and one half hours, a few interviews lasted over two hours due to parental concerns with the subject, marital discord and financial worries.

PARENTAL QUESTIONNAIRE

General Information

1. Parent's Name _____ Child's Name _____

2. Child's Birthdate: Year _____ Month _____ Day _____

3. Grade _____

4. Place of Birth
   (a) Alberta _____
   (b) Elsewhere in Canada _____
   (c) Outside of Canada _____

5. Father's Occupation _____
   (a) Class 1 _____
   (b) Class 2 _____
   (c) Class 3 _____
   (d) Class 4 _____
   (e) Class 5 _____
   (f) Class 6 _____
   (g) Class 7 _____

6. Father's Education
   (a) Grade IX or lower _____
   (b) Grade X to Grade XII _____
   (c) Postsecondary training or courses _____
   (d) University Degree _____

7. Father's Age at time of child's birth
   (a) Under 20 _____
   (b) 20 to 30 _____
   (c) 30 to 40 _____
   (d) Over 40 _____

8. Mother's Occupation _____
   (a) Works full time outside of home _____
   (b) Works part time outside of home _____
   (c) Full time homemaker _____

9. Mother's Education
   (a) Grade IX or lower _____
   (b) Grade X to Grade XII _____
   (c) Postsecondary training or courses _____
   (d) University Degree _____

10. Mother's Age at time of child's birth
    (a) Under 20 _____
    (b) 20 to 30 _____
    (c) 30 to 40 _____
    (d) Over 40 _____

11. Status of parents
    (a) Father and mother living with the child are the biological parents _____
    (b) Only the mother living with the child is the biological parent _____

12. Race
    (a) White _____
    (b) Black _____
    (c) Oriental _____
    (d) Indian _____

13. Religion
    (a) Protestant _____
    (b) Catholic _____
    (c) Other _____

14. Names and ages of all children in the family (living or deceased)

Name	Age	School Grade/Vocation

15. Others living in the home
    (a) Yes _____
    (b) No _____

16. Family Doctor
    (a) Yes _____
    (b) No _____

17. Pediatrician
    (a) Yes _____
    (b) No _____

18. Utilization of Community Health Clinics
    (a) Yes _____
    (b) No _____

Prenatal History

19. Number and year of incompleted pregnancies:
    A. Miscarriage

(a) Yes _____
(b) No _____

B. Stillbirths
(a) Yes _____
(b) No _____

C. Therapeutic Abortions
(a) Yes _____
(b) No _____

20. Pregnancy
(a) Planned _____
(b) Unexpected _____

21. Illness during pregnancy (especially first three months)
(a) Severely ill _____
(b) More than expected _____
(c) No more than expected _____
(d) Less than expected _____
(e) Rarely ill _____

22. Vaginal bleeding in the first three months of pregnancy
(a) Profuse _____
(b) Moderate _____
(c) Spotting _____
(d) Nil _____

23. Vaginal bleeding in the last three months of pregnancy
(a) Profuse _____
(b) Moderate _____
(c) Spotting _____
(d) Nil _____

24. Physiological changes (swelling of hands and feet, rash, increased blood pressure, abnormal weight gain or loss)
(a) Hospitalized due to unusual changes _____
(b) Observed frequently by a doctor due to changes _____
(c) Normal or expected changes _____

25. Nutrition
(a) Enjoyed eating (ate better than ever) _____
(b) Maintained normal eating patterns _____
(c) Lost interest in eating _____
(d) Ate erratically _____
(e) Vomitted frequently _____

26. Perception and attitude toward pregnancy
(a) Positive _____
(b) Negative _____
Why? _____

_____

27. Did you take any drugs during the pregnancy aside from iron and vitamin preparations?
(a) Yes _____
(b) No _____
If yes, please give the following information:

Name of Drug	Amount per(day/week)	Duration of time taken

28. Length of gestation
(a) 36 to 38 weeks _____
(b) 39 to 41 weeks _____
(c) 42 weeks and over _____

29. Other observations for the prenatal part _____

Labour and Delivery

30. Position of the child
(a) Head _____
(b) Breech _____

31. Length of labour
(a) Under 2 hours _____
(b) 2 to 16 hours _____
(c) Over 16 hours _____

32. Method of delivery
(a) Caesarian _____
(b) Vaginal _____

33. Use of anesthetic
(a) Yes _____
(b) No _____

34. Use of analgesic
(a) Yes _____
(b) No _____

35. Delivery
(a) Induced _____
(b) Spontaneous _____

36. Use of forceps
(a) Yes _____
(b) No _____

37. Birth weight
(a) Under 5 pounds _____
(b) 5 to 7 pounds _____
(c) Over 7 pounds _____

38. Presence of unusual problems for child at birth (difficulty breathing, excessive mucous, unusual color)
(a) Yes _____
(b) No _____
If yes,
(a) Caused infant excessive stress _____
(b) Caused infant some stress _____

39. Length of hospitalization
(a) Under 5 days _____
(b) 5 to 8 days _____
(c) Over 8 days _____

40. Illnesses in first month of life (pruexia, pneumonia)
(a) More than other children _____
(b) No more than other children _____
(c) Healthier than other children _____

41. Observation of any anomalies
(a) Increased head circumference _____
(b) Electric hair _____
(c) Epicanthus deeply covered _____
(d) Bottom of ears in line with mouth or lower _____
(e) Adherent lobes--lower edges of ears extend upward and back toward crown of head _____
(f) Hands --fifth finger markedly curved inward toward other fingers _____
(g) Feet --third toe is definitely longer than second toe _____

42. Other observations for the labour and delivery part ___

_____

Developmental History

43. As an infant your child cried:
(a) Very little _____
(b) An average amount _____
(c) An excessive amount _____
What caused his crying? _____

44. Feeding
(a) Breast _____
(b) Bottle _____

If breast, was the length of time?
(a) 0 to 3 months _____
(b) 4 to 6 months _____
(c) 7 to 9 months _____
(d) 10 to 12 months _____
(e) Over 12 months _____

45. Receptiveness of infant to new foods
(a) Not receptive _____
(b) Receptive _____
(c) Very receptive _____

46. Receptiveness of infant to new methods of feeding
(a) Not receptive _____
(b) Receptive _____
(c) Very receptive _____

47. Weight gain
(a) Slow _____
(b) Normal _____
(c) Fast _____

48. Sleeping patterns
(a) Erratic _____
(b) Sometimes erratic _____
(c) No problem _____

49. Childhood illness
(a) Rarely ill _____
(b) Occasionally ill _____
(c) Average amount of illness _____
(d) More than expected _____
(e) Frequently ill _____
Name the illnesses _____

_____

50. Accidents and injuries
(a) None _____
(b) Very few _____
(c) No more than other children _____
(d) More than other children _____
(e) Very many _____
Name the accidents and injuries _____

_____

51. Has he ever poisoned himself?
(a) Yes _____
(b) No _____

52. Has he ever been hospitalized?
(a) Yes _____
(b) No _____
If yes, why? _____

53. Motor development (standing, walking, holding)
(a) Slow _____
(b) Average _____
(c) Fast _____

54. Speech development (single words, sentences)
(a) Slow _____
(b) Average _____
(c) Fast _____

55. Toilet training
(a) Late _____
(b) Normal _____
(c) Early _____
Age at which toilet training was completed
(a) 1 year to 18 months _____
(b) 19 months to 2 years _____
(c) 25 months to 30 months _____
(d) 31 months to 36 months _____
(e) Over 36 months _____

56. Discipline
(a) Rarely _____
(b) Occasionally _____
(c) As much as other children _____
(d) Quite often _____
(e) Constantly _____
Causes _____

_____

57. Method of discipline _____

_____

58. Habits
(a) Yes _____
(b) No _____
Name them _____

_____

59. Fears
(a) Yes _____
(b) No _____
Name them _____

60. Enuresis
(a) Never _____
(b) Rarely _____
(c) Occasionally _____
(d) As much as other children _____
(e) Quite often _____
(f) Constantly _____

61. Relationship with others
A. Preschool-Peers
(a) Difficulty interacting _____
(b) No problem interacting _____
(c) Very good interaction _____

B. Preschool-Siblings
(a) Difficulty interacting _____
(b) No problem interacting _____
(c) Very good interaction _____

C. Schoolage-Peers
(a) Difficulty interacting _____
(b) No problem interacting _____
(c) Very good interaction _____

D. Schoolage-Siblings
(a) Difficulty interacting _____
(b) No problem interacting _____
(c) Very good interaction _____

E. Adults
(a) Difficulty interacting _____
(b) Interaction same as other children _____
(c) Well liked by adults _____

62. Other observations for the developmental part _____

_____

Family History

The following questions apply to the mother, father, brothers, sisters, aunts, uncles, paternal grandparents or maternal grandparents of the boy.

63. Did any of the above have problems in school?
(a) Failed more than one grade _____
(b) Failed one grade _____
(c) Never learned to read _____
(d) Never learned to write _____

(e) Found it difficult to learn to read _____

_____

(f) Found it difficult to learn to write _____

_____

64. Had difficulties getting along with others?
(a) Considered irritable _____

(b) Frequently angry _____

(c) Unpredictable _____

(d) Impulsive _____

65. Had high activity levels
(a) Always on the move _____

(b) Frequently shifts from one thing to another _____

_____

66. Were any of the family members?
(a) Hospitalized for a psychiatric disorder _____

_____

(b) Hospitalized for a physical disorder _____

(c) Received counselling for any emotional disorder

_____

(d) Served time in prison or jail _____

(e) Had alcoholism _____

67. Other observations for the family history part _____

_____

_____

CHAPTER IV

RESULTS

The results of the study will be presented in three major sections. The first section will deal with the analysis of the Parental Questionnaire up to the Family History section. The second section will deal with the analysis of the Family History section. The last section will examine the relationships among the scores from Reitan's Trail Making Test Part I and II; the Porteus Maze Mental Age score and Q-score; and the subject's I.Q. and age.

Parental Questionnaire: Sections One, Two and Three

Two statistical methods were applied to the questions on the questionnaire in order to determine if a significant difference existed between the hyperactive and nonhyperactive group. A chi square test for independence was applied to questions which had a set number of responses. Eighty-three percent of the questions met this criteria. The remaining 17 percent of the questions were ones in which the mothers were asked to name, list or describe behaviors. Consequently, due to the variation in responses, a content analysis was completed on these questions. A certain number of questions had the chi square statistic and a content

analysis applied to them because the question had a set number of responses plus a space to describe the nature of the chosen response.

