THE PSYCHOMETRIC VERSUS THE BASIC SKILLS MODEL OF LITERACY AND NUMERACY: COMPETING OR COMPLEMENTARY APPROACHES?

ROSS W. NEWHOOK

THE PSYCHOMETRIC VERSUS THE BASIC SKILLS MODEL OF LITERACY AND NUMERACY: COMPETING OR COMPLEMENTARY APPROACHES?

by

Ross W. Newhook

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Department of Educational Psychology
Memorial University of Newfoundland

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To Jim and Moe for their patience and support. To my parents who believed in me when others doubted. I dedicate this work to their memory.

Abstract

This study examines the relative and confounding effects of the psychometric and the basic skills models of achievement on literacy and numeracy. Specifically, it addresses six questions. First, how responsive are the psychometric and basic skills factors to changes in family environment? Secondly, does family environment affect basic skills achievement over and above the effects of the psychometric model? Thirdly, when controlling for the impact of the psychometric and basic skills measurement models on reading, does family background have any effect? Fourthly, does family background have effects on mathematics achievement over and above the effects of the psychometric and basic skills models? Fifthly, does the psychometric model have independent effects on literacy and numeracy over and above the effects of family background and basic skills? Finally, does the basic skills model have independent effects on literacy and numeracy over and above the effects of the family background and psychometric models?

All data for this study were obtained from The Structure of Elementary School Achievement (SESA) Project. Only relevant information was used. These data have been collected from eight schools located in urban and rural areas of the province. Students completed standardized academic aptitude and achievement tests over a three year period. The parents also

completed a questionnaire.

Principal component analysis was conducted as an aid to describing the psychometric properties of the instrument. Path analysis was conducted using the results from a multiple regression analysis wherein the effects of each variable was examined in light of and individually from the other predictor variables. The alpha reliabilities and construct validities of the measures fell well within acceptable ranges.

On the basis of the data analysis it was found that by themselves neither academic aptitude nor basic skills accounts for a comprehensive theory of literacy and numeracy. It was also found that while the direct effects of socioeconomic status on achievement was negligible, the indirect effect via academic aptitude and basic skills, was quite powerful. In other words, children from advantaged homes tend to achieve at a higher level than individuals from less privileged backgrounds. Results further show that a family's socioeconomic status does affect basic skills achievement beyond the effects of academic aptitude and socioeconomic status governs academic aptitude and basic skills which, in turn, affects both literacy and numeracy. Also, the direct effect of the psychometric model on math, when controlling for socioeconomic status and basic skills, is powerful. Similar results have been found for reading. A final result of the data analysis shows that the direct effect of basic skills on math and reading, when controlling for socioeconomic status and

academic aptitude, is powerful.

It would appear that while the basic skills an individual acquires as a result of schooling are quite powerful, they are in fact governed to a great extent by one's academic potential. Also, there appears to be a great deal that schools can do to compensate for a deprived socioeconomic background. There is little doubt that the psychometric and basic skills models are certainly complementary. To develop an accurate profile of an individual's learning style, it is necessary to take all three of socioeconomic status, academic potential and basic skills factors into account.

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CHAPTER I

The Problem

Introduction

Since formal education began there has been a controversy as to whether academic aptitude or whether basic skills acquired as a result of schooling, most strongly accounts for literacy and numeracy. While other factors certainly play a role within the educational process, few would disagree that academic aptitude and basic skills account for academic success measured as literacy and numeracy. This study will examine both of these concepts to determine whether they are in fact competing or complementary theories of achievement.

The concepts described here are best represented through the use of models which can be regarded as formal or operationalized theories expressed mathematically. The three models discussed within this study are the socioeconomic model, the psychometric model (academic aptitude or cognitive ability), and the basic skills model of school achievement. In its simplest form the psychometric model of literacy and numeracy is one in which X_3 (reading) and X_4 (mathematics) are expected to be responsive to x_1 (academic aptitude). These relationships are depicted in Figure 1.1.

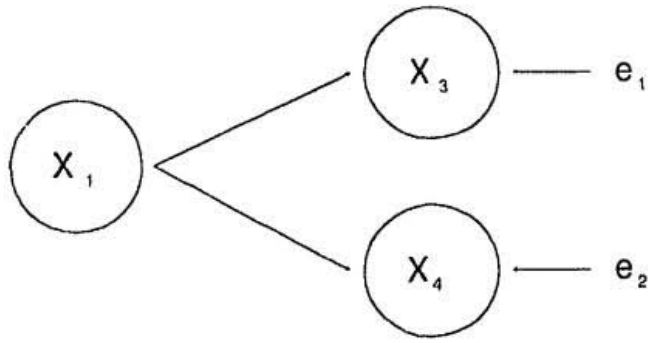


Figure 1.1 Psychometric Model of Literacy and Numeracy

where X_1 = academic aptitude
X_3 = reading comprehension
X_4 = math achievement
e_1 and e_2 = residual terms

Paralleling the psychometric model is the basic skills model as exemplified by such instruments as the Iowa Tests of Basic Skills or, in Canada, its equivalent, the Canadian Tests of Basic Skills. Thus, according to the basic skills model, X_3 and X_4 are responsive to x_2 (basic skills) as depicted in Figure 1.2.

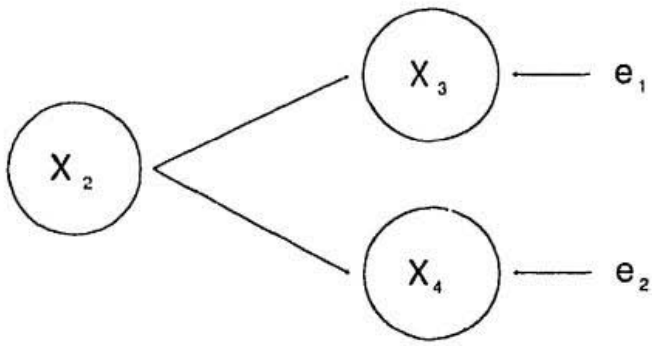


Figure 1.2 Basic Skills Model of Literacy and Numeracy

where X_2 = basic skills
X_3 = reading comprehension
X_4 = mathematics achievement
e_1 and e_2 = residual terms

In equation form the two models are captured as follows:

$$X_3 = a_1 + b_1 x_1 + e_1 \quad (1)$$

$$X_4 = a_2 + b_2 x_1 + e_2 \quad (2)$$

$$X_3 = a_3 + b_3 x_2 + e_3 \quad (3)$$

$$X_4 = a_4 + b_4 x_3 + e_4 \quad (4)$$

By definition, however, the psychometric model is logically prior to the basic skills model. The psychometric model is a model of potential achievement; where as the basic skills model is a model of actual achievement or current knowledge. It follows, therefore, that while potential achievement is designed to be a predictor of actual achievement, actual achievement can only be regarded as a proxy for potential achievement, not as a predictor of it. If this view of the relationship between potential and actual achievement is accepted then the competing versus complementary theories model will be one in which the measure of potential achievement is depicted as being logically prior to actual achievement. See Figure 1.3.

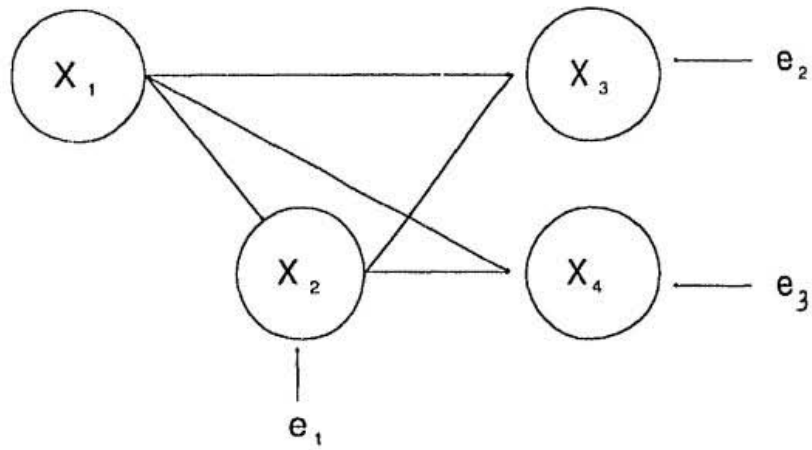


Figure 1.3 A Competing Theories Model of Literacy and Numeracy

where x_1 = aptitude
x_2 = basic skills
x_3 = reading
x_4 = mathematics
e_1 - e_3 = residuals

The relationships in Figure 1.3 may be captured by the following equations:

$$x_2 = a_1 + b_{21}\, x_1 + e_1 \quad (5)$$

$$X_3 = a_2 + b_{31}\, x_1 + b_{32}\, x_2 + e_2 \quad (6)$$

$$X_4 = a_3 + b_{41}\, x_1 + b_{42}\, x_2 + e_3 \quad (7)$$

Few explanations in education are as simple as suggested in the above discussion of the competing theories approach to literacy and numeracy. First, potentially confounding variables have to be considered. These are sometimes equally important theories. One such theory focuses on the family environment. The family environment argument holds that a

family's social structure is dependent on the observed abilities or competencies of the parents and that these abilities govern the intellectual configuration of the home. This intellectual configuration, in turn, will govern the child's opportunity to learn, thereby influencing literacy and numeracy acquisition over and above either aptitude or achievement.

While such a model is easy to formalize as shown in Figure 1.4 with its related equations, it is not an easy one to test as it calls for the achievement testing of parents. Nevertheless it is possible to use a proxy in the form of family socioeconomic status in an attempt to approximate the contribution to a child's literacy and numeracy of parent's ability. This is the route followed in this thesis and is depicted in Figure 1.5. First we have the more elaborate model as shown in Figure 1.4. Note that it is necessary to change the notation in order to handle a model of greater complexity.

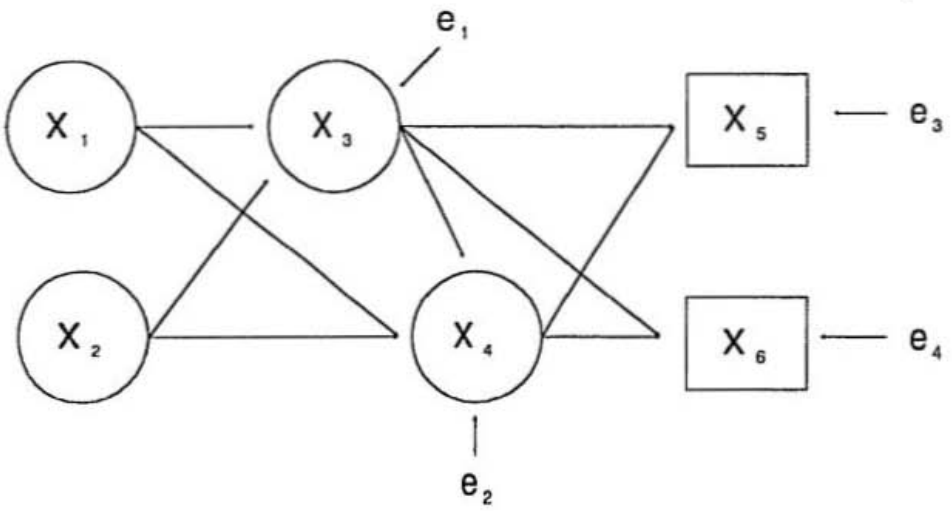


Figure 1.4 A Model Depicting the Intergenerational Transmission of Ability.

where
X_1 = father's ability
X_2 = mother's ability
X_3 = child's aptitude
X_4 = child's achievement
X_5 = child's current reading competency
X_6 = child's current mathematical proficiency
e_1 - e_4 = residual terms

Variables in circles are unobserved latent constructs, while variables in rectangles are observed.

The model specification in Figure 1.4 assumes that parental abilities will operate indirectly on literacy and numeracy via aptitude and achievement, and not directly. Note, too, that reading and mathematics are assumed to be acceptable proxy variables standing for literacy and numeracy respectively. The equations are:

$$x_3 = a_1 + b_{31} x_1 + b_{32} x_2 + e_1 \qquad (8)$$

$$x_4 = a_2 + b_{41} x_1 + b_{42} x_2 + b_{43} x_3 + e_2 \quad (9)$$

$$x_5 = a_3 + b_{53} x_3 + b_{54} x_4 + e_3 \quad (10)$$

$$x_6 = a_4 + b_{63} x_3 + b_{64} x_4 + e_4 \quad (11)$$

As noted above because parental abilities are not easy to measure--parents are not disposed to being tested--the best proxy available; namely, a measure of socioeconomic status of the family, is used instead. This model is depicted in Figure 1.5.

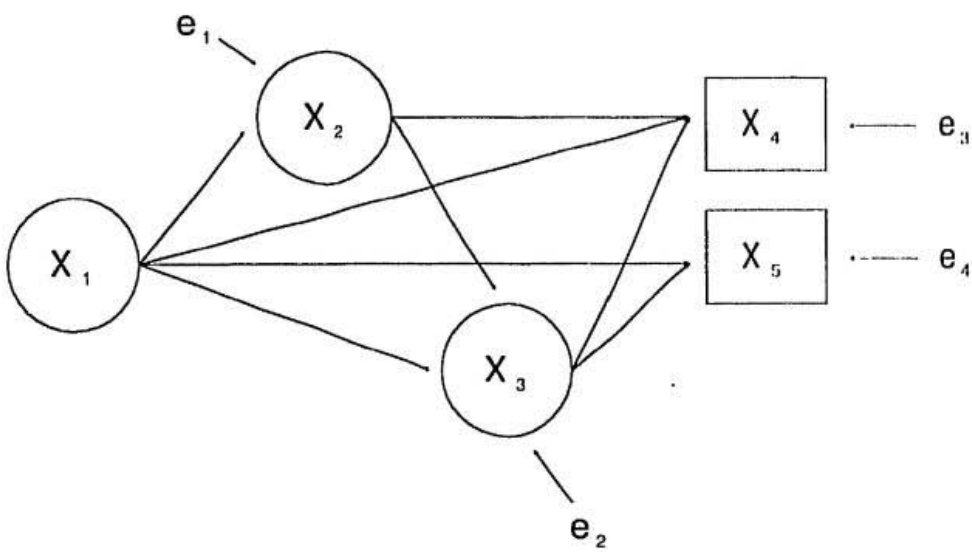


Figure 1.5 A Competing Theories Model of Literacy and Numeracy

where x_1 = family socioeconomic status
x_2 = academic aptitude
x_3 = achievement
x_4 = reading
x_5 = mathematics

Figure 1.5 equations are:

$$x_2 = a_1 + b_{21} x_1 + e_1 \quad (12)$$

$$x_3 = a_2 + b_{31} x_1 + b_{32} x_2 + e_2 \quad (13)$$

$$x_4 = a_3 + b_{41} x_1 + b_{42} x_2 + b_{43} x_3 + e_3 \quad (14)$$

$$x_5 = a_4 + b_{51} x_1 + b_{52} x_2 + b_{53} x_3 + e_4 \quad (15)$$

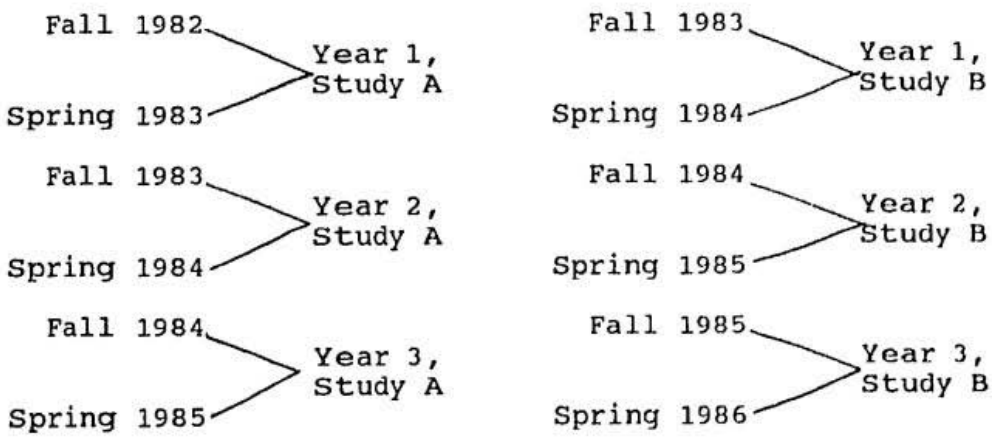
Estimation of equations 12 through 15 will generate the findings necessary to clarify whether these three theories of literacy and numeracy competency--the family environment theory, the psychometric theory and the basic skills theory--are competing theories or complementary theories. Suppose the direct and indirect effects of x_1 (social status) on x_4 (reading) were substantial and statistically significant, but that the parallel effects on x_5 (mathematics) were negligible, it would not be unreasonable to argue, given the specification of equations 12-15, that literacy was more responsive to family background factors than numeracy. In other words, while the effects of family environment on literacy acquisition was powerful over and above the effects of aptitude and achievement, such was not the case with numeracy. In effect, mathematics (or numeracy) in this instance would be largely unresponsive to family background compared to reading (or literacy).

Unfortunately, while it is easy to formulate competing theories models as sets of equations, it is far from easy to gather the data and construct accurate measures of the model

constructs. Nevertheless, in its simplest form this thesis is concerned with the kind of relationships depicted in Figure 1.5; hence, with the estimation of equations similar to equations 12-15.

Background to the Problem

Data for the current project came from the Structure of Elementary School Achievement (SESA) Project--a four year study conducted by Mr. Jeffrey Bulcock of the Institute for Educational Research and Development, Memorial University of Newfoundland (1982-1986). The SESA Project followed children from the beginning of Grade 2 to the end of Grade 4. Two overlapping 3 year studies, with a one year lag, allowed validation of the first study. That is, Study A began in 1982 and the children were followed up through the next three grades.



Study B began in 1983--a year later--and also continued for three years. Study A was completed in the Spring of 1985, Study B was completed a year later, 1986. The idea was that the literacy-numeracy models for each study would be the same in terms of specification. If the parameters for the Study A models were the same as those for the parallel Study B models, then the models would be validated. If model A/model B comparisons were different then the validations effort would be a failure. This however; is not a concern of the current thesis which used merged Study A and Study B data.

The total number of children to participate in the study was 328--217 in the main study and 111 in the validation study. The researchers were interested in identifying the information processing strategies and those elements of the social learning environment which provides learners with the tools needed for achievement in elementary school.

