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NAME OF AUTHOR/*NOM DE L'AUTEUR* Linda Crawford Eaves

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PERMANENT ADDRESS/*RÉSIDENCE F* [redacted]

SOME PREDICTIVE ANTECEDENTS OF POOR SCHOOL ACHIEVEMENT

by

Linda C. Eaves

B.A. (Hons.), Portland State College, 1964

M.Sc., University of Washington, 1966

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Approval

Name: Linda Crawford Eaves

Degree: Doctor of Philosophy

Title of thesis: Some Predictive Antecedents of Poor School Achievement

Examining Committee:

Chairperson: Richard Freeman

E.M. Coles
Senior Supervisor

Elinor Ames

Raymond Koopman

Bernice Wong
Associate Professor
Education
Simon Fraser University
Alternate Member

Otfried Spreen
Professor
Psychology
University of Victoria
External Examiner

Date Approved: 28 May '82

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Linda Crawford Eaves

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ABSTRACT

The research reported in this thesis was designed to identify some antecedents of poor school achievement. The hypotheses were (a) that it would be possible to identify children in kindergarten or Grade I who would later develop learning problems; (b) that early immaturities would not be outgrown and (c) that learning problems would have many interacting antecedents.

The study consisted of a comprehensive seven year follow-up of thirty-one children considered to be at-risk for learning disabilities on the basis of test performance in kindergarten and twenty-six controls. The kindergarten test was followed by neurological and psychological examinations in Grade I; teacher ratings in kindergarten, Grade I and Grade III and achievement tests in Grade III. Outcome measures included reading achievement and teacher and parent ratings of the children in Grade VII. Birth events, developmental milestones and socioeconomic status were also examined for contribution to prediction. Thus a group of at-risk children were compared with controls at several points from birth to puberty.

Prediction as to whether the children would be achieving well or poorly in school at age 13 varied depending on the sets of predictor and outcome variables used. The kindergarten test was 68% accurate, and the psychological/neurological diagnosis

in Grade I 86% correct. The kindergarten teacher checklist alone accounted for nearly half of the variance in the Grade VII teacher checklist, and combined with the Grade I teacher checklist almost 60% of the variance was accounted for. Visual perceptual tests, reading tasks and general school readiness also contributed to prediction. Five (16%) at-risk children "caught-up" between ages 6 and 8 1/2, but none after that. None of the control group was performing below average in Grade VII. Only one control child (4%) had repeated a grade in contrast with 13 (42%) at-risk.

Birth events, intelligence quotients and socioeconomic status contributed very little to prediction. Abnormal birth events, developmental milestones, the neurological exam or parents' ratings did not distinguish between the at-risk and controls.

It was concluded that early identification is possible for the majority of children, but school achievement is neither unidimensional nor influenced by only one variable. The prediction of poor school achievement or learning disabilities consequently requires multivariate models.

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TABLE OF CONTENTS

LIST OF TABLES

A. INTRODUCTION

I. STATEMENT OF THE PROBLEM

This thesis is an investigation of some of the predictive antecedents of learning disabilities or more generally poor school achievement. Learning disabilities have been identified for some time (Hinshelwood, 1900; Johnson and Myklebust, 1967; Orton, 1937) and such identification has been shown to be reliable for the majority of children (Mercer, Algozzine and Trifiletti, 1979b) but important questions remain about just how early it can be done, what are the best identifying variables or antecedent conditions, how reliable they are in predicting for individual children and how good such identification is in predicting over several years in school. Other questions exist concerning the relationship between insults at birth and learning problems but there are few good studies on the topic and results are equivocal (Balow, Rubin and Roser, 1975-1976). Studies reporting longterm outcome for children with learning disabilities also give mixed results.

Part of the problem undoubtedly resides in the definition. The concept of learning disability has evolved over the years and implies a biological defect which is manifest in psychological and behavioural symptoms as well as in difficulty with school learning. Consequently, there is overlap and

confusion in the definitions. Children who are not doing well in school and who have associated behavior problems have, in fact, been identified by at least 38 different labels (Clements, 1966). Some definitions imply neurological involvement (e.g., minimal brain dysfunction or MBD) and others emphasize a psychological aspect of the problem (e.g., perceptual motor disability).

Learning disabled children are so-called partly by exclusion from other groups. Learning disabled children are not retarded, blind, deaf or seriously emotionally disturbed. They are not severely economically deprived and have attended school regularly. Yet they still perform at least one to two years below what is expected for their grade placement and many have associated behaviors which disturb parents or teachers.

A further problem in definition, particularly for research purposes, is that none of the learning disabled children show all of the characteristics that may be included in the definition. Some are hyperactive and impulsive; they may or may not have difficulties with auditory processing or visual-motor integration or language. Some have neurological signs and/or EEG irregularities; others do not. Most learning disabled children do not share a common set of the behaviors and traits included in the definition. Because of the difficulties with definition, researchers have generally selected smaller, "cleaner" categories, and as a result, 80% of the studies on learning

disabled/MBD children are studies of children with reading delays (Torgeson, 1975).

The evolution of thinking in the field and the need to acknowledge the many possibilities in defining learning disabilities are apparent in the following definition of children with "specific" learning disability which was accepted by the United States Congress for purposes of providing classes for the learning disabled in the public schools:

> Those children who have a disorder in one or more of the basic psychological processes involved in understanding or using language, spoken or written, which disorder may manifest itself in an imperfect ability to listen, think, speak, read, write, spell or do mathematical calculations. Such disorders include such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia. Such term does not include children who have visual, hearing or motor handicaps, or mental retardation, or emotional disturbance or environmental, cultural or economic disadvantage (Education for All Handicapped Children Act, Public Law 94-142, Office of Education, 1976).

In the present study, the general notion of poor school achievement was used to describe the children who, for a variety of reasons were not doing well in school by age 13. The poor school achievement was thought to occur for reasons other than low IQ, severe economic deprivation, physical handicap, lack of adequate instruction or sensory deficit. The children who at age 13 demonstrated poor school achievement were termed, at the beginning of this longitudinal study (in 1972, when they were in kindergarten) as showing minimal brain dysfunction (MBD). This term carried the implication of being at-risk for poor school

achievement/learning disabilities, and was based on the observation of one or more of the following signs: 1) hyperactivity; 2) perceptual motor impairments; 3) disorders of attention (short attention span, perseveration, distractibility); 4) impulsivity; 5) disorders of memory and thinking; 6) speech problems; 7) emotional lability; 8) equivocal neurological signs and EEG irregularities (Clements, 1966).

There is evidence today, which the present study will support, that children who show some or all of these signs at age five or six are much more likely to have difficulty in school. Whether they have minimal brain dysfunction however is an unresolved question. There is still a significant amount of interest in and support for the concept (Black, 1981; Rie and Rie, 1980) yet it has not been very useful for research or clinical purposes. It carries no implications for treatment and it is so vague and inclusive that groups of children so described may share very little in common. Some have recommended dropping the term completely (Ross, 1968; Satz and Fletcher, 1980).

The children who will be called poor school achievers, learning disabled or at-risk for learning disabilities in the present thesis could, according to current usage, also be said to have MBD, or specific learning disabilities. These terms describe the same types of children and vary only with the

predeliction or training of the researchers.

Considering the many definitions, a wide range of prevalence estimates is not surprising. Estimates range from one to thirty percent of all children as being learning disabled, depending on the strictness of the defirition (Belmont, 1980; Wender, 1971). For legislative purposes in the United States, it was recommended that one to three percent of the school population be considered to be learning disabled, "at least until research provides objective criteria for identifying these children more clearly" (Lerner, 1970). In Canada, the CEIDIC Report (1970), applying a relatively broad definition which included children with either emotional or learning disorders, estimated that close to one million children were suffering from a learning disability, which would be 10-15% of the school population.

Being At-Risk for Learning Disabilities

In addition to the concept of learning disability, there exists that of being "at-risk" for learning problems. This idea came from the broad interest in the early identification (between ages three and five) of the children defined above, before school achievement problems and their secondary emotional and behavior problems were evident. It is based on the emphasis on the importance of early education, the presumed greater

plasticity of the child before age five (Bloom, 1964; Hunt, 1961), and the assumption that remediation, given early, would prevent the development of later problems.

Evidence from children with other handicaps (e.g., blindness, deafness, mental retardation, metabolic disorders or cerebral palsy) has shown the importance of early identification for these problems (Tjossem, 1976). Early identification leads to early intervention which is vital and relatively easy to prescribe in the more handicapping conditions (e.g., a deaf child gets a hearing aid and language training; parents of blind or retarded infants receive counselling and training in stimulating their children) although less clear for the learning disabled.

There are problems with the notion of being "at-risk". The first concerns the errors that are necessarily made in predicting the condition. There are always some learning disabled children missed (false negatives) and some normal children falsely identified (false positives). The rates of these errors vary from study to study, and there is debate as to their importance. If individualized programs are implemented on the basis of the early identification, then the cost of such errors may become significant. However, for the children involved, the false positive errors are not too serious if a program does not emphasize the at-risk label. Any child would benefit from individualized instruction. The false negatives are

also less serious a problem if continuous monitoring of the children's progress takes place. When it is apparent that a child is having difficulty learning, then previously applied "no-risk" status must be dropped and changes made in the curriculum. A useful early identification program must not be rigid.

One type of false positive error is the child who is developing at a slower pace, showing a true developmental lag, not a real deficit. Although this type of child contributes to the error rate for a given identification battery, the child would not be harmed by the type of programs designed for those who won't catch up. Again, careful monitoring is required to insure that when a child "catches up" he or she no longer receives specialized instruction.

Another concern with the notion of "at-risk" is that the label becomes a "self-fulfilling prophecy". If a child is thought to be at-risk for learning difficulty he or she may receive less instruction or suffer the social stigma (imagined or real) of being sent to a learning assistance centre and hence be deprived of normal learning opportunities. Furthermore there is some evidence that differential expectations are generated by a set of disability labels (Foster and Ysseldyke, 1976). Teachers may treat children differently if they feel they are at-risk and the children may develop learning problems or a negative self-concept as a result of that treatment.

Keogh (1976) has also cautioned against developing a new category in special education, that of being "educationally high risk". Her concern is that if the category becomes rigid, then children will be identified simply to fit that category.

Nevertheless, despite these problems, there is general agreement that early identification of learning disabilities is valuable and important; and it is now law in the United States that free and appropriate public education be provided for all handicapped children aged 3-21. Preschoolers must not only be identified, but treated as well.

The Present Thesis

Well controlled long term follow-up studies are required to provide information about learning disabled populations. The present study was designed to answer questions regarding prediction and outcome with a comprehensive seven year follow-up on 31 children considered to be at-risk for learning disabilities on the basis of test performance in kindergarten, and 26 normal controls. The screening test in kindergarten was followed by neurological and psychological exams in Grade I (age 6 1/2); teacher ratings in kindergarten, Grade I and Grade III (age 8 1/2); and achievement tests in Grade III. Birth records were collected from the hospitals and the mothers' reports of the birth and developmental milestones were obtained. Outcome

data at age thirteen were in the form of teacher and parent ratings and achievement test results. Thus a group of at-risk children were compared with controls at several points from birth to puberty.

There have been many early identification studies, many follow-up studies and many studies attempting to link birth events to later disorders. The present study combines several aspects of the best of these studies:

1. using the longitudinal method with a school, not clinic, sample over a long period of time;
2. screening for potential learning disabilities in kindergarten with follow-up to Grade VII;
3. validating the screening test and hence the concept of being "at-risk" with psychological and neurological examinations;
4. using multivariate analysis for longterm prediction from kindergarten, Grade I and Grade III to outcome in Grade VII;
5. using birth events to predict school achievement.

To this date there has been no published study combining these features.

The hypotheses of the present study focus on prediction of outcome at age 13 from different sets of antecedent variables. The results are presented in terms of:

1. differences at birth between at-risk and normal children, and the prediction of at-risk status in kindergarten and Grade I and the prediction of outcome at age 13 from birth

events;

2. differences between at-risk and normal groups on developmental milestones;
3. prediction of behavior and school performance at age 13 (what should be Grade VII) from kindergarten, Grade I and Grade III variables, including teacher ratings;
4. differences between groups on the neurological exam in Grade I (age 6 1/2);
5. differences on the parent ratings at age 13.

B. REVIEW OF THE LITERATURE

I. EARLY IDENTIFICATION STUDIES

Introduction

The educational and psychological literature relevant to the present study falls into three closely related categories. These are 1) the kindergarten or early Grade I identification of learning problems; 2) outcome studies or the follow-up of young children diagnosed as learning disabled; 3) the identification of at-risk children on the basis of birth events.

A distinction between these categories is made on the basis of the time in the child's life at which predictive information is collected, and is somewhat arbitrary. The studies are usually longitudinal, all concerned with the same kind of problem behavior, i.e., poor school achievement, and all beset with the methodological problems characteristic of longitudinal studies. There is a somewhat different emphasis in the early identification or prediction studies as opposed to the follow-up or outcome studies. In the former, measurements are taken on the children before real problems are evident, usually in kindergarten. After waiting only a short time (one to three years) the accuracy of the identification is examined.

Prediction is usually specific (e.g., predicting Grade I or II achievement). In contrast, in the follow-up studies, children are often selected for study on the basis of already having been identified as having a problem (e.g., attending special classes, having been referred to a learning assistance centre or scoring among the bottom five percent on a reading test). Such studies generally cover longer periods of time, ideally being open-ended, and are less concerned with making predictions and more with observing natural outcome.

Early identification studies will be discussed in this chapter and follow-up studies in the next. A third chapter will deal with studies linking birth events to poor school achievement, where special attention will be given to the intervening variable of socioeconomic status.

Early Identification Studies

About twenty years ago researchers became interested in attempting to identify poor school achievers early in their school careers. Since then, a great many variables have been examined for predicting later school performance, which in most cases meant reading skills. In a survey of the literature, deHirsch (1971) reported that socioeconomic status, sex, age, neurological status, laterality, emotional state, visual perception, body image, language, motor skills and intersensory

integration have all been found to contribute to prediction but that there was no general agreement as to the best predictors.

The following review will consider the major studies in the field in terms of the type of variable(s) used as predictors. These include motor, visual perceptual, language and reading readiness tests. Multiple test batteries and teacher ratings are also discussed.

Gross Motor Performance as Predictor

It has been observed that children with learning disabilities are often clumsy, but gross motor performance has been neither widely used nor very successful as a predictor of later school achievement. On the Meeting Street School Screening Test, gross and fine motor skills in combination with visual perception and language were found to be good predictors (Hainsworth and Sigueland, 1969). However, Rogolsky (1968) concluded that while language and perceptual factors were reliable predictors of school success, gross motor performance was not. If children are to be screened in kindergarten or Grade I, such skills as balancing, skipping or throwing are probably too well established in any group of six year olds to serve as a basis for differentiation.

Visual-Perceptual Tests as Predictors

Since reading is seen, particularly in the early stages, as a perceptual task, many predictive tests have included measures of visual perception or perceptual-motor skills (e.g., matching or copying). These tests have generally been more successful than language or gross-motor tests in predicting later achievement.

The Bender Visual-Motor Gestalt Test, which involves using a pencil to copy designs from stimulus cards, has figured prominently in many screening batteries and has been found to contribute to prediction (Book, 1974; deHirsch et al., 1966a; Jansky and deHirsch, 1972; Kerr, 1972; Koppitz, 1971; Wallbrown, Engin, Wallbrown and Blaha, 1975). Norfleet (1973) and Feringen and Jacobson (1970) both found it better at predicting a good outcome or absence of learning disabilities than poor reading performance. It is therefore less useful for identifying children at-risk for learning disabilities. Keogh (1965; Keogh and Smith, 1967) demonstrated consistent significant relationships between Bender scores in kindergarten and later school achievement but did not find the relationship to be high enough for individual prediction.

Robinson and Schwartz (1973) found a visual-motor coordination test given in kindergarten combined with the Bender to be weak predictors of reading achievement after two years in

school. Only 25% of those considered to be high-risk on the basis of their performance on the visual-perceptual tests became poor readers, although this was a much larger percentage than in those showing normal visual-perceptual skills in Grade I.

A complex visual-motor task, a timed matching and underlining test, was found to be among the best predictors of reading after four years by Rourke and Orr (1977).

Language Tests as Predictors

As seen above, perceptual-motor tests often predict better than language tests, but combined with others aid prediction (Hainsworth and Sigueland, 1969; Rogolsky, 1968) and language items appear in many readiness tests (Silver, 1978). An aspect of language, auditory association, was one of five factors found by Silver and Hagin (1976) to account for 61% of the total variance in predicting Grade II reading performance from kindergarten. However, Hammill and Larson (1974) have found auditory skills much less useful in predicting reading ability.

Another test designed to measure language skills, the Language and Learning Assessment for Training Test was found to correctly predict reading scores after 1 1/2 years for 78% of a small group (n=23) of children (Lyons and Bangs, 1972).

Reading Readiness Tests

The oldest type of early identification is from traditional reading readiness tests which have been used extensively to help place students and plan Grade I programs. As a rule, they translate scores into percentiles, allowing for comparison of a child to the normative group. Thus, they are not predictive, but give only the current "readiness" status of a child. Austin and Morrison (1974) found that 85% of the schools in the United States used such tests routinely. Silver (1978) reported an analysis of the content of these tests and concluded that while at least twenty different areas were measured by them, the most frequently assessed ones were auditory and visual discrimination, and visual motor skills.

A few studies have been done using readiness tests as predictors. Zaeske (1970) concluded that one such test, the Metropolitan Readiness Test (MRT) was a good predictor of Grade I reading achievement and had an advantage of being a group test. Severson (1972) found correlations of .65 to .70 between the MRT and the end of Grade I achievement. In two separate studies, Book (1974) and Rubin, Balow, Dorle and Rosen (1978) both found the MRT given in kindergarten predicted achievement tests scores in Grade II or III correctly for from 70 to 88% of the children, but with better prediction for the good achievers than for the failures.

Preacademic Tests as Predictors

Tasks closely related to reading have been found to be good predictors. Busch (1980) reported that the ability to recognize letters and sounds early in Grade I was the best single predictor of reading at the end of Grade I; and prereading knowledge of letter names along with visual discrimination were found to be useful predictors of Grade I achievement by Barrett (1965a, 1965b) and Dykstra (1967, 1968). Jansky and deHirsch (1972) also found letter naming to be a good predictor, while Satz, Taylor, Friel and Fletcher (1978) reported that alphabet recitation was one of their best predictors.

Multiple Test Batteries as Predictors

In most studies the batteries predicted better than individual tests of any type. This is not surprising since school learning is a multivariate process that is dependent upon a range of skills, and any group of kindergarten children must contain some with perceptual-motor immaturity, some with language difficulties and some with social-cultural disadvantage, any of which could be missed by a single test. With such a disparate group, using a set of different kinds of predictive tests should maximize prediction. Also more of the researchers using batteries, as opposed to those who used single

tests, analyzed the data with multivariate statistics rather than simply reporting correlation coefficients. This too would maximize prediction by identifying the best combinations of predictors.

Only one study using a multiple test battery reported a failure to identify low achievers in kindergarten and this was of questionable validity. Badian and Serwer (1975) used several methods for picking at-risk children but found those selected became average readers at the end of Grade I and scored in the average range on the Wechsler Intelligence Scale for Children and the Illinois Test of Psycholinguistic Abilities. The children were selected in kindergarten as at-risk for learning disabilities if they 1) scored lower on the Metropolitan Readiness Test and letter naming than on two measures of IQ: the Primary Mental Abilities and the Goodenough-Harris Draw-a-Man Test; 2) had a discrepancy between verbal and non-verbal IQ of at least 12 points; 3) showed scatter on the Primary Mental Abilities IQ test; 4) received the lowest rating on form copying and 5) showed a discrepancy between visual-motor tasks and verbal measures. The researchers did not state how many of these criteria the children had to meet in order to be considered be at-risk. The 20% of 300 kindergarten children who were selected, however, were on the average doing well at the end of Grade I.

There are several problems with this study. On the surface it appears that the selection criteria were inadequate. Apart

from the form copying none of the other methods have been widely used with kindergarten children, although verbal/performance IQ discrepancies and scatter on an IQ test are often considered to be signs of minimal brain dysfunction. The form copying test used here was scored on only a three point scale which may not have been broad enough to discriminate among those with good and poor perceptual motor skills. Also, inadequate statistical analysis may have prevented the identification of truly at-risk children. Instead of deriving a relationship from the scores (e.g., using a discrepancy between scores rather than a score itself) they should have used the Metropolitan Readiness Test, Draw-a-Man, Primary Mental Abilities, form copying and letter naming scores in a regression equation, and also used scores from each of the five criteria as independent variables in the equation. It is likely some combination of these would have identified the at-risk very well. The rather vague clinical criteria for identifying the at-risk also led them to include 20% of the kindergarten classes, which was probably too many. Satz and Friel (1978) have shown that accuracy in prediction is best when only the most severe (a much smaller number than 20%) are identified.

The deHirsch Predictive Index is a widely quoted and influential work (deHirsch, Jansky and Langford, 1966). Although the original Index was developed on a very small (n=53) homogeneous sample it achieved prominence, not because of the

superiority or applicability of the study, but because it was one of the first systematic attempts to develop a screening test by actually examining its predictive accuracy. It also appeared at a time (1966) when there was great interest in early identification and few available instruments that were specifically designed for that task.

The ten item battery was derived from thirty seven items which had been taken from many sources, including existing readiness tests. The authors' position was that reading disorders resulted from disorders of language and the tests they selected reflected this. The ten items that comprised the final battery were selected on the basis of high positive correlations with reading achievement at the end of Grade II, and the fact that this particular set of items correctly identified nine of the ten children who were failing readers at that time.

Others have used the deHirsch battery for successful prediction. Feshbach, Adelman and Fuller (1974) predicted correctly for 73% of children after 1 1/2 years but a large number of those who were predicted to do poorly on the basis of the test results in fact did well. Paves, Kendall and Crichton (1974) found 85% overall correct prediction from kindergarten to end of Grade I, with much better prediction for passing than for failing readers.

It is not surprising that this battery would predict well, using as it does a combination of perceptual motor, language and

preacademic items, all of which have been shown to contribute to prediction. The results to date, however, have not supported the original position of deHirsch et al. that language items would be the most important predictors.

The deHirsch Battery was further refined following testing on a larger sample. Jansky and deHirsch (1972) tested over 500 children in kindergarten and 68% of these were followed to the end of Grade II. Seventy six percent were correctly identified as good or failing readers in Grade II on the basis of the kindergarten tests. The tests identified 79% of the failures but misclassified 25% of the good readers. The best predictors included letter naming, picture naming, Gates Word Matching (a visual task requiring the child to find the word to match a stimulus word from four similar ones) and the Bender Visual-Motor Gestalt Test.

An important and influential series of studies involving the development of a multiple test battery was done by Satz and his colleagues (Satz and Friel, 1973; Satz and Friel, 1974; Satz, Friel and Rudgeair, 1976; Satz, Taylor, Friel and Fletcher, 1978). Satz et al. began with a different position from that of deHirsch et al, who emphasized the importance of language disabilities in reading disability. They postulated that lags in perceptual discrimination and analysis accounted for immaturities in kindergarten children and would predict later reading difficulties. Accordingly they gave a 16 item

screening test emphasizing these areas to over 400 kindergarten boys and followed them to Grade V. Twenty percent of the sample was found to be two or more years behind in classroom reading skill at that time and the kindergarten tests predicted correctly for 72% of the children overall and for 85% of the severe reading failures. An abbreviated battery of eight items predicted the extreme groups of severe and superior readers at the end of Grade II very well (over 90% correct prediction). It included measures of sensorimotor-perceptual skills (finger localization, Recognition-Discrimination Test, Beery Test of Visual Motor Integration), verbal-conceptual skills (Peabody Picture Vocabulary Test, Dichotic Digit Recall Test), and verbal-cultural experience (Wepman Auditory Discrimination Test, Alphabet Recitation, and socioeconomic status). The sensorimotor-perceptual skills accounted for most of the predictive variance, but the combination of verbal, cultural, visual-motor and preacademic items maximized prediction.