The chi square statistic allows for the comparison of observed frequencies to a theoretical or expected frequency in order to determine whether a significant difference exists between the two types of frequencies. After a chi square value is calculated, it is compared to a critical value at a certain significance level and corresponding degrees of freedom (df). If the calculated chi square value is equal to or greater than the critical value, the difference between the observed and expected frequencies is termed as significant and is not merely due to sampling fluctuations (Ferguson, 1976).

The results of the Parental Questionnaire will be presented in three sections. The sections follow the exact organization of the questionnaire. Chi squares and when appropriate, content analysis, will be presented in each section.

Section One

Section one of the parental questionnaire obtained demographic data and general information. Table III contains the chi square values and the degrees of freedom for the variables in section one. A content analysis was not required for any of the questions in section one.

TABLE III

Difference Between the Nonhyperactive Group and Hyperactive Group in Terms of Demographic Data and General Information

Question	Variable	Chi Square Value	df
4	Place of birth	3.71	2
6	Father's education	9.45	3
8	Mother's occupation	5.39	2
9	Mother's education	6.51	3
7	Father's age	5.90	3
10	Mother's age	1.57	3
11	Biological parents	10.13**	1
12	Race	1.02	3
13	Religion	2.09	2
14	Number of siblings	8.43	3
14	Birth order	0.88	3
15	Others in the home	0.15	1
16	Family doctor	0.15	1
17	Pediatrician	0.32	1
18	Use of community health clinic	4.20*	1

*$p < 0.05$
**$p < 0.01$

Two variables in section one were significant. The first, contained in question 11, examined whether both biological parents lived in the home with the child or if the mother was the only biological parent living at home, this not precluding the fact that she may have married or was living with an adult male. The data that was obtained for this variable is presented in the contingency table below.

	Both biological parents at home	Mother only biological parent at home	Row Total
Nonhyperactive Group	25	0	25
Hyperactive Group	15	10	25
Column Total	40	10	

Chi square = 10.13
Degrees of freedom = 1
$p < 0.01$

The values within the contingency table indicate that in the nonhyperactive group, both biological parents in the entire group were living at home. In the hyperactive group, only 15 of the possible 25 sets of biological parents were living at home, and in the remaining 10 homes the mother was the only biological parent at home.

The second variable which was significant in section one, contained in question 18, examined whether Community Health Clinics were utilized by either of the groups. The

data that was obtained for this variable is presented in the following contingency table.

	Utilized Community Health Clinics	Did not utilize Community Health Clinics	Row Total
Nonhyperactive Group	23	2	25
Hyperactive Group	16	9	25
Column Total	39	11	50

Chi square = 4.20
Degrees of freedom = 1
$p < 0.05$

The values within the contingency table indicate that all but 2 of the mothers in the nonhyperactive group utilized Community Health Clinics, whereas only 16 of the 25 mothers in the hyperactive group utilized them.

Section Two

Section two of the parental questionnaire obtained the history of previous maternal difficulties and characteristics of the pregnancy, including labour and delivery of the subject. Table IV contains the chi square values and the degrees of freedom for the variables in this section, showing no significant variables at the 0.05 level.

A content analysis was completed on question numbers 26, 27, 29, and 42 since these questions required the mother to list or describe behaviors. A description of the mother's

Table IV

Differences Between the Nonhyperactive and Hyperactive Groups in Terms of Previous Maternal Difficulties and Characteristics of the Pregnancy, Labour and Delivery of the Subject[a]

Question	Variable	Chi Square Value	df
19A	Miscarriage	0.00	1
19B	Stillbirth	0.19	1
19C	Therapeutic abortion	0.52	1
20	Planning of pregnancy	0.09	1
21	Illness during pregnancy	4.14	4
22	Vaginal bleeding first 3 months	0.27	3
23	Vaginal bleeding last 3 months	2.45	3
24	Physiological changes	1.58	2
25	Nutrition	3.13	4
26	Attitude	2.48	1
27	Use of drugs	0.00	1
28	Length of gestation	3.25	2
30	Head position	0.27	1
31	Length of labour	1.13	2
32	Method of delivery	0.00	1
33	Use of anesthetic	0.73	1
34	Use of analgesic	0.09	1
35	Type of delivery	0.19	1

(continued on next page)

Continuation of TABLE IV

Question	Variable	Chi Square Value	df
36	Use of instruments	0.54	1
37	Birth weight	2.70	2
38	Unusual problems at birth	0.00	1
39	Length of hospitalization	3.41	2
40	Illness first month	1.24	2
41	Anomalies	2.14	7

[a] No chi square value was significant at the .05 level

response to each question follows:

Question

26. Perception and attitude toward pregnancy
(a) positive _____
(b) negative _____
Why? _____

No significant difference was found between the non-hyperactive and hyperactive groups in regard to the choice of the positive or negative response. When asked the reason "Why?", members of the nonhyperactive group who stated they had a positive attitude gave reasons such as: the baby was a bonus, they felt better than ever or very good, they felt very feminine, and they loved being pregnant. If the members of the nonhyperactive group stated they had a negative experience, reasons such as depression, not wanting more children and feeling confined, were given.

Members of the hyperactive group who stated they had had a positive attitude, gave reasons such as: they were in a good mood, their self image was better than ever, and two members commented that they were glad they did "not show" until later in the pregnancy. Seven members stated they had a positive attitude but the reasons they gave contained conflicting statements: for example, one mother stated she felt "O.K." and then remembered that she had also been depressed. If members of the hyperactive group stated they had had a negative experience, reasons such as depression, loneliness and discouragement were given, and coupled with

these reasons were statements of interpersonal difficulty. For example, one mother left her husband, another felt rushed and as if things were hectic during pregnancy, and one mother stated she had been raped by a young man who threatened her not to reveal his identity throughout the pregnancy. The reasons given by these mothers showed the stress they must have been under.

Question

27. Did you take any drugs during the pregnancy aside from iron and vitamine preparations?
(a) Yes _____
(b) No _____

If yes, please give the following-information:

Name of drug	Amount per (day/week)	Duration of time taken

There was no significant difference between the two groups in regard to whether drugs had or had not been taken during pregnancy. The majority of the mothers could not remember the amount or duration of time the drug was taken. Names or description of the type of drugs taken by the mother in the nonhyperactive group, were: Hydrodiural, Gravol (two women), Darvon compound, Demerol, Penicillin, pills for morning sickness, high blood pressure, nerves and birth control.

Only one mother in the hyperactive group was able to identify by name the drug she had taken (Valium), the other mothers identifying the drugs by use: pills for phelibitus,

nausea, water retention (two women), high blood pressure, kidney infection, and antibodies. In addition, one mother stated she had to have shots in the hospital to calm her down because her husband was upsetting her.

Question

29. Other observations for the prenatal part

At the end of the set of questions pertaining to the prenatal part, the mothers were asked if they had any other observations. Two mothers in each group had had X-rays, and one mother in the nonhyperactive group had suffered whip lash when she was in a car accident in her fourth month of pregnancy.

Question

42. Other observations for the labour and delivery part

At the end of the set of questions pertaining to the labour and delivery part, the mothers were asked if they had any other observations. In the nonhyperactive group, one mother noted that she had a different blood type than her husband, and another mother, on reflection, thought her son had probably been allergic to milk, while other observations in this group pertained to physical changes noted at birth, such as a turned in left foot. In the hyperactive group most of the observations referred to

physical changes such as an enlarged penis, droopy eye and slight discoloration in one eye. The observations of anomalies in the hyperactive group is consistent with the review of the literature in regard to the relationship between hyperactivity and increased incidence of anomalies (Waldrop, Pedersen and Bell, 1968).

Section Three

Section three of the parental questionnaire obtained information on the development of the subject and his ability to form interpersonal relationships. Table V contains the chi square values and the degrees of freedom for the variables in this section. Five variables in section 3 were significant. The first variable, contained in question 48, examined whether there was a significant difference in the sleeping patterns of the subjects in each group and the data that was obtained for this variable is presented in the following contingency table.

Sleeping Patterns

	Erratic	Sometimes erratic	No problem	Row Total
Nonhyperactive Subjects	0	5	20	25
Hyperactive Subjects	5	1	19	25
Column Total	5	6	39	50

Chi square = 7.69
Degrees of freedom = 2
$p < 0.05$

TABLE V

Differences Between the Nonhyperactive and Hyperactive Groups in Terms of the Development of the Subjects

Question	Variable	Chi Square Value	df
43	Crying	0.14	2
44A	Method of feeding	0.00	1
44B	Length of time on breast	9.17	4
45	Receptiveness to new food	0.33	2
46	Receptiveness to new methods of feeding	4.71	2
47	Weight gain	4.00	2
48	Sleeping patterns	7.70*	2
49	Childhood illnesses	7.17	4
50	Accidents and injuries	8.45	4
51	Poisoning	0.66	1
52	Hospitalizations	3.79	1
53	Motor development	5.61	2
54A	Toilet training	0.81	2
54B	Age toilet trained	2.14	4
55	Speech development	2.19	2
56	Discipline	14.16**	4
58	Habits	0.32	1
59	Fears	0.00	1

(continued on next page)

Continuation of TABLE V

Question	Variable	Chi Square Value	df
61A	Relationship with pre-school peers	12.62**	2
61B	Relationship with pre-school siblings	13.42**	2
61C	Relationship with schoolage peers	15.44**	2
61D	Relationship with schoolage siblings	2.80	2
61E	Relationship with adults	1.39	2

*$p < 0.05$

**$p < 0.01$

The values within the contingency table indicate that 5 of the 25 boys in the nonhyperactive group sometimes had erratic sleeping patterns. In the hyperactive group, 5 boys had erratic sleeping patterns and one sometimes had erratic sleeping patterns.

The second variable, contained in question 56, examined whether there was a significant difference in the amount of discipline received by the subjects in each group, and the data that was obtained for this variable is presented in the following contingency table.

	Discipline					
	Rarely	Occasionally	As much as other children	Quite often	Constantly	Row Total
Nonhyperactive Subjects	2	9	8	5	1	25
Hyperactive Subjects	0	1	10	6	8	25
Column Total	2	10	18	11	9	50

Chi square = 14.16
Degrees of freedom = 4
$p < 0.01$

The values within the contingency table indicate that 2 of the 25 nonhyperactive subjects rarely had to be disciplined, 9 of the 25 occasionally had to be disciplined, 8 of the 25 had to be disciplined as much as other children, 5 of the 25 had to be disciplined quite often and 1 had to be disciplined constantly. In the hyperactive group,

1 of the 25 boys had to be disciplined occasionally, 10 of the 25 had to be disciplined as much as qther children, 6 of the 25 had to be disciplined quite often and the remaining 8 boys had to be disciplined constantly.

The remaining three significant variables, contained in question 61A, B and C, examined the nature of each subject's relationship with his peers and siblings. The first contingency table below represents how the boy interacted with his peers prior to going to school, the second contingency table represents how he interacted with his siblings prior to going to school, and the last contingency table represents how he interacted with his peers while at school.