The SESA project had a data base, gathered by questionnaires and formal assessment, which was designed to address several issues of which the current thesis was one. Each family's socioeconomic status (SES) level was determined by using the information from questionnaires which had been sent to the parents of each of the 328 children in the study. Academic aptitude and basic skills scores were identified by the Canadian Cognitive Abilities Test and the Canadian Tests of Basic Skills, respectively.

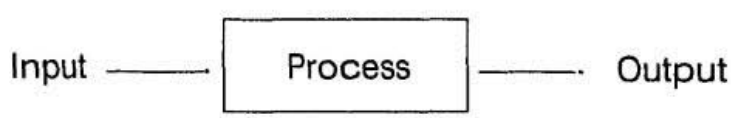
Purpose of the Study

The purpose of the present study was to examine the extent to which the psychometric model of literacy and numeracy accounted for the reading and mathematics performances of children when controlling for the confounding effects of both the basic skills or current knowledge of children and their socioeconomic background. By the same token, the study was designed to measure the obverse of this; namely, to what extent the basic skills model of literacy and numeracy accounted for the reading and mathematics performances of children when controlling for the potentially confounding effects of both the psychometric model and the socioeconomic model.

The present study, therefore, focused on two models of school achievement--the psychometric model and the basic skills model. Its primary purpose was to discover which of the two theories had the greatest influence on literacy and numeracy in the early grades. It poses the following questions: (a) Are the models competing explanations? That is, in the presence of one is the explanatory value of the other attenuated? or (b) Are the models complementary explanations? That is, are both models necessary in order to obtain a clear picture of what accounts for variability in literacy and numeracy? The findings of such a study have relevance for the current debate over the validity of generic tests compared to achievement tests as educational indicators of school

achievement. This writer also believes that the study has important implications for the establishment of a national educational indicators system. Such a system must address questions about how well students perform in various subject areas; how well such achievements can be predicted; and the extent to which predictor variables can be policy manipulable. At present there is a movement among countries, provinces and states to establish measures of literacy and numeracy outcomes and to establish national standards for student achievement. These projects are designed to construct school performance indicators.

Performance indicators take many forms and are most often used within the educational system for accountability purposes. The educational system levels most commonly compared include the school, the school district, the province and the nation i.e. schools are compared within districts, districts within provinces, provinces within Canada, and Canada is compared to reference group nations such as the United States of America, Britan or Australia. A measure of the outcome of performance is usually the desired end with the three stages of performance assessment being inputs, processes and outcomes. This system may be represented visually by the following model:



A primary requirement of any system of accountability is that the appropriate indicators of performance be identified and available for assessment. These indicators must be relevant, reliable and valid: that is, they must accurately measure some real aspect of performance, and for each of the main categories it must be determined what indicators meet these criteria. Specifically the purposes of this study are to provide answers to the following research questions:

1. How responsive are the psychometric and basic skills factors to changes in family environments?

2. Does family environment affect basic skills achievement over and above the effects of scholastic aptitude?

3. When controlling for the impact of the psychometric and basic skills measurement models on reading does family background have any effect?

4. Does family background have effects on mathematics achievement over and above the effects of psychometric and basic skills measurement models?

5. Does the psychometric model have independent effects on literacy and numeracy over and above the effects of family background and basic skills?

6. Does the basic skills model have independent effects on literacy and numeracy over and above the effects of the family background and psychometric models?

Significance of the Study

The current study has significance to parents, educators, policy-makers and all others interested in the field of education. It is both timely and relevant in that perhaps at no other time in the history of education, has there been a greater emphasis on the quality of education being offered and the accountability issue (Psacharopolous & Velez, 1993). Parents and educators are questioning the methods currently being used, particularly in light of the massive amounts of money being poured into the education system and the relatively poor return, in measurable literacy and numeracy. For example, The Globe and Mail (January 4, 1993) reports that, in constant 1989 dollars, the cost per student of education in Canada's primary and secondary schools rose from less than $2,000 in 1960 to $5,000 in 1990. As well, the student/teacher ratio fell from 25.6 to 15.6. One would assume that these statistics would show a positive correlation between investment and return over time; instead, composite scores on standardized achievement tests have fallen to approximately 90% of what they were in 1960. Many parents and educators are questioning why this phenomenon has occurred. Many blame changes in curriculum policy. One such change has been the shift from a basic skills approach to a whole language approach to the promotion of literacy and numeracy.

Today, with the emphasis on whole language, some schools choose to discard the teaching of phonics and spelling,

otherwise known as basic skills, in favour of a more holistic approach to learning. This transition has lead to questions regarding the standardization and quality of education being offered to students. Today we introduce children to environments and themes around which we structure learning. It is believed that such an enriched environment will allow even the most disadvantaged individuals to realize their full academic potential. Classrooms have been converted, for example, to simulate farms and other environments; students become immersed in the "farm experience" which is incorporated into all subject areas. While many of these children may end up knowing something about farming, one sometimes wonders about their acquisition of reading and mathematics skills.

With the whole language approach the student's, or the group's, own words and compositions are used as the material of instruction for reading, writing, spelling, speaking and listening. It claims to be the bridge between the child's oral language on the one hand and reading and writing on the other. The problem with this approach is that until the child has reached a threshold level of oracy, reading and writing acquisition will be difficult. This is especially the case in rural Newfoundland. Research has found that many of these students come to school deficient (about one standard deviation or 1.3 years behind their mainland counterparts) in vocabulary and language usage development.

Maclean's Magazine devoted the bulk of its January 11,

1993 edition to the question of why many parents are giving failing grades to their children's teachers. Many parents appear to be displeased with their province's approach to literacy and numeracy. Groups such as Parents In Action, (Ontario); Parents for Basics, (Manitoba); and PARENT, (Nova Scotia) are lobbying for a back-to-basics educational reform while other groups are seeking funding for back-to-basics private schools. This sort of breakaway philosophy has recently taken hold within Newfoundland as this province is about to open its third privately funded school. Canadian businesses are also requesting that reading, writing, and computational skills be given higher priority so that graduates will be able to compete in high-tech industries. Many teachers, as well, appear to be less than satisfied with the trend towards a whole language approach. They claim that standards must be lowered because of political and bureaucratic pressure to keep students in school, and as a result schools have no choice but to advance children with a poor grounding in the basics. Because of its lack of standards and accurate achievement measures the whole language approach allows for this type of advancement.

Another major point to be made with regard to the above discussion is that traditional methods have been used to assess the achievement levels of students. That is, instruments are used which were designed to assess achievement via basic skills and as a result may not present an accurate

profile of the individual's actual achievement level obtained via a whole language approach. In other words, even though the content and methods of delivery of education have changed, the standards by which we measure students' attainment levels have not. Standardized testing methods must be developed which account for the shift in methodology from basic skills to whole language as well as to take other confounding factors into account. Results of these standardized measures will empower parents to make schools more accountable for the quality of education they offer but in order to do this it must be determined what it is, exactly, that these tests measure. To that end, this study examines several performance indicators and their relative impact upon literacy and numeracy. The results of this study will present educators and policy-makers with the information necessary to decide which types of instruments best suit their particular needs.

Another area of significance for the current study lies with the streaming of students. Children are frequently placed in grades or classrooms based upon their performance on standardized tests of achievement. The underlying assumption is that teachers are doing an adequate job of information dissemination and effectively teaching the skills. It may be the teacher's devotion to ineffective practices, however, that account for the lack of academic success of a portion of the students, rather than the inherent limitations of the children themselves. In other words, even though a child's academic

potential is adequate, methods to measure that aptitude may be based upon the acquisition of basic skills; consequently, a low academic achievement score, as assessed by a standardized test, may be no more than a proxy for basic skills and prove only that the school has failed to educate. More comprehensive and accurate measurement instruments must be incorporated into any efficient assessment program.

With the current emphasis on accountability, informal assessment has given way to more formal evaluation of children. This transition has not however, gone without criticism. Teachers and teachers' organizations often object to the use of standardized tests as national indicators of achievement because they claim that such instruments ignore the social, economic and linguistic differences between individuals and provinces. Because of these claims educators and policy-makers seek efficient methods with which to evaluate students' potential and actual achievement while taking socio-economic factors into account.

This quest for the perfect assessment instrument has also reopened questions as to the validity and reliability of various measures. Some of these questions include: What exactly do academic aptitude and achievement tests measure? How do these tests differ? In what respects are they the same? Are these measures valuable only to policy makers? What practical use can measures of aptitude and achievement have for the student?

This study will examine the competing theories issue as it relates to academic achievement. While controlling for socio-economic factors, it will examine the relative impact upon literacy and numeracy of the generic learning ability of the individual in relation to the basic skills acquired as a result of schooling. From this study it is hoped that answers may be generated to the above questions.

Definition of Terms

Several of the variables used in this research have meanings particular to this study. So that the reader will have an accurate understanding of the meanings as they apply to the current study, definitions are offered below.

Socioeconomic Status (SES): Socioeconomic status is an exogenous variable constructed from father's occupation, father's education, mother's education, and total number of children in the family. This latent construct was subjected to a principal component analysis, retaining as appropriate measures only those items with appropriate content and factor loadings greater than .50. The total number of children in the family was dropped from the composite. The total SES score is a weighted additive composite of the three indicators of the construct.

Academic Aptitude: The academic aptitude composite was formed using the twelve subtests of the Canadian Cognitive Ability Test. This test has been validated and reliability

scores have been determined. The reliability of this test in the present study was found to be .93. This test battery measures an individual's cognitive ability on verbal tasks, quantitative tasks and nonverbal tasks. The CCAT is a broad-based test designed to measure scholarly potential in three broad areas--verbal, numerical/quantitative, and perceptual ability. Other terms used within this thesis which imply the same meaning as academic aptitude are: the psychometric model of achievement; aptitude test; potential for achievement; generic aptitude; and cognitive ability.

Basic Skills: The basic skills composite was obtained from the Canadian Tests of Basic Skills. These tests consist of eleven subtests which measure academic achievement. These include Reading Comprehension, Vocabulary, Spelling, Capitalization, Punctuation, Language Usage and Expression, Map Reading, Reference Materials, Mathematical Concepts, Mathematical Problem Solving and Mathematical Computation. These subtests can be grouped into five major areas. These include Vocabulary, Reading Comprehension, Language Skills, Mathematical Skills, and Work Study Skills. The basic skills model consists of a more specific set of tests than the CCAT. Each subtest is a skill area deemed to be essential for the learning of other school subjects. The numbering of the tests is such that clarification needs to be made. The number at the end of each test does not necessarily signify the grade level at which the student is enrolled. For example: SPELL1 is the

Spelling subtest which is given at the beginning of grade two; SPELL2 is the subtest given at the end of grade two; SPELL3 is the subtest given at the beginning of grade three; SPELL4 is the subtest given at the end of grade three; SPELL5 is the subtest given at the beginning of grade four; and SPELL6 is the subtest given at the end of grade four. Other terms used within this thesis which refer to the basic skills model are: achievement tests; current knowledge; background knowledge; test of basic skills; and achievement.

Literacy: Literacy was measured at the end of grade four using the Reading Comprehension subtest of the Canadian Tests of Basic Skills (Grade 5). CTBS 5 were used because, theoretically, children at the end of grade four should be reading at approximately a grade five level.

Numeracy: Numeracy was measured using the Math Concepts and Math Problem Solving subtests of the Canadian Tests of Basic Skills.

Assumptions

The assumptions of this investigation are as follows:

1. Cognitive ability is a latent construct which can be measured.

2. Socioeconomic status, scholastic aptitude and the acquisition of basic skills account for most of academic achievement.

3. Parents and students were candid when completing questionnaires.

Limitations

As with all studies, the current project is faced with several limitations. They are as follows:

1. Literacy, as used here accounts for only reading and does not attempt to incorporate the writing component; therefore, no conclusions regarding the writing literacy of individuals can be reached.

2. This study is concerned with the product of reading rather than the reading process. It looks at the level of reading accomplishment rather than the strategies used; however, to do so, process must be taken into account. While the author realizes the importance of strategies, it is beyond the scope of this thesis to examine the reading process in detail. Because of this limitation the project does not attempt to make observations and conclusions about the reading process.

3. Mathematical models such as the ones formulated and estimated in this thesis are stochastic, not deterministic. The best the analyst can do is to identify the most important systematic components in an equation, thereby minimizing the host of non-systematic or random influences. The stochastic disturbance terms in these models are indicators of the extent

of the errors of observation, specification errors and irreproducible system noise. Obviously, the set of equations constituting a model are not "realistic". Models are unreal by definition. The purpose of the mathematical model is not to mirror reality; but, rather to reduce the features of reality to a form which is manageable for the purposes of prediction and control. If prediction is impossible there is no knowledge.

4. Research designs always involve compromise: compromise between what is desirable and what is possible. In theory, the completely randomized experimental design is the ideal. In educational settings such designs, though desirable, are seldom possible. In such an event researchers have to choose confounding factors or control variables in order to exclude (or minimize) all the potential disturbing external influences. This is why in this study when focusing on the impact of the psychometric model, the potential confounding effects of the socioeconomic environment and basic skills models are controlled. In this way, the effect of the psychometric model on the literacy and numeracy outcomes can be examined uninfluenced by the disturbing influences of confounding variables. Even so, it is not possible to control for all potentially confounding variables, just the more important ones. That is what was attempted in the present study; but, it is recognized that some unknown, but poten-

tially confounding variables, were erroneously omitted from the model specification.

Organization of the Study

This chapter provided the background to the study. It introduced the problem, outlined its purpose, identified the central questions, defined terms, stated the underlying assumptions, summarized its limitations and stated the significance of the study.

Chapter II reviews the related literature and presents a conceptual framework for the study. It examines research into the effect of socioeconomic status as well as the psychometric and basic skills approaches to literacy and numeracy. It then uses various integrated models which incorporate the above mentioned factors. This chapter ends with a list of hypotheses which this study will address.

Chapter III provides details of the methodology used for the study. It examines the instruments used and relates how data were collected and analyzed.

Chapter IV analyses the measurement models, provides descriptive statistics and summarizes the findings of the study.

Chapter V offers the conclusions of the study. It examines problems and procedures, summarizes the findings, draws conclusions, makes implications and finally provides recommendations for further research.

CHAPTER II

Review of Related Literature and the Theoretical Model

This chapter is divided into two sections. The first section deals with the independent variables used within this study, namely; socioeconomic status, academic aptitude, and basic skills and their direct and indirect effects upon literacy and numeracy. The relationships between these variables are also examined. The second section presents an overview of the theoretical model derived from this literature. That is, a model is developed that reflects the major research findings regarding socioeconomic status, academic aptitude, and basic skills acquired as a result of schooling and their effects on academic achievement. This model is then used as a basis for the analyses presented in Chapter IV.

Review of the Related Literature

This section reviews the related literature and is divided into three subsections. The subsections are identified as socioeconomic status, academic aptitude, and basic skills. Within each subsection, the relationship of the independent variable to the dependent variables is discussed. The independent variables are socioeconomic status, academic aptitude,

and basic skills. The dependent variables are literacy and numeracy.

This review proved problematic in that there were no studies which dealt with a model such as the one presented within this study. While there is a wealth of information available on each of the components of the model, none exists which combines more than a few of the variables.

The Socioeconomic Status Model of Literacy and Numeracy

The socioeconomic model of literacy and numeracy examines the impact of childrens' home environments upon their academic achievement. Because this study uses father's education, mother's education, father's occupation and number of children in the family as the indicators of a socioeconomic composite, the review will concentrate on these variables. This portion of the review identifies the major influences of the home upon literacy and numeracy--the two variables by which academic achievement is most often judged.

Specific factors of the home environment which may influence a student's academic performance include: the education level of the parents, the experiences provided by the parents, the intellectual level of the parents, the family income and the expectations of the parents. Clarke-Stewart and Apfel (1978), concluded that intellectual and social development is affected by permanent deprivation or enrichment of

sensory and social experiences. Thus, environmental input during the early years has a great influence on children's development. They also concluded that it is not a single parental behaviour alone which determines the child's development.

Generally speaking, the higher one's level of education, the greater will be career opportunities, the greater the family income and the more material resources the home will acquire. By North American standards these factors are synonymous with the socioeconomic status of the family. Kohn (1977), in a review of social class and conformity, proposed that the most important variable to account for SES differences is the father's occupation. White collar workers are more likely to have a higher standard of living and place a greater emphasis on academic achievement than blue collar workers. Furthermore, the socioeconomic status of the family is increased if both parents are well educated and working.

Marjoribanks (1987) used an interactionist framework to examine the relationships between children's individual characteristics, family influences, and mathematics achievement. He investigated the association between mathematics performance at different family learning environment levels and the measures of children's intellectual ability and school related attitudes. By using a measure of family status from an equally weighted composite of father's occupation and the

educational level of both parents, Marjoribanks suggested that the mathematics performance of 11-year-olds has strong associations with intellectual abilities, moderate relations to family environmental influences, and negligible to modest associations with school-related attitudes. He suggested:

> A task for further individual-environmental analysis of mathematics performance should be to construct refined family and classroom mathematics learning sub-environments. In these analyses, the children's perceptions of sub-environments should be examined. Only when such refinements are adopted will it be possible to achieve a more complete understanding of children's mathematics achievement. (Marjoribanks, 1987, p. 122)

Parents with a higher level of education will often place greater emphasis upon the attainment of a sound education for their children and strive to provide for these educational goals. At-home opportunities which promote learning include: more conversation, books, games, and computers, and travel opportunities. Clarke-Stewart and Apfel (1978), in a study of the influences of parental behaviour on children's development, concluded that stimulating talk and play, encouragement of exploration and independence, and maintenance of moderate control are the kinds of parental behaviours that facilitate

children's intellectual development. It would also appear that reading skills are more home dependent than mathematics skills. Parents provide reading material for children in the form of magazines or vicariously as cereal boxes, instructional labels and even television. Because of this, parents often help their children acquire reading skills. Many children arrive at school with the ability to recite the alphabet, count, print letters and numbers or read and compute at a basic level. Wigfield and Asher (1978) indicated that there is a positive relationship between the number of books in the home and children's reading abilities. The amount of reading material is usually proportionate to the financial resources of the home and the value parents place on literacy and numeracy. Briggs and Elkind (cited in Wigfield & Asher, 1978) noted that parents of early readers were more likely to be middle class and upper class rather than lower class. This being the case, the education level of the parents and the family income, in relation to the number of occupants of the home, should directly influence the child's reading achievement.