Silver and Hagin (1976) with a battery called SEARCH identified five factors accounting for 61% of the total variance in predicting Grade II reading performance from kindergarten. These were 1) an auditory association factor, 2) a visual neurological factor, 3) psychiatric impairment, 4) chronological age and 5) IQ from the Wechsler Preschool and Primary Scale of Intelligence.

Book (1974) used a battery combining the Metropolitan Readiness Test, the Bender Motor Visual Gestalt Test and the Slossen Intelligence Scale. After two years in school, correct prediction of reading skills had been made for 88% of the children. Almost half of those who had been predicted to become poor readers became good readers, but only 1% of those predicted to do well failed.

Keogh (1976) reported the use of a slightly different kind of battery. A group of kindergarten children were rated on behavioral observations and on teachers' ratings. The ratings included such things as attention to task, disruptive or out-of-seat behavior, and verbal interchange with the teacher. The teachers rated the children on readiness for reading, ability to follow directions, attitudes to class rules and relationships with classmates. Further testing included the traditional predictors of the Peabody Picture Vocabulary Test, three Bender figures, Matching Familiar Figures, Children's Embedded Figures and tempo regulation tasks. Eighty five percent of the children were correctly identified in terms of Grade I achievement. Keogh concluded that there were two components contributing to success in school. One was academic aptitude and the other, behavioral adaptability. The latter, which may be more amenable to modification, also contributed more to identification of being at-risk in kindergarten, while academic skills became more important in Grade I.

Teacher Ratings as Predictors

Teacher rating scales of behavior and performance in kindergarten and Grade I have also been found to predict school success (Dykstra, 1967; Eaves, Kendall and Crichton, 1974; Perinden and Jacobson, 1970; Haring and Ridgway, 1967; Keogh and Smith, 1970). Such rating scales predicted later performance about as well as school readiness tests given in kindergarten and were useful in identifying at-risk children. Successful prediction for teacher ratings ranged from 70 to 90% (Mercer, Algozzine and Trifiletti, 1979b). Even parents trained to be teacher's aides in an inner-city Headstart program identified the children with specific learning deficits almost as well as did a test battery (Colarusso, Mathis and Schessel, 1979).

Glazzard (1979) found the teacher ratings to be the best predictor of reading achievement one year later, and equal to the Gates McGinitie Reading Readiness test in predicting reading achievement four years later. Lilenfield (1976) found they continued to predict well up to six years later. However, when mental age was partialled out, Brekke and Williams (1973) found little correlation between reading readiness and the teachers' ratings. In their study it appeared that teachers were simply identifying bright children.

Busch (1980) found a Behavior Rating Scale completed by the

kindergarten teachers to be one of the best predictors of Grade I reading achievement along with IQ and the preacademic item that has frequently been found to be a good predictor, letter recognition. Almost 60% of the variance in reading scores was accounted for by these three factors. Satz and Friel (1978) however, reported that teachers were less accurate than a test battery in predicting the severe at-risk children (teachers identified only 19% vs. 75% identified by test) although overall accuracy of good or bad outcome was high (nearly 80%). Since it should be easier to identify the severe cases than the mild ones, the authors suggested that the teachers feared mislabeling. When they actually predicted a severe case and a poor outcome they were 90% accurate.

In a Canadian sample, Gershman and Kershaw (1977) found that a fairly simple battery given in kindergarten, consisting of the Draw-a-person IQ, copying of geometric designs, a teacher-psychologist interview in which the teacher indicated the presence of problems such as a short attention span, gross or fine motor difficulties or memory or language problems, and a teacher rating scale in Grade I, classified 86% of the children correctly in terms of grade placement four years later. The teacher's rating alone was the most significant factor and almost as good as all of the items together.

In this study, it was observed that prediction was less reliable for lower SES children, and that such children were

much more likely to have failed a grade or be in a special class, yet multivariate analysis was not used to provide the relative contribution of SES or IQ to prediction and the amount of covariance with teacher's ratings. Interestingly, while low SES was related to a poor outcome, being born outside of Canada or having English as a second language was not.

It is not surprising that kindergarten teachers, who should be very familiar with the expectations of the early grades in school, should be able to predict which children will do well. There is, however, the possibility that some of the variance in prediction is accounted for by either the well-known "self-fulfilling prophecy" or by "halo effects". The Grade I teacher may read reports from the kindergarten teacher and before interacting with the children may have an idea of who will do well and who will fail and thus treat them accordingly. While teacher expectations must play a role in children's performance, it is probably more complicated than simply a "halo effect". If such effects could be proved to be so powerful, learning disabilities could be eliminated by teachers writing glowing reports about learning disabled children for their colleagues.

Problems with Prediction/Early Identification Studies

As has been shown above, many researchers reported prediction of poor achievement in school after one to five years from kindergarten or early Grade I measures. The correlation coefficients most often ranged from .40 to .60 with some as low as .22 while others were as high as .75 (Dykstra, 1967; Keogh and Becker, 1973; Pikulski, 1973). Others reported the percentage of correct predictions for various groups which ranged from 40% to 90% correctly predicted. However, false positive rates (prediction of failure but with successful outcome) were often high and rates of correct prediction differed for failing and successful children. Seventy to ninety percent of achievers have been correctly predicted in different studies, while hit rates have been lower for failures (Reaves et al., 1974; Feshbach et al., 1974; Pate and Webb, 1970; Rubin, Balow, Dorle and Rosen, 1978). Because of these variable rates caution must be used in interpreting them. Rubin et al. (1978) concluded that "present evidence will not support attempts to make individual predictions regarding which preschool children will later experience serious academic skill difficulty" (p.9).

Mercer et al., (1979b) summarized the "state of the art" in early identification. They concluded that it was possible to identify the potential learning failures in kindergarten with a variety of instruments including teacher checklists. They were

concerned, however, that many researchers involved in early identification failed to discuss the different kinds of prediction, i.e., the percentage of those predicted to do poorly who turned out well (false positives) and those who turned out poorly who had been predicted to do well (false negatives). Satz and Fletcher (1979) observed that such errors occurred in predicting for individual children on the basis of group figures and by the failure to use prevalence estimates of the event to be predicted.

More general criticisms of nearly all of the early detection studies have also been discussed by Satz et al. (1978). They described the requirements for prediction research to be:

1. a multivariate design in which multiple measurements are made on the same subjects over time;
2. sufficient time between the original test and the criterion reading test;
3. use of a homogeneous population to avoid confounding the results by race, SES, sex or cultural variables;
4. use of a separate group of children upon which to cross-validate the predictive usefulness.

None of the above mentioned studies (with the exception of those by Satz et al.) met all of these rigorous requirements. In particular many studies report the follow-up after very short intervals, (e.g., nine months to two years) which may not be

long enough to provide true "outcome" information. Very few studies have followed children for as long as five to seven years. The concern of Satz et al. (1978) about the need to use homogeneous populations however, may not be warranted if the variables of race, SES and sex are considered as independent variables in multiple regression equations. In this way their relationship to the dependent variable will be accounted for and important information about their contribution to learning disabilities may be uncovered.

Conclusions from Early Identification Studies

Despite the methodological problems in studies on the early identification of learning disabilities, there has been a substantial amount of consistency in the results. Many found that it was possible to predict correctly for the majority of children whether they would be failing or passing in school from one to six years later. Perceptual and sensori-motor tasks often figure prominently in the batteries and prediction has been done with about equal success with group tests, traditional readiness tests or specifically designed learning disabilities batteries. It may be possible that what is being measured in common by this variety of tests is the child's ability to sit still and pay attention, clearly requirements for success in school. The approach of Keogh (1976) in measuring attentional and tempo

regulation factors would seem to be a promising one in improving prediction.

Prediction is best when the tests and outcome measures are similar. Letter-naming, for example, repeatedly emerges as a good predictor and it is quite similar to word recognition which is a frequently used outcome measure of reading ability (Dykstra, 1967). Keogh (1977) reported that while behaviorally immature children are often identified as high-risk in kindergarten, it is the indicators of immaturity in academic areas that prove to be the best predictors of actual achievement.

There are several reasons why prediction is not better than it is. First, the way in which a poor outcome or "failure" is defined will raise or lower the percentage of correct prediction. When only those children who are among the bottom 5-10% on a given outcome measure are called "failures" (i.e., a small number) then prediction is best. A second reason for poor prediction is that motivational, cultural and emotional factors have been measured only indirectly by early identification devices and they likely affect school success. Third, differential developmental rates may have accounted for some errors. Some children may simply have been "late bloomers" and appeared quite immature and unready for school tasks in the early grades yet caught up later. deHirsch et al. (1966) and Satz and Van Nostrand (1973) considered this to be a factor;

however, Rourke (1976), with a neuro-psychological follow-up study from ages 7-8 to 11-12, concluded that a developmental deficit, not a lag, accounted for poor reading achievement in school.

There is also the possibility that because learning disabled children are relatively easily identified, teachers have initiated special programs for them and the resultant improvement contributed to the false positive rate. In fact, if remediation is effective then prediction must necessarily be very poor. Although intervention has rarely been considered in prediction research, in one study it was reported that accuracy of prediction was poorer when children received intervention (Lyons and Bangs, 1972). Satz and Friel (1978) also noted that in their mildly affected group, for whom prediction was poor, eight of elever children had been involved in individual treatment programs. Presumably they failed to develop the predicted learning problems because of treatment.

Usually the amount, quality and suitability of remediation is impossible to assess in studies concerned with early identification and follow-up. Such remediation is ideally individualized and varies greatly among schools and teachers. Instructional variables and situational effects clearly affect the outcome of learning disabilities but contribute to an unknown extent to the variance in prediction (Adelman, 1970; Keogh and Becker, 1973).

The type of study required to clearly answer questions regarding treatments would be considered unethical. Carefully matched groups of learning disabled children must be followed, half with treatment and half without. It is not likely teachers or parents would allow children, once identified, to be in the control (untreated) group and hence it is very difficult to answer questions in more than a general way.

In summary the following conclusions may be drawn:

1. The percentage of correct prediction of outcome from kindergarten or early Grade I for most studies was between 65-90%.
2. Tests of visual-motor skills have been used more often and are better predictors than gross-motor or language tests.
3. Teacher rating scales are in most cases as good or better than the tests or batteries in predicting outcome of school achievement.
4. Preacademic tests which are similar to the outcome measures of reading skills are good predictors.
5. There is no "best" test, battery or rating scale that can be recommended for early identification, but some combination of visual-motor and preacademic tests, teacher ratings and behavioral assessment will identify in kindergarten most children who will have trouble later in school.
6. Measures of attention and behavioral characteristics have not been used extensively for prediction but appear to be

promising both for prediction and for program planning.

II. FOLLOW-UP STUDIES

As has been seen, it has been possible to identify ahead of time many children who are likely to develop learning problems. What happened after identification was less clear. Many questions remain regarding the outcome of learning disabled samples because there have been few good long term studies.

As mentioned above, problems exist in classifying children who do not do well in school, in part because they usually have more than one problem and there is no general agreement in the field as to what to call them. If the problem is an obvious one, such as hyperactivity or impulse disorder, then they usually see a neurologist or psychiatrist, and that problem is what is emphasized, although most hyperactive children have learning problems as well. The term minimal brain dysfunction (MBD) is more general, and as seen in the introduction, includes both learning problems and hyperactivity as possible defining characteristics. This term is used more by researchers with medical or neurological training and less by educators. It implies that the learning problem or hyperactivity has a neurological base. To futher confuse the picture, the term hyperactive has been dropped by the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-III) and

children who were previously called hyperactive will now be classified as having an attention deficit with or without hyperactivity. Children with learning problems and relatively good behavior are studied by educators and generally called simply learning disabled, although many learning disabled children show an attention deficit.

Since the follow-up studies reviewed in this section were all begun some years ago, the most widely used categories were hyperactivity, MBD, and learning disabilities, which in most cases meant reading disability. The children who have been studied might be called one or the other term either because of the prominence of their symptoms or the preferences of the investigator. The children share some or all of the characteristics described by Clements (1966) for defining MBD.

For the purposes of this chaper an artibrary distinction will be made but with the awareness that in few of the studies do the childrer represent a clean well-defined sample. First, the studies concerned with the outcome of children diagnosed as being hyperactive, or having MBD or both with or without learning problems will be reviewed. Second, studies concerned with the outcome of learning disabilities, with no reference to hyperactivity or MBD will be discussed. Finally, the outcome of any of these problems or combinations over a longer period of time, i.e., to adulthood is presented.

Some of the earlier studies reported favorable outcomes, but the more recent ones, perhaps because of larger samples or better defined criteria, indicated that most children with an early history of learning disabilities, minimal brain dysfunction or hyperactivity suffered problems in social, educational or employment areas as they grew up.

The assumption in all of the studies in this section is that the children's problems had been identified by professionals for their parents. Many in fact were in special classes or attending neurological clinics. They were picked for study of outcome because of their condition so in most cases there was no control group, the outcome of normal children not being of interest to the investigators. The question of the effects of being identified or receiving remediation was usually not addressed and the outcomes reported are assumed to be what happens in the normal course of events for such children.

Just what the "normal course of events for such children" is cannot be specified, but over the last two decades it has included a variety of special classes, private tutoring, drugs, counselling and learning assistance in the schools. The treatment has depended less on the child's problems and more on other factors. Keogh and Becker (1973) stated that "a particular intervention may be in large part a matter of program availability, point of view of the diagnostician, intuition and a little bit of faith" (p.7).

Obviously, studies reporting outcome are as much a reflection of the effectiveness of the different methods of intervention (or the lack of it) as the natural development of learning disabled children. As seen in the previous section the question of remediation is rarely examined systematically because of the difficulties of doing such studies.

Outcome of Hyperactivity and/or MBD

Some studies focussed on hyperactive children with or without learning disorders. The results of these studies agree, in general, that while some improvement may be seen in the hyperactive behavior, it is not completely outgrown.

Mendelson, Johnson and Steward (1971) found half of a group of hyperactive children markedly improved as teenagers, two to five years after diagnosis. However, the symptoms of restlessness, distractibility, impulsiveness, excitability and aggressiveness persisted in most children and they did poorly in school (58% had failed one or more grades.) A number were also delinquent.

A Montreal group reported two studies of hyperactive children. Minde, Lewin, Weiss, Lavigueur, Douglas and Sykes (1971) found the outcome discouraging, with hyperactive children showing far more behavioral problems, increase in learning problems and lower IQ scores then controls when seen after four

to six years. Weiss, Minde, Werry, Douglas and Nemeth (1971) found in a group of hyperactive children with MBD, that the children were less hyperactive than they had been originally, but social, emotional, attentional and learning problem persisted. Seventy percent had repeated at least one grade as compared with fifteen percent of matched controls.

Dykman, Peters and Ackerman (1973) reported on children with MBD and learning disabilities, some of whom were hyperactive. Fifty-three children were seen at age fourteen, three years after diagnosis. The learning disabled children were inferior to controls in IQ, with difficulties in conceptual, sequencing and symbolic abilities. They were several years behind in school subjects. Only four children had no difficulties on follow-up.

In a study by the present author (Paves and Crichton, 1974-1975) it was found that after five years only three of thirty-nine children diagnosed as having MBD (8%) had no school or behavioral problems. Twenty-five to thirty-five percent were still distractible, restless or overactive at a mean age of 12 years 2 months, and almost 60% were behind their grade level in academic subjects.

Riddle and Rapaport (1976) found that boys diagnosed as hyperactive at eight years of age were significantly less so two years later, and achieving at an average rate, although lower than the controls. Despite this improvement, their parents were

nearly all seriously concerned about their sons' immature and impulsive behavior.

There is general agreement in all of these studies. Children diagnosed as having hyperactivity and/or minimal brain dysfunction in middle childhood do not entirely outgrow the problems and after two to six years most are having difficulty adjusting to the home or school environment. There is continued academic failure, poor social adjustment, behavior problems, poor concentration and impulsivity.

Outcome of Learning Disabilities

In the studies reviewed in this section the defined population was called learning disabled, chiefly reading disabled, with no reference to hyperactivity or minimal brain dysfunction. In general these studies reported little improvement in the school achievement of the children, although there were a few exceptions. The amount of improvement the children made in reading was unrelated to remedial instruction, in those studies in which such assistance was reported. In some studies the children with higher IQs showed the most improvement although not to average levels. In some early studies, which concluded favorably that children who were behind in reading showed high educational and vocational achievement in later life, mean IQs were above 120 (Robinson and Smith, 1962; Rawson,

1968). Balow and Blomquist (1965) reported, even with an average IQ, that outcome was good, with most graduating from high school.

In several studies, it was found that deficits in reading not only persisted with age but grew larger relative to age and grade placement (Gottesman, Belmont and Kamines, 1975, after 3-5 years; Koppitz, 1971, after 5 years; Silver and Hagin, 1964, after 12 years; Trites and Fiedorowicz, 1976, after 2 1/2 years; Yule, 1973, after 5 years).

Koppitz (1971) followed 71 learning disabled children for five years in special classes. She found that less than 20% were able to return to regular classes. Those most likely to improve had IQs of more than 85 and were no more than two years behind in reading. The average gain in school skills for all the children was three to four months for every year spent in special classes, although those who returned to regular classes gained one year in reading for each year in the program. None of the children at the end of five years was reading close to what their grade level should have been. Their reading ability ranged from Grade 2.8 to 4.7 at ages 11-17. A similar finding of four months gain in reading skills for each year in school was found by Gottesman et al., (1975) in a follow-up of three to five years. The gain was the same whether the children received remedial help or not. The average IQ of this group of 58 children was only 88 but improvement in reading was unrelated to

IQ. Only half of the children who were 15 or older at the time of follow-up could read as high as the Grade 4 level. However, in a further follow-up on the same children, Gottesman (1979) did find IQ to be a factor. The children who had higher IQs and had been placed in regular classes had the best outcome. IQ acccunted for 14% of the variance in reading test scores after five to seven years.

Rourke (1975) reported a four year follow-up of 59 retarded and normal readers. Some retarded readers made significant advances but overall the normal readers made four years progress while most of the retarded group progressed only two years in the four year period. He does not mention if they received any special instruction.

Muehl and Forell (1973-1974) found a similar slow rate of improvement in 43 children who were three grades behind in reading at the time of diagnosis. Five years later, in high school, only four percent read at an average or above level. Improvement was unrelated to remedial instruction, but the children who were younger at the time of diagnosis and had higher IQs showed the largest gains. Those with higher SES also read better at follow-up, but SES was not independent of IQ and age of diagnosis.

Ackerman, Dykman and Peters (1977) also found that while small numbers of children appeared to overcome their difficulties, such improvement was unrelated to intervention and

special instruction. In this study, the original delay of two years which qualified the eight to eleven year old boys to be called learning disabled, was, by the time the boys reached 14, widened to 2 1/2 years. Compared to controls, the learning disabled group was four years behind. Two thirds had repeated one or more grades. Those who also showed hyperactivity presented behavior problems at home and school.

Hinton and Knights (1971) queried a group of 67 mothers whose children had been referred three years earlier for learning problems. Seventy five percent reported that the children's behavior had improved. This was in the absence of specific treatment although some families in the study had received counselling and some children had been placed on medication. No scores on academic tests were given but over half of the children had failed at least one grade in school.

Yule (1973) after retesting disabled readers four to five years following diagnosis, made a distinction between "backward" readers and "retarded" readers. The "backward" group, with a lower IQ score (IQ=86) was more than two years behind what would be expected from their chronological age, while the "retarded" group (IQ=98) was more than two years behind what would be expected from age and IQ. On follow-up, both groups were far behind their expected level but the "backward" group was higher in reading and spelling than the "retarded" group, and seemed to be simply slow learners, while the "retarded" readers had a true

reading disability which was independent of tested intelligence.

Werner and Smith (1977) in their longitudinal study of over 600 children found three percent to be learning disabled, many with signs of MBD. Eight years after diagnosis, 80% showed school underachievement, acting out behavior, some leading to deliquency and generally poor adjustment with a persistence of perceptual motor problems.

The evidence from these studies on learning disabled children, identified at ages 8 to 12 and followed into adolescence, indicates that problems in reading persisted although some achieved reading levels of Grade 6 which is considered functional literacy. In some studies improvement was related to higher IQ and SES, but it was not usually related to specific treatment.

Outcome to Adulthood

Outcome to adulthood has been reported by only a few investigators. The results in general echo those of the previous section: children with learning problems and/or hyperactivity/MBD do not improve in adulthood to become average in reading or behavior although adjustment to emplcyment may be satisfactory. There was one exception to these negative findings. Rawson (1968) found the "dyslexics" in her study to have attained a higher level of education than the controls. All

had completed high school, and most completed college. They did have, however, an average IQ of 131, high social class and were given intensive and individualized instruction in reading.

Spreen (1978) found the degree of neurological impairment directly related to quality of outcome in a group of 255 learning disabled children, who were first seen between ages 8 to 12 and followed to late teens and early adulthood. He had four groups of children: 1) definitely brain-damaged; 2) minimally brain damaged; 3) learning disabled with no neurological findings and 4) normal controls. In several areas (education, social, personal or occupational) those with more neurological abnormalities were poorer in adjustment and achievement although the IQ was not significantly different in the three learning disabled groups. Actual achievement level in reading or school subjects was not reported, but fewer than 40% of the three learning disabled groups were still in school compared with 69% of the controls at an age range of 13-25 years.

Frauenheim (1978) reported skill attainment in academic subjects for forty adult males who were dyslexic in childhood. He concluded that "adult learning difficulties were essentially identical to those evidenced at the time of diagnosis." His subjects were reading at the Grade 3.6 level, with gains of just over one year in the ten years between diagnosis and follow-up. He cautioned, however, that because they were from a clinic

population, they may well have represented the bottom of a continuum of reading disability.

Silver and Hagin (1964) found that poor readers as adults had slightly lower IQs than controls, but that only 30% were still inadequate readers. Neurological findings and the severity of the original reading difficulty were related to the poor outcome.

Menkes, Rowe and Menkes (1967) reexamined eleven of eighteen adults 24 years after diagnosis of hyperactivity with MBD. Three were still hyperactive, four psychotic, two retarded and eight self-supporting (but four of these had been institutionalized at some time). IQ was a good predictor of adult outcome.

Preston and Yarington (1967) in a follow-up of eight years found that most of their 50 retarded readers completed school but with more grade repeats than the average school population and limited vocational aspirations. The IQ range was unusually wide (53-123) but only four of the subjects were unemployed. Information about actual academic achievement was not reported.

Laufer (1971) found half of his sample of 60 with "minimal cerebral syndromes" including hyperactivity were in high school or had graduated up to twenty years after original referral. Thirty percent of the entire sample still had emotional or antisocial problems, but 41% stated that their hyperactivity had disappeared.

Herjanic and Penick (1972) summarized some of the literature on adult outcome of disabled child readers. They concluded that outcome was usually not encouraging but maintained that factors such as social class, intelligence, psychiatric illness and type or quantity of remedial instruction were often overlooked and may have contributed significantly to the poor outcomes.

Weiss, Hechtman and Perlman (1978) found that workers who had been diagnosed as hyperactive in childhood were reported as being no different from controls in their employers' evaluations of them, although teachers had rated them as having been less successful when in school. This suggested that the reports covering only school years should not be taken as "outcomes" since it is clear such children don't do well in school, especially if they have learning problems. However, when examining adult outcome, the results of Weiss et al. did not necessarily demonstrate the absence of adult problems for the grown hyperactives. The average age of the subjects was 19 years with a range of 17 to 24. While they may have been doing well in employment, their occupations were not given and some were only summer jobs. It is likely that they were the kind of jobs young people usually get, i.e., unskilled, possibly manual or outdoor work. They may have performed well because the jobs were physical and didn't require sitting or concentrating. However, these young people may have difficulty getting the necessary

training for other jobs and hence may be stuck in the unskilled jobs while the controls may later advance.

There was a suggestion from the study of Borland and Heckman (1976) that occupational outcome should be measured at a later date than immediately after high school. In a comparison of hyperactive boys and their brothers, they found that not only did about half of the hyperactive boys remain hyperactive at age 30, they achieved a lower SES than their brothers and fathers although there were no differences in IQ or number of years of education. Half of the grown hyperactives also had psychiatric problems while none of their brothers did. So while grown hyperactives may have performed well immediately after high school (Weiss et al., 1978) the long term outcome was not favorable (Borland and Heckman, 1976).