Preschool Peers

	Difficulty interacting	No problem interacting	Very good interaction	Row Total
Nonhyperactive Subjects	3	15	7	25
Hyperactive Subjects	14	10	1	25
Column Totals	17	25	8	50

Chi square = 12.62
Degrees of freedom = 2
$p < 0.01$

The values within the contingency table indicate that 3 of the 25 subjects in the nonhyperactive group had difficulty interacting with their preschool peers, 15 of the 25 subjects had no problems interacting with their preschool peers, and the remaining 7 had a very good level of interaction with their preschool peers. In the hyperactive group, 14 of the 25 subjects had difficulty interacting with their preschool-peers, 10 of the 25 had no problem interacting with their preschool peers and only one had a very good level of interaction with his preschool peers.

The following contingency table represents how the subjects intereacted with their siblings prior to going to school.

	Preschool Siblings			
	Difficulty interacting	No problem interacting	Very good interaction	Row Total
Nonhyperactive Subjects	4	11	10	25
Hyperactive Subjects	10	15	0	25
Column Total	14	26	10	50

Chi square = 13.42
Degrees of freedom = 2
$p < 0.01$

The values within the contingency table indicate that 4 of the 25 subjects in the nonhyperactive group had difficulty interacting with their preschool siblings, 11 of the 25 had no problem interacting with their preschool siblings and the remaining 10 had a very good level of interaction with their preschool siblings. In the hyperactive group, 10 of the 25 subjects had difficulty interacting with their preschool siblings and 15 of the 25 had no problem interacting with their preschool siblings. No subject in this group was viewed as having a very good level of interaction with his preschool siblings.

The following contingency table represents how the subject interacted with his peers while at school.

Schoolage Peers

	Difficulty interacting	No problem interacting	Very good interaction	Row Total
Nonhyperactive Subjects	2	15	8	25
Hyperactive Subjects	14	10	1	25
Column Total	16	25	9	50

Chi square = 15.44
Degrees of freedom = 2
$p < 0.01$

The values within the contingency table indicate that

2 of the 25 subjects in the nonhyperactive group had difficulty interacting with their schoolage peers, 15 of the 25 had no problem interacting with their schoolage peers, and the remaining 8 had a very good level of interaction with their schoolage peers. In the hyperactive group, 14 of the 25 subjects had difficulty interacting with their schoolage peers, 10 of the 25 had no problem interacting with their schoolage peers and only one had a very good level of interaction with his schoolage peers.

A content analysis was completed on question numbers 43, 49, 50, 52, 56, 57, 58, 59 and 62 for section three on the parental questionnaire. These questions asked the mother to list or describe behaviors. A description of the mother's response to each question follows:

Question

43. As an infant your child cried
(a) very little ____
(b) an average amount ____
(c) an excessive amount ____
What caused his crying? _____

There was no significant difference between the two groups in regard to the amount of crying the infand did. The causes of crying were very similar for both groups, the primary cause being hunger, then wetness. Four members in the nonhyperactive group and five members in the hyperactive group gave colic as a reason.

Question

49. Childhood illness
(a) rarely ill _____
(b) occasionally ill _____
(c) average amount of illness _____
(d) more than others _____
(e) frequently ill _____
Name the illnesses _____

There was no significant difference between the two groups in regard to the frequency of childhood illnesses, chicken pox, mumps, and measles being identified as the primary illnesses in both groups. Other illnesses mentioned by the mothers in the nonhyperactive group, included: bronchitis, mononucleosis, whooping cough, scarlet fever, pneumonia, croup, Osgoodshalater's Disease and nose bleeds. Illnesses mentioned by the mothers in the hyperactive group included: asthma, tonsillitus, spinal menigitis, flu, diarrhea and croup.

Question

50. Accidents and injuries
(a) none _____
(b) very few _____
(c) no more than other children _____
(d) more than others _____
(e) very many _____
Name the accidents and injuries _____

There was no significant difference between the two groups in regard to the number of accidents and injuries either group may have had, the accidents and injuries for both groups generally including cuts, falls, broken or dislocated bones, sprains and chipped teeth, with falls

composing the majority of the accidents and injuries in both groups. Mothers in the hyperactive group tended to state that their sons had a lot of falls, and would be able to describe a fall in a certain situation, such as down the stairs.

A few unusual accidents and injuries were reported in each group. In the hyperactive group these were: driving into a telephone pole on a bicycle, pulling an iron from the ironing board and catching testicles on a bicycle seat. In the nonhyperactive group, the unusual accidents were: putting a hand through a wringer, chipping an ear, being bitten by a dog three times and being hit by a car.

Question

52. Has he ever been hospitalized?
(a) Yes _____
(b) No _____
If yes, why? _____

There was no significant difference between the two groups in regard to whether the child had or had not been hospitalized, the hospitalizations for the two groups being due to surgery, a medical problem or an emergency condition. Reasons given for hospitalization by the hyperactive group, referring to surgical intervention, included: stitches, removal of tonsils and adnoids, skin graft, circumcision, surgery on a hernia, testicle, eye, leg and finger. Reasons given by the nonhyperactive group, referring to a surgical intervention included: tracheotomy, removal of ton-

based on a medical problem were very similar for both groups, medical conditions common to both groups being: pneumonia, croup, bronchitus, asthma, seizures, diarrhea and infection. Aside from these conditions, the hyperactive group also mentioned the following difficulties: anemia, investigation due to abnormal EEG, concussion and behavior problems. The nonhyperactive group also gave additional reasons aside from the reasons they had in common with the hyperactive group, namely jaundice and urinary retention.

Hospitalization due to an emergency condition referred to the subject staying in hospital for a short (4 to 24 hours) observation period. Emergency hospitalization in the hyperactive group was due to poisoning, swallowing a pin and stepping on a needle, while emergency hospitalization in the nonhyperactive group was due to stomach pains and cramps, and one child had his arm go through a wringer.

Question

56. Discipline
    (a) rarely ____
    (b) occasionally ____
    (c) as much as other children ____
    (d) quite often ____
    (e) constantly ____
    Causes _____

There was a significant difference between the two groups in regard to how frequently a subject had to be dis-

ciplined, and there was a notable difference between the two groups in terms of why a subject had to be disciplined. The central theme cited in the nonhyperactive group was disobedience: for example, a boy did not do what he was told, would not listen or remember something, came home late and did not get his work done; a few subjects were disciplined because they fought, "bugged" others, or had a temper.

In the hyperactive group, a central theme was an inability to get along with others, with causes for discipline including behaviors such as "bugging" others, fighting, biting and being mischievious. Another theme, focused on the activity of the child, with causes for discipline including behaviors such as tearing the room apart, touching everything and always moving. Disobedience was also a problem, as evidenced by reasons such as: a boy would not do what the parents wanted, he wandered, he would not come in from play, and he would not go to bed on time.

Question

57. Method of discipline _____

The method of discipline was very similar for both groups. The two main methods cited were spanking and reasoning, the latter including the removal of privileges. Three methods of discipline used by some mothers in the hyperactive group were unique to that group: two of the

mothers stated they used no method of discipline; another mother "picked up an object and threatened"; and yet another would bite her child because he bit others.

Question

58. Habits
(a) Yes ____
(b) No ____
Name them _____

There was no significant difference between the two groups in regard to the presence or absence of habits, the two main habits for both groups being nailbiting and thumb sucking. Other habits mentioned by mothers in the nonhyperactive group, included: constant movement, nibbling, hugging a blanket, rocking, walking without shoes tied and sticking out the tongue. In the hyperactive group, habits such as fingersucking, toenail biting, hugging a blanket, fidgeting and eating a lot were mentioned.

Question

59. Fears
(a) Yes ____
(b) No ____
Name them _____

There was no significant difference between the two groups in regard to the presence or absence of fears. When the fears were named, there was very little similarity between the two groups in terms of the type of fears the subjects had: only the fear of bees and darkness were mentioned by both groups. Other fears mentioned by the

mothers in the nonhyperactive group included: dogs, fast balls, not being loved, school work, trees in front of a grandparent's house, sleeping by himself and thunder. In the hyperactive group other fears that were mentioned included: death, water, closed doors, heights, arguments and basements.

Question

62. Other observations for the developmental part _____

At the end of section three the mothers were asked if they had any other observations upon which mothers in each group noted their sons had allergies, and one son in each group was on Ritalin. Aside from these common observations, the other observations were quite dissimilar for both groups. Some mothers in the nonhyperactive group, noted that their sons were musical, athletic, confident and happy, whereas the observations made by some of the mothers in the hyperactive group, were that their sons were lonely, depressed and nervous. One mother in the hyperactive group stated that her son was placid till the age of two, and four mothers stated their sons were presently on medications.

Parental Questionnaire: Family History

The last section of the parental questionnaire ob-

tained information about the mother, father, brothers, sisters, maternal aunts and uncles, paternal aunts and uncles, maternal grandparents and paternal grandparents of the subject. For each kinship grouping, identical information regarding learning difficulties, temperamental characteristics, activity levels, emotional/social difficulties and physical illness was obtained. Each variable, excluding physical illness, had a number of subcategories. If the mother could state that one subcategory of a variable pertained to a relative, this was viewed as sufficient evidence to conclude that the particular relative displayed a certain behavioral pattern. For example, the variable labelled temperamental characteristics includes the following four subcategories: considered irritable, frequently angry, unpredictable, impulsive. If a relative was considered unpredictable, the presence of the variable temperamental characteristic, would be indicated as positive.

In the following section, the chi square values for each kinship grouping will be presented. The last question on the questionnaire asked if there were any other observations for the family history part. No observations were made by either group and consequently a content analysis was not required.

Mothers

Table VI contains the chi square values and the degrees of freedom for the variables pertaining to the mothers in

TABLE VI

Differences Between the Mothers in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	2.60	1
64	Temperamental characteristics	2.91	1
65	Activity levels	0.94	1
66a,c,d,e	Emotional/Social difficulties	1.22	1
66b	Physical illnesses	0.22	1

[a]n = 25 for each group

each group, showing no significant difference between the mothers in the two groups for any of the five variables.

Fathers

Table VII contains the chi square values and the degrees of freedom for the variables pertaining to the fathers in each group, with only the variable pertaining to learning difficulties (contained in question 63) appearing significant at the 0.05 level. The data that was obtained for this variable is presented in the following contingency table.

	Learning Difficulties: Presence	Learning Difficulties: Absence	Row Total
Fathers in the Nonhyperactive Group	5	20	25
Fathers in the Hyperactive Group	12	13	25
Column Total	17	33	50

Chi square = 4.37
Degrees of freedom = 1
$p < 0.05$

The values within the contingency table indicate that only 5 of the 25 fathers in the nonhyperactive group had some learning difficulties, whereas 12 of the 25 fathers in the hyperactive group had some learning difficulties.