Higher socioeconomic status parents will also tend to become more actively involved in the child's formal education by monitoring school progress and assisting in career planning. Scarr (1981) hypothesized that several factors have been demonstrated to influence both aptitude and school

achievement including parental socioeconomic status. This claim is also made by Reccord (1988) who stated, "It is a widely accepted premise of education that academic achievement and home background are related. Socioeconomic status is the most frequently cited aspect of home background which has been shown to relate to cognitive development and achievement" (p. 58).

Not all researchers however, believe that the socio-economic status variable has such a profound direct effect on school achievement. Song and Hattie (1984), in a study of Korean adolescents, found that self-concept is a mediating variable between home environment and academic achievement. This is a modification of the commonly held belief that home environment exerts direct effects on academic achievement. Academic self-concept affected academic achievement more strongly than presentation of self or social self-concept. Their research found that family psychological characteristics, which are mainly affected by social status, have indirect effects on academic achievement via influences on presentation of self.

There is little question that the socioeconomic status of the family, whether directly or indirectly, has some significant impact upon a child's educational attainment. However, due to confounding effects, estimating the relative impact of each variable which creates this composite becomes difficult

to determine. Clarke-Stewart and Apfel (1978) evaluated parental effects on child development by drawing upon two bodies of literature: reports of educational programs for parents and accounts of observational or experimental research on parents. They concluded:

> Within the SES index itself, variables of income, education and occupation are confounded, and consequently it is not clear which of these aspects may be responsible for observed differences. Exploration of education and occupation as separate factors suggests that they do have differential effects. (p. 58)

The number of children in a family and its relative impact on academic achievement has been the focus of a number of studies. The findings usually indicate that the greater the number of dependents in the family, the fewer financial resources will be available to invest in educational materials. This may not always be the case however; other factors which make up the SES composite may compensate for this material loss.

Within the SES variable itself more research needs to address the relative impact of the factors which compose this variable. Also, more investigation needs to be conducted in examining the direct and indirect effects of SES upon

achievement when mediated by other variables such as academic aptitude and/or skills acquired in school. The impact of these two variables is obviously quite important. Children from families of similar socioeconomic status differ greatly in achievement, therefore other variables must come into play. The academic aptitude and basic skills variables will be examined in the following two sections. Only by exploring these relative impacts can we obtain a clear picture of the major contributors to academic achievement and consequently explain why children achieve at different levels.

The Psychometric Model of Literacy and Numeracy

The psychometric model of literacy and numeracy is designed to predict and explain school achievement by examining the relationship between academic aptitude and reading and math competencies. Explanation and/or prediction has been the focus of most research conducted to date within this model. The psychometric model of literacy and numeracy deals with two basic issues; the correlation between generic measures of aptitude and achievement in terms of literacy and numeracy, and the predictive ability of cognitive potential upon actual academic achievement.

Academic aptitude tests measure a student's academic potential through the application of general rules and methods. They measure an individual's potential to apply

universal principles of problem-solving and the ability to decipher signals and codes. Achievement tests, in contrast, measure an individual's wealth of specific knowledge as it relates to the curriculum; assessing what the individual actually knows and his/her ability to apply this knowledge.

While there are many arguments surrounding the aptitude/achievement issue, most scholars agree on two general points: (a) there is a direct relationship between aptitude and achievement; and (b) the interrelationships between aptitude and achievement increase with age (Bond, 1960; Farr, 1969: Harris, 1979; Stanovich, Cunningham & Feeman, 1984). The implication of the second claim is that the achievement levels of some students, relative to other students, decline with time. This is because the relationship between aptitude and achievement is strengthened over time due to an increase in outcome variation. Outcome variation increases and the gap between the most able and least able students grows. The question remains, therefore, how can schools prevent the gap between the best students and the worst students from growing? One way is by neglecting the best students and giving a disproportionate amount of available educational resources to the weaker students. This seems to be effectively the case in the Headstart or mainstreaming models popular today. The elitist, bilingual schooling model, however does not allow mainstreaming. Thus, the question seems to be how can the

school narrow the gap between the most able and least able without imposing constraints on the most able which would undermine their academic potential? One answer may lie in individual programs; however, extensive assessment both of potential achievement and actual achievement may be necessary before accurate profiles, and consequently, appropriate individual educational programs can be developed. To determine what types of assessment instruments are most appropriate it is first necessary to examine exactly what each does.

The results of many studies indicate a strong relationship between aptitude and achievement (Marek, 1981; Naglieri, 1980). Carver (1990), in an investigation of aptitude and reading ability in grades two through twelve, found the correlations to be .50. He stated, "General intelligence, ... has a strong and consistent relationship to reading ability" (p. 449). Other researchers (Meuhl & DiNello, 1976; Sexton & Treolar, 1982; Phelps & Branyan, 1990) also obtained .50 correlations. Kuusinen & Leskinen (1988), by using latent structure analysis of longitudinal data on relations between academic aptitude and school achievement, showed that aptitude explains 49% of the variance in general achievement. This finding suggests that these two variables are more highly correlated than was believed with the previously accepted 25% level (Bloom, 1976). Still, much of the variance, about half, remains unaccounted for. Obviously, other factors impact

significantly upon academic achievement.

Like literacy, the study of mathematics is an extremely complex subject due to the number of learner, instructor and content variables which interact at any given time. Researchers such as Stanley, Keating and Fox (1974), however, found that mathematical talents emerge at a very early age. This suggests a primary aptitude or predisposition to the learning of mathematics. Thus, psychologists have taken a vested interest in the study of mathematics skills acquisition. Research has also shown that individuals vary in their ability to acquire mathematics at all levels. Fennema and Behr (1980) sorted mathematical aptitudes into cognitive and affective aptitudes. Cognitive abilities can be further classified into abilities and information-processing styles that include logical reasoning, spatial visualization, creativity, and flexibility of thought processes. These abilities have been studied as part of research that attempts to explain natural maturation development, school practices and the relationship between these abilities and school learning. Sowder (1980) suggested that reasoning ability develops much later than supposed; however, the logic of this late development is not clear.

Cronbach and Snow (1977) studied aptitude treatment interaction effects in instruction but could find little supporting evidence. Fey (1980) concluded,

> The learning of mathematics seems to be driven so strongly by innate mental abilities, the background of previously acquired knowledge, and the internal structure of the ideas themselves that few short-term or moderate alterations in the teaching approach have any noticeable impact on student achievement. (p. 1178)

Since their creation, the use of standardized aptitude and achievement tests in schools has become so routine that rarely has their use been questioned. Recently, however, a focus of many studies, within the field of education has been on the predictive ability of general aptitude upon achievement.

Lustberg, Motta and Naccari (1990), with a quantitative model, used an aptitude test to predict which students are most likely to be successful on a gifted education program and found, at well above chance levels, that these predictions were accurate. Still, over 10% of the gifted students did not achieve--implying other mediating factors. From these results it would appear that aptitude test scores can be used to successfully predict later achievement. However, while this may be true for exceptional students, studies such as this need to be conducted for students with average or below average levels of actual achievement. Gifted students may have

the academic potential along with the skills and positive environmental influences necessary to excel. Other students may not necessarily have this winning combination.

By using the Canadian Tests of Basic Skills, the Lorge Thorndike Group Intelligence Test and an index of the families' socioeconomic status, Tremans-Zirremba, Malonie, Michayluk, Julian, and Taylor (1979) examined several predictors of achievement in grade four children. These included: self-concept, birth order, academic aptitude, sex, position in the family, family size, age and socioeconomic status. They found that aptitude accounted for most of the variance (40.45%) and concluded. "The relationship between aptitude and reading achievement found in previous studies was verified. Aptitude accounted for a significant percentage of the variance in both reading vocabulary and comprehension" (p. 264). But what about the other 59.55% of the variance? It would appear that other factors account for a great deal of achievement. Tremans-Zirremba et al. proceeded to say:

> The literature relating to intelligence test results and reading achievement indicate a strong and positive relationship. However, because intelligence and reading have a high positive correlation does not mean that they represent identical abilities. This is indicated by the fact that more

> than half the variance in vocabulary and comprehension scores remain unaccounted for. This means there are other factors affecting reading achievement outcomes. (p. 264)

Antonak, King and Lowy (1981), by using a series of multivariate statistical analyses, found that the best predictor of achievement at grades two and four was academic aptitude. They stated, "The multiple regression analyses reported here for the second and fourth grade data reveal that the single best predictor of achievement within a grade is the IQ variable at that grade" (p. 372). However, they also said, "While the IQ variable is the best predictor of achievement within a grade, IQ becomes a negligible factor when predicting achievement between grades" (p. 372). The implication of this statement is that the aptitude test did not assess universal principles of learning at all, rather it examined specific skills acquired via instruction.

Because aptitude tests were designed to assess student's academic potential, it has been widely accepted that individuals who possess this capacity will meet with academic success. While it cannot be questioned that the results of aptitude tests may have a significant bearing upon a person's academic achievement, there are other factors which contribute to one's level of achievement. Curtis and Glaser (1982)

stated:

> We are nearing the threshold in the transition from education based on a theory of human differences that presupposes selective assessment to a theory that enables us to focus on developing educated and competent people. There is less emphasis on only selecting individuals for available opportunities and increasing activities devoted to helping them succeed in these opportunities. The selective emphasis placed too much burden on the condition of the student, and too little burden on the possible influences of teaching, training, and instruction. We are now aware that we have not come close to assessing the limits of effective education and the development of competence. (p. 141)

Antonak (1988) stated that the three main uses of aptitude tests are to explain current achievement, to predict later scholastic achievement, and to identify strengths and weaknesses. This being the case it would appear that a test of academic aptitude would be the only instrument necessary to evaluate a student's performance and potential at any given time. However, students' scores on tests of academic potential do not always reflect their actual level of achievement. Frequently the child's academic potential greatly exceeds

their actual performance and while the child may have the academic potential, they may be unable to maximize it. This inability may be due to deprived home environmental resources, a specific learning disability of the child, an absence of encouragement, or because they lack the skills necessary to realize that potential. Therefore, the impact of a student's home environment and the basic skills acquired must be taken into account before a thorough academic assessment can be completed.

From these studies it would appear that while academic aptitude and actual achievement are certainly related, they measure two different elements of the learning process. Therefore, they must be assessed individually. It is only when potential achievement is compared to actual achievement with the SES variable taken into account that an accurate profile of an individual's achievement potential can be created. Variables such as the socioeconomic status of the individual in combination with the quality of instruction appear to complement the academic potential of the individual.

The next section will examine the impact of the basic skills an individual acquires as a result of schooling upon achievement, both by itself and in combination with the socioeconomic status of the family and the individual's academic aptitude.

The Basic Skills Model of Literacy and Numeracy

The basic skills model of literacy and numeracy examines the relationship between the acquisition of basic skills, defined as skills attained as a result of schooling, and academic achievement. The basic skills model for this study was adapted from the Canadian Tests of Basic Skills, a nationally normed and administered achievement test. The specific subtests used for the basic skills composite include the vocabulary subtest plus all four language subtests: spelling, capitalization, punctuation, and language usage and expression. Because these subtests were chosen to create this composite, the following review will be conducted in light of these subtests.

Basic skills can be roughly divided into two categories: language arts skills and mathematics skills. Successful attainment of these skills determine, to a great extent, success in all other subject areas. It is because of this dependency upon basic skills for success that literacy and numeracy have been selected as the most appropriate outcome variables by which we measure academic achievement.

A major part of the language arts program in most schools has included instruction in the basic language skills. These skills include spelling, capitalization, punctuation and language usage and expression skills. Teachers have spent countless hours drilling students on these interrelated

skills, often at the expense of comprehension. Today much less time is spent on the instruction of basic skills in isolation, and more energy is devoted to comprehension and reading for meaning. Instructional methodology has moved away from a traditional approach towards a holistic approach. This transition has created a great deal of controversy among scholars and researchers. The traditionalists argue that learning cannot take place until a student has mastered the basic skills of reading, writing and arithmetic. Whole language teachers believe that because comprehension is the desired end result of reading, it should take priority over the rules which govern the traditional approach.

A similar transition has occurred within mathematics instruction. Students are no longer drilled in the rote memorization of facts such as multiplication tables. Thanks to the calculator the emphasis has moved away from factual knowledge to knowledge of application. The processes of mathematics and the ability to know where and when to use specific procedures has become more important than isolated facts. Both the traditional and the whole language approaches will be critically examined within the following sections; however, because the acquisition of a working vocabulary underlies all reading and comprehension, it will be examined first.

Vocabulary.

The written word provides the basis for nearly all formal education. Furthermore, an individual's level of success within school hinges on the successful decoding of letters and the acquisition of a basic sight vocabulary along with a set of fundamental rules of application. The vicarious attainment of letter decoding skills leading to the ability to read and comprehend is highly unlikely. Specific instruction in letter-sound relations must be delivered and practised. If a child does not master these invariant features of reading, comprehension the desired end result, is sure to suffer. Because so much of the curriculum is based on the written word, the child who does not master reading and consequently comprehend what is read, will learn very little other than what can be garnered through oral instruction. The same may be said for mathematics. If a child does not master the basic skills of mathematics such as addition, subtraction, multiplication and division, achievement will be unlikely in any area of the curriculum related to arithmetic.

Within the field of vocabulary acquisition, studies usually fall into one of three main categories: the relationship between vocabulary and reading comprehension; the development of children's word knowledge; and the effects of vocabulary instruction programs. There is little doubt a direct relationship exists between vocabulary and reading

comprehension and it is unlikely that the child who has not acquired a basic sight vocabulary will learn to read. Quantitative vocabulary studies have examined the number of words a child knows and found that this may range from 7,000 basic sight words to 200,000 total words for college sophomores (Lorge & Chall, 1963). From these studies basic sight word lists have been developed for teaching and assessment purposes. Furthermore, Chall (1958) and Klare (1974-1975) have consistently found, from studies of readability, that the most important predictor of a passage's difficulty is a vocabulary factor.

Investigative research has approached the vocabulary-comprehension interaction from several perspectives. Davis (1968) and Spearitt (1972) developed subskills theories of comprehension while Thorndike (1973) focused upon global theories of vocabulary and comprehension. Anderson and Freebody (1979) proposed two explanations for the vocabulary-comprehension relationship. The instrumentalist position claims that vocabulary knowledge is reflective of general aptitude, which is in turn related to comprehension ability. The instrumentalist position may be compared to the psychometric model of literacy and numeracy. The general-knowledge position supposes that vocabulary knowledge reflects general knowledge which, in turn, affects comprehension. The general-knowledge position is based upon the same premise as

the basic skills model of literacy and numeracy; namely, that skills are learned.

Stahl (1980) studied the acquisition of word meaning and discovered two aspects of mature word knowledge: definitional knowledge, which is the knowledge of words related to each other in a semantic network and; contextual knowledge which examines how the meaning is affected by its context. Bransford and Nitsch (1978) and Nelson (1978) believed that children and adults go through a similar process of decontextualization while learning new words, but once the new word is known, both retain definitional and contextual knowledge. Understanding how words fit together and the ability to read for meaning appear to be skills that are acquired through instruction and practice.

The role of exposure and experience appears to have a profound effect on an individual's ability to read and solve mathematical problems. Nagy, Herman, and Anderson (1986) concluded that good reading comprehension ability and experience with a large volume of printed texts are the major determinants of vocabulary growth. They felt that incidental learning from reading should be able to account for a substantial amount of vocabulary growth and stated: "Our results strongly suggest that a most efficient way to produce large scale vocabulary growth is through an activity that is all too often interrupted in the process of reading instruc-

tion: reading" (p. 252).

Trabasso (1981) stated, "Vocabulary (conceptualization) knowledge, regardless of domain, is a crucial pre-condition to comprehension since without understanding the basic concepts contained in the text or question, one cannot make inferential links" (p. 63). This research implies that vocabulary instruction is necessary before comprehension can take place. The individual must learn to make the link between vocabulary and inference making. In other words he must learn that the words come together to mean something and deliver a message.

Both the psychometric and the basic skills models used in this study contain a vocabulary component which has been shown to contribute significantly to academic achievement. It has also been shown that vocabulary development opportunities, whether through spoken word or vicariously within the home, impact significantly upon the number of words an individual uses and carries over into the learning environment. The psychometric model assumes that individuals have a certain propensity toward vocabulary acquisition and achievement. The basic skills model claims also to have a significant impact upon vocabulary development and consequently upon academic achievement in that the more exposure and practice an individual receives, the more developed that individual's skills become.

The nature-nurture debate continues to be a growing

controversy among scholars. Some believe that one's ability to read and perform academically is innate and requires little more than nurturing. In other words, people show a propensity towards academic success. Others believe that everyone, with appropriate instruction, can learn to read and complete mathematical problems. This has essentially been the philosophy adopted by our current educational system. It is these two opposing theoretical perspectives which provide the basis for the current study. If the former theory holds true then the psychometric model should have the greatest impact on literacy and numeracy. If the basic skills model proves to be more powerful, then the traditional approaches to literacy and numeracy would appear to be the most appropriate.

The next section will examine the language skills component of the basic skills model of literacy and numeracy. These skills have been identified as spelling, capitalization, punctuation, and language usage and expression.

Language skills.

Language skills appear to be essential to comprehension--the desired end result of reading. Because reading is a decoding process whereby letters represent specific sounds, it is imperative that the beginning reader be able to identify and blend these sounds to form words and consequently garner meaning from a passage. The individual who has not developed

efficient spelling skills or skills in structural analysis is unlikely to achieve reading fluency. The same may be said for punctuation. Each symbol represents a specific function and carries a meaning of its own. For example, the period indicates the end of a sentence, the comma indicates a pause, and the question mark signifies a question. They provide the cues necessary to the reader to alter reading patterns and look for different meanings from the words. The reader who has not mastered punctuation is also likely to have a difficult time with comprehension. Another basic language skill is capitalization. To become a good reader and writer the individual must learn where and when to use capitalization. For example, the use of a capital letter at the beginning of a word within a sentence usually indicates that it is a proper name. Seeing a word capitalized gives the reader, who is familiar with this rule, the cue that a proper name is to follow--a metacognitive skill necessary for comprehension. The attainment of these basic language skills often determine whether or not an individual is successful with the reading process which is, in turn, reflected by general academic performance. Unfortunately, these skills are difficult to learn incidentally. They are all skills which must be taught, usually at home or at school. The individual must first learn to recognize the basic symbols of grammar such as letters and punctuation marks and then learn general rules of application.

It is only when the individual has mastered these basic reading skills that comprehension and achievement become likely.