Problems in Evaluating Follow-up/Outcome Studies

The confusing diagnostic picture makes evaluation of outcome difficult. Studies which used school populations and focused on the learning problem usually have not had neurological information, yet their learning disabled samples probably have contained some hyperactive or MBD children. The studies examining children with neurological dysfunction also have had mixed populations, some with learning disabilities and some without. In addition, many studies have failed to report IQ

or socioeconomic status or to consider them as predictors.

Learning problems occur at all levels of IQ but it has been a consistent finding that learning disabled samples on the average have dull normal to low average IQs (i.e., IQ=80-100) (Eaves et al., 1974; Gottesman, 1979; Satz et al., 1978; Weiss et al., 1971). However, the meaning of IQ in an learning disabled sample is unclear. Weaknesses in verbal and perceptual-motor areas may lower performance or produce uneveness on individual IQ tests. Attention deficits or poor reading skills themselves would lower scores on group tests. In general, learning disabled/hyperactive children with high IQ test scores and no neurological problems have the best outcome. Poorer outcome is related to lower but average IQ or increase in the number or severity of neurological signs.

Some studies have reported SES; however, it has rarely been used as a variable to predict outcome. Those studies reporting the best long term outcome have involved private school students of high SES (Lewis, 1977; Rawson, 1968). In most cases, SES was controlled in a general manner, by selecting the control subjects from the same school as the learning disabled subjects. But even in schools that select their student population from certain social groups (i.e., private and church schools) there will still be variability in SES, and that variability is much greater when the student population is drawn from a geographic area as is the case with public schools.

The variations in outcome for different social classes has been investigated by the present author (Faves, 1975). In a survey of reading disability defined as a Grade I level on a standardized test in Grade III, it was found that there was an 8% rate of reading failure in schools in the higher socio-economic areas of Vancouver (areas predominantly inhabited by members of classes I and II) while it was 25% in schools in the lower sociceconomic areas (areas predominantly inhabited by members of classes IV and V). Social class was a rating based on the average income and occupational level of the census tract in which the school lay.

In another Canadian sample, Bell, Abramson and McRae (1977) found 71% of poor academic performance in the low SES with 18% in the middle SES and only 3% in the high SES subjects.

Learning disabilities in the poorer schools may be related to lack of stimulation, poor or disorganized home environments, little value placed on education and possibly even poorer quality of educational opportunity. If this is the case, then some of the low SES children might improve given appropriate remediation, social intervention or personal motivation at some later time. In the better schools, the children who can't read probably have biologically determined perceptual or language problems, which would be the most resistant to remedial education. Thus, the rates of successful long term prediction would be quite different for the two groups, with much more

variable (i.e., poorer) prediction for the low SES group.

Although assumptions of homogeneity of school populations and mutual exclusiveness of social classes may be unwarranted, it remains that SES contributes to prediction of learning problems even when it is crudely measured (Rubin and Balow, 1977; Satz and Friel, 1978). When the average SES for a school is calculated there is obviously variation within the school (e.g., poor homes in a good district) yet differences in average levels of achievement can be found between high and low SES schools. Furthermore, SES is related to IQ as well, and the interaction of these two variables remains to be fully explored in future follow-up studies.

Conclusions from Follow-up/Outcome Studies

Although some of these studies were better than others, there were weaknesses in many of them and questions regarding outcome in learning disabled populations remain to be answered. Small skewed samples, lack of controls, poorly defined or inadequate measures of outcome and failure to examine IQ or SES as intervening variables were just a few of the difficulties. Despite these problems, the general conclusions were quite consistent and may be summarized as follows:

1. The vast majority of learning disabled children diagnosed after two or more years in school did not improve in

academic subjects (chiefly reading) to become average for their grade placement level by the time they left school.

2. Such improvement as did occur appeared to be independent of special treatment or instruction, but was related to IQ.
3. Although there was some improvement in the symptoms of hyperactivity (i.e., attention deficits, distractibility or poor impulse control) many of such children still had difficulties as young adults, and the prognosis for overall social adjustment was poor.
4. There was some indication that adjustment to certain types of employment was better for grown learning disabled/hyperactives than adjustment to school had been.
5. Those studies which reported neurological difficulties found a greater number of neurological problems to be directly related to poorer outcome.

III. BIRTH EVENTS AND POOR SCHOOL ACHIEVEMENT

In the search for antecedents of learning disabilities, hyperactivity and/or MBD, birth events have been examined. The notion that a range of negative outcomes occurred following abnormal events in pregnancy and birth, ranging from miscarriage and neonatal death to subtle motor and/or learning problems was supported by research of Pasamarick and colleagues and called the "continuum of reproductive casualty" (Kawi and Pasamanick, 1959; Knobloch and Pasamanick, 1960; Pasamanick and Knobloch, 1966; Pasamanick and Lilienfield, 1955). As many as 60% of all pregnancies are abnormal, to the extent that the mothers have some unusual events in pregnancy, labor or delivery or the newborn suffers some problem (Parmelee, Kopp and Sigman, 1976). Most of these infants will in fact do well so it is not realistic to consider all of them "at risk" for later difficulties. Therefore, investigators have searched for specific relationships among abnormal pregnancy and birth events and a variety of subsequent problems. The findings in general have shown no or very low correlations between single events in pregnancy and birth and later outcome, but stronger associations with multiple events (Parmelee and Haber, 1973).

The topic of this chapter is the relationship between

complications of pregnancy and birth and subsequent cognitive functioning. This means chiefly learning disabilities or poor school achievement but in some cases the relationship with IQ will be mentioned because it is often investigated along with learning problems. Low IQ and the presence of learning disabilities are correlated but the nature of the relationship is complex and not fully understood at present.

There are several problems in evaluating and comparing the studies which attempt to link birth events and poor school achievement. First, various methods have been used: retrospective, retrospective-follow-up or prospective. In the retrospective design, the children are seen after developing learning problems and at that time birth records are collected. In the retrospective-follow-up method, children are selected at some point, data collected on their past, then they are followed for a time. In a prospective study, children are selected at birth on the basis of events at the time, then followed to observe outcome.

Apart from the method used, a variety of antecedent conditions have been examined. Prematurity (less than 36 weeks gestation), and/or low birth weight (LBW; below 2050 grams) and anoxia have been the most commonly investigated abnormalities but other specific complications of pregnancy or birth have been selected for study as well. Simply the total number of complications, without regard to their varying severity has been

used (Colligan, 1974). Finally, there is wide variation in the outcome conditions which are of interest to different researchers. Reading, school behavior or achievement, IQ, hyperactivity, psychoses or emotional problems are just a few of these.

Other problems in evaluating the research include the varying quality of the measuring devices used, the fact that some studies relied on parents' reports of birth events and often, failure to control for socioeconomic status (Gottfried, 1973). Because of these many factors, results in the area vary; however, some consistent conclusions may be drawn.

Birth Events and Poor School Achievement

In studies of children born with low birth weight (LBW) or short gestation period, it has generally been found that there is a higher incidence of poor school achievement or lower reading scores in such groups than in controls (DeHirsch, Jansky and Langford, 1966b; Doehring, 1968; Douglas, 1960; Malmquist, 1956; Versacci, 1966; Weiner, Rider, Oppel and Harper, 1968). Studies examining other complications of pregnancy and birth have been less consistent with some supporting the relationship with learning problems (Kawi and Pasamanick, 1959; Galante, Flye and Stephens, 1972; Black, 1972; Colletti, 1979) and some failing to support it (Lyle, 1970; Doehring, 1968; Versacci,

1966). In one longitudinal study, significant differences between anoxic and normal infants on 21 cognitive and perceptual tests occurred at three years but disappeared by age seven on all but one language and one perceptual measure (Corah, Anthony, Painter, Stern and Thurston, 1965).

In an important review article, Balow, Rubin and Rosen (1975-76) surveyed 28 studies in which the relationship between reading disability and complications of pregnancy and birth were examined. They concluded that twenty of these studies confirmed the link between birth events and reading problems while eight failed to confirm it. Fourteen of the 28 studies were prospective and, of these, eleven confirmed the link which was persuasive as these studies were generally of better design. Their conclusion was that a low-order (although statistically significant) relationship exists between perinatal events and reading disability. Moreover, they found evidence for a "strong suggestion of a causal chain from perinatal anomaly to neurological insult to reading disability in some small but significant proportion of the reading disabled population" (p. 59).

In another review, appearing the same year, the authors interpreted a related group of studies in a different manner. Sameroff and Chandler (1975) acknowledged that the links between birth events and later problem (emotional and cognitive) were apparent, but that the environment, particularly as reflected in

the variable SES, was important in modifying the influence of negative birth events. They pointed out that prematurity and most complications of pregnancy and birth occurred more often in the lower social classes and thus SES confounded any attempt to examine birth events alone. Although Sameroff and Chandler (1975) failed to examine some of the studies considered by Balow et al. (1975-76) (possibly because they were not specifically interested in the outcome variable of reading disability) they gave considerable evidence for the powerful influence of social class, and for their conclusion that "the data from these various longitudinal studies of prenatal and perinatal complications have yet to produce a single predictive variable more potent than the familial and socioeconomic characteristics of the caretaking environment" (p. 208).

These somewhat different conclusions, the one supporting a connection between birth events and cognitive problems (Balow et al., 1975-76) and the other denying the importance of the link and emphasizing social class variables (Sameroff and Chandler, 1975) may be in part the result of analyzing different studies with different designs. They are not, however, completely incompatible, but rather rely on different emphasis and/or interpretations. Balow et al. pointed out that only one study they examined used multivariate methods and several failed to control for SES. Only one which they reviewed suggested the possibility of SES interacting with birth events (Koppelman,

Rosenstein and Ganter, 1972).

As regards the negative long-term findings for LBW babies, Sameroff and Chandler interpreted them as being the result of the parents' perceptions and differential treatment rather than the effects of prematurity per se. Further, they concluded that the reason few long term effects have been found following anoxia at birth is that the parents may not have known that their child suffered anoxia and hence did not treat him or her differently.

An example of the difficulties in interpreting results was demonstrated in the study by Smith, Flick, Feriss and Sellmann (1972). Although generally supporting the hypothesis of a link between birth events and learning problems, it could be further interpreted, as Sameroff and Chandler (1975) did, as support for the overriding importance of SES.

Smith et al. followed a sample of low SES black children from birth to age seven. At seven, the children were divided into normal and abnormal groups based on being one standard deviation or more above or below the mean on IQ and achievement tests. The birth and early childhood variables were then used in a discriminant analysis. Forty birth variables correctly classified 75-85% of the children, and the addition of items obtained at twelve months and four years raised the percentage of correct classification to 98%. The confounding factor was that two of the variables they considered to be birth variables

were IQ and education of the mother. These two were also significant contributors to the discriminant function.

Clearly IQ and education of the mother are not simply birth variables, but had a continuing influence on the child. This study was one of the better ones done on this topic in recent years, using as it did, data from the Collaborative Perinatal Project[1] yet it suffered from flaws in both design and interpretation. In addition to assuming that education and IQ of the mother were birth variables, by selecting the extreme groups in their sample they guaranteed finding differences (probably on all variables). Using a multiple regression model would have allowed for identifying the specific contribution of the mother's education and IQ and the extent to which it correlated with the other variables.

In a better study, in which the data were analyzed with multiple regression techniques, Rubin and Balow (1977) concluded that the single best predictor was indeed the SES of the child's family. They analyzed data from the Collaborative Perinatal Project on over 700 children from birth to age twelve. In

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[1] The National Collaborative Perinatal Research Project was a prospective study of perinatal complications conducted at fourteen medical centers in the United States, sponsored by the National Institute of Neurological Diseases and Stroke. Data were collected from 1959 to 1966 on over 50,000 pregnancies. The children were examined in the neonatal period and with neurological, psychological, speech and language examinations at 3, 4, 7 and 8 years. At the Minnesota branch of the study, researchers have been particularly interested in the educational and behavioral consequences of prenatal, perinatal and early childhood conditions and events.

predicting IQ at four or seven years, achievement at six, seven or nine years, or teacher ratings, R^2s of .46-.68 were obtained, with the chief contributor (R^2=.28-.41) the mother's age, education and SES. The mother's reproductive history, medical history, variables of the pregnancy, delivery and neonatal variables and exams during the first year each contributed very little more to the R^2 (combined, the amount of variance accounted for by these variables increased by 13-18%).

Coletti (1979) found a sample of learning disabled children to have had more problems at birth with only 34% well and healthy at birth and 30% with severe birth or neonatal problems. It would appear that in this sample the children had severe rather than mild learning problems (although achievement test scores are not reported) as they had been referred to a "neuro-education center" for diagnosis and were found to have "minimal neurologic dysfunction". This study, which has serious flaws, appeared recently in a reputable journal. It highlights many of the problems with learning disabilities research in general: unclear definitions, inadequate sampling and statistical design, and conclusions extending far beyond the data. Moreover, the author appeared to be in ignorance of other studies which reported only a tenuous link between birth events and learning disabilities. The misleading conclusions reflect the fuzzy thinking in this area and the difficulty of investigating the contribution of birth events to subsequent

learning disabilities.

There were further problems with the study. First, minimal brain dysfunction (MBD) and learning disabilities were equated and the terms used interchangeably without any definition nor description of how the diagnosis was made. Second, children ranging in age from seven to twelve were included although the definition of both learning disability and MBD varies with age. Also, the author implied a direct linear relationship from the large number of abnormal birth events found in the learning disabled sample to their poor school achievement seven to twelve years later. No mention was made of the possibility of interaction between the child and environment or the variables of temperament or SES, and no multivariate statistics were used to compare the relative contribution of birth events with other variables to the outcome scores. Moreover, on the basis of this weak evidence of finding abnormal birth events in a group of children referred to a neurological-education clinic, the author suggested that birth records should be made available to the schools so that the diagnosis of learning disability/MBD could be made from them alone before the child showed school problems. The data are not strong enough to support this suggestion.

The Environmental Variables

Socioeconomic status (SES) is a measure of the income, occupation and/or educational level of the head of a household and is presumed to reflect social conditions. It has been assessed by a combination of family income, education and occupation (U.S. Bureau of Census Index, Myrianthopoulos and French, 1968), education and occupation (Hollingshead and Redlich, 1958) or simply a rating of one or both parents' educational level or father's occupation (Blishen, 1965). As has been shown here, when it is included in studies of factors influencing children's development, it is frequently found to be a source of variance.

Clearly, it is a complex factor with multiple influences. Block (1971) observed that:

> Knowledge of the social class of an individual conveys in an ill-defined way information regarding the stimulus or learning context in which that individual was formed...the characteristics of the psychological environment...and often implies some genetic selectivity that has behavioral consequences(p. 272).

A popular and simple measurement of SES or environmental influences has been the educational level of the mother, and its predictive value has been documented (Drage, Berendes and Fisher, 1969; Rubin and Balow, 1979). Presumably the quality of home life, child care and level of stimulation are reflected in this variable.

Kagan, Lapidus and Moore (1978) found, in a search for infant antecedents of later temperament in normal children, that social class, measured only by the parents' education explained the greater portion of the variance in reading scores at age ten. It was also a better predictor of poor scores than was irritability, less sustained attention or poor vocalization at one year. Higher IQ in the children was also related to higher educational level of the parents. The surprising result was that even when crudely measured, SES emerged as an important predictor from their extensive battery. The sample of 160 children was divided into four social class groups based on the following rough guide to the level of parental education. The groups were:

1. one or both parents failing to finish high school and neither with more then Grade 12 education;
2. high school graduates, no university, father typically skilled labor or white collar worker;
3. both parents attended or graduated from university, father typically an entrepreneur or white collar worker;
4. both parents university graduates, one or both with graduate training.

In another study, a different but equally simple measure of SES was employed and found to be predictive. Finkelstein and Ramey (1980) used the following variables obtained from birth certificates: race, education of mother, age of mother, number

of previous live births who died, birth order, legitimacy, month prenatal care began and birth weight. Using this set of variables, they correctly classified 80% of their children as to whether they were educationally handicapped or not in Grade I (educational handicap being defined as one SD below the mean on the Peabody Picture Vocabulary Test and a Pupil Rating Scale).

In attempting to specify what it is about SES or the mother's education that might be the important influence, the Home Observation for Measurement of the Environment Inventory has been devised (Elardo, Bradley and Caldwell, 1975). The resulting measures of the child's home environment during infancy were found to be better than scores on infant mental tests for predicting later IQ (Bradley and Caldwell, 1976) or school achievement (Werner, Bierman and French, 1971).

Discussion

The evidence, then, suggests that events at birth account for small amounts of the variance in later IQ or school achievement, while global social class/environmental variables outweigh them in predictivenss. The parents' level of education, mother's IQ and age, as well as such indirect measures or correlates of SES as race, care during pregnancy and birth weight emerge repeatedly as good predictors. In terms of the minimal time and expense of obtaining such measures, compared

with interviews and examinations, they are to be recommended. However, in order to accurately identify at-risk infants for such practical purposes as intervention programs, the global environmental variables are too general.

At present, the best model for identifying at-risk children in infancy is a complex interactive one, in which no single variable is the most important (i.e., no linear relationship is expected from perinatal events) but rather combinations of variables allow for prediction. To this point Galante, Flye and Stephens (1972) found that "cumulative minor deficits" provided for almost 100% prediction of school underachievement. These included being male, later born, in an inadequate home environment, with an unusual birth history. If deficits continued to accumulate and later, the child showed mixed dominance, eye muscle imbalance, a low Draw-a-Person score with poor mastery of spatial relationships in kindergarten, prediction for severe underachievement in school was very high. These data were not subjected to multiple regression analysis which might have highlighted the relative contribution of the factors; however, it was clear that no single factor was the chief determinant.

Such a model of cumulative minor difficulties, whether in the family or in the child, is similar to the one proposed by Sameroff and Chandler (1975) which they called a transactional model. Not only does the environment affect the child but the

child influences the environment. A child with a negative birth history, might be less responsive at birth, thus failing to reinforce the mother adequately (Goldberg, 1979). If she is already overburdened with more children than she wanted, low income and crowded housing, she may not stimulate a new baby well nor possibly even feed it adequately. Under these circumstances the baby may develop into a scrawny, irritable one, who is ignored because he or she is so unattractive and unrewarding. Transactions are thus set into motion which continue throughout childhood. When he or she performs poorly in kindergarten, it is difficult to specify the weight of each contributor to the school failure.

Transactions work in a positive direction as well. In studies of low birth weight babies, it has been shown that high SES ameliorated the effects of low birth weight. The lowest weight babies in the highest SES families outperformed the heaviest babies in the lowest SES by preschool years (Drillien, 1964; Eaves, Nuttall, Klonoff and Dunn, 1970). Thus, in a good environment with adaptive parents, initial ill-effects may be overcome or modified; in a bad environment with stressed parents, they are amplified.

This emphasis on the importance of SES as a predictor does not mean that birth events don't matter. Beyond the obvious results of death or severe damage, they do matter in at least two ways: first, to the extent that they interact with life

events, and second, if they result in clear neurological injury. The life events, particularly the transaction between infant and environment, are at present difficult to specify and are crudely represented by such things as mother's education or a global rating of SES. A neurological insult, which in some cases is the clear result of birth trauma, may be the only direct predictor, and the same trauma (e.g., anoxia, toxemia, low birth weight) when it fails to lead to an abnormal result on a neurological exam in infancy, may be unimportant in predicting outcome.

Directions for Future Research

At least two possibilities for future work result from the examination of the evidence, one for the practitioners who wish to do something about at-risk children now, and the other for the long-lived longitudinal researchers who can wait twenty years for answers. For the former group, selecting at-risk infants on the basis of birth variables plus social class measures, which are imperfect indicators of "riskiness" would identify many children suitable for intervention programs. Parmelee, Kopp and Sigman (1976) have proposed such a multivariate risk score system which acknowledges that some perinatal problems cause only transient injury, that some forms of brain injury are not manifest until later in infancy or childhood, and that some parents intuitively help at-risk

infants to overcome possible deviance. Because of these factors, they extended the period of time during which at-risk status might be determined. They added assessments at four and eight months to the rating of pregnancy and birth events before considering a child to be at-risk. They acknowledged the importance of environmental influences, but interestingly, did not include a measure of them in the cumulative rating scale.

For the longitudinal researchers, prospective studies of large samples of infants (both at-risk and normal on the basis of birth events) with careful observation of home environment and child-rearing techniques, might provide answers to questions about which infants are likely to do well. The specific behaviors reflected by mothers' education or other measures of SES are not clear and require further investigation.

Conclusions

Two points must be emphasized. First, while SES is at present the best predictor variable of IQ or school achievement, it has, in most cases accounted for no more than half of the variance in such scores, leaving ample remaining for birth events, or genetics, or temperament. Moreover, a full range of outcomes is found in studies where only one social class is sampled, and it is such studies where the link between birth events and outcome on cognitive tasks is emphasized (Galante et

al., 1972; Lyle, 1970; Smith et al., 1972). Second, Sameroff and Chandler (1975), from evaluating studies in which low SES children had more negative outcomes than high SES children, concluded that "high SES dissipates the effects of such perinatal complications as anoxia or low birth weight" (p. 236). This conclusion obscures that fact that while high SES children may have moved into the average range on outcome measures, and low SES children performed poorly, the high SES children are performing much lower than would be predicted from their social class. In studies of low birth weight children, the high SES ex-premature children have scored as much as 10-15 IQ points below the mean for their own social class (Drillien, 1964; Eaves and McBurney, 1982). With normal children, Rubin and Balow (1979) also found that low scores on the Bayley Infant Scale of Mental Development predicted IQ at age seven best for low IQ, low SES children, while high SES children who scored low on the infant test moved into the average range by age seven. These findings suggested to them that "factors associated with high SES may serve to obscure cognitive deficits associated with early developmental impairment" (p. 226).

Events at birth and in infancy must not be discounted because of the greater influence of SES and its interaction with those events. The task remains to specify the nature of both perinatal events and environmental influences, and their interaction in a manner useful for prediction in individual

cases. Significant relationships of the magnitude thus far reported are not large enough to warrant individual prediction. At present we can neither specify nor predict.

C. A LONGITUDINAL STUDY

I. INTRODUCTION

The present study encompasses and extends a study which was originally designed to identify and predict learning problems over a short period of time (i.e., from kindergarten to Grade III). The data collected from 1972-1975 have been extended in two ways: retrospectively to include birth records, and with a follow-up to age 13 for home and school outcome information. Thus, this study seeks to answer questions about the predictive antecedents of poor school achievement with a longitudinal follow-up of 57 children from birth to puberty.

An important contribution made here is the wide range of variables used for prediction. It is unique for psychological and neurological data to be collected on presumed normal children in an early identification study. Often follow-up studies have such information as they frequently use clinic populations or children specifically referred for psychological and neurological evaluations because of concern over poor school achievement. The children in the present study were not an extreme group; they were all attending regular kindergarten when first screened and had not been singled out for special attention. Other studies have either screened a kindergarten sample and followed them for only one or two years, or

identified a learning disabled sample later in school and followed them for longer to observe outcome. Usually this has been done without a control group, which the present study provides. So it will be possible, from the data in this study, not only to compare at-risk and normal children, but to compare the methods of determining at-risk status: the brief screening device vs. the elaborate and expensive neurological and psychological exams.

The general hypotheses of the study are: (1) that learning disabilities or poor school achievement can be identified before the actual school failure occurs; (2) that early immaturities are not outgrown and (3) that they are not unitary phenomena but are complex with many antecedents, and that cumulative minor deficits, rather than a single predictor, will describe the poor achievers.

In order to evaluate these hypotheses it is necessary to examine the predictive usefulness of a wide range of antecedents. Accordingly, birth variables, kindergarten and Grade I test results, neurological exams and school performance will be compared for at-risk and normal children. This will be done with single variables and in combinations to predict the outcome of good or poor school achievement at age 13.

The following specific hypotheses will be tested:

1. Children thought to be at-risk on the basis of test performance in kindergarten and Grade I will have

significantly more negative birth events than controls. However, when considered in a multivariate fashion, SES and maternal variables will contribute more to prediction than birth events.