Sisters

Table VIII contains the chi square values and the de-

TABLE VII

Differences Between the Fathers in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	4.37*	1
64	Temperamental characteristics	2.01	1
65	Activity levels	2.60	1
66a,c,d,e	Emotional/Social difficulties	0.10	1
66b	Physical illnesses	2.08	1

[a]n = 25 for each group

*$p < 0.05$

TABLE VIII

Differences Between the Sisters in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	2.45	1
64	Temperamental characteristics	0.29	1
65	Activity levels	0.27	1
66a,c,d,e	Emotional/Social difficulties	0.13	1
66b	Physical illnesses	0.00	1

[a]n = 41 for the nonhyperactive group
25 for the hyperactive group

grees of freedom for the variables pertaining to the sisters of the subject in each group. The subjects in the nonhyperactive group had 34 sisters whereas the subjects in the hyperactive group had 29 sisters. There was no significant difference between the sisters in the two groups for any of the five variables.

Brothers

Table IX contains the chi square values and the degrees of freedom for the variables pertaining to the brothers of the subjects in each group. The subjects in the nonhyperactive group had 41 brothers and the subjects in the hyperactive group had 25 brothers, with no significant difference between the brothers in the two groups for any of the five variables being apparent.

Maternal Aunts

Table X contains the chi square values and the degrees of freedom for the variables pertaining to the maternal aunts of the subjects in each group. The subjects in the nonhyperactive group had 45 maternal aunts and the subjects in the hyperactive group had 48 maternal aunts. The variable, contained in question 65, pertaining to activity levels was significant at the 0.05 level, the data for which is presented in the following contingency table.

TABLE IX

Differences Between the Brothers in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	2.34	1
64	Temperamental characteristics	1.44	1
65	Activity levels	0.39	1
66a,c,d,e	Emotional/Social difficulties	0.87	1
66b	Physical illnesses	0.00	1

[a] n = 34 for the nonhyperactive group
29 for the hyperactive group.

TABLE X

Differences Between the Maternal Aunts in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	0.90	1
64	Temperamental characteristics	4.77*	1
65	Activity levels	4.51*	1
66a,c,d,e	Emotional/Social difficulties	1.62	1
66b	Physical illnesses	3.02	1

[a]n = 45 for the nonhyperactive group
48 for the hyperactive group

*$p < 0.05$

	Activity Levels: Presence	Activity Levels: Absence	Row Total
Maternal Aunts in the Nonhyperactive Group	1	44	45
Maternal Aunts in the Hyperactive Group	7	41	48
Column Total	8	85	93

Chi square = 4.51
Degrees of freedom = 1
$p < 0.05$

The values within the contingency table indicate that only one out of the 45 maternal aunts in the nonhyperactive group was viewed as having a high activity level, whereas 7 out of the 48 maternal aunts in the hyperactive group were viewed as having a high activity level.

Another variable which was significant in this kinship group, contained in question 64, pertained to temperamental characteristics (irritable, frequently angry, unpredictable, impulsive). The data obtained for this variable is presented in the following contingency table.

The values within the contingency table indicate that only 2 out of the 45 maternal aunts in the nonhyperactive group were considered to have a temperamental characteristic, whereas 12 out of the 48 maternal aunts in the hyperactive group were viewed as having the same.

	Temperamental Characteristics: Presence	Absence	Row Total
Maternal Aunts in the Nonhyperactive Group	2	43	45
Maternal Aunts in the Hyperactive Group	12	36	48
Column Total	14	79	93

Chi square = 4.77
Degrees of freedom = 1
$p < 0.05$

Paternal Aunts

Table XI contains the chi square values and the degrees of freedom for the variables pertaining to the paternal aunts in both groups, there being 48 paternal aunts in each group. Only the variable, contained in question 64, pertaining to temperamental characteristics was significant at the 0.05 level. The data that was obtained for this variable is presented in the following contingency table.

	Temperamental Characteristics: Presence	Absence	Row Total
Paternal Aunts in the Nonhyperactive Group	15	33	48
Paternal Aunts in the Hyperactive Group	6	42	48
Column Total	21	75	96

Chi square = 4.71
Degrees of freedom = 1
$p < 0.05$

TABLE XI

Differences Between the Paternal Aunts in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	0.00	1
64	Temperamental characteristics	4.71*	1
65	Activity levels	0.00	1
66a,c,d,e	Emotional/Social difficulties	0.00	1
66b	Physical illnesses	0.34	1

[a]n = 48 for the nonhyperactive group
48 for the hyperactive group

*$p < 0.05$

The values within the contingency table indicate that 15 of the 48 paternal aunts in the nonhyperactive group were considered to have temperamental characteristics, whereas only 6 out of the 48 aunts in the hyperactive group were considered to have them.

Maternal Uncles

Table XII contains the chi square values and the degrees of freedom for the variables pertaining to the maternal uncles in both groups. The subjects in the nonhyperactive group had 43 maternal uncles and the subjects in the hyperactive group had 57 maternal uncles. Two variables were significant. The first variable, contained in question 63, pertaining to learning difficulties was significant at the 0.01 level. The data that was obtained for this variable is presented in the following contingency table.

	Learning Difficulties: Presence	Learning Difficulties: Absence	Row Total
Maternal Uncles in the Nonhyperactive Group	6	37	43
Maternal uncles in the Hyperactive Group	25	32	57
Column Total	31	69	100

Chi square = 10.25
Degrees of freedom = 1.
$p < 0.01$

TABLE XII

Differences Between the Maternal Uncles in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	10.25**	1
64	Temperamental characteristics	1.92	1
65	Activity levels	0.01	1
66a,c,d,e	Emotional/Social difficulties	3.86*	1
66b	Physical illnesses	0.55	1

[a]n = 43 for the nonhyperactive group
57 for the hyperactive group

*$p < 0.05$
**$p < 0.01$

The values within the contingency table indicate that 6 of the 43 maternal uncles in the nonhyperactive group had learning difficulties. In the hyperactive group, 25 of the 57 maternal uncles had learning difficulties.

The second variable, contained in question 66a,c,d,e pertaining to emotional/social difficulties was significant at the 0.05 level. The data that was obtained for this variable is presented in the following contingency table.

	Emotional/Social Difficulties: Presence	Emotional/Social Difficulties: Absence	Row Total
Maternal Uncles in the Nonhyperactive Group	2	41	43
Maternal Uncles in the Hyperactive Group	10	47	57
Column Total	12	88	100

Chi square = 3.86
Degrees of freedom = 1
$p < 0.05$

The values within the contingency table indicate that 2 of the 43 maternal uncles in the nonhyperactive group had emotional/social difficulties. In the hyperactive group, 10 of the 47 maternal uncles had emotional/social difficulties.

Paternal Uncles

Table XIII contains the chi square values and the degrees of freedom for the variables pertaining to the paternal uncles in both groups, the subjects in the nonhyperactive

TABLE XIII

Differences Between the Paternal Uncles in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	44.95**	1
64	Temperamental characteristics	6.62*	1
65	Activity levels	2.90	1
66a,c,d,e	Emotional/Social difficulties	13.32**	1
66b	Physical illnesses	1.34	1

[a]n = 73 for the nonhyperactive group
48 for the hyperactive group

*$p < 0.05$
**$p < 0.01$

group having 73 paternal uncles, and the subjects in the hyperactive group having 48 paternal uncles. The variable (contained in question 63) pertaining to learning difficulties, the variable (contained in question 64) pertaining to temperamental characteristics, and the variable (contained in question 66a,c,d,e) pertaining to emotional/social difficulties were all significant. The data obtained for the variable pertaining to learning difficulties is presented in the following contingency table.

	Learning Difficulties: Presence	Learning Difficulties: Absence	Row Total
Paternal Uncles in the Nonhyperactive Group	4	69	73
Paternal Uncles in the Hyperactive Group	21	27	48
Column Total	25	96	121

Chi square = 44.95
Degrees of freedom = 1
$p < 0.01$

The values within the contingency table indicate that only 4 out of the 73 paternal uncles in the nonhyperactive group had learning difficulties. Almost half of the paternal uncles in the hyperactive group, 21 out of 48, had learning difficulties.

The data obtained for the variable pertaining to temperamental characteristics is presented in the following contingency table.

Temperamental Characteristics

	Presence	Absence	Row Total
Paternal Uncles in the Nonhyperactive Group	10	63	73
Paternal Uncles in the Hyperactive Group	16	32	48
Column Total	26	95	121

Chi square = 6.62
Degrees of freedom = 1
$p < 0.05$

The values within the contingency table indicate that 10 out of the 73 paternal uncles in the nonhyperactive group had temperamental characteristics and a third of the paternal uncles in the hyperactive group, 16 out of 48, had temperamental characteristics.

The data obtained for the variable pertaining to emotional/social difficulties is presented in the following contingency table.

Emotional/Social Difficulties

	Presence	Absence	Row Total
Paternal Uncles in the Nonhyperactive Group	3	70	73
Paternal Uncles in the Hyperactive Group	13	35	48
Column Total	16	105	121

Chi square = 13.32
Degrees of freedom = 1
$p < 0.01$

The values within the contingency table indicate that only 3 out of the 73 paternal uncles in the nonhyperactive group had emotional/social problems. A little over a fourth of the paternal uncles in the hyperactive group, 13 out of 48, had emotional/social difficulties.

Paternal Grandparents

Table XIV contains the chi square values and the degrees of freedom for the variables pertaining to the paternal grandparents in each group. There was no significant difference between the paternal grandparents in the two groups for any of the five variables.

Maternal Grandparents

Table XV contains the chi square values and the degrees of freedom for the variables pertaining to the maternal grandparents in each group. There was no significant difference between the maternal grandparents in the two groups for any of the five variables.

Reitan's Trail Making Test and the Porteus Maze Test

Reitan's Trail Making Test and the Porteus Maze Test were administered to every hyperactive and nonhyperactive subject. Reitan's Trail Making Test is composed of two parts, part I and part II, and the Porteus Maze Test gives two scores: one is a mental age score and the other is a

TABLE XIV

Differences Between the Paternal Grandparents in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	0.15	1
64	Temperamental characteristics	2.25	1
65	Activity levels	0.00	1
66a,c,d,e	Emotional/Social difficulties	0.54	1
66b	Physical difficulties	0.07	1

[a]n = 50 for each group

TABLE XV

Differences Between the Maternal Grandparents in the Nonhyperactive and Hyperactive Groups[a] in Terms of Family History

Question	Variable	Chi Square Value	df
63	Learning difficulties	0.34	1
64	Temperamental characteristics	0.71	1
65	Activity levels	3.05	1
66a,c,d,e	Emotional/Social difficulties	1.33	1
66b	Physical illnesses	0.05	1

[a] n = 50 for each group

Q-score. A t-test was applied to each part of the two tests, the results of which are presented in Table XVI.