The basic skills or traditional model of literacy and numeracy has placed great emphasis on vocabulary and language arts skills. The whole langauge approach does not devote the same amount of time to the learning of these skills. The question follows then, why, if these skills are necessary for achievement has their importance been diminished? To answer this question each of the traditional and whole language approaches to literacy and numeracy will be examined. While they are not central to this thesis, the outcome of this study may have profound implications for their use.

The next section will examine the traditional and whole language approaches to literacy and numeracy; however, it is first necessary to examine the theoretical bases upon which these approaches have been built. The basal approach emphasizes the basic skills model that is, specific instruction in fundamental skills, while the whole language approach reflects the psycholinguistic model of literacy.

The traditional (basic skills) approach to literacy and numeracy.

The traditional view of literacy has its roots in behavioral psychology and is sometimes referred to as a basal

approach to reading achievement. It emphasizes the basic skills of reading: letters, letter-sound relationships and word and sentence fragments and relies heavily upon basal reading texts and workbooks and concentrates on the reading product rather than the process. This approach builds from letter formation to the alphabet, to sounds and phonemes, which in turn lead to words, sentences, paragraphs and stories.

The basal method of literacy is a decoding process whereby individuals master a collection of separate sequential skills of reading, writing and spelling. Thorn (1974) proposed that a good basic program provides a carefully developed sequence of skills in word perception and interpretation and a plan for systematic instruction in these areas. There is also an emphasis placed upon spelling, handwriting, and punctuation--the mechanics of literacy. As well, the program deals with scope, sequence and organization and provides a developmental and systematic approach to vocabulary building (Kennedy, 1981).

The basal approach appears to work for approximately 85% of the population in that they learn to read, write and solve mathematical problems to an adequate level of competence (Bulcock, 1982); however, it has recently come under close scrutiny. Some of the major points addressed by researchers against the traditional method of reading instruction include:

1. Because of the emphasis placed upon the development of basic skills and worksheets, it shortens available reading time (Mason, 1983).

2. Researchers now believe that the written form is learned in much the same way as oral language, not a collection of separate, sequential skills. Therefore, it should be taught in the same manner (Holdaway, 1979).

3. Reading and writing are inter-dependent (Newman, 1985).

4. The knowledge children have before they read strongly influences how much they will understand (Clarke, 1976; Durkin, 1966; Torrey, 1969).

5. With the basal approach all students receive instruction at the same time from the same text and are expected to finish at least one full book during a semester or term. This offers no challenge to the advanced reader and often a nearly impossible and frustrating goal for the poor reader (Rudman, 1976).

6. Teachers often place unnecessary emphasis upon the sequence of skills and subskills (Holdaway, 1984).

7. Stories are written to accommodate the skills and words to be learned. As a result they are not always appealing to the reader (Huck, 1977).

The major weaknesses of basal readers as summarized by Goodman (1968) are:

1. They put undue emphasis on isolated aspects of language: letters-sound relationships, words, sentence fragments or sentences. Often, particularly in workbooks, there is no cohesive meaningful text and no situational context.

2. They lead learners to put inverted value on the bits and pieces of language, on isolated words and skills, and not enough on making sense of real, comprehensible stories and expository passages.

3. Basals discourage risk taking by requiring right answers on trivial details.

4. They introduce arbitrary sequences of skills which involve readers in abstract exercises instead of reading to comprehend.

5. They isolate reading from its use and from other language processes.

6. They often create artificial language passages or text fragments by controlling vocabulary or by building around specific skills. They also create artificial texts by applying readability formulas to real texts.

7. They minimize time spent on reading while monopolizing school time for skill exercises.

8. Even the use of real children's literature is marred by gearing it to skills development, rewrit-

ing it, or using excerpts instead of whole books.
9. Basals cost so much that they do not leave funds for school and classroom libraries and other more authentic reading material. (pp. 361-362)

While it would appear that the traditional approach towards literacy and numeracy is replete with faults, no other method has yet been developed which boasts a success rate as high as this one. Because of criticisms such as these, however, educators have been searching for alternate techniques by which to increase childrens' achievement. One such method has been the whole language approach.

The whole language approach to literacy.

Because of the growing dissatisfaction with the traditional view of literacy (Smith, 1973; Goodman, 1968), researchers searched for alternate hypotheses as to how children learn to read. Educators (Otto, 1982) began to question whether reading was a bottom-up process, as believed by the behaviourists, or whether it was, in fact, a top down process. Approaching the issue from a psycholinguistic view, researchers (Cooper & Petrosky, 1976; Smith, 1973; Wigfield, Rodorf & Graham, 1979) came to believe that it makes more sense and is in keeping with the acquisition of oral language, if children approach reading from a top-down perspective where

they use whole, meaningful texts to emphasize the message rather than the skills. They viewed reading as an active process rather than being product centred.

From this cognitive, psychological view of the relationship between language, thinking and learning grew the whole-language approach to literacy. Many educators (Goodman & Burke, 1980, Melvin, 1979) now view literacy as an attempt to make sense out of what a person reads rather than the rote memorization of skills, rules and exceptions. They believe that reading is an amalgamation of graphaphonic, syntactic and semantic cues (Goodman & Burke, 1980). Graphaphonic cues refer to the visual array of print and the sound-symbol relationship. Syntactic cues refer to the grammatical interrelationships of words and semantic cues include the underlying meanings that the words from the text evoke in the reader.

The whole language approach views reading as being child-centred where new words are dealt with in context, as they are encountered. This approach uses books, articles, newspapers and any other print medium which might assist understanding (Durkin 1970; Torrey, 1969). Spelling is seen as an integral part of the reading process and never dealt with in isolation. Experimental spelling is encouraged and material used moves from the familiar to the unfamiliar with a particular emphasis on predictable reading materials and little emphasis on basic skills (Beers & Henderson, 1977; Newman, 1985). Skills are

believed to develop though the use of written language.

Because of the apparent abandonment of basic skills instruction from the curriculum, many parents and educators question the whole-language approach to literacy and numeracy. There is a growing concern among educators, business, and parents that many students are not learning to read via this method. (See articles: Maclean's Magazine, January 11, 1993; The Globe and Mail, December 18, 1992; December 20, 1992; January 1, 1993; January 4, 1993) However, careful analysis of this method indicates that children do receive instruction in basic skills but only within context and as needed. The interactionist approach attempts to meld the strong points of both the traditional and whole-language approaches to literacy and numeracy.

The interactionist approach to literacy.

Some researchers (Cochran, 1989) have proposed an interactionist view of literacy. This perspective incorporates the best of the traditional and whole language approaches. Cochran contends that educators should use all the elements of language--reading, writing, listening and speaking as an integrated whole.

Beebe (1990) believed that phonics and structural analysis should be taught within the context of natural reading. She stated:

> ... all of this is not to say that teachers cannot and do not use basal readers in a whole language classroom. Most whole language teachers begin by incorporating whole language activities into their basal reader programs. As they become more comfortable with the language activities, they are usually less inclined to adhere closely to the basal reader. After two or three years, the importance of the basal tends to decline to the point where teachers incorporate some of the basal suggestions into their themes (p. 161).

The Interactionist approach appears to be a satisfactorily compromising approach to literacy. It attempts to meld the strong points of the basal approach with the whole language approach and holds exciting potential for further research into literacy.

As mentioned earlier there is still a great deal of controversy as to the nature of literacy and numeracy. While it is apparent that one's socioeconomic status, academic aptitude, and the basic skills acquired as a result of schooling all significantly contribute to academic success, it is not clear as to the relative and confounded contribution of each of these variables. The next section will deal with the formulation of a model which attempts to do just this.

A Theoretical Model of Academic Achievement

As outlined in the previous section a student's socioeconomic status, academic aptitude and basic skills acquired as a result of schooling all contribute significantly to that individual's level of academic achievement. This section will attempt to create a model which will examine the relative contribution of these three variables.

Figure 2.1 presents the theoretical model of the study, which was derived from the review of related literature. That is, this model provides a summary of the literature which has been reviewed, and it presents a picture of the relationships to be examined in the present research.

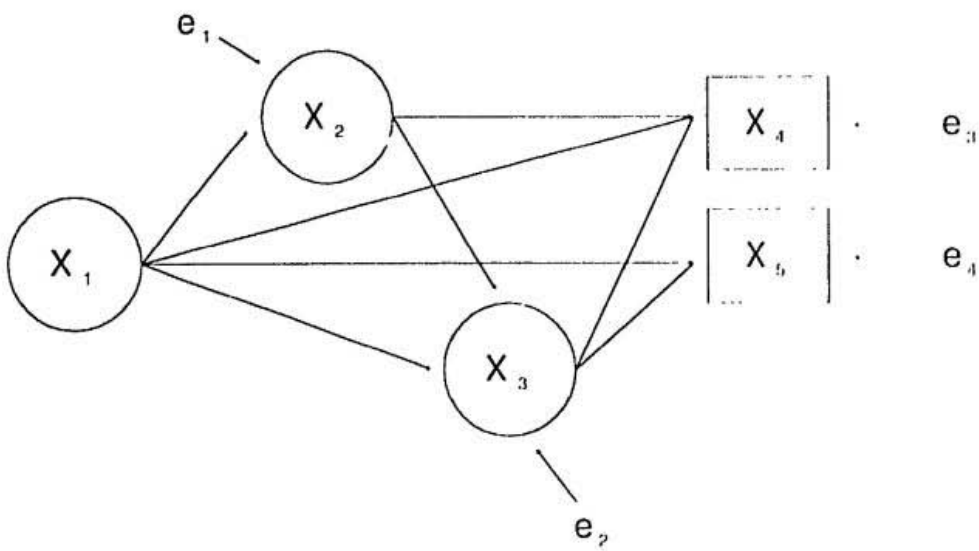


Figure 2.1 A Theoretical Model of Literacy and Numeracy

where x_1 = family socioeconomic status
x_2 = academic aptitude
x_3 = achievement
x_4 = reading
x_5 = mathematics

In the model every variable to the right is affected by every variable to the left and the variables were measured in chronological sequence over a period of years. This sequencing is necessary because, as made evident from the theoretical review, all variables to the left in the model appear to have a significant impact upon the variables to the right. The review of the literature did not indicate the comparable size of each of these relationships, but it is hypothesized that some independent variables will influence each other and literacy and numeracy more than others. As indicated, the three independent variables, SES, academic aptitude, and basic skills, have both direct and indirect effects upon the independent variables, literacy and numeracy. It is also noted that the indirect effects are mediated through academic aptitude and basic skills. The literature has suggested that positive relationships will exist between SES, academic aptitude, basic skills and, literacy and numeracy.

CHAPTER III

Methodology

Introduction

The data used in this study were taken from The Structure of Elementary School Achievement (SESA) Project. The project was funded by the Social Sciences and Humanities Research Council of Canada. Its chief investigator was Mr. Jeffrey Bulcock of the Institute for Educational Research and Development at Memorial University of Newfoundland. Consultation was provided by Dr. Mona Beebe, also of Memorial University of Newfoundland.

The Project was a longitudinal, quantitative study covering two overlapping three year periods. The instruments used included a parent's questionnaire, and for each student, a test of academic aptitude (the Canadian Cognitive Abilities Test) and a test of academic achievement (the Canadian Tests of Basic Skills). The study was conducted with 217 students from grade two through grade four. This thesis used only a portion of the available data from the SESA project.

The Parent Instrument

The parent questionnaire contained 116 items and a consent form among other things. It attempted to assess the

socioeconomic status of the family by examining father's education, mother's education, father's occupation and number of children in the family. Students who returned the signed parental consent form were tested using the Canadian Cognitive Abilities Test (CCAT) and the Canadian Tests of Basic Skills (CTBS). The section of the parent instrument used for this study can be found in Appendix A. Only items which best represent the socioeconomic status (SES) of the family were selected from the parent questionnaire to complete the SES construct. Question 98 and 99 of the parent questionnaire provided information on the education of the father and mother, respectively and were selected as a proxy for the social status of the family. Parental educational level choices ranged from Elementary School Only up to Advanced Education, Post Graduate Degree (eg., Master's, Ph.D, M.D., LL.B., C.A., etc.).

Questions 100 and 113 were selected as a proxy for the economic status of the family. Questions asked included: How many children are there in the family? and At the present time what is the employment status of the family? Conventional wisdom would suggest that parents employed full time with a small family would have a higher economic status than those unemployed with a large family.

The Canadian Cognitive Abilities Test (CCAT)

The purpose of the aptitude test is to measure an individual's potential for achievement. It deals with logical thought processes and abstractions not based directly upon the curriculum. These abstractions however, do not have an effect on achievement in that they reflect general principles of learning which, when applied to the curriculum, often determine achievement. The achievement test, on the other hand, measures an individual's actual knowledge of the curriculum content.

The Canadian Cognitive Abilities Test is a widely used group aptitude test. Specifically, it examines children's verbal, quantitative and nonverbal academic potential. Scores are presented as standardized age scores which means that scores are adjusted to take chronological age into account. The CCAT was normalized on a standardization sample of approximately 30,000 students from across Canada stratified by province and size of school. The CCAT is composed of three batteries of subtests. The Verbal battery assesses the individual's ability to deal with abstractions in verbal forms. The Quantitative battery examines the individual's ability to deal with quantitative concepts and the Nonverbal battery assesses abstract aptitudes not influenced by reading. Each battery of the CCAT is further divided into specific subtests which will be outlined in detail within the instru-

mentation section of this chapter. This battery is also pictorial or diagrammatic in nature which make it suitable for non-readers.

In the Fall and Spring of each of the three years of the two SESA projects, subtests of the Canadian Tests of Basic Skills (CTBS) were administered to all participants. Achievement was assessed in vocabulary, reading comprehension, language skills and mathematics skills.

The Canadian Tests of Basic Skills (CTBS)

The Canadian Tests of Basic Skills (CTBS) are group administered achievement tests. The items on the tests measure knowledge acquired primarily in school though not directly related to content fields. The knowledge assessed focuses on process skills. The CTBS measures achievement in vocabulary, reading comprehension, language skills (including capitalization, punctuation, usage and spelling), work study skills (including map reading, reading graphs and tables, and knowledge and use of reference materials) and mathematics skill (including mathematical concepts, mathematical computation and mathematical problem solving).

Each test is continuous, covering the range of achievement development in the elementary school. Six overlapping levels of each test were assembled by combining blocks or modules of test items, each representing an increasingly

higher level of skill development.

The CTBS emphasize skills rather than factual knowledge. King, Hieronymus, Lindquist and Hoover (1982) stated. "Measures of the basic intellectual skills are far more valuable for use in the improvement and individualization of instruction and in educational guidance than are measures of the acquisition of specific information in special subjects" (p.6).

The Sample

Parents of grade two children from two school boards on the Avalon Peninsula were provided with letters of invitation and consent forms asking them to participate in the SESA project. The response rate ranged from 60%-100% for the seventeen classes involved in both studies and resulted in an initial sample size of 217 for the main study and 111 for the validation study. The schools were located in urban, suburban and rural communities and participants came from a cross-section of socioeconomic levels weighted slightly in favour of mid to high SES families.

Two percent of the children from the very lowest end of the ability scale either repeated a grade or moved into special education classes, thus ending their further participation in the project. A further 8% of drop-outs occurred as a result of student transfers. This percentage would have been

higher except that some students transferred to schools or boards participating in the project and were permitted to remain in the project with the school's permission.

There was no attempt to balance the sample by sex because the samples were selected by school. Only students who returned a signed parental consent form were allowed to participate in the study.

Collection of Data

Prior to the collection of the data, approval was granted by the Department of Education and the Faculty of Education Ethics Committee as well as from the school board and parents of the students participating in the study.

In the Spring of 1985, when most of the participants in the study were in grade four, parents were asked to provide researchers with information about their child and about themselves via a parent questionnaire. The parent questionnaire assessed four dimensions of children's home background: availability of role models, the opportunities provided by the home, the encouragement and rewards used by the parents, and the expectations of the children held by the parents. Only questions pertaining to the socioeconomic status of the home (father's education, father's occupation, mother's education and total number of children) were used in the current study.

The Canadian Cognitive Abilities Test was used to gather

data on the academic aptitudes of each participant. In the Winter of grade three the ten subtests of the Canadian Cognitive Abilities Test were administered to all participants. This is group administered, multilevel instrument which takes approximately one hundred minutes to complete. The verbal battery contains one hundred items and requires thirty-four minutes working time. The quantitative battery contains sixty items and requires thirty-four minutes working time and the non-verbal battery requires thirty-four minutes to administer the eighty items.

In the Fall and Spring of each of the three years of the two SESA projects, subtests of the Canadian Tests of Basic Skills (CTBS) were administered to all participants. It should be noted that the numbers in each label does not necessarily indicate the school year of the individuals. For example; within the APT composite VOC3, SEN3, VCLAS3, VANA3, QREL3, NOSER3, EQUA3, FIGCL3, FIGAN3, and FIGSYN3 were all measured during the Winter of grade three while the Basic Skills variable (SPELL4, VOC4, USE4, CAPS4, and PUNC4) were all measured in the Spring of grade 3; yielding a five month difference between the time that the student's academic aptitude and actual achievement were measured. Within the Basic Skills composite the 4 is meant to indicate that by the Spring of grade three, or the end of the school year, technically children should be reading at the grade four

level. Because the subject's Socioeconomic status was measured in grade two, their academic aptitude was measured in the Winter of grade three, their basic skills were measured in the Spring of grade three, and their Literacy and Numeracy levels were measured at the end of grade four. There is a temporal sequencing, thus allowing researchers to make causal statements. Achievement was assessed in vocabulary, reading comprehension, language skills and mathematics skills.

Analysis of Data

Each of the domains of the Structure of Elementary School Achievement was analyzed using a principal component analysis. The principal component analysis calculates the relative proportion of the variance contributed by each item. Using the appropriate weights computed for each item in a construct, scores were computed for that construct. Frequency tables and barcharts were also generated to provide a graphic representation of each construct.

A composite score was generated for each variable within the model and scores were then standardized to yield a mean score of 100 and a standard deviation of 15. Standard scores are a set of transformed scores derived from the mean and standard deviation of the raw scores (Borg & Gall, 1983).

Multiple regression equations were estimated to examine the magnitude of the relationships between independent

variables and each dependent variable. This procedure uses the "principles of correlation and regression to help examine the variance of a dependent variable by estimating the contributions of two or more independent variables to this variance" (Kerlinger & Pedhazur, 1967, p. 4).

Path analysis was conducted using the results from the multiple regression analysis. Borg and Gall (1983) stated, "path analysis is a method for testing the validity of a theory about causal relationships between three or more variables that have been studied using a correlational research design" (p. 60). Each variable was then subjected to a partial correlation with another variable while adjusting for the effects of one or more additional variables.