2. Early developmental milestones will be significantly different in the at-risk and control children.
3. Kindergarten data and Grade I at-risk status will predict outcome to age 13 (i.e., early deficits will not be outgrown). If a developmental lag describes learning disabled children, prediction from Grade III to Grade VII would be much better than from kindergarten or Grade I to Grade VII, the years from 5 1/2 to 8 being those in which the lagging children should catch up. This will be tested but it is hypothesized that kindergarten data will predict Grade VII outcome as well as Grade III data.
4. The neurological exam will provide concrete measurements of the deficit status of the at-risk children, and items from the neurolcgical exam will distinguish between at-risk and controls.
5. Teachers' estimates of children's behavior and other school factors in kindergarten, Grade I and Grade III will predict school achievement at age 13.
6. Items from the Parent Checklist of home behavior at age 13 will distinguish between at-risk and control children.

The report of the study is organized in the following manner: first there is the method section in which the subjects, assessments, variables and statistical analyses are described. Second, general results are given on the topics of attrition of the study children, comparisons between at-risk and normal children, agreement between the KMPI and at-risk diagnosis, and factor analysis of kindergarten, Grade I and Grade III variables Third, the results are presented according to the hypotheses. Results for birth events, developmental milestones, prediction of outcome, neurological exam and school variables are discussed separately in that order. Finally, the summary and discussion are given.

II. METHOD

In this study, spanning 13 years, there were several procedures and various assessment devices used to obtain the data. Birth records were gathered retrospectively from the hospitals when the children were 13 years old. Developmental histories were taken from the mother's account when the child was examined at 6 1/2 years of age. A screening test was given to the children in kindergarten and neurological and psychological examinations in Grade I. Teacher checklists were collected four times: in kindergarten, Grade I, III and VII, and a parent checklist was obtained in Grade VII, or at age 13 years.

In the first section of this chapter, the study sample will be described, then in the next section the procedures and materials will be given in general. In the third section, the variables or data obtained will be specified. Finally the methods of statistical analyses will be discussed.

The Study Sample

In the spring of 1972, over 2000 kindergarten children in 57 schools in Vancouver, British Columbia were screened for potential learning problems with a version of the deHirsch Predictive Index (deHirsch et al., 1966), called the Kindergarten Modified Predictive Index (KMPI). At that time, this screening test appeared to hold promise specifically for the identification of "at-risk" children. Subsequent research has shown that this battery is a good screening device and the important variables to measure in kindergarten are those closely related to school-type tasks (Mercer et al., 1979a; Rubin et al., 1978). The deHirsch battery includes a variety of such tasks.

All Vancouver elementary schools were contacted and included if the principal was interested in the project. This resulted in a broad sample of over two-thirds of the elementary schools in School District #39 being involved.

Two thousand three hundred and eighty children were tested with 2063 (86.7%) passing four or more items on the KMPI and 317 (13.3%) failing (passing three or fewer of the 12 KMPI items).

From this population, 73 failures[1]

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[1] At-risk status based on a low score on the kindergarten screening test will be referred to as "KMPI failure" to distinguish it from the clinically judged at-risk status based on psychological and neurological exams, which will be called simply "at-risk". There was in fact 77% agreement between the two methods of assessing at-risk status. See page 104 for a

and 33 "passes" were selected to receive intensive neurological and psychological examinations in Grade I. The children were initially selected only on the basis of their score on the KMPI with twice as many failures as controls included. Within the failure and passing groups, the selection was random for children meeting the following criteria:

1. between six and six and a half years of age;
2. spoke English before beginning school, although in some cases the language of the family was other than English;
3. passes (normal controls) selected from the same school as at least one failure;
4. parental cooperation.

Cooperation from the parents is always a possible source of bias. For this study a parent had to spend almost a day with the child at Vancouver General Hospital for the two assessments. The only incentive for the parents was knowledge of results given over the telephone after the assessments. However there were few refusals, with parents of failures and controls equally interested in participating. All social classes in the city were represented and the sex ratio was the same as that in the large sample.

The children were tested at the end of Grade I in 1973, and again at the end of Grade III in 1975, with the Grade I results being published in the Journal of Learning Disabilities (Eaves

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[1] (cont'd) discussion of this point.

et al., 1974). The follow-up data in the form of parent and teacher questionnaires and results from achievement tests were collected for the present thesis during the spring of 1979 when the children would normally have been completing Grade VII.

Age 13 was selected as an appropriate time for evaluation of outcome for two reasons. First, by that age the patterns of school achievement are set. If a child is not achieving well by then, it is unlikely that any change in the pattern will occur (Kraus, 1973). Second, Grade VII is the last grade in elementary school and after that the children from one elementary school often go to several junior secondary schools. In the junior secondary schools, they have several teachers and are not as well known to just one person as they would be in Grade VII. Thus, the data on the Teacher Checklists would be likely to be more reliable in Grade VII rather than later. In addition, data collection is easier with fewer schools (i.e., only elementary schools) involved, and particularly schools where the child was likely to have attended for several years and would be better known to the staff.

Procedures and Materials

The children were given the screening test, the Kindergarten Modified Predictive Index (KMPI), in the spring of their kindergarten year by fully trained examiners, who were in

most cases, psychology or education students. These examiners were carefully trained and supervised by the two psychologists (L. Eaves and D. Reimer) involved in the study. The children were taken individually from their kindergarten classrooms for the twelve item, twenty minute exam.

This screening test consisted of the ten items from the deHirsch Predictive Index (deHirsch et al., 1966) to which the Draw-a-man Test and Name Printing were added.

Asking a child to print her or his own name is a device that facilitates the development of rapport in the testing situation. The Draw-a-man Test was included for the same reason. The child relaxes at the familiar tasks of drawing a person and printing his or her name, and can be praised highly for whatever is produced. Thus he or she is likely to feel more comfortable and give a better effort working on the other tests in the battery. Subsequent evaluation of the name printing task proved it to be a useful measure of developmental maturity as well (Reimer, Eaves, Richards and Crichton, 1975).

Drawings of persons have long been regarded as measures of maturational level and school readiness (Coleman, Iscoe and Brodsky, 1959; Silver, 1950). Koppitz (1959) found a childs' score on the Draw-a-man Test at the beginning of Grade I was predictive of the reading level at the end of the year. More recent work emphasized the cognitive aspect of the drawings (Harris, 1963). So for these reasons, as well as the fact the

the deHirsch Predictive Index (deHirsch et al., 1966) was an experimental instrument and was later modified by Jansky and deHirsch (1972), it seemed justified to include the two additional measures.

A pilot study by the present author (Eaves et al., 1972) supported the promise of the deHirsch Predictive Index as an early screening device in predicting poor school performance. Based on results from the pilot study, and the fact that name printing and the Draw-a-man Test had correlated fairly well (r=.43 and .23 respectively) with end of Grade 2 reading in the deHirsch et al. study they were included in the screening battery, hence the "modified" Predictive Index. (See Appendices I and II).

In addition to the Name printing and Draw-a-man Test, four other items were perceptual-motor tasks (pencil use, Bender Motor-Visual Gestalt Test, Horst Reversals and Gates Word Matching); three were language tasks (Wepman Test of Auditory Discrimination, the Number of Words Used to Tell a Story, and naming categories for groups of three items); and three were pre-reading tasks (being taught two words at the beginning of the session and being asked to sight read and spell these at the end).

Teacher Checklists were obtained at the end of kindergarten, Grade I, III and VII. The teacher was asked to rate the study child on a three to five point scale compared

with classmates on a variety of behavior and skills. For example, ability to work at a task, take part in a discussion, and express ideas orally or in writing were included. After kindergarter, the teacher was asked to give a grade placement rating in academic skills and to describe any specific problems the child had. Finally, the teachers indicated any special help the child received and whether he or she was ready for promotion to the next grade. (See Appendices III to VI for copies of the Teacher Checklists).

For the psychological and neurological exams, which were given during the Grade I year near the child's 6 1/2 birthday, the children were brought by a parent to the Health Centre for Children, Vancouver General Hospital. Appointments were arranged by a nurse cocrdinator so that the psychologists and neurologists were unaware of the child's score on the KMPI. The individual examinations took about three hours and in most cases, the psychological exam was before lunch and neurological exam after.

In 1975, when most of the study children were completing Grade III, the Vancouver School Board conducted routine achievement testing of all Grade III pupils. The children's scores on the subtests of Vocabulary and Comprehension of reading of the Gates McGinitie Achievement Test were made available for the present study. When a study child had moved out of the Vanccuver School system or was not in Grade III, the

child was tested individually at school.

In the spring of 1979, when the children ordinarily would have been completing Grade VII, the parents were contacted by telephone. They were asked if they would complete a questionnaire regarding their child's progress (the Parent Checklist) and whether they would give permission for the child's school to be contacted for the Teacher Checklist and achievement test results. This was in accordance with the policy of nearly all the school boards involved, that nothing could be released for research purposes without the parents' consent. After this consent was given the principals were contacted, then the teachers, who were asked to provide information regarding school progress (the Teacher Checklists). Achievement tests were not routinely given in the schools at this grade level so test results were available for only 31 of 57 children. The parents were also asked to sign a form giving authorization to obtain hospital birth records.

There was a compromise made in this study regarding the type of data collected, which is typical of longitudinal research. Second hand data, in the form of teacher rating scales or parent checklists give some measure of a child's performance and behavior and are required when the logistics of individual testing and interviews are too formidable. In the present study, it was not possible for one person to test 57 children who were scattered across the Lower Mainland (and in some cases the

province) during the two months at the end of their Grade VII year. It was also clear that many of the parents would not have consented to elaborate testing, as they did not want their children singled out or to be made to feel different. They were, however, willing to fill out questionnaires themselves and to allow the teachers to do so.

The Variables

Birth Variables

Hospital records were available for 43 of the 57 children (75%). From these it was possible to obtain information on length of pregnancy, mother's obstetrical history, length of labor, complications of delivery, medication given, condition of the newborn and complications during or following birth. Apgar scores were also obtained for some cases, but not all, since they were not routinely used in 1966. General information about the birth, such as birth weight and number of pregnancies, was available from the mother's retrospective account taken by the neurologist when the child was six and a half.

Kindergarten Variables

The Kindergarten Modified Predictive Index (KMPI) included:

1. Pencil Use: ability to hold and use a pencil correctly.
2. Bender Visual Motor Gestalt Test. Cards A, 1, 2, 4, 6, and 8 were presented for copying.
3. Wepman Test of Auditory Discrimination: Child tells whether two spoken words sound the same or different.
4. The number of words used to retell the story of The Three Bears.
5. Categories: The child gives category name for three stimulus items (e.g., red, green, blue; apple, hamburger, ice cream).
6. Horst Reversals: The child must circle the items which are the same as the stimulus items when presented with a number of alternatives, some of which are the same as the stimulus while the others are left-right reversals of it. (e.g., to--to ot ct to ot to).
7. Gates Word Matching
8. Word Recognition I, Word Recognition II and Word Reproduction: At the beginning of the session the child is taught to read two words, "boy" and "train", and told to copy them from a model. At the end of the session, the child is asked to pick from a pack of cards presented successively the words "boy" and "train" and to pick them when the cards are all exposed on the table, and then to write as much of

the two words from memory as can be recalled.

9. Draw-a-man Test

10. Name Printing

(See Appendix II for scoring details.)

The Teacher Checklist at this level was a 15 item checklist on which the teacher indicated whether the child was below, average or above average compared with other children in the class on items of achievement and behavior and whether the child showed evidence of specific difficulties. A summary score was assigned with range 0-30, with 0 representing below average on all items and 30, above average. A copy is in Appendix III.

Grade I Variables

The neurological and psychological exams were given during the child's Grade I year, as close as possible to age six and a half. The neurological examination consisted of a detailed family and developmental history, history of this pregnancy and a 49 item standard pediatric neurological examination. The psychological examination included: The Wechsler Preschool and Primary Scale of Intelligence (WPPSI), the Illinois Test of Psycholinguistic Ability (ITPA), the Kephart Motor Survey, the Beery Test of Visual Motor Integration, a Behavioral Checklist and the Denver Articulation Test.

The purpose of this psychological assessment was to arrive

at a diagnosis of at-risk for learning difficulty or normal. In order to do this, measures of language, speech, cognition, perceptual-motor skills and behavior are required as these are the areas thought to be important in such a diagnosis. The WPPSI (Wechsler, 1967) is considered to be the most reliable and valid IQ test for six year old children (Anastasi, 1968) and has the advantage of providing separate verbal and performance IQs as well as subtests which allow for profile analysis. The ITPA (Kirk, McCarthy and Kirk, 1968) measures many aspects of language functioning and although it has been severely criticized it has not been completely abandoned (see, for example, Prutting, 1979). The Kephart assesses gross motor performance and the Beery, visual and fine-motor integration. The Behavioral Checklist was devised to record the presence of lability, short attention span, low frustration tolerance, impulsiveness, lack of adaptability, and poor ability to relate. (See Appendix VII).

The Teacher Checklist obtained at the end of Grade I consisted of 15 items. The teacher was asked to indicate achievement, behavior and evidence of difficulty compared to others in the class. The score range was 0-30, with 0 representing below average on all items and 30 above average. (See Appendix IV).

Grade III Variables

The Teacher Checklist at the end of Grade III was a 16 item checklist like the previous ones on which the teacher rated the child compared to his or her classmates. It included an estimate of achievement in reading, arithmetic, spelling and writing. The summary score ranged from a low of 0 to the highest possible of 32. (See Appendix V).

Achievement Test scores were from the Gates McGinitie Test. Grade equivalent scores from the subtests of Vocabulary and Reading Comprehension were used.

Socioeconomic Status

Social class or socioeconomic status (SES) was assessed by the average occupational and educational level for the census tract in which each school lay (Greater Vancouver Regional District Census, 1970). All children attending a given school in kindergarten (1972) were assigned the social class of that school. Ratings were from 1 (highest) to 5 (lowest). All social classes were represented in the study. To control for social class, the normal children were selected from the same classroom as at least one failure child.

At-Risk Status

A child's status of being at-risk for poor school achievement or normal at age six and a half was determined from performance on the psychological and neurological examinations.

Diagnoses were made independently by each psychologist and neurologist based on a combination of factors. Then later in consultation the diagnosis was agreed upon. The factors considered by the two psychologists included the child's level of developmental maturity, visual motor skills, language development and behavior (e.g., attention deficits, hyperactivity, impulsiveness, etc.) compared with the norms for six and a half year olds.

The neurological evaluations were done by a pediatric neurologist (J.U. Crichton) and a pediatrician with neurological training (P. McDermott). These examiners considered the results from behavioral observations, physical examination and a functional neurological exam to be the determining items. They interviewed the mother to collect the birth history and developmental milestones, so while the knowledge of the history might have influenced their observations to some extent, there were no cases where an at-risk diagnosis was applied on the basis of the history alone in the absence of behavioral evidence.

As in much clinical work, there were no clear cut-off scores and no one factor outweighed the others. In most cases when a child showed difficulty in several areas, or a significant problem in one (e.g., hyperactivity) accompanied by other minor deficits, an at-risk diagnosis was applied. This was in accordance with the guidelines for diagnosing minimal brain dysfunction (MBD) (Clements, 1966) which carries the expectation of a child developing learning or behavior problems at a later date and hence being at-risk. The child's IQ score was not directly considered (except in the case of IQs below 70 where the child was mildly mentally retarded) but children with impairments in perceptual motor and language areas often score lower on the WPPSI.

Outcome Variables

There were five measures of outcome obtained when the children were 13 years:

1. The Teacher Checklist at the end of Grade VII (or age 13 if the child had been held back or was in a special class) included most recent marks, behavior and achievement in relation to classmates and evidence of difficulty. It consisted of thirteen items with a five point rating on each which yielded a range of 13 (lowest) to 65 (highest). (See Appendix VI).

2. The teacher's assessment of the child's reading ability;

3. The Parent Checklist (PCL) was designed to elicit information from the parents about the child's educational attainment, social participation, attitudes toward school and behavioral adjustment. Specifically included were questions regarding signs of behavioral problems (i.e., attention deficits, overactivity, impulsivity, etc.) Thirty nine items on a six point scale yielded summary scores of 39-234, with low scores indicating positive adjustment. (See Appendix VIII).

4. Four different achievement tests were given in different schools: 1) Canadian Test of Basic Skills 2) The Metropolitan Achievement Test 3)Stanford Achievement Test 4) The Gates McGinitie Reading Test. Grade equivalent scores were used in analyses.

5. A global rating in which the child was defined as being either normal or as showing one of five abnormal conditions. These abnormal conditions were:

   a. learning problems; a child was considered to have learning problems if he or she was at or below the Grade VI level (i.e., one or more years behind) in reading according to either the teacher or tests, and of at least average IQ;

   b. behavior problems, including hyperactivity, impulsiveness or short attention span according to the

teacher;

c. both learning and behavior problems;

d. slow learner (i.e., poor academic achievement consistent with low tested intelligence)

e. emotional and/or peer problems, described by parents or teachers on the Checklists.

In summary, the variables included:

1. Birth: Hospital record; mother's retrospective account of pregnancy and birth.
2. End of Kindergarten (age 5 years 6 months to 6 years 3 months; mean=5 years, 9 months): Kindergarten Modified Predictive Index; Kindergarten Teacher Checklist.
3. Grade I year (age 6 years 6 months): Psychological and neurological exams yielding a diagnosis of at-risk vs. normal; family information; Grade I Teacher Checklist.
4. End of Grade III (age 8 years 6 months to 9 years 3 months): Grade III Teacher Checklist; Gates McGinitie Achievement subtests of Vocabulary and Reading Comprehension.
5. End of Grade VII (age 12 years 6 months to 13 years 3 months): Grade VII Teacher Checklist; Parent Checklist; Achievement Tests; normal vs. abnormal global rating.
6. SES.

Statistical Analyses

The purpose of the study was to identify some antecedents of poor school achievement. The data collected consisted of variables for which some connection with school achievement or learning disabilities had been demonstrated in the literature. These included social class, birth events, developmental milestones, a kindergarten screening test, teacher's reports, and psychological and neurological evaluations.

The goal was to find which groups of these were redundant and which combinations predicted best. Multivariate analysis was required as learning problems are no longer considered to follow from a single cause. However, limitations exist for the analysis of such a large number of variables measured on only 57 children: the number of variables in a given analysis should not exceed the number of subjects, and the computer places a limit on the number of variables that it is possible to enter in certain analyses. Therefore data reduction was required. This was initially accomplished by the use of summary scores for the Teacher Checklists in Grades I and III and the Parent Checklist in Grade VII, the Full Scale IQ rather than subtest scores, and a global rating of at-risk or normal, rather than scores on the many items that went into that diagnosis. In the case of the twelve kindergarten screening test items and items from the Teacher Checklist in Kindergarten, they were used individually

in regression equations, as well as in summary score form.

A further attempt at data reduction was made with factor analysis (principal axis solution, orthogonal rotation to varimax criterion). This was done separately for kindergarten, Grade I and Grade III data to identify related groups of variables so that redundant variables could be eliminated from consideration and to provide factors which could be used in regression.

There were four methods of analyzing the data. First, t-tests were calculated on certain variables to determine whether the means for the at-risk and normal children were significantly different. Second, prediction tables were made comparing different antecedent categories with outcomes and giving the percentage of correct prediction (hit rates). Chi-squares were used to test the independence of these categories. Third, correlation coefficients were calculated between selected single variables. The fourth and most elaborate analyses were multiple regression analyses.

Multiple regression analyses were done to discover the relationships between several predictor variables, considered together and various outcomes. In this way, the correlations between individual pairs of variables was taken into account. The purpose of the procedure is to select from a large number of potential predictors, a subset which, in combination, gives the best possible equation (highest R^2) for predicting a criterion

measure. Variables which do not make a significant contribution to prediction are eliminated. The predictors of interest (independent variables) were SES and items from birth, kindergarten, Grade I and Grade III and the outcomes (dependent variables) were Grade III or Grade VII achievement, Grade VII overall outcome and the Grade VII Teacher Checklist.

The variables were entered into the model, one at a time, beginning with the one having the highest correlation with the dependent variable. After each one was entered, it was checked by partial F criterion to determine its individual contribution. If a variable entered at an earlier stage became non-significant because of its relationship with variables entered later, the F reflected this and that variable was removed from the model. This process continued until the highest R^2 was obtained.

The multiple correlation coefficients (R^2s) given in each case are the adjusted R^2s which have taken into account the degrees of freedom. The significant F-level required for a variable to be entered into an equation was set at 2.0. The nature of the multiple regression program used (Statistical Package for the Social Sciences, Nie, Hull, Jenkins, Steinbrenner and Blut, 1975) was such that only subjects with complete data on every variable considered in an equation were included in the calculations. Because of missing data, the number in each was often less than 57, the total number of subjects available.

III. RESULTS

Attrition of Study Children

Over the years attrition has been high. In 1975, 84 of the original 106 (79%) were located. In 1979, when they became 13, 76 (72%) were found but only 57 families (54%) were prepared and/or able to participate on the study.

Attrition is a problem in all longitudinal research, particularly in highly mobile Vancouver. Thirty families (28%) could not be traced through their old addresses, schools the children last attended, or family doctors. Another nineteen families who were found did not participate in the follow-up. The reasons for this varied. Some feared ar invasion of privacy; others apparently put aside the questionnaire and consent form and forgot about it; still others appeared to lack the reading skill to complete the parent questionnaire. Since parental consent was the first step in getting cooperation from the schools to release information, such consent had to be forwarded to the school within the two month period before school finished for the year. In some cases this was not done in time and therefore school data, central to the study, was not obtained.

Table 1 shows the number of children located for follow-up according to their original normal vs. clinically judged at-risk status. Seventy-four percent of the normal sample were available for follow-up while only 43% of the at-risk sample were. A X^2, significant at $p=<.01$, indicated that being at-risk and being lost to the study were not independent. Slightly more at-risk families failed to cooperate once they were contacted, with far more at-risk than normal families completely lost.

Differences Between Participating and Non-participating Children

For both groups the participating and non-participating children differed in original IQ (WPPSI Full Scale IQ given in Grade I), sex and at-risk vs. normal status, but not in social class. The biggest IQ difference was within the at-risk group, where the non-participating children had an average IQ of 94, compared to an average IQ of 98.5 for those who participated. However, three children in the non-participating at-risk group had IQs of 58, 68 and 65. They had been originally considered to be mildly retarded rather than at-risk for the development of specific learning problems. When their IQ scores were removed, the difference between the non-participating and participating within the at-risk group diminished to 2.5 IQ points. The differences in the normal group between non-participating and participating children was only two IQ points (normal

Table 1

Participants and Non-Participants After Seven Years by Original Normal vs. At-risk Status

	AT-RISK	NORMAL	TOTAL
Participants	31 (43%)	26 (74%)	57
Non-participants	14 (20%)	5 (14%)	19
Lost	26 (37%)	4 (11%)	30
Total	71	35	

$X^2=9.52$; $p=<.01$; $df=2$

non-participating, IQ=111; normal participating, IQ=113).

Sex differences interacted with at-risk vs. normal status. Overall, 53% of the boys participated and 55% of the girls. However, 50% of at-risk boys and 62% of normal boys were follow-up participants, while 88% of normal girls and only 32% of the at-risk girls were (See Table 2). More at-risk than normal children failed to participate but far more at-risk girls, than any other group were in this category.

One can speculate that being at-risk was related to living in an unstable family. The fact that they were lost to the study suggests some degree of instability (i.e., they moved more than once in seven years and/or failed to leave forwarding information). The question of whether family instability causes, maintains or is simply correlated with at-risk behavior in children is beyond the scope of the present study. Moreover, it cannot be explained why families with at-risk girls would be more unstable (i.e., more likely to be lost). Being lost to the study was related to having at-risk girls and possibly to greater instability. The instability however, was not related to social class. On a scale of 1(highest) to 5(lowest) the average social class rating for the participating group was 3.19, and for the non-participating group, 3.10.