For the two groups, nonhyperactive subjects and hyperactive sujects, a critical t value equal to or greater than 2.010, for 48 degrees of freedom was required for significance at the 0.05 level. The t-ratio obtained between the nonhyperactive and hyperactive groups for Reitan's Trail Making Test Part I and Part II was significant at the 0.05 level.

Spreen and Gaddes (1969, pp. 190) have provided norms for Reitan's Trail Making Test, of males and females aged 8 to 13 years. Comparison of the findings of the hyperactive and nonhyperactive subjects against the norms, represented in average number of seconds needed to complete the test, are presented in Table XVII. For all of the age levels and for both parts of the test, the hyperactive subjects needed more time to complete the test than was indicated in the norms.

It was also deemed necessary to examine if any significant differences existed between the age and I.Q. of each subject in the nonhyperactive and hyperactive groups. A t-test was applied to these two variables, the results of which are presented in Table XVIII. Again, a critical t value equal to or greater than 2.010 for significance at the 0.05 level, for 48 degrees of freedom, was required. The t value obtained for the I.Q. was significant at the 0.05

TABLE XVI

Means, Standard Deviations and t-ratios for the Nonhyperactive and Hyperactive Groups for Reitan's Trail Making Test Part I and Part II and the Porteus Maze Test Mental Age Score and Q-score

Variable	Mean	S.D.	df	t-test	Probability
Reitan's Trail Making Test Part I					
A. Nonhyperactive Boys	17.6400	6.8913	48	2.2838	0.027*
B. Hyperactive Boys	24.1200	12.4007	48		
Part II					
A. Nonhyperactive Boys	44.9200	23.5353	48	2.6689	0.010*
B. Hyperactive Boys	70.8000	42.3881			
Porteus's Maze Test Mental Age Score					
A. Nonhyperactive Boys	9.6600	3.0129	48	1.3970	0.179
B. Hyperactive Boys	8.5600	2.5344	48		
Q-score					
A. Nonhyperactive Boys	53.4400	27.7550	48	0.0388	0.969
B. Hyperactive Boys	53.7200	23.0625			

*p < 0.05

TABLE XVII

Comparison of the Hyperactive and Nonhyperactive Groups Against the Norms for Reitan's Trail Making Test Part I and Part II in Terms of the Average Number of Seconds Required to Complete the Test

	Age	Norms	Number of Ss used for Norms	Hyperactive Group	Number of Ss in Hyperactive Gp	Nonhyperactive Group	Number of Ss in Nonhyperactive Group
Reitan's Trail Making Test Part I	8	32.4	11	45.0	1	0.0	0
	9	26.8	22	38.6	5	23.0	2
	10	21.3	26	23.5	6	22.3	8
	11	15.6	21	21.7	6	18.1	8
	12	16.6	48	19.6	5	16.0	6
	13	16.0	7	36.0	2	8.0	1
Reitan's Trail Making Test Part II	8	77.8	11	174.0	1	0.0	0
	9	58.0	22	59.4	5	46.5	2
	10	51.6	26	88.3	6	52.3	8
	11	43.3	21	77.7	6	49.6	8
	12	39.6	48	62.2	5	31.2	6
	13	40.1	7	72.5	2	112.0	1

TABLE XVIII

Means, Standard Deviations and t-ratios for the Nonhyperactive and Hyperactive Groups for Age and I.Q.

Variable	Mean	S.D.	df	t-test	Probability
Age					
A. Nonhyperactive Boys	10.8400	1.0279	48	0.7059	0.484
B. Hyperactive Boys	10.6000	1.3540			
I.Q.					
A. Nonhyperactive Boys	105.1200	13.8604	48	2.9522	0.005*
B. Hyperactive Boys	94.9200	10.3116			

*$p < 0.05$

level, indicating the nonhyperactive group had a higher I.Q. than the hyperactive group.

To examine the degree of relation among Reitan's Trail Making Test Part I and II, the Porteus Maze Test Mental Age Score and Q-score, and the subject's age and I.Q., inter-correlations were determined for the hyperactive and nonhyperactive groups. The results of the nonhyperactive group of subjects are presented in Table XIX and the results of the hyperactive group of subjects are presented in Table XX.

Correlations involve making paired observations for each subject in the sample. For each of the two groups a correlation value equal to or greater than 0.396 for 23 degrees of freedom was required for significance at the 0.05 level. The correlation between Reitan's Trail Making Test Part II and I.Q., and the correlation between the Mental Age Score obtained from the Porteus Maze Test and Reitan's Trail Making Test Part II, for the nonhyperactive group, were the only significant correlations.

TABLE XIX

Intercorrelations of Reitan's Trail Making Test Part I and Part II, the Porteus Maze Test Mental Age Score and Q-score, Age and I.Q. for the Nonhyperactive Boys

	I.Q.	TM-I	TM-II	M.A.	Q-score	Age
I.Q.	1.000					
Reitan's Trail Making Test Part I (TM-I)	0.281	1.000				
Reitan's trail Making Test Part II (TM-IL)	-0.483*	0.112	1.000			
Porteus's Maze Test Mental Age Score (M.A.)	0.063	-0.111	-0.502*	1.000		
Porteus's Maze Test Q-score	-0.374	-0.260	0.325	-0.208	1.000	
Age	-0.013	-0.338	-0.064	0.224	-0.237	1.000

Degrees of freedom = 23

Critical Value at the 0.05 level for the 2-tailed test = 0.396

*$p < 0.05$

TABLE XX

Intercorrelations of Reitan's Trail Making Test Part I and Part II, the Porteus Maze Test Mental Age Score and Q-score, Age and I.Q. for the Hyperactive Boys

	I.Q.	TM-I	TM-II	M.A.	Q-score	Age
I.Q.	1.000					
Reitan's Trail Making Test Part I (TM-I)	0.169	1.000				
Reitan's Trail Making Test Part II (TM-II)	0.365	0.258	1.000			
Porteus's Maze Test Mental Age Score (M.A.)	-0.015	0.313	-0.191	1.000		
Porteus's Maze Test Q-score	0.000	-0.381	-0.334	0.239	1.000	
Age	-0.262	-0.106	-0.187	0.189	0.315	1.000

Degrees of freedom = 23

Critical Value at the 0.05 level for the 2-tailed test = 0.396

CHAPTER V

DISCUSSION

The results of this study will be discussed in four sections. In the first section the results obtained from the Parental Questionnaire, up to the part dealing with the Family History, will be discussed, while the second section will deal with the results obtained on the Family History part itself. The third section will discuss the results obtained on Reitan's Trail Making Test and the Porteus Maze Test, and will briefly compare the results obtained on both. The last section will discuss implications arising from the results obtained in this research project.

Parental Questionnaire: Section One, Two and Three

The first three sections of the Parental Questionnaire were designed to examine whether there are any distinct behavioral antecedents in the environmental, birth, growth and developmental histories which by nature of their presence differentiate hyperactive from nonhyperactive boys. In the following discussion each of the significant variables which differentiated the hyperactive and nonhyperactive boys will be discussed. The content analysis completed on questions requiring the mother to list, define or describe

behaviors will not be discussed since the process of content analysis involves tabulating the mother's comments, analyzing them for themes or similarities and noting the differences.

Section One

In section one of the Parental Questionnaire two variables proved to be significant. The first variable examined whether both biological parents were in the home, or whether the mother was the only biological parent present. In the hyperactive group a significant number of subjects had only their biological mother living at home, which implies that the home situation had been disrupted through divorce, separation or death. Therefore the possibility arose of the security and stability of the hyperactive subject's home environment having been disturbed.

A few family therapists have identified factors in the family which may contribute to behavioral problems such as hyperactivity in the child. Ackerman (1958) states that behavioral problems in children may be due to immature parental conflicts. Haley (1963) and Satir (1976) state that disruptions or faults in family communications may result in behavioral problems. The same factors which contribute to a child's behavioral problem may also be the cause of the parental separation or divorce. Furthermore, any change in lifestyle, whether caused by death, separation or divorce, may disrupt an individual's equilibrium.

Along with the disruption may come an increase in anxiety until equilibrium is restored (Aquilera and Messick, 1974).

The basic difficulty in relating parental death, separation and/or divorce to hyperactivity is the inability to empirically prove exactly which factor in the above behaviors could contribute to the development of hyperactive behaviors in the child. For example, the following events could result from parental separation: increased anxiety for the child, reduced income for the mother which may in turn require the mother's full-time employment outside of the home, other adult males may have been invited into the home to provide companionship for the mother, and the child may be required to assume additional responsibilities in terms of household tasks and so forth. Of the above events all four, or only one, or any combination of them, may have contributed to the development of hyperactive behaviors in the child.

The other variable which proved to be significant in section one pertained to the mother's utilization of Community Health Clinics. Mothers of the nonhyperactive subjects tended to use the Community Health Clinics more frequently than the mothers of the hyperactive subjects. The significance of this finding must be understood in terms of the services offered by Community Health Clinics. They function on a preventative model by providing immunizations, screening for auditory, motor or visual defects, health

teaching from the prenatal to the geriatric periods, and informal counselling to individuals or groups (Leahy, Cobb and Jones, 1972).

The reasons why the mothers of the nonhyperactive group utilized the Community Health Clinics may only be speculated upon. Firstly, these particular mothers may have done so due to their awareness of the existence of the health facilities: four of the mothers in the hyperactive group were not aware that such facilities existed. Secondly, the mothers of the nonhyperactive subjects may have been more concerned with gathering all possible child-related information in an attempt to further their parenting skills, particularly since provision of information on feeding methods, infant stimulation, and normal growth and development patterns is one of the services provided by community health nurses. Thirdly, the mothers of the nonhyperactive subjects may have had a different attitude toward health. As previously mentioned, Community Health Clinics function on a preventative model, their aim being to prevent illness through education or reduce the impact of illness through early detection (Leahy, Cobb and Jones, 1972). Consequently mothers of the nonhyperactive subjects may have favoured this attitude, which may also be recognized in other spheres (for example, servicing a car before a road trip to reduce the possibilities of breakdown on the journey), toward illness and the care of their children.

A final reason why the mothers of the nonhyperactive subjects utilized the Community Health Clinics may be the most relevant one. Geographically the nonhyperactive group was mainly centered in two particular areas within the city, whereas the hyperactive group was spread throughout. The Community Health staff in the two particular areas may have been more successful than others in alerting the community to their services through such means as visits to the shcools and homes, following which their availability may have been further spread by word of mouth.