Finally, reliabilities were constructed to provide a number of reliability coefficients for each variable. Reliabilities reflect the extent to which a test is free of error variance. Reliabilities coefficients vary between values of .00 to 1.00, with 1.00 indicating perfect reliability, and .00 indicating no reliability at all.

In this study SES is an exogenous variable; it lacks an hypothesized cause. Aptitude, Basic Skills, Mathematics Achievement and Reading Achievement are all endogenous variables with hypothesized causes as shown by the arrows in Fig. 1.5. The path coefficients are the same as the standardized partial regression coefficients or betas calculated in a

multiple regression analysis. "A path coefficient is a standardized regression coefficient indicating the direct effect of one variable on another in the path analysis" (Borg & Gall, 1983, p. 610). From these path coefficients (direct effects) it was possible to calculate the indirect effects among the variables.

Instrumentation

The instrumentation section will examine both the Canadian Cognitive Abilities Test and Canadian Tests of Basic Skills. It will examine the overall structure of the instruments as well as explore differences and similarities at the subtest and question level. This type of comparison is necessary because while both tests attempt to predict academic achievement, each approaches achievement from a different perspective--the CCAT examines academic potential while the CTBS examine actual achievement.

The CCAT and the CTBS were chosen for this study because of their ease of administration and scoring. Both are group administered tests and an optical scanning scoring procedure is available for each. As well, both batteries were standardized on the same population of pupils and were administered under the same conditions at approximately the same time. This makes it possible to compare achievement and aptitude under almost identical conditions.

The Canadian Cognitive Abilities Test consists of three major batteries, each being further divided into specific subtests. The Verbal battery consists of four subtests: Vocabulary, Sentence Completion, Verbal Classification, and Verbal Analogies. The Quantitative battery is composed of three subtests: Quantitative Relations, Number Series, and Equation Building. The nonverbal battery consists of three subtests: Figure Classification, Figure Analogies, and Figure Synthesis. The CCAT is a norm-referenced instrument which examines levels and patterns of developed abilities. It is used to match instructional methods and materials to particular cognitive styles. Each subtest of the CCAT is divided into eight different but overlapping levels with each item in the subtest becoming progressively more difficult. It is a timed test and scores are either reported as a raw score (number right), standard scores, or as percentile ranks and stanines. Group or individual scores are also available. For the current study all subtests of the CCAT were administered to each participant and used to form the Psychometric Model composite variable of the Psychometric Model of Literacy and Numeracy.

The Canadian Tests of Basic Skills examine various levels of achievement and individual abilities. Depending upon the interpretation, the CTBS can be either norm-referenced or criterion-referenced. Like the CCAT, the CTBS attempt to predict later achievement and reflect the continuous nature of

skills development. The CTBS examine the developed abilities needed to profit from learning experience in the basic skills. Specific areas assessed include: Vocabulary Skills, Reading Skills, Language Usage Skills, Work Study Skills and Mathematics Skills. The Language Usage skills are further broken down into specific subtests which include: Spelling, Capitalization, Punctuation, and Usage & Expression. The Work Study Skills component includes Visual Materials and Reference Materials subtests. The Mathematics Test includes the Math Concepts Subtest, the Math Problem Solving Subtest, and the Math Computation Subtest. It is essentially a power test with no emphasis on speed and consists of six overlapping levels of each test which is reflective of the overlapping nature of the curriculum. The specific tests of the CTBS used to formulate the Basic Skills component of the Basic Skills Model of Literacy and Numeracy included only the Vocabulary test and the four Language Usage subtests. The two outcome variables - Literacy and Numeracy use the Reading Comprehension Test and two of the three Mathematics subtests. The Math subtests used to assess numeracy include Math Concepts and the Math Problem Solving.

From the previous review it appears that Language Usage skills in combination with Vocabulary skills are the greatest contributors to literacy while Math concepts and Math Problem solving skills have the greatest impact on numeracy. It also

appears that the Verbal Battery (Vocabulary, Sentence Completion, Verbal Classification and Verbal Analogies) of the CCAT is roughly equivalent to the Vocabulary subtest of the CTBS in combination with the four Language Usage subtests (Spelling, Capitalization, Punctuation and Usage & Expression). Both Vocabulary subtests ask the individual to match similar meanings from a list of possibilities. They appraise an individual's knowledge of different words as well as one's ability to identify the specific meaning of words. Both subtests are, for the most part, identical with the major differences between them being: the CCAT Vocabulary section is a subtest of the Verbal battery while the CTBS Vocabulary subtest is a test within itself; with the CCAT the person has to choose the best answer from five possibilities while the CTBS offer only four choices; the CCAT allows the individual to write the letter of the correct answer on a separate sheet while the CTBS answer involves shading the correct answer on an optical scan answer sheet. With the CTBS a small amount of context is given while none is offered with the CCAT. For example:

CCAT

Vocabulary

Directions: Remember, for each question in this test pick the word or phrase that means nearly the same thing as the word in dark type. Here is one last question for practice. Look at Sample Question 0.

---

0. wish **A.** agree **B.** bone **C.** over **D.** want **E.** waste

Which word means most nearly the same thing as **wish**? The answer is **want**. The letter in front of **want** is **D** so on your answer sheet mark answer space **D** for Sample Question 0 for Test 1.

CTBS

Vocabulary

Directions: In each exercise, you are to decide which one of the four answers has most nearly the same meaning as the word in heavy type above them. Then, on the answer sheet, find the row of answer spaces numbered the same as the exercise you are working on. You are to fill in the answer space on the answer sheet that has the same number as the answer you picked.

1. A **final** look
1) **first**
2) **last**
3) **long**
4) **backward**

The Sentence Completion subtest of the CCAT subtest requires the individual to have both a sense of the structure of the English language as well as a comprehension of the thought or idea expressed in the sentence. For example:

CCAT

Sentence Completion

Directions: In this text you will read sentences. In each sentence, one word has been left out. Read each sentence carefully, then look at the five words that follow it on a line below. From the five words, pick **one** word that makes the truest and most sensible complete sentence.

Look at Sample Question 0.

---

0. The fire is _____.
A. wet **B.** green **C.** hot **D.** running **E. round**

A fire is almost always hot, so **hot** is the best word to put in the sentence. The letter in front of **hot** is **C**; so on your answer sheet make a heavy black pencil mark in the **C** answer space for Sample Question 0 for Test 2.

Now try Sample Question 00.

---

00 John likes to _____ a ball game.
F watch **G** eat **H** help **J** read **K** talk

The answer is **F, watch**. "John likes to watch a ball game" is the sentence that makes the most sense. On your answer sheet, mark the answer space for the letter **F** for Sample Question 00 for Test 2.

Here is a last sample for practice. Read it carefully and then mark your answer on the answer sheet in the row for Sample Question 000.

---

000. _____ me my hat and coat.
L Burn **M** Call **N** See **P** Tell **Q** Bring

You should have marked **Q**. "Bring me my hat and coat" makes the best sense.

The Verbal Classification subtest of the CCAT requires the individual to abstract the common element among three or four verbal stimuli. This ability appears to be indicative of

an individual's capacity for memorization. For example:

CCAT

Verbal Classification

Directions: For each question in this test, a series of words is given in dark type. All the words are alike in some way. For example, **red white blue** are all name of colours. **Mary June Sue** are all names of girls.

0. mouse wolf bear
A rose **B** lion **C** run **D** hungry **E** brown

A **mouse**, a **wolf**, and a **bear** are all animals. A **lion** is also an animal, and the letter **B** is in front of **lion**; so on your answer sheet mark the **B** answer space for Sample Question 0 for Test 3.

Now look at Sample Question 00. Think in what way the words in dark type go together. Then find the word on the line below that belongs with them.

---

00. Bob Jack Fred Bill
F Mary **G** boy **H** name **J** Ed **K** Jones

The right answer is **Ed. Ed** is a boy's name just as the words in dark type are boy's names. The letter in front of **Ed** is **J**. On your answer sheet make a heavy black line in the **J** answer space for Sample Question 00 for Test 3.

Here is one more sample to practice on. Read it carefully, then mark your answer on the answer sheet.

---

000. eye ear mouth
L nose **M** smell **N** head **P** girl **Q** speak

The answer is **nose**, so you should have marked **L** on you answer sheet for Sample Question 000.

The Verbal Analogies subtest of the CCAT requires the individual to discover the relationship between a pair of words and then give a third word which is the first word of a

second pair, completing the analogy. This subtest appears to be indicative of an individual's verbal problem solving ability. For example:

CCAT

Verbal Analogies

Directions: Each question in this test starts with a pair of words that are related to each other in some way. For example, the words might be **big** or **large**. They mean just about the same thing. Or the words might be **wet** and **dry**. These two mean just the opposite of each other.

In each question, you are to figure out how the first two words are related to each other. Then, right after them, you are given a third word that is the **first** word of a **second** pair. From the five **lettered** words that follow on a line below, find a word that **completes the second pair**.

Look at Sample Question 0

---

0. big ——— large: little ———
A girl **B** small **C** late **D** lively **E** more

You would read this "**big** is to **large** as **little** is to ...", and you would look for a word that would complete the statement. The right answer is **B, small."Big** is to **large** as **little** is to **small."**

On your answer sheet, mark answer space **B** for Sample Question 0 for Test 4.

---

00. fire ——— hot: ice ———
F cream **G** melt **H** box **J** cold **K** mice

For this one, the right answer is **J, cold**. You would say "**Fire** is to **hot** as **ice** is to **cold.**" On your answer sheet, mark answer space **J** for Sample Question 00, Test 4.

Here is one more sample to try for practice. Read it and mark your answer on the sheet.

---

000. yes ——— no: stop ———
L red **M** go **N** run **P** quiet **Q** slow

The answer is **M, go**; so you should have marked **M** on your answer sheet for Sample Question 000.

The language usage subtests of the CTBS include: Spelling, Capitalization, Punctuation, and Usage and Expression. The Spelling subtest requires the individual to know how to spell and identify spelling errors. For example:

CTBS

Spelling

Directions: The exercises in this spelling test are like the samples shown at the right. Many of the exercises contain a mistake in spelling. Some do not have any mistakes at all.

You are to look for mistakes in spelling. When you find a mistake, fill in the answer space on the answer sheet that has the same number as the word which is wrong. If there is no mistake in an exercise, fill in the fifth answer space.

The sample exercises below show what you are to do.

S1. 1) **our**
2) **mi**
3) **your**
4) **them**
5) (no mistakes)

S2. 1) **fill**
2) **keep**
3) **was**
4) **saw**
5) (no mistakes)

The Capitalization subtest requires the individual to show whether they know which words in a sentence should be capitalized and to identify mistakes in capitalization. For example:

CTBS

Capitalization

Directions: This is a test on capitalization. It will show whether you know which word in a sentence should be capitalized.

The exercises in the test are like the samples shown below. Many of the exercises contain mistakes in capitalization. Some do not have any mistakes at all.

You are to look for mistakes in the test exercises. When you find a mistake, fill in the answer space on the answer sheet that has the same number as the **line** containing the mistake. If there is no mistake in the exercise, fill in the fourth answer space.

The sample exercises below show what you are to do.

S1. 1) Tom and jerry
2) picked up all the
3) trash from the picnic.
4) (No mistakes)

S2. 1) Sally said that
2) everyone should have
3) been more Careful.
4) (No mistakes)

S3. 1) Let's all help
2) to keep our streets
3) and sidewalks clean.
4) (No mistakes)

The Punctuation subtest shows how well an individual can use periods, commas, question marks, apostrophes, etc. and requires them to identify punctuation mistakes. For example:

CTBS

Punctuation

Directions: This is a test on punctuation. It will show how well you can use periods, commas, question marks, apostrophes, etc.

The exercises in the test are like the samples shown below. Many of the exercises contain mistakes in punctuation. Some do not have any mistakes at all.

You are to look for mistakes in the test exercises. When you find a mistake, fill in the answer space on the answer sheet that has the same number as the **line** containing the mistake. If there is no mistake in an exercise, fill in the fourth answer space.

CTBS

S1. 1) Our family tries
2) to practice
3) rules of safety
4) (No mistakes)

S2 1) We all fasten
2) our seat belts
3) before, we leave.
4) (No mistakes)

S3 1) We do our best
2) to make our home
3) a safe place to live.
4) (No mistakes).

The language usage and expression subtest of the CTBS requires the individual to know words according to the standards of correctly written English and to identify mistakes. For example:

CTBS

Usage and Expression

Directions: This is a test on the use of words. It will show whether you know how to use words according to the standards of correctly written Englis!

The exercises in the test are like the samples shown below. Many of the exercises contain mistakes in the use of words. Some do not have any mistakes at all.

You are to look for mistakes in the exercises. When you find a mistake, fill in the answer space on the answer sheet that has the same number as the **line** containing the mistake. If there is no mistake in an exercise, fill in the fourth answer space.

The sample exercises below show what you are to do.

S1. 1) He showed us the way.
2) Are you afraid to try ?
3) Me and him took turns.
4) (No mistakes)

S2. 1) Tim went first.
2) The bird flew away.
3) Pat found a dollar.
4) (No mistakes)

The CCAT subtests involve such mental tasks as comprehension of thought, memorization, and verbal problem solving which can be classified as abstract principles of learning. The CTBS focus on the actual basic skills involved in reading such as spelling, capitalization and the ability to find mistakes. To be successful on the CTBS the individual must have mastered specific knowledge related tc spelling, punctuation, and language usage and expression - all skills which result from direct exposure to the words and knowledge

of specific rules. The CTBS asks the examinee to identify mistakes, but does not require they be corrected.

In comparing the CCAT and the CTBS subtests we see that while they are very similar there is a difference in how they approach literacy and numeracy. It would appear that the Sentence Completion subtest of the CCAT is roughly equivalent to the Language Usage subtest of the CTBS. Both require the individual to have a working knowledge of the English language and to be able to comprehend ideas. The Verbal Classification subtest of the CCAT appears to incorporate the Spelling, Capitalization, and the Punctuation subtests of the CTBS. There appears to be no equivalent to the Verbal Analogies subtest of the CCAT in the CTBS as this subtest requires a higher level of cognitive functioning absent from the CTBS.

The Quantitative battery of the CCAT is composed of three subtests: Quantitative Relations, Number Series, and Equation Building. The Quantitative Relations subtest requires the individual to make decisions about relative size or amount of quantitative materials most of which are common to children and considered basic to the development of quantitative concepts and reasoning. For example:

CCAT

Quantitative Relations

Directions: In the first test each problem shows two quantities, one in Column **A** and one in Column **B**. You are to compare the amount or quantity in Column **A** with the amount or quantity in Column **B**. Then, on your answer sheet, you will mark one of three answer spaces - **A**,**B**, or **C** - like this:

Mark **A** if the amount in Column **A** is **greater** than that in Column **B**.

Mark **B** if the amount in Column **B** is **greater** then that in Column **A**.

Mark **C** if the amount in Column **A** is exactly **equal to** that in Column **B**.

Column A **Column B**

1.

Which domino has more spots on it ? If you count you will see that the one in Column **B** has more spots. The one in Column **A** has **less** spots. The rule is that when Column **B** is **greater** than Column **A**, mark answer space **B**. Look at your answer sheet and find the rows of answer spaces labelled **Practices** for the **Quantitative Battery**. You will see that **Practice Question 1** has been correctly marked. Answer space **B** has been marked.

Now try Practice Question 2.

	Column A	**Column B**
2.	**3 + 2**	**2 + 3**

Which is bigger, 3 + 2 or 2 + 3 ? Neither. They are just the same. The rule is that when the value in Column **A** is **the same as** the value in Column **B**, mark answer space **C**. Make sure you have marked it on your answer sheet.

The Number Series subtest requires the student to

discover the relationship among a series of numbers which has important implications for the development of quantitative reasoning and problem solving. For example:

CCAT

Number Series

Directions: For each question in this test a series of numbers is given in a certain order. You are to figure out the way in which the numbers are arranged. Then you are to think what number should come next and find that number among the choices given. Look at Sample Question 0.

---

0. 1 2 3 4 5 —— **A** 4 **B** 5 **C** 6 **D** 7 **E** 8

In the series of numbers 1 2 3 4 5 each number is one **more** than the number that comes before it. The number that is one more than 5 is 6. The letter in front of 6 is **C**; so, on your answer sheet, make a heavy black mark in the **C** answer space for Sample Question 0.

Now look at Sample Question 00. Find the number that should come next.

---

00. 20 19 18 17 16 —— **F** 11 **G** 12 **H** 13 **J** 14 **K** 15

In this series, each number is one **less** than the number before it. The number that is one less than 16 is 15, and the letter in front of 15 is **K**. On your answer sheet, mark the **K** answer space for Sample Question 00.

Here is one more for practice. Look at Sample Question 000.

---

000. 10 12 14 16 18 20 —— **L** 21 **M** 22 **N** 23 **P** 24 **Q** 25

What number should come after 20? The right answer is 22, so you should mark answer space **M** on your answer sheet for Sample Question 000.

Equation Building is an unusual type of test. Although a

knowledge of mathematical conventions is necessary for this test, success on this subtest is dependent, to a large extent, upon the students flexibility in using quantitative concepts. For example:

CCAT

Equation Building

Directions: In this test you will try to discover how to put numbers together to make true equations or number sentences. In each problem you will be given two or more numbers and some signs like +, -, x, and -.

For each problem you will also be given five answer choices. You are to discover how to put together **all** of the numbers and signs given in the problem in a way that gives you **one of the answer choices supplied in that problem.**

Look at Sample Problem 0.

---

0. 2 3 1 + + **A** 4 **B** 5 **C** 6 **D** 7 **E** 8

You could say 2 + 3 + 1 = 6 or 3 + 2 + 1 = 6 or 1 + 2 + 3 = 6. In this problem, no matter how you put the numbers and signs together, you will always get 6. Since 6 is the correct answer, mark answer space **C** on your answer sheet for Sample Problem 0.

Now look at Sample Problem 00.

---

00. 4 5 2 - + **F** 0 **G** 2 **H** 3 **J** 8 **K** 11

Here you are given three numbers, a - sign and a + sign. You could say 4 + 5 - 2 = 7 or 4 + 2 - 5 = 1 or 5 + 2 - 4 = 3. All of these are true number sentences, but only 3 is given in the answer choices. It is choice **H**, so you would mark the answer space for **H** for Sample Problem 00.