Thus, in this sample, over twice as high a percentage of at-risk than normals failed to participate in the follow-up (57% vs. 25%) and more at-risk girls than either at-risk boys or

Table 2

Participants and Non-Participants, Male and Female by At-risk and Normal Status

	NON-PARTICIPANTS		PARTICIPANTS	
	Male	Female	Male	Female
Normal	6 (35%)	2 (12%)	11 (65%)	15 (88%)
At-risk	24 (50%)	17 (71%)	24 (50%)	7 (29%)

Percentages given are the percentage of non-participants or participants considering sex and at-risk vs. normal status; e.g., of a total of 17 normal girls in the original sample, 2(12%) did not participate in the follow-up study, while 15(88%) did.

normal girls were non-participants. More members of the normal control group, who were selected originally only on the basis of having a passing score on the Kindergarten Modified Predictive Index, and matched with the at-risk for social class and sex were, for unknown reasons, available for follow-up. Fortunately, twice as many at-risk than normal control children were included originally, so the numbers and distribution of the sample were adequate for evaluation of outcome.

Comparisons of At-risk and Normal Groups

Table 3 shows the results of comparing the 31 at-risk and 26 controls on several variables. The children had originally been selected on the basis of passing or failing the Kindergarten Modified Predictive Index (KMPI) so differences were to be expected between the groups on this and related cognitive variables. The at-risk children were poorer than their normal classmates on the teachers' ratings from kindergarten and Grade I, they scored lower on the IQ test (Wechsler Preschool and Primary Scale of Intelligence), the language test (Illinois Test of Psycholinguistic Abilities) and perceptual motor test (Beery Test of Visual Motor Integration) at age six and a half. The IQ difference between groups was almost 15 IQ points. The at-risk children were lower and the controls higher than has been reported as the mean IQ for Vancouver schools, IQ=107

Table 3

T-Tests Between At-risk and Normal Groups

Variable	NORMAL	AT-RISK	t	p
KMPI summary score[1]	6.5	2.9	6.09	.000
SES	3.1	3.2	.28	ns
TCLK summary score[2]	16.6	10.7	3.17	.003
Verbal IQ (WPPSI)	113.6	100.7	4.22	.000
Performance IQ (WPPSI)	110.2	96.3	4.4	.000
Full Scale IQ (WPPSI)	113.0	98.5	4.85	.000
ITPA Language Age[3]	80.5	71.0	3.40	.000
Visual-Motor Age Equivalent[4]	80.8	66.9	5.04	.000
Mother's Age	38.0	43.1	.91	ns
Father's Education	2.2	2.1	.28	ns
Mother's Education	2.2	1.9	.88	ns

1. Kindergarten Modified Predictive Index
2. Teacher Checklist in Kindergarten
3. Illinois Test of Psycholinguistic Abilities
4. Beery Test of Visual Motor Integration

(Holmes, 1980). However, the mean for the entire sample of 57 was 105, which has traditionally been considered to be the average classroom IQ (Zimmerman and Woo-Sam, 1978). The variables on which the two groups did not differ were age, social class, mother's age and mother's and father's educational levels. The controls had been selected to match the SES of at least one failure.

Agreement Between the KMPI and At-Risk Diagnosis

One of the important aspects of the present study was to compare the intensive psychological and neurological examinations with the briefer screening tests done in the schools. As has been seen in the literature review, screening devices vary in their validity, and many falsely identify children as being at-risk, or fail to identify those who later fail in school (Mercer et al., 1979a). Thus it is important to compare the brief screening methods with the more elaborate and presumably more accurate measures of being at-risk, to determine if the former are acceptable as substitutes in the face of effort and costs.

There was agreement in 77% (44) of the 57 cases between the clinical diagnosis of being at-risk or normal and the Kindergarten Modified Predictive Index (KMPI) score of failing or passing (three or fewer subtests passed was considered to be

failing). In seven of the cases of disagreement, the children's scores had been very close to the cut-off on the KMPI, and they were diagnosed as immature or borderline at-risk. The remaining six were disagreements where children clearly passed the KMPI (i.e., scored 5-7) yet were considered to be at-risk from psychological and neurological examinations. There were no cases in which children scoring 0 or 1 on the KMPI had been called normal. The KMPI score and the at-risk or normal status were used separately in the statistical analyses so that their predictive efficiency could be compared.

Factor Analysis of Kindergarten, Grade I and Grade III

In an analysis of kindergarten data, four factors accounted for 84% of the variance. However, the first two reflected method variance in that Factor I was made up of items from the Kindergarten Teacher Checklist; Factor II consisted of four items from the Kindergarten Modified Predictive Index and the Kindergarten Modified Predictive Index composite score; Factor III consisted of the language of the child and family and Factor IV included only the quality of speech.

In Grade I, Factor I accounted for 88% of the variance and appeared to be one of general "school-mindedness" including such things as listening comprehension, following instructions, taking part in discussions, and reading and arithmetic skills.

This was followed by Factor II which was visual-motor items and the absence of specific problems, and Factor III, verbal expression.

Grade III factoring was similar to Grade I with four factors accounting for 85.2% of the variance. Factor I was again a general "school-mindedness" factor; Factor II was academic achievement; Factor III was ability to work steadily at a task and general behavior; while Factor IV was fine and gross motor coordination and handwriting appearance.

Particularly in kindergarten the factors matched the tests (Kindergarten Modified Predictive Index and Kindergarten Teacher Checklist) while later in school, both academic achievement and the teacher's rating of the child's work habits and skills were prominent. In this analysis then, the factors did not contribute to data reduction so were not used in the regression equations as they would not have been likely to improve prediction.

Birth Events

It was hypothesized that children who had been clinically judged to be at-risk or who had failed the Kindergarten Modified Predictive Index, would have significantly more negative birth events than controls; however, when considered in a multivariate fashion, it was expected that SES and maternal variables would outweigh the birth events.

Birth History Given by Mother

T-tests were calculated between at-risk and control groups on the items from the mothers' accounts of the birth histories. No significant differences were found between the groups on any of the following variables: bleeding, illness, x-rays or drugs taken during pregnancy; length of gestation; duration of labor; whether a doctor was present at the birth; whether it was a multiple birth; presentation or mode of delivery; whether anesthetic was used; whether the mother felt the baby had any difficulty or whether she reported that it cried or breathed immediately; whether the baby was blue, needed help breathing, or feeding, or had convulsions, jaundice or spent time in an incubator. Birth weight was also not significantly different in

these two groups.

Abnormal Birth Events

Hospital records of birth were available for 43 children. For the remaining children no records were available because they were either born outside Canada, the hospitals were unable to locate the records, or in two cases the records had been destroyed.

The records were searched for any abnormality or complication that occurred during labor, delivery or immediately following birth without regard to severity. Any event which deviated from the average or expected procedure and could be considered to be potentially neuropathic was included. The sum of such items in this sample ranged from 0 to 5 and was called abnormal birth events (ABE).

Table 4 gives the items which were included in the rating and a comparison of at-risk and normal control children with the incidence in the general population. Items which might also have been significant (e.g., respiratory distress syndrome, low birth weight, anoxia, etc.) but not on this table did not occur in this sample. Sixty five percent of the children (28) had no or one complication; 26% (10) had two; only 12% (5) had three or more. The combined percentage of those with two or fewer was 88.3%, very close to what has been reported elsewhere as the

Table 4

Abnormal Birth Events (ABE) Found in 43 At-risk and Normal Children

	At-Risk n=24		Normal n=19		Population[1]
Conditions of Pregnancy					
Length of Pregnancy					
<37 weeks	1	4.1%	1	5.2%	8.6%
>44 weeks	0		2	10.5%	2.6%
Induced Labor (Pitocin)	0		2	10.5%	na[2]
X-rays during pregnancy	0		1	5.2%	na
maternal age 31 or more	10	41.6%	7	36.8%	30.9%
virus illness	0		1	5.2%	
previous miscarriage	2	8.3%	0		na
Conditions of Labor and Delivery					
Length of labor <2 hrs.	1	4.1%	0		na
Length of labor >14 hrs.	0		1	5.2%	na
Meconium staining of amniotic fluid	1	4.1%	2	10.5%	na
Presentation other than vertex	2	8.3%	0		4.0%
Forceps delivery (low or outlet)	6	25%	4	21%	31.2%
Caesarian Delivery	1	4.1%	3	15.7%	7.0%
Conditions of Newborn					
Jaundice	2	8.3%	0		na
Apgar <8 at 1 min.	3	15% (n=20)	1	8.3% (n=12)	6.8%
Prolonged apnea	1	4.1%	0		0.9%
Foetal distress	1	4.1%	3	15.7%	na
Birthweight >9 lbs.	0		1	5.2%	na
Blood incompatibility Rh- baby; Rh+ mother	2	8.3%	0		1.4%
Oxygen required	3	12.5%	0		na
Cord around neck	1	4.1%	0		na

1. Source: Ontario Perinatal Mortality Study (1967) or Niswander and Gordon (1972).
2. Incidence figures not available.

percentage of uneventful births. Niswander and Gordon (1972) found 85% of newborns in the Collaborative Perinatal Project to be "well and healthy" while Werner et al., (1971) observed that 87% had no or mild stress at birth in the Kauai study.

The number of children experiencing any of the abnormal birth events was too small in most cases for any formal comparison, however some interesting differences are seen. The at-risk group included more mothers over 31 years, and more mothers with a history of previous miscarriages. Presentation was other than vertex in more at-risk cases (8.3% vs. 4% in the general population and none in the normal control sample). An Apgar score of less than 8 at one minute was also found with higher frequency in the at-risk group. The normal controls however, experienced more Caesarian sections and foetal distress than the at-risk sample.

ABE by Kindergarten Modified Predictive Index and At-risk Status

In Table 5 Kindergarten Modified Predictive Index (KMPI) scores are compared with the number of abnormal birth events. A non-significant X^2 indicated that there was no tendency for low KMPI scores to go with either a high or low number of ABE. Similarly, when ABE were compared with clinically judged at-risk or normal status at age six and a half, the X^2 was not significant (Table 6).

Table 5

Kindergarten Modified Predictive Index (KMPI) Scores by Number of Abnormal Birth Events (ABE)

	NUMBER OF ABE		
	0-2	3-5	Total
KMPI SCORE			
0-3 (failing)	21	2	23
4-10 (passing)	17	3	20
Total	38	5	43

X^2=.44; p=.50; df=1

Table 6

At-risk and Normal Status at 6 1/2 by Number of Abnormal Birth Events (ABE)

	Number of ABE 0-2	3-5	Total
At-risk	21 87.5%	3 12.5%	24
Normal	17 89.4%	2 10.5%	19

X^2=.872; p=.52; df=1

Further, the number of abnormal birth events was not significantly different between the normal and at-risk groups. For the normal children (n=19) the mean number of Abnormal Birth Events was 1.21, while for the at-risk group (n=24) the mean was 1.20. A non-significant t resulted when these means were compared by t-test.

Correlations and Multiple Regression Analysis using ABE

Small, significantly positive correlations were found when ABE were correlated in a univariate fashion with the KMPI, Kindergarten Teacher Checklist, mother's age, WPPSI Full Scale IQ, Vocabulary and Comprehension in Grade III, Grade III Teacher Checklist, Reading in Grade VII, Grade VII Teacher Checklist and the Parent Checklist. Table 7 gives the correlations between these variables. Correlations of r=.26-.38 were found between the Teacher Checklists and abnormal birth events, while the correlation between the KMPI and ABE was r=.33. Non-significant correlations were found between ABE and mother's age, comprehension and vocabulary scores in Grade III, reading achievement in Grade VII and the Parent Checklist.

Further evidence for the weak relationship between ABE and the KMPI score was found when the ABE score was entered into a regression equation with mother's age, education and social class. The adjusted R^2 was .076 (F=3.67) using ABE alone to

Table 7

Pearson Correlations Between Abnormal Birth Events (ABE) and Variables from Kindergarten to Grade VII

	r with Abnormal Birth Events Score (ABE)
Kindergarten Modified Predictive Index (KMPI)	.33
Teacher Checklist in Kindergarten	.37
Mother's Age at time of birth	.12
WPPSI Full Scale IQ at age 6 1/2	.23
Teacher Checklist in Grade I	.27
Vocabulary Test in Grade III	.22
Comprehension Test in Grade III	.15
Teacher Checklist in Grade III	.38
Reading level in Grade VII	.17
Teacher Checklist in Grade VII	.26
Parent Checklist at Age 13	.16

$r \leq .25$ is significant at $p = .05$ or better

predict KMPI, and mother's education raised the R^2 to .10 (F=2.05). Thus abnormal birth events accounted for only 7% of the variance in Kindergarten Modified Predictive Index scores.

Summary: Birth Events

1. The number of abnormal birth events from the mother's account of the birth or from the hospital record did not distinguish between at-risk and normal kindergarten children.
2. Small positive correlations were found between birth events and kindergarten test results and teacher Checklists in Grades I, III and VII, but the amount of variance accounted for was insignificant for practical purposes.

Early Developmental Milestones

It was hypothesized that early developmental milestones would be significantly different between at-risk and controls. Accordingly the normal and at-risk children were compared on their developmental milestones as reported by their mothers in the interview with the neurologist when they were six and a half. She was asked the age at which the child sat up, crawled, walked, spoke single words, spoke sentences, dressed him or herself, was toilet-trained, and buttoned clothing. There was only one significant difference when t-tests were used to compare the means of the groups. The children walked, talked and dressed themselves at the same ages, but the at-risk group was toilet-trained later ($t=2.10$; $p=.04$).

Prediction of Outcome

It was hypothesized that kindergarten and Grade I data would predict outcome to age 13 to a large degree and would predict nearly as well as Grade III data predicted age 13 outcome. In this section, prediction using different sets of the kindergarten and Grade I data to different Grade VII outcomes will be reported. First the Kindergarten Modified Predictive Index (KMPI) pass or failing score is compared with a normal or abnormal overall outcome, and with reading ability in Grade VII. Second, the normal or at-risk status at six and a half is compared with normal or abnormal outcome at age 13, and then with reading ability.

Prediction from the KMPI to General Outcome at age 13

Table 8 shows the results of comparing children who had failing scores on the KMPI (0-3) with those passing (4-10) in terms of Grade VII outcome. Only 34% (11 of 32) of the kindergarten test failures were doing well seven years later with no specific problems reported by parents or teachers. This was in contrast to 72% (18 of 25) of the passes. The majority of the failures (21 of 32, 66%) were having difficulty compared

Table 8

Prediction from KMPI to Outcomes at Age 13

	KINDERGARTEN MODIFIED PREDICTIVE INDEX		
	0-3 (failing)	4-10 (passing)	Total
OUTCOMES			
NORMAL	11	18	29
ABNORMAL			
Learning Disabled	3	2	5
Behavior Problems	1	1	2
Both Learning and Behavior Problems	12	0	12
Slow Learner	2	1	3
Emotional/Peer Problems	3	3	6
Total	32	25	57

$X^2 = 13.57$; $p = .02$; $df = 5$

Overall percentage of correct prediction is 68%.

with 28% (7 of 25) of the passes. The significant X^2 (13.57, p=.02) indicated that failing the KMPI and abnormal status seven years later were not independent events.

Prediction from the KMPI to Reading Achievement at Age 13

Table 9 shows the KMPI passing and failing scores compared with reading achievement in Grade VII. Nineteen of thirty KMPI failures (63%) were reading one or more years behind the Grade VII level; only 22% (5 of 18) of the KMPI passes were this far behind. Only two of the KMPI passes (9%) were severe reading problems or as many as three years behind in reading (i.e., Grade IV level in Grade VII) while 6 of 30 (20%) of the KMPI failures were in that category. The significant X^2 (14.03; p=.03) indicated the dependence between KMPI failure and later reading failure.

Overall Prediction from the KMPI

The overall percentage of correct prediction (the hit rate) using the KMPI screening test to predict Grade VII outcome was 68% (39 of 57 children). In predicting reading achievement of at least Grade VII level in Grade VII, the KMPI predicted correctly for 69.8% (37 of 53 children).

Table 9

Prediction from the KMPI to Reading Achievement at Age 13

	KINDERGARTEN MODIFIED PREDICTIVE INDEX				
	0-3 (failing)		4-10 (passing)		Total
Reading Level at age 13					
Grade 3	1	(severe reading	0		
Grade 4	5	problem)	2		24
Grade 5	6	(mild reading	1		
Grade 6	7	problem)	2		
Grade 7	8	(average)	6		
					29
Grade 8	2	(above average)	5		
Grade 9	1		7		
Total	30		23		

$X^2 = 14.03$; $p = .03$; $df = 6$

Overall percentage of correct prediction is 69.8%.

Prediction from Normal vs. At-Risk Status to Outcome at 13

Prediction to Grade VII (age 13) outcome using at-risk vs. normal status at age six and a half resulted in a higher hit rate than using the Kindergarten Modified Predictive Index (KMPI). Table 10 gives the results. The highly significant X^2 indicated that at-risk status at age six and a half was related to abnormal outcome at age 13. Outcome for 86% of the children was correctly predicted on the basis of the rating given at age six and a half. Of these, 88% (23 of 26) were normal and 84% (26 of 31) abnormal on both occasions. Three children rated as normal at six and a half developed problems, although only one had a learning/behavior problem while the other two had peer and/or emotional difficulties.

Of the five at-risk children who had no problems by Grade VII, four of them were having difficulty learning in Grade I but by Grade III all were at least average in achievement and Teacher Checklist rating. None had received learning assistance in the school with the exception of one boy who spend one to three hours a week in motor training in Grade III.

Prediction from Normal vs. At-risk Status at Six and a Half to Reading Achievement at age Thirteen

In Table 11 normal vs. at-risk status at six and a half is

Table 10

Prediction from At-risk vs. Normal Status at Age 6 1/2 to Outcome at Age 13

	STATUS AT 6 1/2 Normal	At-risk	Total
Outcomes at 13			
Normal	23	5	28
Abnormal			
Learning Disabled	0	6	6
Behavior Problem	0	2	2
Both Learning and Behavior Problems	1	10	11
Slow Learner	0	3	3
Emotional/Peer Problems	2	5	7
Total	26	31	57

$X^2=28.74$; p=.000; df=5

Overall percentage of correct prediction is 86%.

Table 11

Prediction from At-risk vs. Normal Status at age 6 1/2 to Reading Level at Age 13

	STATUS AT 6 1/2 Normal		At-risk	Total
Reading Level at Age 13				
Grade 3	0	(severe reading	1	
Grade 4	1	problem)	6	
				24
Grade 5	1	(mild reading	6	
Grade 6	2	problem)	7	
Grade 7	8	(average)	6	
				29
Grade 8	6	(above average	1	
Grade 9	6	reader)	2	
Total	24		29	53

$X^2 = 16.45$; $p = .01$; $df = 6$

Overall percentage of correct prediction is 75%.

compared with the teacher's estimate of reading ability at age 13. The significant X^2 (16.45; p=.01) indicated again that reading at 13 was not independent of status at six and a half. Almost 70% (20 of 29) of the at-risk children were reading one or more years behind the Grade VII level, while only 17% of the normal children were. Prediction was correct for 75% of the children overall.

Prediction of achievement test results in Grade VII was possible for only 31 children for whom test scores were available. Table 12 shows the results, which were very similar to those predicting the teacher's rating of reading ability. Twelve of thirteen (92%) of the normal children were reading at the Grade VII level or better while only six of eighteen (33%) of the at-risk children were. The significant X^2 (6.93; p=<.01) indicated that being at-risk at six and a half and reading at the Grade VI level or lower in Grade VII were not independent events.

Results of Multiple Regression Analyses

Twenty six kindergarten variables, sex, SES and abnormal birth events score were used in multiple regression analysis to predict Grade III and Grade VII outcomes. The kindergarten variables included the KMPI composite score and individual items from that test and the composite score and individual items from

Table 12

Prediction from At-risk vs. Normal Status at 6 1/2 to Achievement Test Results at Age 13

	STATUS AT 6 1/2	
	Normal	At-risk
Reading at 13		
Grade 6 or less	1 (8%)	12 (67%)
Grade 7 or better	12 (92%)	6 (33%)
Total	13 (100%)	18 (100%)

$X^2=6.93$; $p=.01$; $df=1$

Overall percentage of correct prediction is 79.5%.

the Kindergarten Teacher Checklist. In this section, first the prediction to the three Grade III outcomes (Vocabulary and Comprehension Test Scores and the Grade III Teacher Checklist) are given. Then the prediction to Grade VII outcomes of reading achievement and Teacher Checklist follow. Third, prediction combining composite scores from kindergarten and Grade I with IQ, SES and at-risk status to Grade VII reading skill and the Grade VII Teacher Checklist is given. Finally, the Grade III variables were added to those from kindergarten and Grade I and the combined prediction to Grade VII is shown.

Prediction Using Multiple Regression Analysis to Grade III

Tables 13, 14, and 15 show the results of using the 29 variables to predict the Grade III variables of Vocabulary and Comprehension test scores and Teacher Checklist summary score. In Table 13, five items from the Kindergarten Teacher Checklist and three from the Kindergarten Modified Predictive Index (KMPI) combined to produce an $R^2 = .65$ with the vocabulary test score in Grade III. Four were verbal/listening items and three were visual-perceptual items. The remaining item was the kindergarten teacher's estimate of the child's readiness for Grade I.

In Table 14, it can be seen that seven of the same eight items, plus comprehension in kindergarten and the Bender Motor-Visual Gestalt Test, combined with an $R^2 = .77$ to predict

Table 13

Results of Multiple Regression Analysis from 29 Variables to Vocabulary Test Score in Grade III

Adjusted R^2=.65; df=8,23

Variable	F to remove
Listening Comprehension[1]	20.45
Word Recognition I[2]	6.78
Word Recognition II[2]	11.20
Auditory Discrimination[1]	19.61
Quality of Verbal Expression[1]	7.79
Readiness for Grade I[1]	7.52
Word Reproduction[2]	4.92
Ability to discuss[1]	4.28

1. Item from the Teacher Checklist in Kindergarten
2. Item from the Kindergarten Modified Predictive Index

Table 14

Results of Multiple Regression Analysis from 29 Variables to Reading Comprehension Test Score in Grade III

Adjusted R^2=.77; df=9,22

Variable	F to remove
Word Recognition I[2]	18.74
Listening Comprehension[1]	41.53
Auditory Discrimination[1]	9.50
Readiness for Grade I[1]	12.93
Word Recognition II[2]	10.85
Word Reproduction[2]	8.10
Ability to discuss[1]	9.99
Comprehension[1]	4.95
Bender Motor Visual Gestalt Test[2]	3.55

1. Item from the Kindergarten Teacher Checklist
2. Item from the Kindergarten Modified Predictive Index

reading comprehension score in Grade III. The only item which appeared in the prediction to Grade III vocabulary score which did not also predict Grade III comprehension score was the teacher's estimate of the quality of verbal expression in kindergarten.

Table 15 shows the prediction to the Grade III Teacher Checklist summary score. Again, more items from the Kindergarten Teacher Checklist than from the KMPI combined to predict Grade III Teacher Checklist with $R^2=.71$. A slightly different type of item than found in the prediction to the comprehension and vocabulary test scores predicted here. Three of the eight were concerned with overall behavior and competence in kindergarten (thinking, following instructions, and working at a task). Fine motor coordination and three visual perceptual/pre-reading tasks from the KMPI (Gates Word Matching and Word Recognition I and II) were the predictors. Auditory discrimination in kindergarten and the Word Recognition tasks contributed to the prediction of all three Grade III outcomes.

Multiple Regression Analysis Prediction to Grade VII

Prediction to the Grade VII outcomes of reading achievement and Grade VII Teacher Checklist summary score are given in Tables 16 and 17. Table 16 shows that nine items predicted reading achievement in Grade VII with $R^2=.75$. Five items were

Table 15

Results of Multiple Regression Analysis from 29 Variables to the Teacher Checklist in Grade III

Adjusted R^2=.71; df=7,24

Variable	F to remove
Gates Word Matching[2]	44.89
Fine Motor Coordination[1]	10.29
Thinking Ability[1]	6.93
Ability to Follow Instructions[1]	8.89
Word Recognition I[2]	3.87
Ability to Work at a Task[1]	3.81
Word Recognition II[2]	4.46

1. Item from the Kindergarten Teacher Checklist
2. Item from the Kindergarten Modified Predictive Index

Table 16

Results of Multiple Regression Analysis from 29 Kindergarten and Grade I Variables to Reading Skill in Grade VII

Adjusted R^2=.75; df=9,29

Variable	F to remove
Visual Perception[1]	3.85
Bender Motor Visual Gestalt Test[2]	16.89
Readiness for Grade I[1]	8.06
Word Recognition I[2]	17.94
Word Recognition II[2]	6.39
SES	10.28
Number of Words in a Story[2]	3.99
Pencil Use[2]	4.42
Comprehension[1]	2.06

1. Item from the Kindergarten Teacher Checklist
2. Item from the Kindergarten Modified Predictive Index

from the Kindergarten Modified Predictive Index (KMPI), three from the Kindergarten Teacher Checklist, and SES were the variables included. Five of these were perceptual-motor items (visual perception from the Kindergarten Teacher Checklist, the Bender Motor Visual Gestalt Test, Word Recognition I and II, and pencil use). Two, which added only a little to the prediction, were verbal (the number of words used in a story, and Comprehension in kindergarten). The teacher's overall estimate of the child's readiness for Grade I combined with the Bender and visual perception items from the kindergarter teacher checklist to account for over half of the variance in Grade VII reading achievement.