Section Two

Section two of the Parental Questionnaire obtained the history of previous maternal difficulties and characteristics of the pregnancy, including labour and delivery of the subject. In reviewing the literature it had been noted that disorders of pregnancy such as toxemia and hypertension correlated with hyperactivity in the child (Pasamanick et al, 1956; Laufer and Denhoff, 1957; Anderson, 1963; Wender, 1971; Lopez, 1965; Safer and Allen, 1976); and an increased incidence of minor physical anomalies were observed in hyperactive children (Waldrop, Pederson, Bell, 1968; Rapoport, Quinn and Lamprecht, 1974).

No variables proved to be significant in section two. This result supported the findings of Minde, Webb and Sykes (1968) who compared 56 hyperactive and normal children in regard to 23 different perinatal and prenatal complications,

and only found an unusual length of labour when associated with instrumentation to be significant.

Section Three

Section three of the Parental Questionnaire obtained information about the development of the subject and his ability to form interpersonal relationships. Five variables proved to be significant in section three.

The first variable pertained to the sleeping patterns of the hyperactive and nonhyperactive subjects. Twenty per cent of the hyperactive subjects had erratic sleeping patterns, whereas none of the nonhyperactive subjects were found to have this problem.

Many researchers have included sleeping patterns as part of the hyperactive profile (Wender, 1973; Cantwell, 1975; Satterfield, 1972; Ross and Ross, 1976). The sleeping problems have taken the following forms: inability to fall asleep, rising early, awaking frequently during the night, and sleeping so soundly that the child is very hard to arouse. Wender (1973) states that problems in sleeping are probably due to inborn temperamental differences. These in turn are caused by a chemical imbalance in the brain determined possibly by prenatal influence or genetics.

The next four variables which proved to be signficant refer to the amount of discipline required and the nature of the interpersonal relationships for the preschoolage and

schoolage periods of the subjects. The four variables are interrelated since the reason the hyperactive subject required more discipline was also usually the reason he had difficulty forming positive interpersonal relationships with his peers and siblings.

Discipline problems and difficulty in forming interpersonal relationships have been documented as characteristic of the hyperactive child. Wender (1973) gives a list of parental descriptions of the hyperactive child which include: "obstinate ... stubborn ... negativistic ... bossy ... disobedient ... sassy ... not caring ..." (p. 21). Safer and Allen (1976) also note that parents have observed belligerence, sibling quarrels, fighting and disobedience. Furthermore, they attribute these difficulties in forming interpersonal relationships and the need for discipline to impulsivity, low frustration tolerance, low self esteem and a short attention span. Similar conclusions to those of Safer and Allen have been drawn by Stewart and Olds (1973), Bakwin and Bakwin (1972), Cantwell (1975), and Laufer and Denhoff (1957).

In the research study it was noted that the hyperactive subjects had difficulty interacting with their peers and siblings prior to going to school. This finding is consistent with the observation of hyperactivity in the young child (Cantwell, 1975; Safer and Allen, 1976). However in the research project it was noted that when the hyperactive subjects reached schoolage they only had difficulty inter-

acting with their peers. No significant difference was observed between the two groups in terms of their ability to interact with their siblings. It may be hypothesized that the siblings of the hyperactive child had "learned" to get along with him by avoidance, giving in, or simply by tolerating him. Families may also have worked out a management system whereby the effects of the hyperactive child's behavior may be diminished.

The hyperactive subject's difficulty in getting along with schoolage peers may be accented by a number of factors. Firstly, play becomes more organized as a child grows older, thereby demanding increased attentiveness by the participants. Secondly, schoolage children are more aware of social behaviors than preschoolers. Groups begin to form and a certain degree of compliance to the group norm is expected. The hyperactive child with his impulsivity and unpredictability soon stands out as different from the others. Lastly, the hyperactive subject's peers do not have to tolerate his behavior when he is bossy or stubborn or suchlike, whereas his siblings may have little choice.

This section has discussed the variables which were significant in sections one, two and three of the Parental Questionnaire. The next section focuses on the Family History part of the Questionnaire.

Parental Questionnaire: Family History

The last part of the Parental Questionnaire obtained information about the mothers, fathers, brothers, sisters, maternal aunts and uncles, paternal aunts and uncles, maternal grandparents and parternal grandparents of the subjects. For each of the kinship groupings, identical information regarding learning difficulties, temperamental characteristics, activity levels, physical/emotional difficulties and physical illness was obtained.

No significant difference was found between the mothers, brothers, sisters, paternal grandparents and maternal grandparents for the hyperactive and nonhyperactive groups. Also, no significant difference regarding the presence or absence of physical illness was found for any of the kinship groupings.

Kinship groupings in which significant differences were observed between the hyperactive and nonhyperactive groups will be discussed.

Fathers

The only difference between the fathers of the hyperactive subjects and the nonhyperactive subjects, was in the area of learning difficulties. The fathers of the hyperactive subjects had more grade failures and greater difficulty in learning to read or write. It has been noted in the literature that learning impediments or difficulties are characteristic of a majority of hyperactive children

(Safer and Allen, 1976; Werry, 1968; Stewart, 1966; Menkes et al., 1967). Therefore the fathers in this research study had a common behavioral trait with their sons. Mendelson et al. (1971) also found a significant number of fathers of hyperactive children had learning problems as a child.

Maternal Aunts

Two variables proved to be significant between the maternal aunts of the hyperactive and nonhyperactive subjects. The first variable pertained to temperamental characteristics. The maternal aunts of the hyperactive subjects were more likely to be viewed as irritable, frequently angry, unpredictable and impulsive. The second variable pertained to activity levels. The maternal aunts of the hyperactive subjects were more active and more frequently shifted from one thing to another than the maternal aunts of the nonhyperactive subjects. These two variables are characteristic of part of the clinical picture exhibited by the hyperactive child. Therefore it is reasonable to infer that a significant number of maternal aunts may have been or still are hyperactive.

Paternal Aunts

One variable proved to be significant between the paternal aunts of the hyperactive and nonhyperactive subjects. The paternal aunts of the nonhyperactive subjects were more likely to be viewed as irritable, frequently

angry, unpredictable and impulsive. This was the only kinship grouping and the only variable in the family history section in which the nonhyperactive group showed a significant difference from the hyperactive group in regard to the nonhyperactive group reporting a greater frequency of a behavior pertaining to a particular variable. It is difficult to explain why this variable was significant for the nonhyperactive group. A possible explanation for this finding may be due to the fact that only the mothers of the subjects were interviewed and they gave information about their sisters-in-law (paternal aunts of the subjects). Perhaps the mothers viewed the sisters-in-law as rivals and therefore stated that the sisters-in-law were irritable, unpredictable and so forth, as a means of dealing with their feelings towards them. Also, since the mothers gave the information, this may explain why no variable was significant between the mothers of the two groups. Perhaps the mothers did not like admitting that they could be considered irritable, and so forth.

Maternal Uncles

Two variables proved to be significant between the maternal uncles of the hyperactive and nonhyperactive subjects. The first variable pertained to learning difficulties. As has already been noted, learning difficulties are characteristic of a majority of hyperactive children. The second variable which was significant, showed that the maternal uncles of the hyperactive subjects had a greater incidence

of emotional/social difficulties than maternal uncles of hyperactive subjects. Social/emotional difficulties in respect to this kinship grouping referred only to alcoholism and a prison record. The prison record was used as an indication of antisocial behavior.

A number of researchers have also observed a greater prevalence of alcoholism and antisocial behavior in relatives of hyperactive children (Stewart et al., 1966; Morrison and Stewart, 1973; Cantwell, 1975). The relationship between alcoholism, antisocial behavior and hyperactivity may be due to environmental or genetic factors. In terms of environmental factors, Mendelson et al. (1971) and Weiss et al. (1971) have both noted that hyperactive children who are antisocial are more likely to come from "pathological families". However, such a finding does not give sufficient evidence to conclude a child has learned to be antisocial.

In terms of the genetic factors, Morrison and Stewart (1973) and Cantwell (1975) examined whether a genetic relationship exists between hyperactivity and alcoholism and antisocial behavior, through the use of adoption studies. When nonbiological relatives of adopted hyperactive children were compared to biological relatives of hyperactive children, a greater prevalence of alcoholism and antisocial behavior was observed in the biological relatives of the hyperactive children.

Paternal Uncles

Three variables proved to be significant between the

paternal uncles of the hyperactive and nonhyperactive subjects. The paternal uncles of the hyperactive subjects had a greater number of learning difficulties, were more frequently reported as irritable, angry, unpredictable and impulsive, and had more emotional/social difficulties than the paternal uncles of the nonhyperactive subjects.

It is not surprising that the paternal uncles had learning difficulties, since their brothers (fathers of the subjects) also had such problems. Also, it should be noted that the females (paternal aunts) did not have learning difficulties. The second variable pertaining to irritability, anger, unpredictability and impulsivity, refers to part of the clinical picture of the hyperactive child. This finding indicates that the paternal uncles may have been, or perhaps are, hyperactive. The last significant variable, pertaining to emotional/social difficulties referred only to alcoholism and imprisonment for this particular kinship grouping. (Refer to the maternal uncles section for discussion of this variable).

In this section, it was noted that a significant difference existed between the hyperactive and nonhyperactive groups only in certain kinship groupings. Also, the significant findings generally pertained to second degree relatives. The only significant finding pertaining to first degree relatives was represented by the fathers.

The results may be due to genetic or environmental factors, since no conclusive mechanism of genetic transmission can be inferred from the results. Furthermore,

the results must be interpreted cautiously since the mothers were the only source of information.

Reitan's Trail Making Test and the Porteus Maze Test

Reitan's Trail Making Test

A significant difference was found between the hyperactive boys and the nonhyperactive boys regarding their performance on both parts of Reitan's Trail Making Test. The hyperactive boys required more time than the nonhyperactive boys to complete the test. Reitan (1955) views the Trail Making Test as a short, easy to administer test which is useful in differentiating persons with or without organic brain damage. However, Reitan does not refer to the locus, extent or type of brain damage he is measuring. Therefore the results of the study indicate that, according to Reitan, a significant number of hyperactive boys have brain damage.

Reitan's Trail Making Test can also be examined in terms of Das, Kirby and Jarman's (1975) simultaneous and successive processing model of information integration and a theory pertinent to central nervous system dysfunction (Weithorn, 1973) due to the nature of the tasks inherent in both parts of the test. Reitan's Trail Making Test can be applied directly to Das, Kirby and Jarman's (1975) model of information integration. The paper and pencil test was presented to the subject, who was instructed to begin at a certain point. In terms of the model this means the external input was received through the visual modality and was presented in a successive manner. In the central processing

unit, the task was processed at a conceptual level due to the requirement of the subject to serially order numbers for Part I and to serially order numbers and letters for Part II. Since only select portions of the subject's performance were surveyable at any given moment during the task, successive rather than simultaneous processing was required. When the subject drew a line to a certain number, the task was completed. In regard to the model, this means the output was successive.