Remember, in arithmetic, no matter in what order you arrange numbers, you always multiply or divide before you add or subtract. For example, if you have 2 + 3 x 4 this means to multiply 3 x 4 first, then add 2. It means 3 x 4 = 12 and then 2 + 12 = 14. You may not add 2 and 3 and then multiply by

4; multiplication or division must be done before addition or subtraction.

Now try Sample Problem 000.

000. 2 2 3 + x L 6 M 8 N 9 P 10 Q 11

You can say 2 + 2 x 3 = 8. Here you first multiplied 2 x 3 and then added 2 to get 8. Or you can say 3 + 2 x 2 = 7. Here you first multiplied 2 x 2 and then added 3 to get 7. But only 8 is given in the answer choices. Since 8 is answer choice **M**, mark the answer space for **M** for Sample Problem 000.

Try each problem but do not spend too much time on ones you find very hard. Do those that you can; then go back and answer those you skipped if you have time left.

The Quantitative Battery of the CCAT, like the Verbal Battery, measures what is commonly known as "g" or a general reasoning factor or "academic ability". Both tests appear to be good predictors of success or aptitude in typical academic settings.

The Nonverbal Battery, which appears to be less curriculum specific but requires higher levels of cognitive functioning, consists of three subtests: Figure Classification, Figure Analogies, and Figure Synthesis. Rather than using words or numbers, all items within these subtests involve symbols and figures and have little direct relationship to formal school instruction. The Figure Classification subtest requires the individual to identify common elements among stimuli. For example:

CCAT

Figure Classification

Directions: This booklet contains three tests that will give you a chance to show how well you can work problems that use shape and figures.

You will mark all your answers on your separate answer sheet. It will help you to keep in the right place on each test, because it has answer spaces for marking only those questions that you are supposed to try. Do not write or mark in this booklet.

In the first test each question starts with a set of figures or drawings that are alike in some way. You are to figure out how they are alike, and then find among the answer choices on the right the figure that belongs with them.

Look at Practice Question 1 below.

---

1. 

All the first three drawings are dark. The only one on the right that is dark is **C**; so **C** is the correct answer.

Now look at your answer sheet and find rows of answer spaces labelled **Practices** for the Nonverbal Battery. You will see that Practice Question 1 has been correctly marked. Answer space **C** has been marked.

Now look at Practice Question 2.

---

2. 

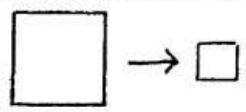
How are the three figures on the left alike? They are all half-circles. Which drawing on the right belongs to them? The answer is **G**, because this is also a half-circle. On your answer sheet, mark the answer space under the letter **G** for Practice Question 2.

The Figure Analogies subtest requires the individual to discover relationships among elements. For example:

CCAT

Figure Analogies

Directions: Each question in this test starts with a pair of figures or drawings that are related to each other in some way. For example, the figures might be



and

These figures are just the same shape, but the second one is smaller than the first.

In each question, you are to decide how the first two figures, or drawings, are related to each other. Then, right after these, you are given a third figure which is the **first** figure of a **second** pair. From the five **lettered figures** that follow on the right, find the **one** that goes with the third figure in the same way that the second figure goes with the first.

Look at Sample Question 0.

0.

You should think "Big Square is to little square as big circle is to ..." and the answer would be "little circle." The little circle is answer choice **B**; so on your answer sheet mark answer space **B** for Sample Question 0 for Test 2.

Now look at Sample Question 00.

00. 

You should think "Little light triangle is to dark big triangle as little white half-circle is to ...". The right answer is "big dark half-circle." This is the answer choice **K**. On your answer sheet, mark answer space **K** for Sample Question 00 for Test 2

The Figure Synthesis subtest requires the student to show flexibility in mentally manipulating spatial configurations

and mentally organize separate pieces into a whole . For example:

CCAT

Figure Synthesis

Directions: In this test you put pieces together to make different shapes, just like putting pieces of a puzzle together. In the test, you cannot actually lift up and move the pieces, but imagine that you can.

For each problem, or question, you will be given two or more pieces and a number of complete shapes. The **pieces** are solid black; the **shapes are shaded** with black lines around them. You are to figure out whether **all** of the pieces can be arranged so as to cover all of the shaded part and form the shape made by the black lines.

The rules are:

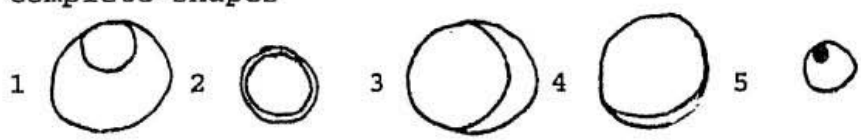
1. **All the given pieces** must be used for each shape.
2. Each piece can be used **only once** for each shape.
3. The shaded part of each shape must be completely covered by the pieces.
4. No piece may be placed either partly or entirely on top of another piece.
5. The pieces may be **turned** in any direction of they may be flipped over and turned in any direction to make them fit into the shaded area of the shape.

To show you how to do the questions and mark your answers on the separate answer sheet, we shall try some Samples for practice. Look at Sample Question 0 below.

---

0. **Given pieces**

Complete shapes



You have been given two pieces - two half circles. Now look at shape **1**. Can the two pieces be arranged so that they will cover all the shaded part of shape **1** and just fit inside the curved black line on the outside?

Put the straight edges of the two pieces together like this and they will cover all the shaded part of the shape and just fit inside the curved black line on the outside. The answer, then, is **Yes** for shape **1**.

Look at the answer sheet and find Sample Question 0 for Test 3. Mark the **oval answer space** for **Yes** beside the number **1** and for shape **1**.

Now look at shape **2**. Can the pieces be moved around in any way so that they will completely cover the shaded part of shape **2** and form four straight lines (a square) on the outside? The answer is **No**. Each one of the given pieces has only one straight line. There is no way to form four straight lines. So on your answer sheet mark the oval for **No** beside the number **2** for shape **2**.

Now look at shape **3**. Can the two pieces be arranged to cover all the shaded part of shape **3** and form two straight lines on the sides and two curved lines in the middle that touch each other? You could turn the two pieces around so that their curved sides are touching ; then the two pieces will completely cover the shaded part of the shape. On your answer sheet, mark the oval for **Yes** for shape **3**.

Now look at shape **4**. Can the two pieces be moved around so that they will completely cover the shaded part of shape **4** **without putting one piece on top on the other one** ? The answer is **No**. The only way that shape **4** could be formed is by placing part of one piece over another as shown by the dotted lines below:

. . . . . .

This is against the rules, so on your answer sheet mark the oval for **No** for shape **4**.

Now look at shape **5**. Can the two pieces be moved around in any way so that they cover the shaded part and form the shape outlined by the black line? The answer is **Yes**, one piece can be turned around and part of the straight side can be pushed against part of the straight side on the other piece as shown by the dotted outline below:

. . . . . .

By doing that you will cover all the shaded part and form the shape shown by the solid black line. Mark the oval for **Yes** for shape 1.

The authors claim that the Nonverbal Battery can be extremely useful in that it can be translated into any language, eliminating cultural biases; scores are not influenced by reading ability or language facility; and it allows students who process information in a holistic fashion to show how well they can reason.

The Reading Comprehension test of the CTBS is the instrument used within this study to assess the outcome variable Literacy. It includes a short reading selection followed by a comprehension question from which the individual chooses the most appropriate answer. For example:

CTBS

Reading Comprehension

Directions: This test consists of several reading selections. After each selection there are some exercises.

Read each selection quickly and answer the exercises. Four answers are given for each exercise, but only one of these answers is right. You are to choose the one answer that you think is better than the others. Then, on the answer sheet, find the row of answer spaces numbering the same as the exercise. Fill in the answer space for the best answer.

The sample exercise below shows you how to mark your answers on the answer sheet.

Every Sunday after dinner Dad gets a ball game on TV. The next thing we know he is snoring.

S1. What does Dad do on Sunday afternoon ?
1) Works in the yard
2) Goes to church
3) Takes a nap
4) Plays ball

The Mathematics Skills test of the CTBS is composed of the Mathematics Concepts, the Mathematics Problem Solving, and the Mathematics Computation subtests. For the current study the two subtests chosen for the Numeracy composite include the Mathematics Concepts and the Mathematics Problem Solving subtests. The Mathematics Concepts subtest requires the individual to exhibit their understanding of the number system and the terms and operations used in mathematics. For example:

CTBS

Mathematics Concepts

Directions: This is a test of how well you understand the number system and the terms and operation used in mathematics.

Four answers are given for each exercise, but only one of these answers is right. You are to choose the one answer that you think is better than the others. Then, on the answer sheet, find the row of answer spaces numbered the same as the exercise. Fill in the answer space for the best answer.

1. What whole number is greater then 7 and less than 9 ?

1) **2** 2) **6** 3) **8** 4) **10**

The Mathematics Problem Solving Subtest of the CTBS requires the individual to exhibit skills in solving mathematics problems. For example:

CTBS

Mathematics Problem Solving

Directions: This is a test of your skill in solving mathematics problems. The exercises in the test are like the samples shown at the right. After each exercise are three possible answers and a "Not given" - meaning that the correct answer is not given.

Work each exercise and compare your answer with the three possible answers. If the correct answer is given, fill in the answer space on the answer sheet that has the same number as the right answer. If the correct answer is not given, fill in the fourth answer space.

The sample exercises show you what to do.

S1. Peg has 1 sister and 2 brothers. How many brothers and sisters does she have ?
1) **2** 2) **3** 3) **4** 4) (Not given)

S2. Ben had 5 butterflies in a jar. He opened the jar and 4 flew away. How many did he have left ?
1) **5** 2) **4** 3) **2** 4) (Not given)

This chapter has examined the methodology and instrumentation used for the current study. Specific features analyzed included the Parent Instrument, the Canadian Cognitive Abilities Test (CCAT), the Canadian Tests of Basic Skills (CTBS), the sample of individuals used for the study, data collection and analysis techniques. It then moved into a thorough examination of the instruments used for the study. It

compared and contrasted general characteristics and specific subtests of the CCAT and the CTBS. The comparisons have shown that while many of the specific questions posed in each measure are much alike in structure and function, these two tests perform different functions. The CCAT deals with logical processes and high level abstractions designed to measure potential for learning. The CCAT is less directly related to school-based curriculum knowledge than the CTBS. The CTBS are concerned with the application of school-based knowledge to specific skill areas. Thus, measuring what is learned in school.

CHAPTER IV

Measurement Models and Model Estimation

Introduction

The purpose of this chapter is twofold. First it examines the measurement models and analyzes the data generated. Then it attempts an estimation of the model relationships. Several latent constructs, or linear composites, in the model were assembled hypothesizing one latent variable composed of several observed indicators. These constructs include: the socioeconomic composite, the academic aptitude composite, and the basic skills composite.

Each measurement model was subjected to a principal component analysis in order to construct weighted composites for the five variables--socioeconomic status, academic aptitude, basic skills, and literacy. Standardized item alpha reliability scores were generated and construct validity was measured.

A measurement model was used for the latent constructs (unobserved variables) in the study. Each latent variable reflects its observed indicators, which are measurable from the responses assigned to them. For example the latent variable SES, is a reflection of the scores on the four questionnaire items comprising socioeconomic status. Measures

of the components of SES must accurately represent this latent variable. This is illustrated in Figure 4.1.

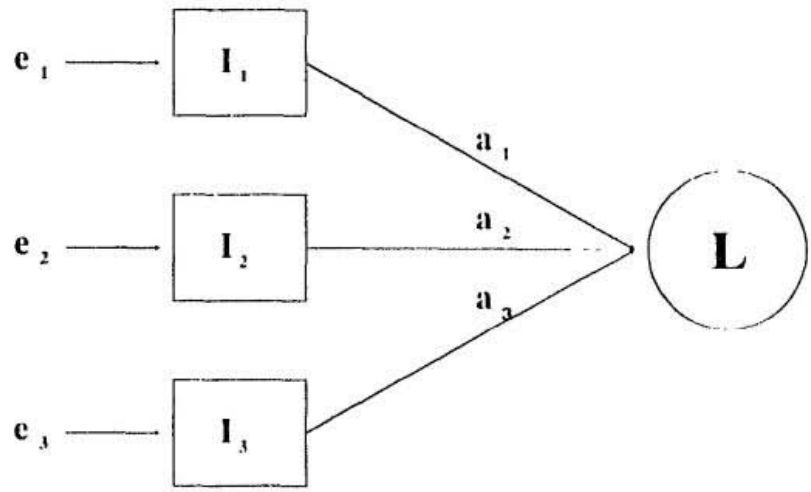


Figure 4.1 A Sample Measurement Model

L is the latent construct
I_1 - I_3 are the observed items (indicators for the latent variable)
a_1 - a_3 are the factor loadings
e_1 - e_3 are the residuals

The factor loading tells how well each item correlates with the construct. The residual on each item is calculated by using the formula $e = (1 \div h)^{1/2}$ where h represents the communality.

A standardized score was computed for each of the latent variables using the general equation:

$$L = a_1(X_1 - \overline{X}_1)/SD_1 + \ldots + a_n(X_n - \overline{X}_n)/SD_n$$

where L is the latent variable score

$a_1 - a_n$ are factor score coefficients computed by dividing the factor loading by the overall eigenvalue.

$(X_1 - \overline{X}_n)/SD$ is a general equation used to standardize the variable by transforming the raw item score into a standard score with a mean of zero and a standard deviation of one.

Each dimension of the achievement data was subjected to a principal component analysis before computing a score for that variable. Operating under the assumption that the variance in the items composing that construct would be responsible for the variance in that construct, items were retained only if they had appropriate content and factor loadings greater than .50. The items retained would be ones which appeared to be factorially homogeneous and thus could be considered to be a single meaningful construct. The indicators of the latent variables retained were used to compute the standardized score for that variable.

Socioeconomic Status

Socioeconomic status is a two-dimensional concept which was measured using employment status as a proxy for economic status, and years of educational training as a proxy for social status. The correlation matrix for the four items of

the parent questionnaire which composed the SES composite is displayed in Table 4.1 along with the means and standard deviations. The instrument was constructed hypothesizing one construct for the four items analyzed. However, because socioeconomic status is a multifaceted composite only the first three items had a significant factor loading, that is their factor loadings were greater than .50. Consequently, they became the final version of the construct. H107, number of children in the family, was dropped from the composite.

Table 4.1

Correlation Matrix for SES Composite

	Focc	H105	H106	H107	X	SD
Focc	1.000				45.48	14.21
H105	.621	1.000			4.211	1.691
H106	.3542	.4547	1.000		3.821	1.474
H107	-.0081	-.1123	-.1959	1.000	2.527	.8952

Determinant of correlation matrix = .4589
Kaiser-Meter-Olkin measure of sampling adequacy .6264

The mnemonics for this table have the following meanings: Focc = Father's Occupation, H105 = Father's Education, H106 Mother's Education, H107 = Total number of children in the family.

The remaining items were again subjected to a principal component analysis. The standardized alpha reliability was calculated to be .745. With all item loadings greater than .50 these items became the final version of the construct. The socioeconomic level was then calculated for each student using the general formula:

$$SES = FSC_1(VAR_1 - M_1)/SD_1 + \ldots FSCn(VAR_n - M_n)/SD_n$$

where FSC_i - FSC_n is the factor score coefficient

VAR_i - VAR_n is the variable used

M_i - M_n is the variable mean

SD_i - SD_n is the standard deviation

Factor score coefficients are shown in Table 4.2. The factor score coefficient was computed using the formula F_{sc} - $F_l \div E$. where Fl = factor loading and E = eigenvalue. (e.g., the factor score coefficient for item FOCC is $.8277 \div 1.962$). Using these figures the SES level was calculated as follows:

SES = .422((Focc - 45.483)/14.205)
+ .445((H105 - 4.211)/1.169)
+ .336((H106 - 3.821)/1.474)

Table 4.2

Principal Component Analysis for the SES Composite

	Factor Loadings	Factor Score Coefficients	Residuals
Focc	.8277	.422	.561
H105	.8732	.445	.488
H106	.7174	.366	.697

Standardized Alpha Reliability = .745
Eigenvalue = 1.962

The measurement model for the latent variable socioeconomic status (SES) is depicted in Figure 4.2. It shows the domain and the extent to which it reflects the observed variables, Focc, Fed, Med.

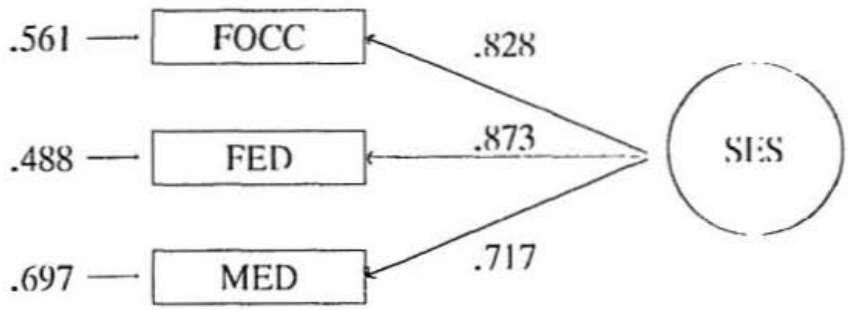


Figure 4.2 Measurement Model: Socioeconomic Status Composite (SES)

The Aptitude Composite

The correlation matrix for the 10 items which composed the aptitude composite is presented in Table 4.3 along with the means and standard deviations. As before, each item was subjected to a principal component analysis and only items with a factor loading greater than .50 were retained (see Table 4.4). The instrument was constructed hypothesizing one construct for the ten items analyzed. All items were retained. The level of aptitude was then calculated as follows:

```
Apt = .121((Voc3 - 12.562)/4.851)
    + .134((Sent3 - 17.709)/3.676)
    + .133((VClass3 - 14.798)/4.791)
    + .139((Vana3 - 16.596)/5.266)
    + .123((QRel3 - 15.670)/4.505)
    + .123((Noser3 - 15.367)/3.142)
    + .129((Equat3 - 12.378)/2.936)
    + .125((FigCl3 - 20.404)/3.562)
    + .137((FigAn3 - 16.657)/5.144)
    + .118((FigSyn3 - 25.232)/3.748)
```

Table 4.3

Correlation Matrix for the Aptitude Composite

	Voc	Sent	VClass	Vana	QREL	Noser	Equat	FigC1	Figdn	Figsyn	X	SD
Voc	1.000										12.56	4.851
Sent	.5868	1.000									17.71	3.676
VClass	.7194	.6560	1.000								14.80	4.791
Vana	.6408	.7057	.7111	1.000							16.60	5.266
QREL	.5406	.5409	.5993	.5682	1.000						15.67	4.506
Noser	.3958	.5981	.5079	.5330	.5153	1.000					15.37	3.142
Equat	.4881	.5807	.5625	.5837	.5759	.5851	1.000				12.38	2.936
FigC1	.3950	.5700	.5138	.5687	.5199	.5442	.5505	1.000			20.40	3.562
Figdn	.4820	.5513	.5627	.6606	.5806	.6443	.6363	.6734	1.000		16.65	5.145
Figsyn	.4458	.4908	.4606	.5196	.4942	.4677	.5274	.5508	.6317	1.000	25.23	3.749

Determinant of Correlation Matrix = .0017

Kaiser-Meyer-Akin Measure of Sampling Adequacy = .9302

Table 4.4

Principal Component Analysis for Aptitude Composite

	Factor loading	Factor Score coefficients	Residuals
Voc3	.840	.121	.543
Sent3	.828	.134	.560
VClass3	.811	.133	.585
Vana3	.807	.139	.591
Qrel3	.784	.125	.620
Noser3	.756	.129	.654
Equat3	.755	.130	.656
FigCl3	.744	.125	.675
FigAn3	.741	.137	.672
FigSyn3	.714	.118	.700

Standardized item alpha = .894
Eigenvalue = 6.05

The mnemonics for this table have the following meanings: Voc3 = Vocabulary Grade 3, Sent3 = Sentence Completion Grade 3, VClass3 = Verbal Classification Grade 3, Vana3 = Verbal Analogies Grade 3, Qrel3 = Quantitative Relationships Grade 3, Nosers3 = Number Series Grade 3, Equat3 = Equation Building Grade 3, FigCl3 = Figure Classification Grade 3, FigAn3 = Figure Analysis Grade 3, and FigSyn3 = Figure Synthesis Grade 3.