Table 17 shows the results of using kindergarten variables to predict the Grade VII Teacher Checklist summary score. Here the Kindergarten Teacher Checklist, the Gates Word Matching from the KMPI and the teacher's estimate of fine motor coordination in kindergarten resulted in an $R^2=.76$. Very little more was added by the two perceptual-motor items, the Bender and the Draw-a-man Test.

Multiple Regression Analysis with Teacher Checklists in Kindergarten and Grade I, the KMPI, IQ, SES and At-risk Status as Predictors

It can be seen from the above regression analyses that the

Table 17

Results of Multiple Regression Analysis from 29 Kindergarten and Grade I Variables to Teacher Checklist in Grade VII

Adjusted R^2=.79; df=5,33

Variable	F to remove
Kindergarten Teacher Checklist Summary Score	8.23
Gates Word Matching[2]	23.57
Fine Motor Coordination[1]	7.08
Bender Motor Visual Gestalt Test[2]	3.49
Draw-a-Person[2]	2.73

1. Item from the Kindergarten Teacher Checklist
2. Item from the Kindergarten Modified Predictive Index

Kindergarten Teacher Checklist and certain perceptual-motor items from the Kindergarten Modified Predictive Index (KMPI) were good predictors of Grade VII outcomes. Therefore, the summary scores from the Kindergarten and Grade I Teacher Checklists and the KMPI were entered into a regression equation with IQ, SES and at-risk vs. normal status in order to compare the contribution to prediction from the last three global items with the former three. Table 18 shows the results of using these six variables to predict Grade VII reading skill. The Grade I Teacher Checklist, the KMPI summary score, Full Scale IQ and at-risk vs. normal status accounted for 48% of the variance. The F to enter the equation for the last two, the Kindergarten Teacher Checklist and SES, was not significant.

In Table 19, the prediction to Grade VII Teacher Checklist with the above six variables is shown. Here the two earlier Teacher Checklists in kindergarten and Grade I, the KMPI summary score and SES accounted for 62% of the variance in the Teacher Checklist score in Grade VII. At-risk status and IQ did not have a high enough F to enter the equation.

Multiple Regression Analysis with Kindergarten, Grade I and Grade III Variables Combined

Grade III variables were then added to the above six and prediction to Grade VII was done with the following variables:

Table 18

Results of Multiple Regression Analysis from the Kindergarten Modified Predictive Index, Teacher Checklists in Kindergarten and Grade I, SES, IQ and At-risk vs. Normal Status to Grade VII Reading Skill

Adjusted R^2=.48; df=4,47

Variable	F to remove
Grade I Teacher Checklist Summary Score	11.52
KMPI Summary Score	24.97
Full Scale IQ[1]	5.04
At-Risk vs. Normal Status	2.26

1. Wechsler Preschool and Primary Scale of Intelligence Full Scale IQ, given at age 6 1/2.

Table 19

Results of Multiple Regression Analysis from Kindergarten Modified Predictive Index, Teacher Checklists in Kindergarten and Grade I, SES, IQ and At-risk vs. Normal Status to Teacher Checklist in Grade VII

Adjusted R^2=.62; df=4,47

Variable	F to remove
Teacher Checklist in Grade I Summary Score	10.69
Teacher Checklist in Kindergarten Summary Score	12.28
KMPI Summary Score	9.24
SES	2.59

Kindergarten Modified Predictive Index (KMPI), Teacher Checklist summary scores from kindergarten, Grade I and Grade III, reading ability from the Grade III Teacher's estimate, Vocabulary test score in Grade III, Comprehension Test score in Grade III, IQ, SES and at-risk vs. normal status. Table 20 shows the results of predicting to reading skill in Grade VII. The Vocabulary Test score in Grade III along with the KMPI and Grade III Teacher Checklist acccunted for nearly 60% of the variance in Grade VII reading. The other variables contributed nothing.

In Table 21 the results of predicting to the Grade VII Teacher Checklist with the same variables are shown. Here Grade I and Grade III Teacher Checklists, at-risk vs. normal status, reading ability in Grade III, and the Kindergarten Teacher Checklist acccunted for 72% of the variance in Grade VII Teacher Checklist scores. The remaining five variables did not enter the equation.

Summary: Prediction of Outcome to Grades III and VII

1. A passing or failing score on the KMPI predicted general outcome in Grade VII correctly for 68% of the children and reading achievement in Grade VII for 69.8% of the children.
2. Normal vs. at-risk status at age six and a half predicted Grade VII cutcome correctly for 86% of the children and reading achievement in Grade VII correctly for 75%.

Table 20

Results of Multiple Regression Analysis from Kindergarten to Grade III Variables Combined to Reading Skill in Grade VII

Adjusted R^2=.59; df=3,48

Variable	F to remove
Vocabulary Test Score	26.59
KMPI	12.16
Teacher Checklist in Grade III Summary Score	7.45

Table 21

Results of Multiple Regression Analysis from Kindergarten to Grade III Variables Combined to Teacher Checklist in Grade VII

Adjusted R^2=.73; df=5,46

Variable	F to remove
Teacher Checklist in Grade III, Summary Score	21.05
Teacher Checklist in Grade I, Summary Score	22.87
At-risk vs. Normal Status	14.02
Reading Ability[1]	6.31
Teacher Checklist in Kindergarten Summary Score	3.48

1. From the Grade III Teacher Checklist

3. Five children who had been diagnosed at-risk at six and a half improved to be considered normal in Grade VII. All had shown the improvement before Grade III and had been considered normal then. No children changed status from Grade III to Grade VII. Only one child considered normal at six and a half developed learning/behavior problems later, and his problems occurred before Grade III.
4. Using multivariate analysis to predict Grade III vocabulary or comprehension test scores, R^2s of .66-.77 were obtained from kindergarten variables. Seven kindergarten items predicted Grade III Teacher Checklist with R^2=.71.
5. Using multivariate analysis to predict Grade VII reading achievement, nine kindergarten items predicted with R^2=.75. Perceptual-motor items in kindergarten were prominent.
6. The Kindergarten Teacher Checklist and four other variables gave an R^2 of .76 with the Teacher Checklist in Grade VII.
7. When the KMPI, Teacher Checklists and at-risk status were combined with IQ and SES, the Grade I Teacher Checklist, KMPI, and IQ accounted for almost half of the variance in Grade VII reading skill.
8. The Grade VII Teacher Checklist was predicted with R^2=.59 from the Teacher Checklists in kindergarten and Grade I.
9. When Kindergarten, Grade I and III variables were combined to predict Grade VII outcome, the vocabulary test in Grade III, KMPI, and Grade III Teacher Checklist predicted Grade

VII reading with R^2=.59.

10. The Grade III Teacher Checklist and Grade I Teacher Checklist predicted Grade VII Teacher Checklist with R^2=.67.
11. The variables of abnormal birth events score and sex did not appear as predictors in the multivariate analyses while SES and IQ only rarely figured in the equations.

Neurological exam: General Findings

It was hypothesized that the neurological exam would provide concrete measurements of the deficit status of the at-risk children and that items from the neurological exam would distinguish between at-risk and controls.

The standard pediatric neurological examination given to the children at age six and a half consisted of 48 items on which the children were rated as normal or abnormal. Table 22 gives a list of the items with the number of times they were found to be abnormal in this sample of 57. Only 28 items were rated as abnormal and of these, ten were found only once. The most common abnormality was that of being left-eyed and right handed which occurred in 23 children.

T-tests were calculated between the at-risk and normal groups to determine if the presence or absence of any of the neurological signs distinguished between the groups. No significant differences were found.

Only twelve of the 57 children had three or more neurological abnormalities, and only four had five or more. None of these four children was considered to be normal in either Grade I or VII. Nearly equal numbers of normal and at-risk children had two or less neurological abnormalities. Thus,

TABLE 22

Items From the Neurological Examination

Exam Item	Number of times it was found to be abnormal in 57 cases
Affect	1
Mentation below average	4
Dominant eye left, right hand	23
Opthaloscopy right	1
" left	2
External eye movements	1
Conjugate gaze	0
Corneal reflexes	0
Trigeminal motor power	0
Facial asymmetry	0
Hearing--normal conversation	0
" whisper	0
" watch (rt. ear)	0
" watch (left ear)	0
Palate	0
Tongue	0
Sternomastoids	0
Trapezii	0
Limbs tone	2
" power	0
Reflexes tendon	2
" abdominal	0
" Babinski	1
" Chaddock	2
Sensation touch	1
" joint position	0
" vibration	0
" stereognosis	1
" finger localization	3
" 2 point discrim.	3
Perseveration	1
Concentration	2
Ability to cross midline	2

Table 22 (continued)

Simultaneous face/hand touch test		3
"	sound f/h touch test	8
Opticokinetic nystagmus		0
Hyperactive		8
Distractible		5
Rapid alternating movements		3
Fine finger movements		4
Dressing praxis		1
Constructional praxis		1
Cerebellum:	Romburg	0
	Finger-nose, eyes open	0
	Finger-nose eyes closed	2
	Heel shin, eyes open	3
	Heel shin, eyes closed	3
Nystagmus		0

showing up to three or four abnormalities on the neurological exam did not distinguish between normal and at-risk children. There was a tendency for five or more abnormal items to be related to at-risk status at age six and a half and to an abnormal outcome at age 13.

Table 23 shows status at age six and a half compared with the number of neurological abnormalities. The non-significant X^2 (4.31; $p<.10$) indicated independence between these categories although a trend can be seen. In Table 24 the relationship between status at age 13 and the number of neurological abnormalities at age six and a half is shown. Here the X^2 is significant ($X^2=6.63$; $p=<.05$).

No clear patterns were seen in the four children with 6-10 abnormal neurological items. Nineteen different items were found to be abnormal among them, with only three of the nineteen appearing in as many as three of the children (fine finger coordination, being left eyed and right handed, and being distractible). Five were found twice in the four children.

Summary: Neurological Exam

1. None of the individual items from the 48 item pediatric neurological exam significantly distinguished between normal and at-risk groups.
2. Only 8 (14%) of the children had three or four abnormal

Table 23

Number of Neurological Abnormalities at 6 1/2 by Normal vs. At-risk Status at 6 1/2

	Status at 6 1/2 Normal	At-Risk	Total
Number of Neurological Abnormalities at 6 1/2			
0-2	21	24	45
3-4	5	3	8
5 or more	0	4	4
Total	26	31	57

$X^2=4.31$; $p=<.10$ (n.s.); df=2

Table 24

Number of Neurological Abnormalities at 6 1/2 by Normal vs. Abnormal Outcome at Age 13

	Outcome at Age 13 Normal	Abnormal	Total
Number of Neurological Abnormalities at 6 1/2			
0-2	26	19	45
3-4	3	5	8
5 or more	0	4	4
Total	29	28	57

$X^2=6.63$; $p=<.05$; $df=2$

items on the neurological exam. Only four (8%) had five or more.

3. There was a tendency for five or more neurological abnormalities to go with at-risk status at six and a half years of age and abnormal outcome in Grade VII. These items did not, however, form any pattern which could constitute or verify at-risk status.

School Variables as Predictors

It was hypothesized that teacher's estimates of children's behavior and other school factors would be good predictors of later school achievement. In this section first the correlations between the Teacher Checklists in kindergarten, Grades I, III and VII are given; followed by passing or failing the Kindergarten Modified Predictive Index (KMPI) and at-risk vs. normal status at age six and a half are compared with grade placement at age 13; and finally, the problem of evaluating learning assistance is discussed.

Differences between At-risk and Normals on School Variables

Table 25 gives the results of t-tests comparing the at-risk (n=31) with the controls (n=26) on Grade III and VII variables. The differences on every item were significant. By Grade VII, the at-risk children were almost two years behind the controls in reading, and were rated significantly lower in all areas by their teachers.

Table 25

Differences Between At-risk and Normal Children on School Measures

	NORMAL	AT-RISK	t	p
TCL1 summary score	19.9	7.8	6.48	.000
Vocabulary (Gd. 3)	5.6	4.1	2.31	.02
Comprehension (Gd. 3)	5.5	3.6	3.05	.004
TCL3 summary score	24.2	19.3	1.82	.07
Reading Level (Gd. 7)	7.5	5.8	4.29	.000
Arithmetic Level (Gd. 7)	7.0	5.8	3.38	.001
Reading Test (Gd. 7)	7.5	5.6	4.44	.000
TCL7 summary score	46.9	35.4	3.18	.002

The Teacher Checklists

As shown in the preceding section, the Teacher Checklists contributed to prediction of outcome, particularly if that outcome was assessed by a later Teacher Checklist. Table 26 shows the intercorrelations among them. The correlations between the Grade I Teacher Checklist and later ones was higher and more consistent than between the Kindergarten Teacher Checklist and Grade III and VII Teacher Checklists. These teacher rating scales were clearly measuring similar factors at each age, and the children tended to stay in the same rank order on them.

Grade Placement at Age 13

Table 27 shows grade placement at age 13 compared with passing or failing the Kindergarten Modified Predictive Index (KMPI). The study children began Grade I in 1972 and normally should have been in Grade VII. The majority of both passing and failing kindergarten children were in Grade VII (43 of 57, 75%) however 11 of the KMPI failures (34%) but only 3 of 25 (12%) of the passes had failed one year or were in a special class. If a child failed the KMPI, it was almost three times more probable that he or she would have failed a grade or be in a special class by Grade VII.

When at-risk vs. normal status at six and a half was used

Table 26

Intercorrelations Among Teacher Checklists

	TCLK	TCL1	TCL3	TCL7
TCLK	1.00	.67	.48	.67
TCL1		1.00	.70	.73
TCL3			1.00	.73
TCL7				1.00

Table 27

Grade Placement at Age 13 by Kindergarten Modified Predictive Index Score

	Grade Placement at Age 13		
	Grade VII	Grade VI	Special Class
KMPI score			
0-3 (failing) n=32	21 (66%)	9 (28%)	2 (6%)
4-10 (passing) n=25	22 (88%)	2 (8%)	1 (4%)

as the comparison with grade placement at 13, only one child who was considered normal at age six and a half had repeated a grade while 13 (42%) of the at-risk children had done so (Table 28). Here, as in other comparisons, clinical judgements made when the child was in Grade I predicted outcome more accurately than did passing or failing the KMPI one year earlier.

The retention rate for the entire sample was 19%. This was slightly higher than that reported in large scale American surveys. Both Roberts and Baird (1972) and Rubin and Balow (1971) found 15% of public school children had been held back one grade by age 11.

Learning Assistance

Only a rough evaluation of the special instruction or learning assistance children received in school was made. This was chiefly because it was not possible to quantify learning assistance. (See Chapter 2 of the review section). There was no way to compare the types of instruction in different schools, the amount and the quality of teaching or its appropriateness for a child's problems. The training for learning assistance teachers varies widely with no uniform standards applied in British Columbia. Certainly, regular classroom teachers also vary in their ability to teach at-risk children and possibly the reason some of the children did not receive special learning

Table 28

Grade Placement at Age 13 by Normal vs. At-Risk Status at Age 6 1/2

Status at 6 1/2	Grade Placement at Age 13		
	Grade VII	Grade VI	Special Class
Normal n=26	25 (96%)	1 (4%)	0
At-Risk n=31	18 (58%)	10 (32%)	3 (10%)

assistance was that they were already being "treated" in their classrooms. Most schools offer some form of learning assistance in the early grades but there was wide variation among schools as to whether they even offered learning assistance after Grade III. Whether a child received learning assistance and the type and quality depended on many factors, many of which were unrelated to the child's difficulties.

Receiving learning assistance did not appear to be positively related to outcome in this sample. None of the five children who changed from at-risk to normal status by Grade VII had received such special individualized instruction, while almost a third (9 of 31) who failed to improve had attended learning assistance centres.

Thus, an answer to the question of whether treatment makes a difference cannot be found in these data. There is a suggestion that the rather random and discontinuous form of learning assistance usually given in the schools does not help very much. The large majority of at-risk children did not improve yet they were clearly recognized by their teachers as having difficulty from kindergarten on.

Summary: School Factors

1. Individual correlations between Teacher Checklists in Kindergarten, Grades I, III and VII were r=.48 to .73. In

most cases the highest correlations were found between the shortest intervals.

2. Multiple correlations among Teacher Checklists were also high. Kindergarten Teacher Checklist alone accounted for nearly half of the variance in Grade VII Teacher Checklist. Kindergarten Teacher Checklist and Grade I Teacher Checklist combined accounted for almost 60%, and Grade I and Grade III Teacher Checklists combined acccounted for 67% of the variance in Grade VII Teacher Checklist summary scores.
3. Thirty four percent of the Kindergarten Modified Predictive Index failures had failed one grade or were in a special class by Grade VII. Only 12% of the KMPI passes had failed.
4. Forty two percent (13 of 31) of the at-risk children but only 4% (1 of 26) of the normal children had failed a grade or were in special class by age 13.

The Parent Checklist

It was hypothesized that items from the Parent Checklist of home behavior at age 13 would distinguish between at-risk and control children.

The 39 item Parent Checklist was completed by the parents of the children at age 13. It was designed to elicit information about how the child behaved at home, whether she or he was considered difficult or unhappy and whether behavior such as hyperactivity, impulsiveness or disobedience was evident.

Overall, the Parent Checklist summary score did not distinguish between the at-risk and normal children. (Mean for the at-risk was 51.5; for the normals, 52.5; t=.10, n.s.). The at-risk children were having more trouble in school, and their teachers rated them significantly below their classmates on the Grade VII Teacher Checklist, but their parents did not report that they were more difficult to live with.

Table 29 shows the comparison of parent's perception of the child's happiness with normal vs. at-risk status. None of the parents reported their children to be extremely happy or unhappy. Only three of the six possible categories were used. Eighty eight percent of the parents of normal children and 74% of parents of at-risk children considered their children to be

Table 29

Comparison of Normal and At-risk Children on Parents' Perception of Their Happiness

	Normal		At-risk	
Do You Think Your Child Is?				
Extremely Happy	0		0	
Very Happy	11	(42%)	10	(32%)
Slighty Happier than Average	12	(46%)	13	(42%)
Somewhat Unhappy	3	(11%)	8	(26%)
Unhappy much of the time	0		0	
Miserable and Unhappy	0		0	
Total	26		31	

$X^2=1.91$; $p=.50$; $df=2$

at least slightly happier than average. Over twice as many parents of at-risk than of normals reported their children to be somewhat unhappy, but the non-significant X^2 indicated that unhappiness and being at-risk were independent.

Table 30 shows the comparison between the parent's perception as to how easy or difficult the child was to live with compared with normal vs. at-risk status. The categories in the questionnaire were those used by Thomas et al. (1964) to describe temperament. The non-significant X^2 (2.6; $p=<.50$) indicated that there was no tendency for any one category to go with either normal or at-risk status. The majority of both groups (58% of normals and 71% of at-risk) were reported as "easy to live with". Only one parent of a normal child and two of at-risk children felt they were "difficult to live with". Over twice the percentage of parents of normal than of at-risk children reported that they could not classify their child into just one category.

The three items from the Parent Checklist which specifically asked about impulsive, overactive behavior were examined separately for the at-risk and normal children. They were:

1. "How often does your child shift or change activities, jumping from one thing to another?" with a rating of 1 for "rarely or never" to 6 for "constantly";
2. To what extent is your child a)" active, lively and

Table 30

Comparison of Normal and At-Risk Children on Parents' Attitude Toward Child

	Normal	At-risk
Rating at Age 13		
Easy to Live With	15 (58%)	22 (71%)
Difficult to Live With	1 (4%)	2 (6%)
Slow to warm up to anything new	1 (4%)	2 (6%)
Cannot put into any one category	9 (35%)	5 (16%)
Total	26	31

$X^2=2.60$; $p=<.50$; $df=2$

energetic?" and b) "impulsive, jumps into things without thinking?" with possible ratings from 1-6 for "rarely or never shows this trait" to "extreme amount of this trait". From these three items it would have been possible to obtain a score from 3 tc 18, the higher number reflecting a very active, impulsive, distractible child. Again these items did not distinguish between the two groups. The mean fcr the normal children was 9.23 with a range of 5 to 15. The mean for the at-risk was 8.87, with a range of 3 to 14.

Summary: Parent Checklist

1. Neither the summary score nor individual items from the Parent Checklist distinguished between at-risk and normal children in Grade VII.

IV. SUMMARY AND CONCLUSIONS OF THE LONGITUDINAL STUDY

This study demonstrates both the value and weaknesses of attempting to predict Grade VII learning problems from data available in Grade I and before. There were methodological problems which are inherent in all longitudinal studies. Attrition was high and more at-risk than control children were lost. However, prediction of outcome was correct for the majority of cases.

Of the six hypotheses initially proposed, three were not confirmed. There were no differences between normal and at-risk children in number of abnormal birth events, developmental milestones (with the exception of toilet training) and items from the Parent Checklist at age 13. One hypothesis, that regarding school events and teacher ratings, was confirmed: teacher checklists and school variables were indeed good predictors.

Results for the hypothesis regarding neurological items were equivocal. There was a tendency for the at-risk children to have more abnormal neurological characteristics than controls but these did not form a pattern. The number of abnormal neurological items did not distinguish between at-risk and normal groups. Yet, the neurologist's overall estimate of the

child as being at-risk or normal was in agreement with the psychologists' and this diagnosis proved accurate for predictive purposes for almost 90% of the cases (i.e., children called at-risk at six and a half were having problems in school or behavior at 13 years).

The hypothesis regarding prediction from the kindergarten screening vs. prediction from Grade III was also not clearly supported or refuted. Predictions from kindergarten to Grade III, Kindergarten to Grade VII, or Grade III to Grade VII were all roughly the same (R^2s=.60 to .79) with different sets of items predicting different outcomes. For the Teacher Checklist the prediction improved from kindergarten to Grade III. In predicting the Grade VII Teacher Checklist, 49%, 54% and 60% of the variance in that score was accounted for by Teacher Checklists in kindergarten, Grade I and Grade III respectively. However, when kindergarten, Grade I and Grade III variables were combined in an equation to predict Grade VII, the Grade III items accounted for the greatest part of the variance, but the kindergarten and Grade I items also contributed. There was a small advantage to predicting from Grade III, but prediction from kindergarten was nearly as good. Five of the children did show what could be called a developmental lag and were considered at-risk at six and a half but normal at eight and a half. The majority showed a deficit and were immature in kindergarten and continued to be behind to Grade VII. No

children changed in the overall rating of normal vs. problem status between ages 8 and 13.

Thus, it was possible to predict correctly for the majority of children whether they would be doing well in school seven years later on the basis of a screening test given in kindergarten. The psychological and neurological exams given at age six and a half confirmed the results of the kindergarten screening test in most cases, but provided more accurate prediction of overall normal vs. abnormal outcome. However, the diagnosis of being at-risk or normal, which resulted from the neurological and psychological exams, was not as important in the regression equations predicting school outcomes as were earlier school measures. Teachers' estimates in kindergarten or Grade I predicted later teachers' estimates best. Visual perceptual and reading tasks predicted later reading best. In addition, a general "school-mindedness" contributed to prediction of outcome.

The number of abnormal events at birth was not a useful predictor and did not distinguish between at-risk and normal samples. Social class and IQ at six and a half contributed almost nothing to the regression equations predicting Grade VII outcomes. There were no differences in SES between at-risk and controls yet there was a large IQ difference. Prediction of school success was best done with school-type items, and teachers early in school can predict quite well what teachers

later in school will think about a given child. Prediction at this level (60-80% accurate), however, is not very useful in individual cases, although prediction for the extreme cases was better. Interestingly, the group of at-risk children, most of whom were considered to be problems by their teachers and were not achieving well in school were not rated any differently from their normal peers on the Parent Checklist of home behavior.