In applying this model to the findings of this research project, it may be inferred that the hyperactive boys had difficulty in successive information integration. This difficulty may be due to a lack of experience in using this mode of information processing, which in turn may be due to genetic or environmental factors (Das, Kirby and Jarman, 1975). Williams (1976) also found that hyperkinetic children had difficulty on the serial recall and free recall tests which are indicators of successive information integration. However, Kirby (1976) warns that successive or simultaneous information integration cannot be inferred on the basis of a few tests. Therefore, at this point inferences regarding a hyperactive child's ability to integrate information successively should be made with caution.

Weithorn (1973) discusses a theory of central nervous system dysfunction put forth by Berlyne (1960), which may have relevance to the fact that the subjects were timed on

on the test. The theory, based on an equilibrium concept, views hyperactivity as a "state of overarousal resulting from defective cortical inhibition" (Weithorn, 1973, p. 43). Therefore, the hyperactive child engages in stimulation-seeking behavior which in turn will reduce cortical inhibition. Consequently, the fact that the subjects were timed may have furthered the state of overarousal.

Another factor, although somewhat remote, should be considered in examining the discrepancy in performance between the hyperactive and nonhyperactive subjects. One of the basic requirements for successfully completing the test was firstly a concept of the numbers 1 to 15 inclusive, and secondly a knowledge of the letters A to G. Piaget (1965) states that by the time a child is 7 years old he has spontaneously formed a concept of number. At this age level the average child has a true understanding of numbers. The average age of the subjects in the hyperactive group was 10.6 years (which is, of course, well beyond 7 years). Yet all the subjects in the hyperactive group were in resource rooms in school due to difficulties in reading, writing or arithmetic. The implication of this factor is that in regard to certain mental abilities the subjects in the hyperactive group were 1 to 2 years behind their peers. Consequently, the increased time those subjects required to complete the test may simply be due to their inability to fully understand number concepts.

Table XIX depicting the intercorrelations of Reitan's Trail Making Test Part I and Part II, the Porteus Maze Test Mental Age Score and Q-score, age and I.Q. shows a significant negative correlation between Reitan's Trail Making Test Part II and I.Q. for the nonhyperactive boys. This means that the longer a subject requires to complete Part II the greater is the probability that he has a lower I.Q. The correlation, although interesting, must be viewed with caution since I.Q. is determined by a number of factors such as familial environment, socioeconomic level, genetic input, level of emotional adjustment, and so forth (Sattler 1974).

The Porteus Maze Test

No significant difference was found between the hyperactive boys and the nonhyperactive boys regarding their performances for both aspects of the Porteus Maze Test. Porteus (1965) states that the maze test is a nonverbal, culture-free intelligence test which has as its foremost objective the measurement of planning ability. Furthermore, Porteus claims that the test is unique due to it's sensitivity to frontal lobe brain damage.

The Porteus Maze Test is a pencil and paper test like Reitan's Trail Making Test, but the subjects are free to work at their own speed. The two tests can also be compared in terms of the Das, Kirby and Jarman (1975) simultaneous and successive processing model of information integration.

The Porteus Maze Test is similar to Reitan's Trail Making Test in that the external input is received through the visual modality and is presented in a successive manner. Furthermore, the test is processed at the conceptual level due to the problem-solving behavior required to successively exit from a maze, and also the output is successive. The difference between the two tests lies in the nature of the processing that occurs in the central processing unit. Reitan's Trail Making Test requires successive processing whereas the Porteus Maze Test requires simultaneous processing. Part of the description of simultaneous processing states that the synthesis irregardless of position is surveyable (Luria, 1973). In terms of the maze, the starting point, correct pathway and exit point are at all times visible.

Three factors may account for the different level of performance of the subject in the hyperactive group compared to the subjects in the nonhyperactive group, between the Porteus Maze Test and Reitan's Trail Making Test. Firstly, the subjects were not under a time pressure on the former. Secondly, the mazes have been used with primitive tribes who have never been exposed to numbers or letters (Porteus, 1959) and the results have been comparable to those obtained from industrialized populations. Therefore the subjects in the hyperactive group may not have been hampered with any learning difficulties regarding letters or numbers. Lastly, the method of processing was simultaneous rather than successive. Das (1974 - 1975) had noted that the overaroused child has

difficulty with simultaneous processing. Since there was no significant difference between the hyperactive and non-hyperactive boys regarding their performances on the mazes, this may mean that this particular group of boys had a normal level of arousal or were underaroused. Again, it may not be prudent to infer a meaning or implication for a particular result based solely on one test.

The Q-score, based on the subject's neatness and care in execution of the maze was introduced by Porteus in an attempt to measure impulsiveness, overconfidence and "a tendency to become so absorbed in the task of finding a way through the maze as to neglect other considerations" (Porteus, 1965, p. 161). Porteus has found significantly higher Q-scores in juvenile delinquents and criminals. It could be argued that the hyperactive boys in the study should have a higher Q-score than the nonhyperactive boys since they qualified for the former group on the basis of the score obtained on the Child Rating Scale for Hyperkinesis (Davids, 1971). One of the characteristics measured on the scale was impulsiveness and inability to delay gratification. Furthermore, Weiss et al., (1971) in a 5 year follow up study of 64 hyperactive children found that the subjects had problems with distractibility, inability to formulate and maintain goals and were emotionally immature. Porteus did not describe the criteria he used to refer to juvenile delinquents, yet characteristics, such as the ones observed by Weiss, should be common to both groups.

Since no difference in the Q-score was observed between the two groups, it may be inferred that this particular age of boys was not concerned with neatness, that the nonhyperactive group had a significant number of boys who were over confident and that impulsiveness as measured by the Child Rating Scale for Hyperkinesis is not an equivalent measure of impulsiveness as measured by care of execution in completing a maze.

Table XIX depicting the intercorrelations of Reitan's Trail Making Test, Part I and Part II of the Porteus Maze Test Mental Age Score and Q-score, age and I.Q., shows a significant negative correlation between the Mental Age Score on the Porteus Maze Test and the Trail Making Test, Part II for the nonhyperactive boys. This means that as the mental age score increases the time required in seconds to complete Reitan's Trail Making Test, Part II decreases. This significant correlation indicates that intelligence and planning behavior as measured by the mental age score favorably affects a subject's performance in quickly sequencing alternating numbers and letters. The finding is plausible since planning ability is one of the factors required to satisfactorily complete Reitan's Trail Making Test, Part II.

Implications

The research study was designed to discern whether there were any significant behavioral antecedents of hyperactivity.

It was hoped that this information would in some way elucidate and/or add to the body of knowledge regarding the etiology of hyperactivity. The study of the etiology of hyperactivity has revealed that the cause of the disorder is not solely organic or environmental (Ross and Ross, 1976). Rather, the causes of hyperactivity could be multiple. For example, neurophysiological studies (Satterfield et al, 1972) and the observation of hyperactive children's differing drug responsiveness (Fish, 1971) show that hyperactive children form a very heterogenous group.

Part of the problem of understanding the cause of the disorder lies in the difficulty of accurately diagnosing the disorder. It is possible that children become labelled hyperactive because parents cannot tolerate a highly active child (Conrad, 1976). Furthermore, many clinicians may not want to thoroughly assess a child prior to instituting a management program. Cantwell (1975) advocates that a very thorough work-up be completed prior to diagnosing a child as hyperactive. This work-up should include: interview with the parents, interview with the child, use of a behavioral rating scale, physical examination, neurological examination and laboratory studies. This work-up if properly completed would be costly and time consuming.

The present research project has only included one of the work-up procedures recommended by Cantwell. Yet, two

The first group pertained to behavioral difficulties as evidenced by the hyperactive child's need for discipline and his difficulty interacting with others. Safer and Allen (1976) recommend that three forms of psychotherapeutic intervention should be considered when a hyperactive child has a behavioral problem. The three interventions are family counselling, individual psychotherapy and behavioral therapy. Family counselling is advocated so parents can learn how to improve the home environment by learning about discipline, supervision and improving the quality of the relationships within the family. Individual psychotherapy for the hyperactive child may help him deal with his feelings of inferiority and depression, assist him in developing interpersonal skills and help him realize his strengths and capabilities. Behavioral therapy is advocated due to the observable effect the therapy has had in changing disruptive behavior to socially appropriate behavior.

The second group of behavioral antecedents which proved to be significant pertained to the family history of the hyperactive child. Traits associated with hyperactivity were mainly observed in the second degree relatives of the hyperactive subjects. The findings, however, did not provide sufficient evidence to conclude a genetic basis of hyperactivity. Cantwell (1975) states that the adoption studies and twin studies "may suggest a genetic

Furthermore, the only way to prove a genetic basis would be through linkage and segregation studies.

Morrison and Stewart (1971) and Cantwell (1972) have observed a greater prevalence of sociopathy, alcoholism and hysteria in parents of hyperactive children. Also, Wender (1971), Satterfield et al.(1974) and Stewart et al.(1966) have found a greater prevalence of psychiatric illnesses in families of hyperactive children. These research findings indicate that a hyperactive child may be at risk. Furthermore, it has been noted that hyperactive children do not grow out of the disorder, as was originally thought (Werry, 1968). Through longitudinal studies it has been noted that the hyperactive child has behavioral problems as an adolescent (Menkes et al., 1967; Weiss et al., 1971; Mendelson et al., 1971). It is possible that these behavioral problems in adolescence become translated into psychiatric illness when the child reaches adulthood.

Further Research Questions

The present research project attempted to study a large number of behavioral antecedents. However it may have been more effective to concentrate in depth on one or two behavioral antecedents such as the effects of an alcoholic father on a hyperactive child.

The area of study, which is most recent and underdeveloped, pertains to the family history of the hyperac-

tive child. It has been noted that a relationship exists between psychiatric illness in families and hyperactivity. However, what is the exact nature of this relationship? Other questions that might be asked, are: Do hyperactive children develop psychiatric illness in later life? What percentage of psychiatrically ill adults were hyperactive? What is the prognosis for the hyperactive child when he has a parent(s) who is psychiatrically ill?

To answer some of the questions it would be advisable to interview as many relatives as possible (not just mothers) and to administer standardized tests to the relatives of the hyperactive child which would give a more accurate indication of personality factors or learning abilities. Another effective approach would be the use of longitudinal studies with regular assessment of the child and relatives.