Standardized Apt. was calculated as follows:

SApt = (((Apt - .012)/1.020)15)+100)

The measurement model for the latent variable Aptitude (Apt) is depicted in Figure 4.3. It shows the domain and the extent to which it reflects the observed variables.

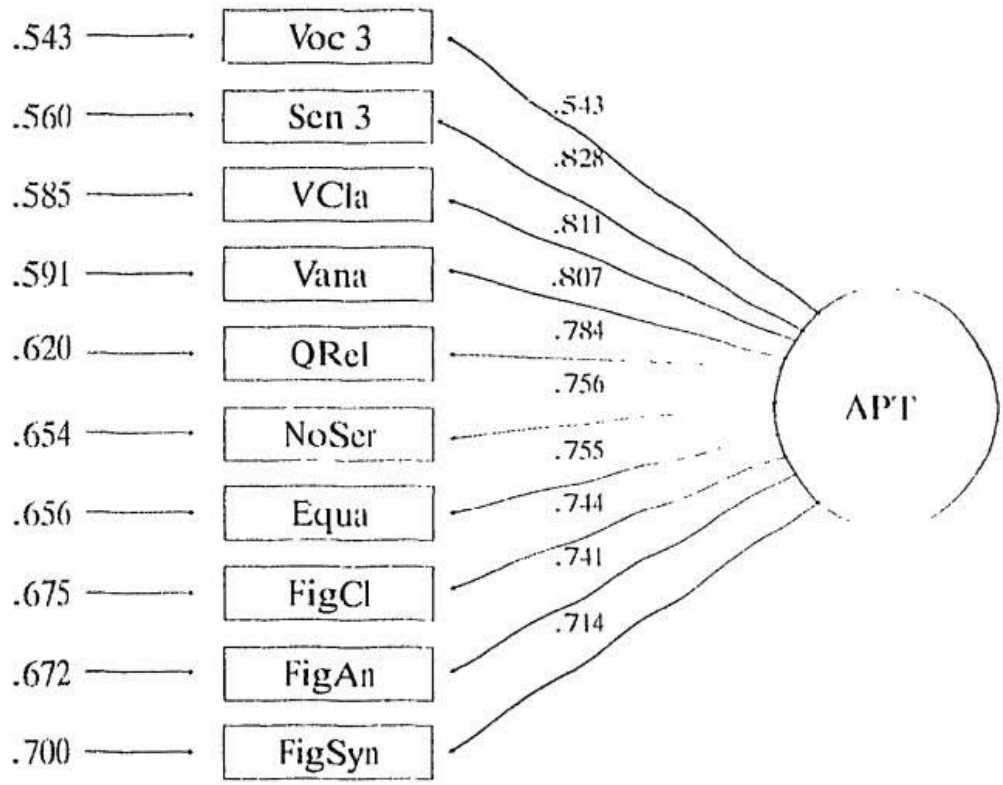


Figure 4.3 Measurement Model: Aptitude Composite (Apt)

The Basic Skills Composite

The correlation matrix for the five items which composed the basic skills composite is presented in Table 4.5 along with the means and standard deviations. The level of basic

skills was then calculated as follows:

$$\begin{aligned} BSkill = {} & .241((Spell4 - 4.080)/1.178) \\ & + .242((Voc4 - 3.896)/.979) \\ & + .241((Use4 - 3.722)/1.074) \\ & + .239((Caps4 - 3.794)/1.092) \\ & + .221((Punc4 - 3.862)/1.136) \end{aligned}$$

Table 4.5

Correlation Matrix for the Basic Skills Composite

	Spell4	Voc4	Use4	Caps4	Punc4	$\bar{X}$	SD
Spell4	1.00					4.08	1.18
Voc4	.667	1.00				3.90	.979
Use4	.683	.729	1.00			3.72	1.07
Caps4	.670	.640	.638	1.00		3.79	1.09
Punc4	.584	.574	.563	.638	1.00	3.86	1.14

Determinant of correlation matrix = .054
Kaiser-Meyer-Olkin measure of sampling adequacy = .879

The mnemonics for this table have the following meanings: Spell4 = Spelling Grade 4, Voc4 = Vocabulary Grade 4, Use4 = Language Usage Grade 4, Caps4 = Capitalization Grade 4, Punc4 = Punctuation Grade 4.

Table 4.6

Principal Component Analysis for Basic Skills Composite

	Factor loading	Factor Score coefficients	Residuals
Spell4	.859	.241	.527
Voc4	.861	.242	.530
Use4	.859	.241	.527
Caps4	.850	.239	.527
Punc4	.789	.222	.509

Standardized item alpha = .899
Eigenvalue = 3.561

Standardized Basic Skill was calculated as follows:

SBSkill = (((BSkill - .008)/1.028)15 + 100)

The measurement model for the latent variable Basic Skills is depicted in Figure 4.4. It shows the domain and the extent to which it reflects the observed variables.

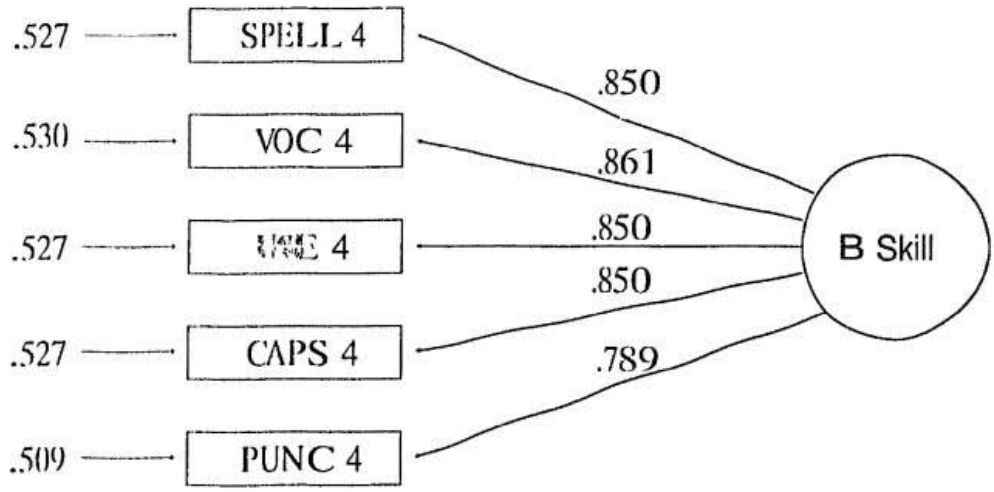


Figure 4.4 Measurement Model: Basic Skills Composite

Reliability

One concept of reliability is internal consistency. Cronbach's Coefficient Alpha is a general form of the Kuder-Richardson method of determining reliability (or internal consistency) of standardized tests (Borg & Gall, 1983, p. 285). This method is used to measure the internal consistency of tests which have multiple choice answers, such as the four-point scales used in the questionnaire for this study. The true reliabilities of the scales approximate or exceed the alpha reliability which is a lower bound estimate of the true reliability. From Table 4.7 we find that in all cases the reliability is acceptable.

Table 4.7

Reliability Coefficients and Validity Index for the Constructs

Variable	N items	Alpha Reliability	Construct Validity
SES	3	.745	.863
APT	10	.894	.946
BSKILL	5	.899	.948

Validity

Construct validity is the degree to which the questionnaire measures the construct postulated. Empirically this can be considered to be the extent to which the construct is a unitary trait, or can be accounted for adequately by one underlying factor. Heise and Bohrnstedt (1970) developed a means of estimating the validity and invalidity of a construct by dividing the reliability variance into validity and invalidity using the equation: "reliability" validity (squared) + invalidity. According to Williams and Batten (1981) when the variance in the construct is due to a single underlying factor the invalidity becomes zero, although the validity can be "less than the square root of the reliability

when the composite's variance is due to several underlying factors instead of a single factor" (p. 23). In this study each construct was developed assuming a single concept. The construct validity was computed as the square root of reliability. The validity of each construct was thus computed and listed in Table 4.7.

The measurement models have all been estimated and shown to be reliable and valid. Our attention will now turn to the estimation of the model relationships. It will begin by examining the descriptive statistics on all the model variables via a correlation matrix followed by a regression analysis and a reliability check.

Descriptive Statistics

The descriptive statistics for each of the variables used in the study are presented first. Although these statistics do not answer any of the questions in the study, they do provide some insight into the nature of the variables. The mean, standard deviation, number of cases, skewness and kurtosis for each variable are reported in Table 4.8.

Table 4.8

Descriptive Statistics for the Variables Used in the Model

Variables	Mean	SD	Cases	Skewness	Kurtosis
SES	.003	1.118	232	.490	.035
SAPT	.011	1.020	291	-1.215	1.730
SBSKILL	.008	1.028	288	-.133	.497
READ4	4.257	1.095	282		
SMATH	.000	1.054	279	.175	.327

The mnemonics for this table and in subsequent tables have the following meanings: SES = Socioeconomic Status, SAPT = Standardized Academic Aptitude, SBSKILL = Standardized Basic Skills, READ4 = Canadian Tests of Basic Skills (Reading, Grade Equivalent Score), and SMATH = Standardized Mathematics.

With the exception of grade four reading each variable in this model was given a standard score with a mean of zero and a standard deviation of one. This is to allow for comparisons between variables using a standard unit of measure. Grade 4 reading was not standardized because it is not a composite score, rather its value is determined by the average reading score of the participants. A mean of 4.257 indicates that the average reading level for each student at the end of grade four was just under the third month of grade four with 50% of the remaining scores falling within one month of the mean.

Descriptive statistical results indicate that the SES variable is normally distributed with a mesokurtic appearance. That is, it is neither too peaked or too flat. The SAPT variable is somewhat negatively skewed and leptokurtic or peaked in one direction. An interpretation of this may be that most of the children participating in the study displayed high levels of academic aptitude. It would appear that all variables are normally distributed; hence have the properties of interval scales. Because of this, it is possible to correlate the variables and conduct a regression analysis.

Before estimating the full model described in this study, the relationships between each variable were examined via a correlation matrix which is a bivariate statistic also known as the zero-order relationships (see Table 4.9). This statistic enables the researcher to describe in mathematical terms the strength of relationships between two variables.

Table 4.9

Correlation Matrix for Model Variables

	READ4	SMATH	SES	SAPT	SBSKILL
READ4	1.000				
SMATH	.6932 (274) p=.000	1.000			
SES	.3421 (221) p=.000	.2816 (223) p=.000	1.000		
SAPT	.7019 (275) P=.000	.7048 (275) P=.000	.3325 (226) P=.000	1.000	
SBSKILL	.7499 (272) p=.000	.7432 (271) p=.000	.3400 (224) p=.000	.7961 (284) p .000	1.000

(coefficient/cases/significance)

An examination of the correlation matrix presented above shows that all of the correlations are significant at p.< .001. The strongest relationship in the matrix appears to be between academic aptitude (r = .7961) and basic skills. This lends support to the theory that the relationship between the psychometric model of education and the basic skills model is very powerful. The next strongest relationship is between basic skills and reading (r = .7499). This indicates that a child's ability to read is very dependent on basic skills

acquired as a result of schooling although it must be cautioned that many children develop a great deal of their reading skills at home. A similar, although less powerful relationship, exists between basic skills and mathematics (r = .7432). Because basic skills and mathematics has a higher correlation than aptitude and mathematics (r = .7048), it would appear that basic skills is a better predictor of success in mathematics than is aptitude. While the relationship between aptitude and reading (r = .7019) is quite powerful, like mathematics, the ability to read appears to be more dependent upon the basic skills a child acquires. The correlation between mathematics and reading (r = .6932), the two outcome variables, is quite powerful as well. Weaker relationships, although very powerful, include those between socioeconomic status and reading (r = .3421); socioeconomic status and basic skills (r = .3400); socioeconomic status and aptitude (r = .3325); and socioeconomic status and mathematics (r = .2816). It can be concluded that while the socioeconomic status of a child has a significant bearing upon academic success, it is a less powerful predictor of literacy and numeracy than is either basic skills or academic aptitude. Also, math achievement is less home dependent as measured by socioeconomic status than reading.

These results indicate substantial support for the hypotheses posited earlier; however, a regression analysis

must be conducted before the model can be validated or refuted. A regression analysis will allow for a comparison between variables while taking into account the influence of other predictor variables. This is necessary because the confounding effects of other variables may lead to a misinterpretation of correlational findings. In a regression analysis the value of one variable is fixed while manipulation of the other variables takes place.

The recursive model will be examined first followed by the nonrecursive model. The model equation for the direct effects of the recursive model may be specified as follows:

(1) $X_2 = a_1 + b_{21}X_1 + e_1$

(2) $X_3 = a_2 + b_{31}X_1 + b_{32}X_2 + e_2$

(3) $X_4 = a_3 + b_{41}X_1 + b_{42}X_2 + b_{43}X_3 + e_3$

(4) $X_5 = a_4 + b_{51}X_1 + b_{52}X_2 + b_{53}X_3 + e_4$

Hypotheses Related to Academic Aptitude

1. There will be a significant relationship between socioeconomic status (SES) and academic aptitude (SAPT). (Accept)

Table 4.10

Regression Analysis Results for SES on SAPT

Independent Variables	SAPT				
	B	SE B	Beta	t	p.
SES	4.270	.8226	.2840	5.191	.0000

Multiple R = .284
R-square = .081
Residual = .959

p. - significance level

The results of the regression analysis indicate that there is a moderately strong relationship between socioeconomic status and academic aptitude. Social status is a function of the ability of a child's parents and some of the parent's abilities seem to be transmitted to the next generation, though the parameter estimate (.284) is less powerful than many suggest explaining only 8% of the total variance.

Hypotheses Related to Basic Skills

1. There will be a significant relationship between Basic Skills (SBSkill) and Academic Aptitude (SAPT). (Accept)

2. There will be a significant relationship between

Basic Skills (SBSkill) and Socioeconomic Status (SES). (Accept)

Table 4.11

Regression Analysis Results for SAPT and SES on SBSkill

Independent	SBSKILL				
Variable	B	SE B	Beta	t	p.
SAPT	.7595	.0370	.7630	20.77	.0000
SES	1.131	.5497	.0760	2.058	.0405
(Constant)	24.06	3.691		6.517	.0000

Multiple R = .788
R-square = .621
Residual =.616

There appears to be a very strong relationship between an individual's academic aptitude and the acquired basic skills. While the direct effect of socioeconomic status is modest it is statistically significant. The effect of socioeconomic status is mediated by academic aptitude. The indirect effect is .284 X .763 = .217. The total effect is therefore .076 + .284 = .360. This is a very powerful relationship and presents justification for the causal flow which is based on the fact that SAPT was measured before SBSKILL by some six months.

Hypotheses related to Mathematics Achievement: Recursive Model

1. There will be a significant relationship between Basic Skills (SBSkill) and Mathematics Achievement (SMath). (Accept)

2. There will be a significant relationship between Socioeconomic Status (SES) and Mathematics Achievement (SMath). (Reject)

3. There will be a significant relationship between Academic Aptitude (SAPT) and Mathematics Achievement (SMath). (Accept)

Table 4.12

Regression Analysis Results for SBSkill, SES, and SAPT on SMath. Recursive Model

Independent	SMath				
Variable	B	SE B	Beta	t	p.
SBSkill	.4081	.0638	.4149	6.397	.0000
SES	.4788	.6178	.0325	.775	.4389
SAPT	.3247	.0634	.3316	5.126	.0000
(Constant)	26.71	4.397		6.076	.0000

Multiple R = .716
R-square = .513
Residual = .698

There is a strong relationship between the basic skills an individual has acquired and mathematics achievement. The same can be said for a student's academic and mathematics achievement. Socioeconomic status has a negligible direct effect of .033. In terms of academic achievement in mathematics it would appear that the basic skills an individual acquires is marginally more important than the aptitude one has and becomes a more important predictor of academic success than does aptitude.

Hypotheses related to Reading Achievement Recursive Model

1. There will be a significant relationship between Basic Skills (SBSkill) and Reading Achievement (READ4). (Accept)

2. There will be a significant relationship between Socioeconomic Status (SES) and Reading Achievement (READ4). (Reject)

3. There will be a significant relationship between Academic Aptitude (SAPT) and Reading Achievement (READ4). (Accept)

Table 4.13

Regression Analysis Results for SBSkill, SES, and SAPT on READ4 (Reading): Recursive Model.