D. AN OVERVIEW

I. PREDICTIVE ANTECEDENTS OF POOR SCHOOL ACHIEVEMENT

The At-Risk Child

The conclusions from this study emphasize two things. First, it is possible to predict from information obtained in kindergarten and Grade I the future school achievement of the majority of children. If a child is thought to be at-risk in kindergarten, and if this at-risk status is confirmed by psychological and neurological tests in Grade I, it is very likely that the child will be having difficulty in school by Grade III, and that this difficulty will still be present in Grade VII. Second, if a child is considered to be normal in kindergarten or Grade I, it is even more likely that he or she will have no difficulty in school. (Two normal children in this sample developed emotional and/or peer problems later in school, but it was beyond the scope of the study to attempt to predict these).

The at-risk children can be described in the following way. They were deficient in a variety of school readiness skills. They passed an average of only 2.9 items on the Kindergarten Modified Predictive Index, compared with 6.5 items for the

controls. When seen for the psychological exam near 6 1/2, they had a language age (Illinois Test of Psycholinguistic Abilities) of 6 years 11 months compared with the controls at 7 years 8 months. But they were far behind this average language level in their visual-motor skills. On the Beery Test of Visual Motor Integration, the at-risk were at 5 years 7 months (almost a year behind their chronological age) while the controls were over a year ahead, at 7 years 8 months. The at-risk were clearly unready for school-type tasks. They had poor ability to match or recognize words, copy shapes, make auditory discriminations, plus generally weak fine motor coordination. On the other hand, the controls were well on their way to recognizing and copying words and were thought by their teachers to be generally mature and competent in both kindergarten and Grade I.

Not surprisingly, one of the best predictors of later reading was Word Recognition. At the beginning of the twenty minute screening test in kindergarten, the child was taught to read two words, and at the end of the session was asked to recognize these words among others. This ability in kindergarten to learn to read two words (or to already know them) predicted subsequent reading ability quite well: a good way to find out if a child can learn to read is to teach her or him.

By Grade III, both groups were reading at or above the Grade III level but the at-risk had difficulty expressing themselves in written or oral work, working independently and

following instructions. By Grade VII, the at-risk, on the average, were two years behind in reading and 42% of them had repeated a grade. The normals were reading at the Grade VII level and only one child had repeated a grade.

In kindergarten, the present sample of at-risk were further behind in perceptual-motor areas than in language, and visual-motor factors accounted for large amounts of the variance in Grade VII scores. However, beyond this, a general readiness factor, a "school-mindedness" or composite of skills was an important variable. It included such things as ability to follow instructions, concentrate, think and work steadily at a task. This may reflect the behavioral, attention deficit aspect that has been found to be characteristic of some learning disabled children. This early lag in school readiness was not a temporary phenomenon, for most children did not catch up. The majority of the at-risk sample were at the bottom of their class in kindergarten and continued to be so at age 13.

Cumulative Minor Deficits

An original purpose of the study, to show that learning disabilities or poor school achievement are complex and that no single test would be the best predictor was well supported by the data. Rather than showing a single weakness, the at-risk children would be better described as having "cumulative minor

deficits" (Galante, Flye and Stephens, 1972). They had several problems, which alone might have been overcome, but in combination resulted in poor school achievement. Their behavior was immature at six, their IQ below 100, they showed perceptual motor and language immaturities and they had no great strengths that could compensate for their disabilities.

There is support for this notion from other studies reviewed in Chapter 2 of the literature review. Bell et al. (1977) found "unevenness in specific developmental patterns" at school entrance to be reflected in later poor school achievement and adjustment. The poor readers in that study had more "specific deficiencies" (4.6 for the poor readers; 1.3 for the good) on a rating very similar to the Kindergarten Modified Predictive Index. The authors concluded that competence and self-confidence at Grade VI was determined before entering school. They echoed the results of the present study when they said "there were few late bloomers" (p. 368).

Satz et al. (1976) reported a "general developmental unreadiness" with "no one particularly striking function or skill area that stood out" (p. 134). In their sample, the children who later became poor readers were delayed on perceptual-motor, auditory and verbal tests.

Weiss et al. (1971) also found the least academically successful in a group of hyperactive children had problems in at least two of the following areas: visual-spatial, verbal or

motor. In addition to their attention deficit the children had uneven cognitive functioning which would penalize them in school and on IQ tests.

Unfortunately this concept of cumulative minor deficits, which looks good retrospectively, is harder to specify prospectively. It is not yet known just how to weight the "minor deficits" or which ones are most important. In the present study low (but within normal limits) IQ, being one year behind in perceptual motor skills in Grade I and the teacher's estimate of unreadiness predicted well over seven years. For Galante et al. (1972) being a boy, having an unusual birth history, showing deficits in perceptual-motor areas and having an inadequate home environment were important. Satz and Friel (1978) found eight items in three areas to predict 90% of severely behind and superior readers. These were 1) sensori-perceptual-motor; 2) verbal-conceptual including Peabody Picture Vocabulary Test IQ; and 3) verbal cultural, including SES.

An example of the usefulness of this concept occurred in the present study. One boy was considered to be at-risk at age six because of his obvious clumsiness and gross motor difficulties. Although his IQ was high and he had good language abilities and high SES, he was classified as being at-risk because gross motor problems were considered to be a sign of MBD. The thinking in the early 1970s when this study was designed was that gross-motor problems were related to learning

problems. The evidence now is that they may be correlated but not causative. He has in fact done very well in school. Had the notion of cumulative minor deficits been applied he would not have been considered at-risk.

IQ and Poor School Achievement

As seen in the review of the literature, Chapters 1 and 2, IQ has figured prominently in the prediction of poor reading in other studies. Satz et al. (1978), using the Peabody Picture Vocabulary Test, found a twelve point IQ difference between superior readers and those with severe reading problems and IQ was one of the predictors included in their abbreviated screening battery. Busch (1980) found IQ, as measured by the Cognitive Abilities group test at the beginning of Grade I, to be one of the three best predictors along with letter recognition and a teacher rating. Bell et al. (1977) found the Stanford-Binet IQ in kindergarten to be directly related to social class and school achievement several years later.

The results from various studies are all consistent in finding a combination of items, usually including IQ (regardless of the test used), SES, teacher ratings and a test or tests closely related to the task of reading, to predict outcome of school achievement, but the role of IQ alone as a predictor is unclear. In spite of a 15 point difference in WPPSI Full Scale

IQ at 6 1/2 between at-risk and normal subjects in the present study, it did not predict as well as specific school type items, nor did IQ distinguish between those of the at-risk who caught up by Grade III and those who did not. For the former the IQ was 98.8 vs. 98.4 for the latter.

Problems in Longitudinal Research

This study also illustrates several problems characteristic of longitudinal research. First, changing knowledge in the field over the seven years since the children were first seen has resulted in a change in the original terminology. Initially, the search was for children with minimal brain dysfunction (MBD) a concept now definitely out of fashion, and possibly without empirical support (Satz and Fletcher, 1980). The original use of the term MBD changed to learning disability or the general notion of poor school achievement.

Second, attrition has plagued the study. After three years, 20% of the subjects were lost; after four more years, another 20% were lost; more at-risk than control children were among the missing. This attrition rate, however, compares favorably to that of other educational follow-up studies. Lilenfield (1976) found 65% of his subjects after six years; Gottesman (1979) found 74% after 3-7 years; Jansky and deHirsch (1972) found 70% after two years; Galante et al., (1972) found 62% after seven

years; Gershman and Kershaw, (1977) found 45.4% after five years. Ackerman, Dykman and Peters (1977) had the same experience as in the present study of finding more of the controls (91%) than the learning disabled children (76%) after 3-6 years. Although only 54% of the original sample in the present study participated in the seven year follow-up, 72% had been located and with more staff or time, they might have participated.

Third, there may be cohort effects in this, a group of learning disabled children who began school just when learning disabilities were receiving increased attention. They may have benefited from the establishment of learning assistance centres, or they may have been victims of the early churning in a complex, rapidly changing field. Evaluation of such effects is beyond the scope of the study but probably impossible to measure.

If the results were biased by the failure to locate and follow-up many of the at-risk children, they may have been biased in a positive direction. The present rather pessimistic conclusions, i.e., that most at-risk kindergarten children don't catch-up by age 13, might have been even more strongly supported had a higher percentage of subjects been available for follow-up. There were more at-risk girls and low IQ children lost. Those with mild mental retardation (IQ<70) would not be expected to improve, and Werner and Smith (1977) found no

learning disabled girls to be improved after ten years. Children who have changed schools more than once between Grades I and VII also may suffer educationally. Thus one can speculate that few if any of the lost children (who included many girls and the three lowest IQs in the study) would have charged from their at-risk status. Particularly in view of the fact that very few of the at-risk children who participated in the follow-up study caught up, it is not likely that more of the at-risk who were not followed up, who may have been a more seriously affected and unstable sample, would have improved.

The Neurological Exam

The relationship of neurological abnormality to learning disabilities is a much discussed topic with few clear conclusions. Opinions and evidence range from those who consider learning disabilities to be just one symptom of neurological dysfunction (Wender, 1971), through those who find some children with neurological abnormalities in learning disabled samples (Bryan and Bryan, 1975), to those who define learning disability as a psychological impairment that occurs in the absence of neurological dysfunction (Cantwell, 1977). Satz and Fletcher (1980) pointed out that the definition of learning disabilities, adopted by the United States Congress, was just a translation by educators of the term "minimal brain dysfunction" which implied

neurological damage on the basis of behavior.

Unfortunately, the present study only confirms the uncertain role of neurological involvement in learning disabilities. Although there was a tendency for a higher number of neurological abnormalities to be associated with at-risk status, neither the number of affected childrer nor the pattern of abnormalities provided clearcut information. Clements and Peters (1963) reported similarly that no one sign was pathognomonic but rather the total number of signs was useful in establishing a diagnosis of MBD. Rutter, Graham and Yule (1970) however, cautioned that the total composite score from a neurological examination was not useful for screening purposes. From the present results the formal neurological examination cannot be recommended for contributing to the diagnosis of at-risk six year olds. This is consistent with recommendations by others that routine neurological examinations are not useful with learning disabled children (Kenny and Clemmens, 1971; Schmitt, 1975).

On the other hand, in the present study, the neurolcgist's global impression of the child and his diagnosis of MBD or immaturity (i.e., at-risk status) at six proved to be quite accurate over time in predicting poor school achievement. It can only be concluded that the neurologist was responding to qualitative characteristics in the child which were not formally measured by the standard pediatric neurological exam. Such

things as adaptability, activity level, perseveration, alertness and distractibility clearly contributed to the neurologist's impression of the child's readiness for school tasks and were easily observed during the examination. The neurologist also conducted an interview with the mother for the birth and developmental history and observed the mother-child interaction. The overall diagnosis, which included far more than simply the performance on the neurological exam, was the result and proved to be accurate for prediction purposes.

Those studies which support the link between neurolcgical abnormality and learning disabilities have generally used children referred to a neuro-educational or neuro-psychological clinic. These may be a more severely affected group or may reflect pre-screening by teachers, doctors or nurses who suspected neurological dysfunction. In the school samples, which are often less seriously affected, (as in the present study) the link between learning disabilities and neurological problems is often not seen (Adams, Kocsis and Estes, 1974; Stine, Saratsiotis, and Mosser, 1975).

Thus we are no closer to understanding the role of abnormal neurological development in poor school achievement. The need to find subtypes among at-risk samples is clear. No doubt some of the at-risk children do have neurological abnormalities which may have implications for their school progress. Attention deficits probably have a neurological base and clearly affect

school achievement.

Also, refinement of the neurological examination itself may be required. In a factor analytic study, Rie, Rie, Stewart and Rettemnier (1978) found neurocognitive functions to be related to general intelligence in eight year old learning disabled children. They concluded that a "diffuse generalized neurological disorganization" was related to lower IQ, and lower verbal and perceptual performance. They cautioned, however, that the nature of these relationships is complex and not useful at present for diagnosis. In fact, they found several "soft signs" to be primarily age linked or developmental. They suggested that refining the pediatric neurological exam to eliminate items which are reflexive or a function of age might increase its predictive value.

Spreen (1978) found the degree of neurological abnormality on a standardized neurological exam in eight to twelve year olds to be closely related to the quality of outcome several years later. The contrast of this finding with that of the present study may be due to what Rie et al. (1978) suggested: the neurological exam at six and a half may have many indicators of a developmental nature and hence be less reliable for longterm prediction at such a young age.

It appears then, that in the absence of behavior that might be treated by a neurologist (e.g., drugs for severe hyperactivity) there is little practical value in the

neurological exam for learning disabled children at the beginning of school. There is of course enormous potential value in the continued search for clear connections between brain and behavior.

The Search for Subtypes

There is a new trend in research which will, in the future, no doubt improve the accuracy of prediction for those at-risk for learning disabilities. This is the search for sub-types, either temperamental (Hall and Keogh, 1978) or cognitive/perceptual-motor (Satz and Morris, 1980). Both emphasize what is now clear: it is possible to identify the majority of children who will have school problems but accuracy of prediction will not be improved until the different types among the learning disabled, and thus the at-risk, are distinguished and prediction made for each group separately.

The approach of Hall and Keogh (1978) is promising. They suggested that examining temperamental "qualitative" characteristics is important in at-risk children. The match between a child's temperament and the learning environment may make the difference between success and failure, especially for "marginal" children. Temperamental characteristics identified by Thomas et al. (1964) were used. These included activity, rhythmicity, responsiveness, adaptability, threshold, intensity,

mood, distractibility and attention-span. In a small sample of at-risk children, Hall and Keogh found three distinct temperament groups and concluded that being at-risk was not a unitary condition but must be described in terms of the child's temperament and the environment.

Satz and Morris (1980) reported that their learning disabled sample was grouped by cluster analysis into five subtypes. These included two language based impairments, one visual-motor, one mixed and one "unexpected" type, i.e., children who were at least average on all of the cognitive and neuro-psychological tests. They emphasized that the work was tentative. If such subtypes can clearly be shown to exist at age eleven, then future work should involve identifying the characteristics of each type at five, along with temperamental factors, and determining if different subtypes have different prognoses.

There is some support in this preliminary work of Satz and Morris (1980) for the role of cumulative minor deficits and fairly clear rebuttal to notions of single causes for learning disabilities. Seventy percent of the children in their study had lower SES, parents were were poor readers, and soft neurological signs along with their global language impairment, perceptual impairment or both.

Birth and Early Developmental Variables

The results here regarding the use of birth events to predict achievement were not entirely consistent with those of other studies where negative birth events were predictive of learning disabilities or found at a higher rate in learning disabled children. In the present study there were no significant differences in the number of abnormal birth events between at-risk and controls. Birth events accounted for only seven percent of the variance in kindergarten scores and three to seven percent of the variance in Grade VII outcomes.

As seen in the review of the literature, Chapter 3, Coletti (1979) reported that a clinic-referred learning disabled sample had more problems at birth, with only 34% of the sample well and healthy at birth and 30% with severe birth or neonatal problems. Rubin and Balow (1977) found 26-34% of the variance in school achievement scores were accounted for by birth events, yet they concluded that this was not strong enough to be useful in individual prediction. Galante et al. (1972) also found an unusual birth history more common in children doing poorly in school than in controls. However, they emphasized that the birth events alone were not causative but existed along with other minor deficits. They also failed to use multiple regression analysis to determine how the minor problems interrelated or whether any one of them (e.g., SES) might account for most of

the variance.

Such results and those of other studies (Rubin and Balow, 1977; Werner et al., 1971) permit argument against selecting at-risk children (at least for poor school achievement) on the basis of birth events alone, except in the extreme cases of very low birth weight or neonatal shock, or when combined with some measure of social or environmental risk. The continuum of reproductive casualty (Pasamanick and Knobloch, 1966) with outcomes from death to mild learning disabilities following abnormal birth events has been shown to exist, but it is not known exactly where to apply cut-offs for those expected to have good or bad outcomes. There is a wide gray area where predictions of outcome are often incorrect because of the failure/inability to take into account either the influence of environmental variables and/or the plasticity of the brain.

In the present study there were almost no differences found between the children who subsequently became poor learners and those who were to learn normally until kindergarten. This might reflect methods of data collection as the children were not individually tested with objective standardized tests until kindergarten.

Since the mothers provided information retrospectively about developmental milestones there may have been errors in their recall or distortions to bring the children closer to what were perceived as the norms. It has been shown that after only

two years, parents' memories of events in their children's infancies are shifted to conform closer to the cultural norm provided by Dr. Spock (Chess, Thomas and Birch, 1960). Others have noted that both maternal anxiety and the relationship between the interviewer and the interviewee will affect the accuracy of the recalled data (Brekstad, 1966; Schaffer and Emerson, 1964). Because of the possibilities for error, it was intriguing that one difference, in the age of toilet-training, was significantly later for the at-risk children. Since this is possibly the first formal learning situation, difficulty here may be an indication of future difficulty in taking instructions or a reflection of distractibility and short attention span.

Most children who are at-risk for school achievement problems are clearly different from their normal peers by school age. Gold (1979) found differences between normal and abnormal children at four years but not before. She used mental and neurological exams at eight months and one year, and cognitive tests at three and four years to predict outcome of school achievement at eight. Differences may be present earlier but not readily detectable by present methods. Or, the lack of differences may be due to normal discontinuities in development. Sameroff (1975) argued that "linear sequences are non-existent and that development proceeds through a sequence of regular restructurings of relations within and between the organism and his environment" (p. 285).

From this point of view it would not be surprising that birth events and developmental milestones are not very predictive of later school achievement. Only when skills quite similar to the outcome of reading achievement (e.g., Word Recognition) were tapped did the links appear.

More longitudinal research is needed using more sensitive instruments and direct observation to detect the point at which children begin to fall behind their peers. Since SES is one of the frequently found predictors, it must be specified just what it is about SES that influences future achievement and when this influence becomes evident.

In order to provide successful intervention, more must be known regarding the important variables to manipulate and the nature of the interaction between birth events and social class. Appropriate intervention at the very first signs of delay might prove more fruitful than later intervention during school years.

Implications of Early Identification

Early identification of learning problems is possible in the majority of cases. It cannot, however, be justified as an exercise for its own sake: effective treatment decisions must be made on the basis of the early screening. Setting aside the problems of the type of treatment to recommend and the effectiveness of treatment for learning disabilities, there is

the question of cost effectiveness or whether the children receiving treatment are the ones who really need it. A screening test can only be considered useful and reliable if it includes most of those needing treatment and eliminates those who do not need it.

If treatment had been formally initiated on the basis of a passing or failing score on the Kindergarten Modified Predictive Index, 75% of the children who later turned out to be severe or mild reading problems would have been treated. Five children (9% of the total) who developed reading problems would have been missed while 11 (20%) who later became average or above average readers would have been unnecessarily treated (see Table 31). Overall, giving treatment to children failing the Kindergarten screen would have been correct for 63% and not treating those who passed the screen would have been 78% correct.

These figures are almost identical to those obtained by Satz et al. (1978). On the basis of their abbreviated test battery, they would have correctly treated 65% of failures and 78% of passes. They made a further refinement, which improved prediction and would be important in view of the cost of treatment. By designating four levels of risk, the percentage of correct prediction improved to 78% of the severe high risk and 87% of the very low risk. These would be very acceptable figures with which to justify the use of a screening device for indicating which children need treatment.

Table 31

Decision to Treat or Not by Reading Outcome

	KMPI Failing (Treat)	Passing (Not Treat)
Reading Level in Grade VII		
Severe Reading Failure Grade III or IV	6	2
Mild Reading Failure Grade V or VI	13	3
Average Reader Grade VII	8	6
Above Average Reader Grade VIII or IX	3	12
Percentage of Correct Prediction	63%	78%

Hypothetical decision to Treat or Not Treat based on Passing or Failing the Kindergarten Modified Predictive Index (KMPI)

In the present study the psychological/neurological diagnosis proved to be an even more accurate predictor than the Kindergarten Modified Predictive Index of the long term outcome. Eighty-six percent of the children were correctly predicted from at-risk vs. normal status in kindergarten to abnormal/normal outcome in Grade VII. This outcome however included not only learning disabilities, but behavior, emotional or peer problems or being a slow learner. The recommended treatment for some of these conditions cannot be readily specified, and in fact, the behavior and emotional/peer problems are usually only treated on a crisis basis. Thus, predicting that a child will have difficulty in school on the basis of elaborate and costly neurological and psychological examinations cannot be justified unless some immediate implementable and effective remedial procedures can be made from the examination.

Although in this study, the psychological/neurological exams provided validation of the screening test in identifying at-risk children, they did only a little better than the screening test in predicting reading problems (75% correct vs. 68% correct for the Kindergarten Modified Predictive Index). A brief screening test combined with teacher's ratings would provide for identification in kindergarten or Grade I of the majority of children who will develop learning problems.

As this study and others have shown, the screening test should include items related to the task of reading. For

example, in the present study, Word Recognition and Word Matching were prominent; Jansky and deHirsch (1972) found letter naming and Satz et al. (1978) found alphabet recitation to be important. Teacher checklists have also been found to be good predictors (Busch, 1980; Glazzard, 1979; Keogh, Tchir and Windeguth-Behn, 1974). Teacher ratings are more direct indicators of actual classroom functioning than test scores and, as was seen in the present study, teachers in the earlier grades can predict quite well how teachers later will view a child.

If such identification were followed by treatment and frequent reassessment, the false negatives would soon be obvious and the mildly affected, who are most likely to improve with treatment would be helped. The severely at-risk, who do not get better, would at least be identified so that modifications could be made in their programs and opportunities provided for skill development in other areas.

Those who caution against early identification are concerned with the dangers of labeling or the self-fulfilling prophecy. The results from studies on this topic often do not support the idea that labelling is so powerful or they are contradictory, but the debate continues as to whether in fact parents' and teachers' expectations lead to lowered performance in children (MacMillan, Jones and Aloia, 1974). Keogh (1977) has also expressed concern that the label "at-risk" become a diagnostic entity in itself.

There is some evidence that teachers are influenced more by the actual behavior they see than by a label applied to a child. When they have had time to observe a child, initial negative expectations disappear (Peschly and Lamprecht, 1979). More concern should be directed toward the social ill-effects of learning disabilities from peers. There is evidence that low social position in classrooms is linked to low academic achievement (Siperstein, Bopp and Bak, 1978) and that learning disabled children are rejected by their peers (Bryan and Bryan, 1975).

Social problems are difficult to treat but may have serious lasting effects on the emotional well-being of the child. It was, in fact, in consideration of the secondary emotional ill-effects of learning disabilities that early identification was given the initial impetus over a decade ago. However, the social incompetence which persists into adulthood (see literature review, Chapter 2) may reside in the child and not simply occur as a result of poor school achievement. Efforts should be directed toward teaching social and life skills along with the learning assistance. It may be impossible to measure whether being identified early minimized subsequent adjustment problems in the absence of improved learning skills. It is clear that in the years since early identification has become widely used the learning disabled population has not declined.

It may be, as shown in this study, that most of the children themselves do not change, with or without help. Some of the apparent deficit may be the result of factors in the school systems. Teachers in the early grades are eager to help the slow readers. They provide reading groups by ability level and spend much time teaching reading. By Grade IV, school becomes subject rather than skill oriented, and children who are behind at that point have little opportunity to catch up. Learning assistance, when it is provided in the middle grades, is usually only a few hours a week and the quality of it varies widely from school to school. Once a child is behind, there may be no opportunity, though individualized instruction, to improve. Therefore it is not surprising that in this study, no children caught up after Grade III. Either the children, the schools or their patterns of interaction are very stable from this point on.

Despite the sometimes considerable problems these children had in school, they were thought to be no different from the normal thirteen year olds in their parents' estimates. It may be that unless a child has accompanying hyperactivity or an attention deficit, a learning problem alone is only a problem in school and the behavior problems the teachers report are the result of having difficulty with the academic subjects. Or, it may be that the normal children at thirteen are showing adolescent turmoil and are behaving in ways that make them look like the difficult at-risk children have looked for years.