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APPENDICES

APPENDIX A

The Porteus Maze Test consists of a series of mazes ranging from very simple (age level 3) to complex (adult level). Since the subjects in the sample ranged from 8 to 13 years, testing began at the year V level as recommended by Porteus (1965). The Porteus Maze Test gives a mental age score and a Q-score.

The following information will outline the rules for general application, examples of detailed instructions for Year V and the Adult level and the method used to obtain the Q-score.

Rules for General Application

1. The examiner sits opposite to the subject and places the first maze directly in front of the subject.
2. Testing begins using the Maze for the Year V level.
3. Two trials are given in each test up to year XI, four trials in Years XII, XIV and Adult; a test failure is recorded if the subject does not find his way through a maze in the allotted number of trials.
4. A subject is not allowed to correct a "wrong choice" error and continue tracing through the same design. As soon as the subject makes an error, the maze is removed.

5. Tracing the course in the air or proceeding with more than the alloted number of trials is forbidden.

6. If the subject succeeds in a test after failure has been recorded in the test immediately below it, the test design is inverted and repeated.

7. Testing ceases, if the subject fails to complete the maze in the allotted number of trials, for any three years in the whole series or in two successive years above Year XI.

8. To obtain the mental age score, the year level for the highest test recorded as passed is taken and then a half year is deducted for each unsuccessful trial throughout the whole series.

Instructions

For each year level, the examiner instructs the subjects. The instructions are geared to the year levels.

To illustrate this, the instructions for the maze Year level V and adult level will be given. Also the maze which accompanies the instructions will be shown.

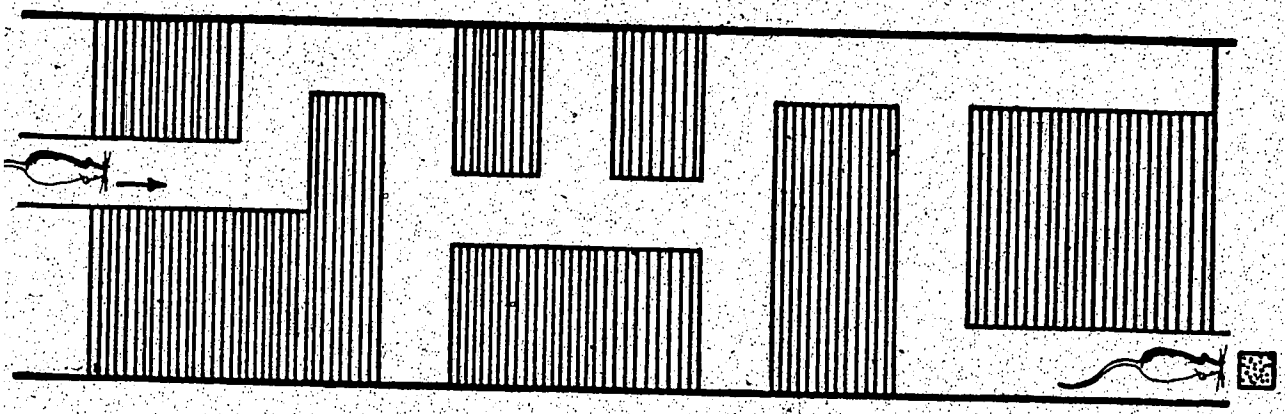
Year V

Examiner says:

"This is what is called a maze and you must try to find your way through it. You can imagine that these lines are all stone walls and that a rat came along and saw this hole."
(Examiner points to entrance to the maze.)

"Then he found his way between the walls until he came to the cheese. Now I want you to draw a line to show me where the rat went to get the cheese. But you must be very careful not to run into any lines or go into any place that is blocked at the end. The rat cannot turn around and come back."

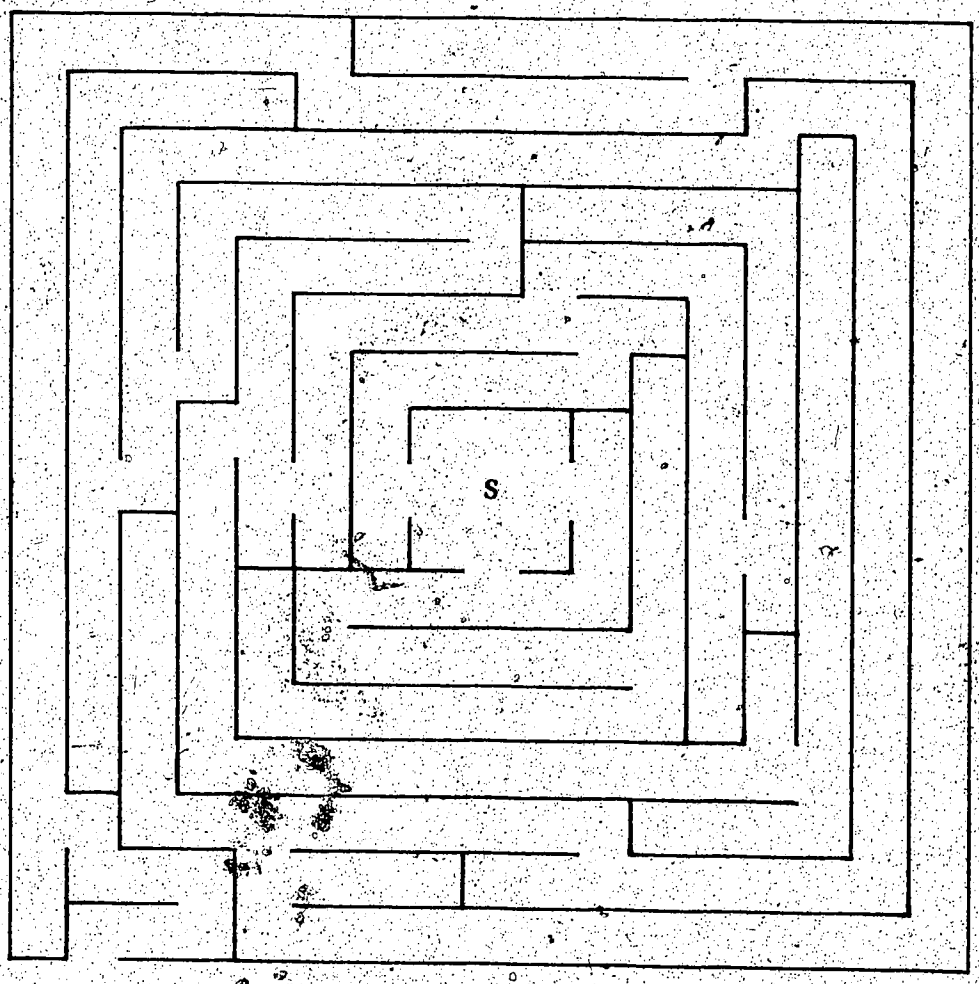
"And one thing more you must remember - you can stop anywhere and look as long as you want to, but try not to lift your pencil until you have found your way out. Now take this pencil and begin here (Examiner points with the finger to the initial arrow) and draw for me the way the rat went to reach the cheese here."
(Examiner points to exit.)



Adult Level

Examiner says:

"Begin here in the middle and find your way out."
(Examiner points to the letter S in the center of the test, but does not indicate the point of exit.)



Q-score

The Q-score is concerned with errors in execution. The following errors are recorded, weighted and totalled in order to give the Q-score:

1. A wrong choice or test age error occurring in the first

third of the design. Weighting 2.

2. A wrong choice error occurring in the last third of the design. Weighting 1.
3. Each cut corner. Weighting 1.
4. Touching a printed line in a maze with the pencil. Weighting 2.
5. Lifting the pencil. Weighting 3.
6. Wavy lines. Weighting 2.
7. Changing direction. The subject stops short of going into a blocked path. Weighting 1.
8. For children under 13 years of age, any qualitative error occurring in Test CI obtains an added penalty of one point for each such error.

Obtained from S.D. Porteus, The Maze Test and Clinical Psychology, Palo Alto: Pacific Books, 1959, pp. 153-162.

APPENDIX B

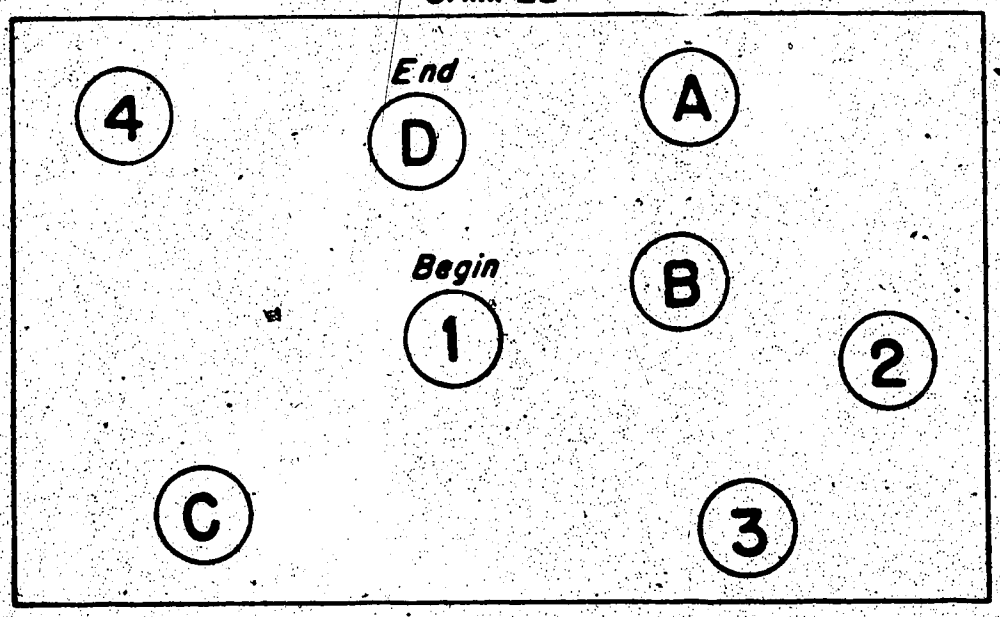
Reitan's Trail Making Test consists of two parts. In the first part the subject is required to connect 15 circles, numbered 1 to 15, as quickly as possible. In the second part there are 15 circles, 8 of which include the numbers 1 to 8 and 7 circles lettered A to G. The subject is required to connect the circles as quickly as possible, but must alternate between the numbers and letters in ascending sequence.

Prior to beginning either part, the subject must correctly complete a sample test. The sample for both parts consists of half the number of circles in one quarter of the space. If a subject makes an error in the sample, the error is pointed out and the subject is required to make the correction.

Both parts of the test are timed with a stop watch.

The sample the subject must complete for part two is illustrated below.

SAMPLE



End

15

Reitan's Trail Making Test - Part I