There was some indication that the at-risk had shown improvement in behavior over the years. In the section of the questionnaire where the parents were asked to provide additional comments, several mentioned that they had seen great improvement in their children's behavior since early childhood. This anecdotal information is not quantifiable but may contribute to the understanding of the apparent lack of differences between at-risks and normals in their parents' eyes. If the children had been more difficult in the past and improved, the parents' ratings might have reflected this. They found them so much easier to get along with now, in comparison with the past, that they indicated that there were no problems.

Parents' perceptions of their childrens' problems may be too complex to measure adequately. Riddle and Papaport (1976) found nearly all of the parents of hyperactive boys to be very concerned about their children's behavior yet the schools reported average achievement and general improvement. On the other hand, Hirton and Knights (1971) found 75% of the parents thought their children were improved in school yet only 39% were in the correct grade for age. The parents' ratings are not an objective measure like an achievement test. They reflect a process, measured at only one point, which consists of a life of experience and anxiety about a possibly difficult child. Whether the parents are concerned or not has to do with how concerned they were in the past and how much change has occurred, not

simply the level of attainment.

All of this is speculative, of course, and the only objective evidence is that the parents of the at-risk rated them as average in most behavior areas at age thirteen. This may give cause for optimism in view of the otherwise rather pessimistic findings. The children may not do well in school, and require vocational rather than academic training in high school but may in fact do all right in real life.

From findings such as these and others which indicate that children who do poorly in school (including those with hyperactivity and neurological involvement) do not improve, it appears that treatment for poor school achievers should not be only academic. They should be given the opportunity to develop other skills (e.g., shopwork, crafts, sports, etc.) which will enhance their self-concept and enjoyment of later life. At some point it must be accepted that certain children will never succeed at reading or school subjects and they should be trained to gain information in other ways and to develop skills appropriate to their talents.

Conclusions

Early identification of poor school achievement is possible in kindergarten and quite accurate by Grade III. Social class, IQ, birth events, developmental milestones and neurological

status all contribute a little to prediction of outcome but none were significant enough to be useful in individual cases. The best predictors of poor school achievement were school type tasks and teacher ratings. The children who scored the lowest on kindergarten and Grade I measures and who had the greatest number of problems (i.e., severely at-risk) were the least likely to improve while the mildly affected or those with fewer areas of difficulty stood a better chance of catching up.

Important questions were raised by this study: when do differences which are clear by five and a half, first appear? Why were more at-risk girls lost and does this have any implications for the effects of unstable family life on girls? Is there intervention that will bring the lowest children up to their class average? What are the elements of SES and IQ that contribute to prediction? Can these elements be identified before school age? Can the transactions between SES, temperament of the child and child-rearing styles be measured? Can types of at-risk children, each with their own etiology and prognosis, be identified? Alternatively, and the results of this study provide no evidence that this is the case, could the problem reside in the school rather than the child?

These questions and many more remain to be investigated. The chief contribution of this study is then in showing the stability and the complexity of what are called learning disabilities. Satz and Fletcher (1980) have said: "the basic

research problem is that of untangling the complex behavioral relationships manifested by these disabilities and their multiple sources of variability" (p.81). To that end the present study is only a beginning.

APPENDICES

APPENDIX I

INSTRUCTIONS FOR THE KINDERGARTEN MODIFIED PREDICTIVE INDEX

1. Learn to "read" BOY and TRAIN

   The words "boy" and "train", written on separate index cards, are shown to the child at the beginning of the testing session. He/she is taught to recognize and say these words when they are presented one after the other and when they are placed side by side on the table. When the examiner is convinced that the child is, at least for the moment, able to "read" them, he/she asks the child to copy the words on lined paper. About half way through the session both words are reexposed and studied.

2. Draw-a-Man Test

   "Draw me a picture of a man. I want to see the very best drawing you can do". For children who are hesitant, or say they can't say, "Try" and/or "I just want to see the best you can do".

3. Print-your-name

   "Now will you print your name up at the top, here, please?" Encourage if necessary, as above.

4. Pencil Use

The child is observed as he/she uses the pencil. The score, from best to worst, ranges from 0-2. The child is penalized one point if the grasp is so loose that he/she can hardly hold the pencil. The penalty is two points if he/she is entirely unable to manipulate the pencil or if pressure is so hard that the page is torn.

5. Bender Visual Motor Gestalt Test (six cards)
"Here are some designs for you to copy. Just copy them the way you see them." See Jansky and deHirsch, 1972, pg. 151 for scoring instructions.

6. Wepman Test of Auditory Discrimination (odd numbered items)
"I am going to say two words. I want you to tell me whether I say the same word twice or whether I say two different words. Try this: Hand-Sand. Did I say the same word twice? You're right, I said two different words: Hand is not the same as sand. Now try this: Month-Month. You're right, I same the same word two times. Now listen to the words I'm going to say and tell me if they sound the same or different. Turn your chair around so you cannot see me. I want to see how well you can listen." The child's score, from 0-15 is the number of errors on dissimilar pairs (X-errors).

7. "Tell me the story of The Three Bears."
Count the total number of words used by the child to tell the story. Contractions of subject and predicate, like

"it's" and "we're" are counted as two words; contractions of the verb and the negative, such as "can't" are considered to be one word; each part of a verbal combination is taken as a separate word: thus "Have been playing" are three words; hyphenated and compound nouns, "oh, boy", "all right", and so forth are counted as one word. The total number of words used is the score.

8. "Boy" and "Train" re-exposed and studied.

9. Categories

"What are these things--Red-Green-Blue?" If the child does not respond correctly, continue: "I'll tell you about three other things: ball-doll-marbles. They are all toys. Now tell me what are Red-Green-Blue? What are Tom-Charley-Henry? And what are Apple-Hamburger-Icecream?" The score is from 0-3, the nnumber of categories missed.

10. Horst Reversals Test

The first row is used to demonstrate only, and is not scored. Since this test is difficult, it may prove necessary to provide considerable help. The examiner shields all but the first row and points to the model. "Tell me which one looks exactly like the one I have my finger on. Now you find another." If the child does not understand, the examiner says, pointing to the model, "You see, some of them are backwards, the others are the right way. Pick out those that look like the one I have my finger on." The shield is

removed after the second row has been attempted. The examiners need not hesitate to point to configurations to help the child keep his place. Assistance is provided as long as the child seems to benefit, but is discontinued if the task is clearly too difficult. A child's score, from 0-9, consists the number of rows in which errors are made in matching.

11. Gates Word-Matching

The first exercise is used for demonstration, and it is not scored. The examiner shields all but the first exercise saying, "There are two words in this box. Which look exactly alike. Can you find them? Take your pencil and draw a line between the ones that look the same. Now ycu do the next one by yourself." If The child fails to understand what is required, the examiner clarifies the task. The shield is removed after the child completes exercises 2 and 3. The number of mistakes, from 0-12, is the child's score.

12. Word Recognition I

"Remember the two words you learned to read? What were they? (If the child fails to remember, they are supplied). "I've put BOY and TRAIN in this pack with some other words. Point to BOY and TRAIN when you see them.

13. Word Recognition II

Expose the pack on the table in rows and ask the child tc pick out BOY and TRAIN. Scoring for both Word Recognitior I

and II is from 0-2 for the number of times the child fails to recognize the words.

14. Word Reproduction

The words BOY and TRAIN are again exposed and the child is asked to remember the way they look. The words are then removed and the examiner says "Now you write the words BOY and TRAIN the way you did when you first came." Score: Each word is scored from 0-3, according to the number of letters written down correctly. BOY 3--word spelled perfectly 2--two letters of the word reproduced 1--one letter reproduced 0--failure to recall any letter. TRAIN 3--word spelled perfectly 2--three or four letters of the word reproduced 1--one or two letters reproduced 0--failure to recall any letter The final score, from 0-6 is the sum of scores for each word. Letter reversals are not counted as errors. However, if letter order is confused, or if letters are added, one point is subtracted from the child's score.

APPENDIX II

CRITICAL SCORE LEVELS FOR THE KINDERGARTEN MODIFIED PREDICTIVE INDEX

The critical score levels given here represent the score required to "pass" each item. They were obtained from deHirsch et al. (1966) and were those that gave maximum differentiation between the children who failed in reading at the end of Grade II and the rest of the subjects. The value shown is the lowest a child could have scored and still have attained the critical score level.

TEST	SCORE RANGE	CRITICAL SCORE
Pencil Use	0-2	0 (expected level for age)
Bender Visual-Motor Gestalt Test	0-6	1 (at least 5 copied correctly)
Wepman Auditory Discrimination Test	0-11	1 X error
Number of Words in a Story	594-54	226 words
Categories	0-3	0 (all series correctly categorized)
Horst Reversals	0-9	4 (at least 5 rows correctly matched)
Gates Word Matching	0-12	3 (At least 9 words correctly paired)
Word Recognition I (pack)	0-2	0 (both words identified)
Word Recognition II (table)	0-2	0 (both words identified)
Word Reproduction	6-0	3 (See scoring system in Appendix VII)
Draw-A-Man Test	125-60	IQ score of 85 or better (Harris, 1963)
Name Printing		

HORST REVERSALS

OT TO OT OT TO OT TO

DE DE ED DE ED ED DE

RA AR AR RA RA AR AR

NU NU UN UN NU UN

POT TOP POT POT TOP

BAD BAD DAB DAB BAD

LES SEL LES LES SEL

PIK PIK KIP KIP PIK

SOF FOS SOF SOF FOS

MAN NAM MAN MAN NAM

These are presented in lower case handwriting.

GATES WORD MATCHING TEST

Child must find the matching pair among each set of four words. They are to be typed in large type in a box configuration.

baby tail goat baby
hat cow cow sun
dog ear dog box
see sea see say
shoe she show shoe
boy toy top toy
were were wee went
or ro on on
dig big did dig
dress draw draw drum
here hear her here
which where which white
tell bell bell fell
food foot took foot
chich child child chair

APPENDIX III

KINDERGARTEN TEACHER CHECKLIST

Child's Name
Birthdate

School
Teacher's Name

Check the category in which you would place the child. Try to use his or her age group as a reference group.

	BELOW AVERAGE	AVERAGE	ABOVE AVERAGE
1. Auditory Discrimination--ability to discriminate between words, speech sounds, etc.			
2. Listening comprehension--ability to understand concepts presented verbally.			
3. Comprehension--ability to understand concepts presented verbally with the aid of visual and/or concrete materials.			
4. Visual perception--ability to discriminate between letters, forms, shapes, etc.			
5. Quality of speech--articulation, voice quality, freedom from stuttering, etc.			
6. Quality of verbal expression--fluency, ease with which he/she selects words and sentence constructions to express ideas verbally.			
7. Quality of ideas expressed verbally.			
8. Skill at tasks requiring fine muscle coordination--using a pencil, scissors, etc.			
9. Ability to take part in a discussion without fidgeting, daydreaming, etc.			
10. Ability to work steadily at a task.			
11. Ability to follow instructions without constant supervision.			
12. Maturity in relations with peers.			
13. Ability to make inferences, draw conclusions, and to do original thinking.			

Do you feel this child is ready for Grade I?

Yes: No:

If no, explain recommended placement.

Do you see any of the following problems?

1. Specific learning difficulties (which areas?)
2. Emotional disturbance
3. General immaturity
4. Mental subnormality (e.g., slow learner, mildly retarded)

APPENDIX IV

GRADE I TEACHER CHECKLIST

Child's Name _____ School _____
Birthdate _____ Grade _____ Teacher's Name _____

Check the category in which you would place the child. Try to use his/her age group as a reference group. Please check each question.

	BELOW AVERAGE	AVERAGE	ABOVE AVERAGE
1. Auditory discrimination--ability to discriminate between words, speech sounds, etc.			
2. Listening comprehension--ability to understand concepts presented verbally.			
3. Comprehension--ability to understand concepts presented verbally with the aid of visual and/or concrete materials.			
4. Visual perception--ability to discriminate between letters, forms, shapes, etc.			
5. Quality of speech--articulation, voice quality, freedom from stuttering, etc.			
6. Quality of verbal expression--fluency ease with which he/she selects words and sentences construction to express ideas verbally.			
7. Quality of ideas expressed verbally.			
8. Skill at tasks requiring fine muscle coordination--using a pencil, scissors, etc.			
9. Ability to take part in a discussion without fidgeting, daydreaming, etc.			
10. Ability to work steadily at a task.			
11. Ability to follow instructions without constant supervision.			
12. Maturity in relations with peers.			
13. Ability to make inferences, draw conclusions, and do original thinking.			
14. Academic Achievements:			
Reading			
Writing			

Arithmetic
15. Progress in Art, Crafts.

Attendance; Absences during school year: Days Half Days

Recommended Placement for Sept. 1973:
Repeat Grade I
Grade II
Other (specify)

Do you see any of the following problems in this child?
1. Specific learning difficulties (indicate in which area)
2. Emotional disturbance
3. General immaturity
4. Mental subnormality (e.g., slow learner, mildly retarded)

Behavior problems (check where applicable):
1. Shy, fearful, withdrawn
2. Low frustration tolerance
3. Aggressive, destructive
4. Distractible, hyperactive
5. Short attention span
6. Disruptive, uncooperative
7. Other (please specify)
8. None

Special help child has received in school (check which):
1. Learning assistance (state area, e.g., reading, arithmetic, auditory training, visual perceptual or gross motor training).
2. Speech therapy
3. Other (please specify)

APPENDIX V

GRADE III TEACHER CHECKLIST

Child's name School
Birthdate Grade Teacher

Check the category in which you would place this child. Try to use his/her age group as a reference group. Please check each question.

	BELOW AVERAGE	AVERAGE	ABOVE AVERAGE
1. Auditory discrimination--ability to discriminate between words, speech, sounds.			
2. Listening comprehension--ability to understand concepts presented verbally.			
3. Quality of speech-articulation, voice quality, freedom from stuttering, etc.			
4. Quality of verbal expression, fluency ease with which he/she selects words and sentence construction to express ideas verbally.			
5. Quality of ideas expressed verbally.			
6. Quality of written work-lett formation, sizing, spacing, etc.			
7. Quality of written work-letter formation, sizing, spacing, etc.			
8. Correctness of written work-answers and quality of ideas expressed in writing or printing.			
9. Skill at tasks requiring fine muscle coordination, using pencil, scissors, etc.			
10. Skill at tasks requiring gross motor coordination--throwing, catching, running.			
11. Ability to take part in a discussion			

without fidgeting, daydreaming, etc.
12. Ability to work steadily at a task.
13. Ability to follow instructions without constant supervision.
14. Acceptance by peers.
15. Ability to make inferences, draw conclusions, and do original thinking.
16. Appropriateness of behavior in response to others--knows when to stop, recognizes non-verbal communication signals.

Check level at which child appears to be performing...
(This is not necessarily the level at which he is placed).

	Grade Two			Grade Three			Grade Four		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
Reading									
Arithmetic									
Spelling									
Printing/Writing									

	Grade Five			Grade Six			Grade Seven		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
Reading									
Arithmetic									
Spelling									
Printing/Writing									

Attendance: Days absent during the school year?

Recommended placement for September, 1975:
Repeat Grade III
Grade IV
Other (please specify)

Do you see any of the following problems in this child?
1. Specific learning difficulties. (Indicate in what area)
2. Emotional disturbance.

3. Mental subnormality (e.g., slow learner, mildly retarded)
4. Other (Please specify)

Behavior problems:

1. Shy, fearful, withdrawn.
2. Low frustration tolerance
3. Aggressive, destructive
4. Restless, hyperactive
5. Short attention span
6. Disruptive, uncooperative
7. Other (please specify)
8. None

Please check type of classroom:

1. Self-contained classroom: Number of children
   Number of teachers
   Number of aides
2. Open area classroom: Number of children
   Number of teachers
   Number of aides
3. Give age range in classroom: e.g., multi-age, multi-grade, family grouping, split class, etc.

Reading instruction:

1. Individualized instruction
2. Grouping (give number in group)
3. Both of the above
4. Approximate numbers of hour each week spent in reading instruction.

Does this child attend the learning assistance centre?

1. If yes, for what kind of help?
2. How many hours per day/week?

1. Is this child in a special education class?
2. If yes, please specify type.

APPENDIX VI

GRADE VII TEACHER CHECKLIST

Child's Name School
Birthdate Teacher Grade

Check the category in which you would place this child. try to use his/her age group as a reference. Please check each question.

very much below average	somewhat below average	average	somewhat above average	very much above ave.
1	2	3	4	5

1. Listening comprehension--ability to understand concepts presented verbally.
   1 2 3 4 5
2. Quality of speech-articulation, voice quailty, freedom from stuttering, etc.
   1 2 3 4 5
3. Quality of verbal expression--fluency, ease with which he/she selects words and sentence construction to express ideas verbally.
   1 2 3 4 5
4. Quality of ideas expressed verbally.
   1 2 3 4 5
5. Quality of written work--letter formation, sizing, spacing.
   1 2 3 4 5
6. Quality of written expression--selection of words, sentence construction, etc.
   1 2 3 4 5
7. Correctness of written work--answers and quality of ideas expressed in writing or printing.
   1 2 3 4 5
8. Ability to take part in a discussion without fidgeting, daydreaming etc.
   1 2 3 4 5
9. Ability to work steadily at a task.
   1 2 3 4 5
10. Ability to follow instructions without constant supervision.
    1 2 3 4 5
11. Acceptance by peers.
    1 2 3 4 5
12. Ability to make inferences, draw conclusions and do original thinking.
    1 2 3 4 5
13. appropriateness of behavior in response to others--knows when

to stop, recognizes non-verbal communication signals.
1 2 3 4 5

Check the grade level at which the child appears to be performing in each of the following areas:

	GRADE LEVEL						
	below 4	4	5	6	7	8	9 above 9
Reading							
Arithmetic							
Composition							
Handwriting							
Social Studies							
Other							

Do you see any of the following problems in this child? If so please elaborate.

1. Specific learning difficulties
2. Emotional disturbance
3. Mental subnormality (e.g., slow learner, mildly retarded)
4. Other (please specify)

Do you see any of the following behavior problems in this child?

1. shy, fearful, withdrawn
2. low frustration tolerance
3. aggressive, destructive
4. restless, hyperactive
5. short attention span, distractible
6. disruptive, uncooperative
7. other (please specify)

Does this child receive any extra help in school in the form of learning assistance, private tutoring, etc? If yes, please specify the type of help, number of hours per week or day, and how long it has been going on.

ACHIEVEMENT TEST RESULTS
Name of test
Dates Given
Subject and form
Results

OTHER TESTS
Name of test
Date Given
Results

Grades or marks on the most recent report card;

SUBJECT	MARK	SUBJECT	MARK
Oral reading		French	
Silent reading		Handwriting	
Language		Health	
Social Studies		Music	
Literature		Art and Handwork	
Spelling		Physical Education	
Arithmetic		Other	

Conduct Items	No Problem	Mild Problem	Real Problem
Restlessness			
Level of Concentration			
Daydreaming			
Peer Relationships			
Motivation			
Aggression			
Deliquent Behavior			
General approach to Work			

Any further comments about this child would be appreciated.
Thank you.

APPENDIX VII

BEHAVIOR RATING SCALE

MOTOR PERFORMANCE		
Gross	average	clumsy
Fine	average	poor
LANGUAGE AND SPEECH		
Articulation	average	below
Sentence Pattern	average	below
Vocabulary	average	below
Comprehension	average	below
EMOTIONAL/SOCIAL BEHAVIOR		
Lability	present	absent
Adaptability	adaptable	rigid
Ability to relate	average	withdrawn
Attention Span	adequate	short
Frustration tolerance	adequate	low
Impulsiveness	average	overly impulsive

APPENDIX VIII

PARENT CHECKLIST

Child's Name
Birthdate School Grade.

FAMILY BACKGROUND

1. Does child live with both natural parents, mother only, father only?
2. Does child have a step parent? Mother? Father?
3. If a divorce or separation has occurred since 1973, please give date.
4. Have any sisters or brothers been born, left home or acquired as step-siblings?
5. Give age of all children now living in the family, including study child.

Name	Age	Sex

6. Mother's present educational level
   Occupation?
7. Father's present educational level
   Occupation?

SCHOOL HISTORY

8. Please give grade, name of school, whether a grade was repeated or special help was given.

Grade	School	Comment
preschool		
Kindergarten		
1		
2		
3		
4		
5		
6		
7		

9. Does your child have difficult with any of the following subjects:

	Serious Difficulty	A Little	None
Reading			
Spelling			
Composition			
Handwriting			
Arithmetic			
Social Studies			
French			
Other			

10. Does your child participate in any of the following activities? (Give details.)

Sports

School clubs

Guides or Scouts

Music, drama, art

Church/other

11. How does your child feel about school?

Hates it
Dislikes it quite a bit
Dislikes it slightly more than average
Likes it slightly more than average
Really likes it
Loves it

12. Has he/she had any accidents, injuries or hospitalizations since Grade I? Please give details and date.

13. Have you seen any kind of specialist for your child, such as a psychiatrist, social worker, psychologist, speech therapist, etc.? If yes, give date and details.

14. Has your child been on any medication or prescription drugs? What drug, when, for how long, dosage and for what condition?

15. Apart from school or organized activities, how does your child spend his/her spare time?

16. How much time per week does your child spend watching TV?
Less than 10 hours per week
10-15 hours
16-22 hours
More than 22 hours per week

17. Have you ever belonged to an organization concerned with helping children? If yes, give organization name and dates.

18. Do you think your child is (circle one)
Miserable and unhappy
Unhappy much of the time?
Somewhat unhappy?
Slightly happier than average?
Very Happy?
Extremely happy?

19. Which of the following applies to your child? (circle one)
Easy to live with?
Difficult to live with?
Slow to warm up to anything new?
Cannot put into only one category.

Compared to children his/her age, how does your child rate on the following?: (Circle the number that applies)

HOW OFTEN DOES YOUR CHILD:

20. Get into fights or arguments with others?

6	5	4	3	2	1
constantly	quite	slightly	slightly	quite	rarely

	a bit more	more than average	less than average	a bit less	or never
21. Get mad, have tantrums or sulk?	6	5	4	3	2	1
22. Do cruel or mean things to others?	6	5	4	3	2	1
23. Have difficulty going to sleep?	6	5	4	3	2	1
24. Whine and complain?	6	5	4	3	2	1
25. Show off or try to be the center of attention?	6	5	4	3	2	1
26. Shift or change activities, jumping from one thing to another?	6	5	4	3	2	1
27. Get hurt feelings?	6	5	4	3	2	1

TO WHAT EXTENT IS YOUR CHILD/

	extreme amount of this trait	quite a bit more than average	slightly more than average	slightly less than average	quite a bit less than average	rarely or never shows this
28. Bossy or domineering?	6	5	4	3	2	1
29. Afraid of persons, places or things?	6	5	4	3	2	1
30. Active, lively, energetic?	6	5	4	3	2	1
31. Tense, jittery, fidgety or high strung?	6	5	4	3	2	1
32. Impulsive, jumps into things without thinking?	6	5	4	3	2	1
33. Stubborn or set in his/her ways?	6	5	4	3	2	1
34. Disobedient or non-conforming?	6	5	4	3	2	1
35. Destructive, breaking or destroying property?	6	5	4	3	2	1
36. Forgetful or absent-minded?	6	5	4	3	2	1
37. Demonstrative, shows affection readily?	6	5	4	3	2	1
38. Negativistic or contrary?	6	5	4	3	2	1
39. Moody, or has rapid mood swings?	6	5	4	3	2	1
40. Responsible, takes care of things or people?	6	5	4	3	2	1

41. How bashful, shy or retiring is your child?

6	5	4	3	2	1
very bold	quite a bit less than average	slightly less than average	slightly shyer than average	quite bashful	estremely shy

42. How easily does you child make or keep friends?

6	5	4	3	2	1
has no friends	very few friends	slightly fewer than average	slightly more than average	many friends	very many friends

43. How well coordinated physically is your child?

6	5	4	3	2	1
extremely awkward	quite awkward	slightly more awkward than ave.	slightly less awkward than ave.	quite well coordinated	very well coordinated

44. If your child showed some of these traits in the past, in what areas have you seen improvement, and when?

Thank you! If you have any additional comments please add them here.

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