Independent Variable	B	SE B	READ4 Beta	t	p.
SBSkill	.0350	.0048	.4625	7.261	.0000
SES	.0859	.0466	.0760	1.842	.0664
SAPT	.0209	.0048	.2774	4.367	.0000
(Constant)	-1.326	.3318		-3.998	.0001

Multiple R = .728
R-square = .530
Residual = .686

As with the mathematics construct, the greatest influence upon an individual's ability to read appears to be that of basic skills acquired as a result of schooling. The socioeconomic status of a student appears to have little effect upon reading success. However, we have examined only the direct effects and not accounted for the possible indirect effects of each variable. To get a total picture of the direct and indirect effects of all variables upon the outcome variables, a more thorough analysis will be in order.

Hypotheses related to Mathematics Achievement: Nonrecursive Model

1. There will be a significant relationship between Reading Achievement (READ4) and Mathematics Achievement (SMath). (Accept)

2. There will be a significant relationship between Socioeconomic Status (SES) and Mathematics Achievement (SMath). (Reject)

3. There will be significant relationship between Academic Aptitude (SAPT) and Mathematics Achievement (SMath). (Accept)

4. There will be a significant relationship between Basic Skills (SBSkill) and Mathematics Achievement (SMath). (Accept)

Table 4.14

Regression Analysis Results for READ4, SES, SAPT and SBSkill on SMath. Nonrecursive Model.

Independent	SMath				
Variable	B	SE B	Beta	t	p.
READ4	4.267	.7196	.3279	5.930	.0000
SES	.1124	.5891	.0076	.191	.8489
SAPT	.2357	.0620	.2410	3.805	.0002
SBSkill	.2590	.0655	.2633	3.953	.0001
(Constant)	32.37	4.277		7.569	.0000

Multiple R = .751
R-square = .564
Residual = .660

The direct effect of a student's ability to read on the mathematics construct, within a nonrecursive model, is significant as are the basic skills and one's academic ability. Like the recursive model however, the effect of socioeconomic status on math achievement is negligible.

Hypotheses related to Reading Achievement Nonrecursive Model

1. There will be a significant relationship between Mathematics Achievement (SMath) and Reading Achievement (READ4). (Accept)

2. There will be a significant relationship between

socioeconomic status (SES) and Reading Achievement (READ4). (Reject)

3. There will be a significant relationship between Academic Aptitude (SAPT) and Reading Achievement (READ4). (Accept)

4. There will be a significant relationship between Basic Skills (SBSkill) and Reading Achievement (READ4). (Accept)

Table 4.15

Regression Analysis Results for SMATH, SES, SAPT and SBSkill on READ4 (Reading). Nonrecursive Model

Independent	READ4				
Variable	B	SE B	Beta	t	p.
SMath	.0243	.0041	.3162	5.930	.0000
SES	.0742	.0442	.0656	1.678	.0944
SAPT	.0130	.0047	.1726	2.748	.0063
SBSkill	.0250	.0049	.3313	5.150	.0000
(Constant)	-1.976	.3331		-5.930	.0000

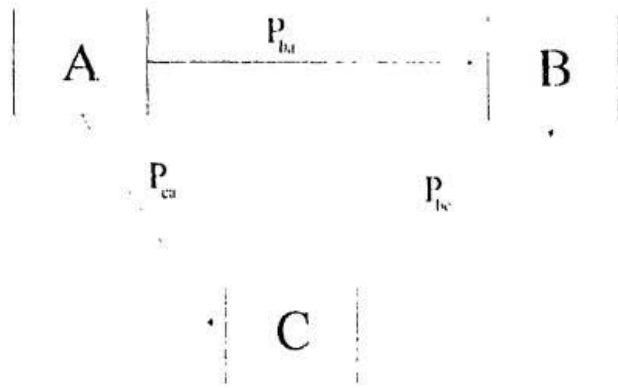
Multiple R = .761
R-square = .579
Residual = .649

The most powerful predictor of an individual's ability to read, in a nonrecursive model, appears to be the basic skills acquired. The effect of a student's ability to do mathematics is also statistically significant followed by academic aptitude. The effect of a student's socioeconomic status is negligible. In all instances the direct effects of the indicator variables upon the outcome variables were stronger within the recursive models than within the nonrecursive models.

In summary, by examining the direct effects it would appear that for both reading and math the most powerful variable is the basic skills a student acquires. While the direct effect of a student's academic aptitude is also quite powerful it is not as strong as the direct effects of basic skills. In the nonrecursive model we see that there is a reciprocal effect between reading and math and success in one depends upon success in the other. As mentioned earlier, to establish a true picture of the effects of the indicator variables on the outcome variables the indirect effects must first be measured.

The direct and indirect effects in path models may be examined. For example, an indirect effect between a dependent variable and an independent variable through an intervening variable may be discovered. Path coefficients are standardized partial regression coefficients; which means that the

coefficient is the relative (or net) effect of a relationship after the effects of the predictors in the equation have been taken into account or partialled out. In the following example, if variable A is viewed as the single cause of B, then the path coefficient (P_{ba}) is equal to the product-moment coefficient (P_{ab}).



However, in the example given, variable A is not the single cause of B, and the path coefficient represents the strength of the relationship between two variables with the effects of the other variable removed (or partialled out). The **"direct"** effect of B on A is the path coefficient (P_{ba}). The path coefficient is usually less than the product-moment for the same variables. It must be noted here that the path coefficient is a lower limit estimate. When there are zero correlations between independent variables, the path coefficients and the zero-order relationships (correlations) are the same.

The "**indirect**" effect is the effect which variable A has on variable B through the intervening variable C. The indirect effect is measured as a product of the path coefficients P_{ca} and P_{bc}. The "**total**" effect between A and B is the sum of the direct effect and the indirect effect between these two variables.

Table 4.16

Correlations, Direct Effects (beta), Indirect Effects, Total Effects and t-values for the Effects of the Independent Variables on the Achievement Outcomes. Recursive Model

Indep Var	Corr (r)	Direct Effect	t-value	Indirect Effect	Total Effect	t-value[A]
Mathematics						
SES	.2816	.033	.775	.216	.249	4.30
SAPT	.7048	.332	5.126	.317	.649	14.50
SBSkill	.7432	.415	6.397	-	.415	7.72
Multiple R = .716						
R-square = .513						
Residual = .698						
Reading Comprehension						
SES	.3421	.076	1.84	.214	.290	4.597
SAPT	.7019	.277	4.37	.353	.630	13.79
SBSkill	.7490	.462	7.26	-	.462	8.81
Multiple R = .728						
R-square = .530						
Residual = .728						

[A] t-value of 2.0 is significant at the $p < .001$ level. The t-value is for the total effects only. The assumption underlying the computation of the t-value for total effects is that in moderately large samples the ratio of the estimator to its standard error follows the t-distribution; hence, the significance level of the total effect parameter can be estimated using the classical method. For theoretical support see Bollen and Stine (1990); for an applications of its use see Bulcock, Whitt and Beebe (1991).

Whereas in the direct effect model basic skills were most powerful in predicting reading and math success, when you take the indirect effects into account academic aptitude becomes very powerful. It affects reading and math over and above skills learned. Because basic skills are so responsive to a child's aptitude then aptitude influences reading and math because it influences basic skills which in turn affects outcome. Therefore, academic aptitude and basic skills variables both need to be considered in predicting or explaining reading and math achievement. The same conclusions apply to the nonrecursive model.

Table 4.17

Correlations, Direct Effects (beta), Indirect Effects, Total Effects and t-values for the Effects of the Independent Variables on the Achievement Outcomes. Nonrecursive Model

Indep Var	Corr (r)	Direct Effect	t-value	Indirect Effect	Total Effect	t-Value[A]
Mathematics						
READ	.6932	.328	5.93	-	-	-
SES	.2816	.008	.191	.193	.201	8.04
SAPT	.7048	.241	3.81	.341	.582	12.17
SBSkill	.7432	.263	3.95	.109	.372	7.94
Multiple R = .751 R-square = .564 Residual = .660						
Reading Comprehension						
Math	.6932	.316	5.93	-	-	-
SES	.3421	.066	1.68	.173	.179	2.76
SAPT	.7019	.173	2.75	.392	.565	11.64
SBSkill	.7490	.331	5.15	.083	.414	7.69
Multiple R = .761 R-square = .579 Residual = .649						

[A] t-value of 2.0 is significant at the $p < .001$ level. The t-value is for the total effects only. The assumption underlying the computation of the t-value for total effects is that in moderately large samples the ratio of the estimator to its standard error follows the t-distribution; hence, the significance level of the total effect parameter can be estimated using the classical method. For theoretical support see Bollen and Stine (1990); for an applications of its use see Bulcock, Whitt and Beebe (1991).

Within the nonrecursive model the direct effects of the three variables, in descending order, upon mathematics is the same as for the recursive model namely; basic skills, aptitude, and socioeconomic status. The total effects of the same three variables, in descending order, upon mathematics is academic aptitude, basic skills and socioeconomic status. The same pat' 'rn of direct effects emerges for reading however, the total effect pattern in descending order is academic aptitude, basic skills and socioeconomic status.

Summary of the Findings

The findings of this chapter which relate to each independent variable (Socioeconomic Status, Academic Aptitude, Basic Skills and Reading and Mathematics Achievement) are grouped together and summarized in this section. Refer to figures 4.5 and 4.6 for a visual interpretation of these relationships.

The first significant finding is that Math and Reading achievement are good predictors of each other. Success in one subject will often determine success in the other. Likewise, failure in one subject will predict failure in the other. An exception to this finding however, is in the case of the student who suffers from a specific learning disability.

A second finding of this study is that socioeconomic status is not a good predictor of math achievement. The direct

effects are negligible; however, the total effects via Academic Aptitude and Basic Skills are significant.

A third finding is that academic aptitude and basic skills acquired as a result of schooling are both good predictors of Math achievement. The child who possesses sufficient academic aptitude and basic skills will likely succeed in Math, regardless of the family's socioeconomic status.

As in the case with Math achievement, socioeconomic status is not a good predictor of reading achievement. The total effects via Academic Aptitude and Basic Skills are significant; however, the direct effects are negligible.

A final conclusion is that the skills an individual acquires as a result of schooling, rather than an academic aptitude, accounts for the lion's share of reading achievement. The direct effects of Basic Skills are more powerful than the direct effects of Academic Aptitude, but the total effects of aptitude in both models are more powerful than the effects of Basic Skills on both outcomes.

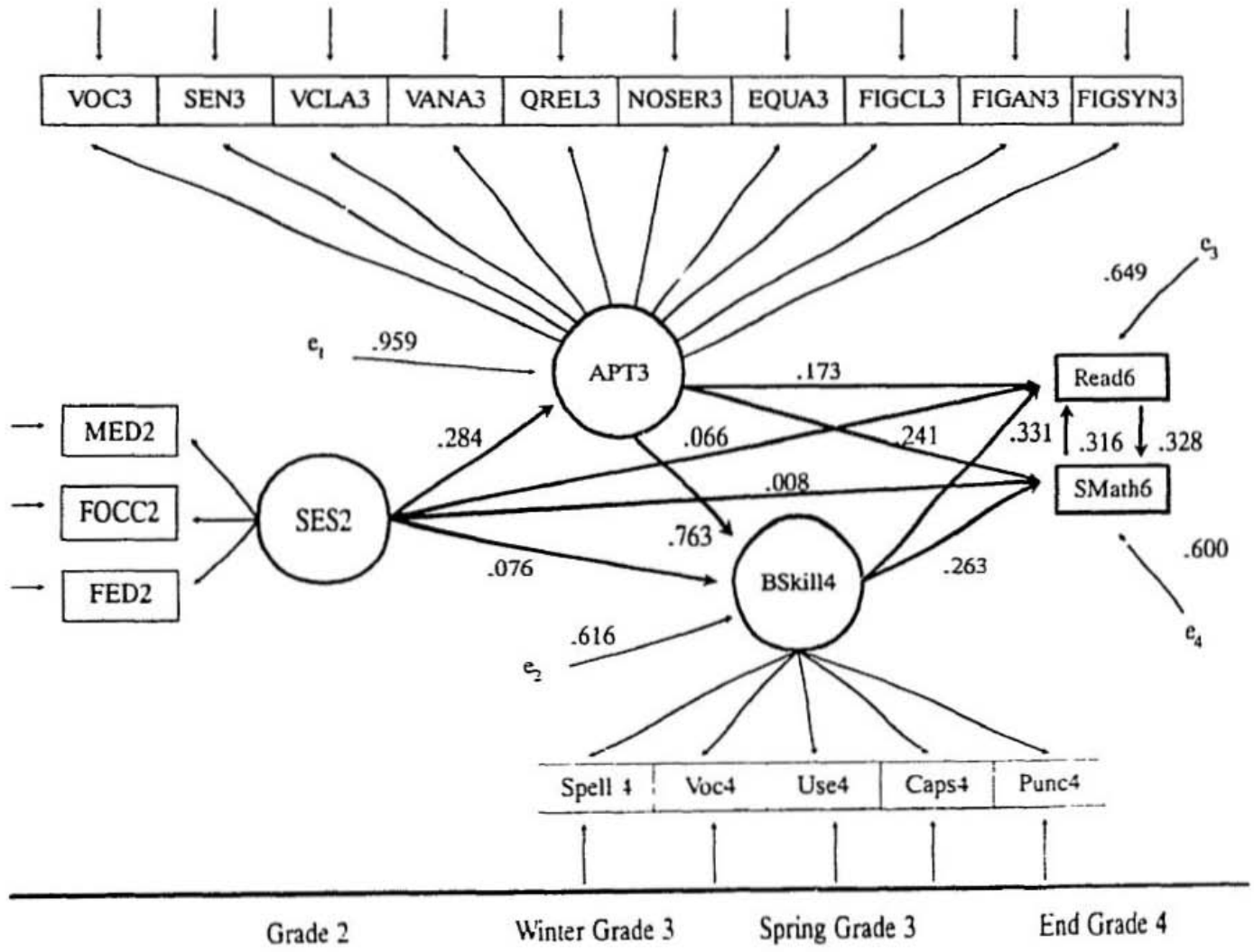
This chapter has examined the measurement models and analyzed the generated data. It then attempted an estimation of the model relationships. Several linear composites were assembled hypothesizing one latent variable composed of several observed indicators. These constructs included: the socioeconomic composite; the academic aptitude composite; the

basic skills composite and the Math composite.

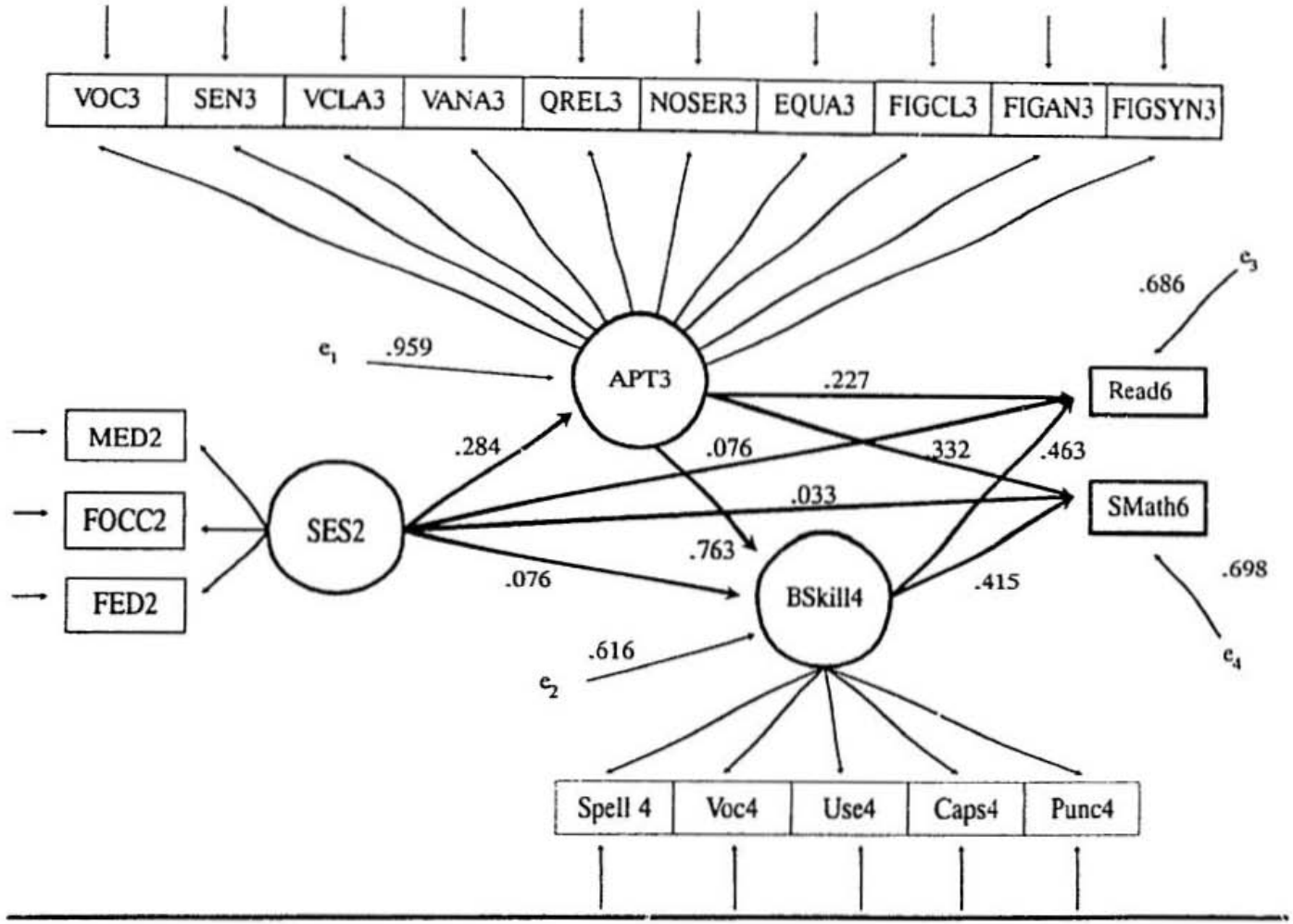
Each model was then subjected to a principal component analysis, standardized item alpha reliability scores were generated and construct validity was measured.

The next chapter will provide a discussion and interpretation of the major findings, provide several theoretical and practical implications, and offer suggestions for further research within this area.

THE DISAGGREGATED NONRECURSIVE MODEL



THE DISAGGREGATED RECURSIVE MODEL



CHAPTER V

Summary and Conclusions

Introduction

This chapter will present a synopsis of the study; discuss the implications of the findings in terms of policy and practice; and suggest potential research which might build on the findings.

Summary

By themselves neither basic skills nor academic aptitude provides for a comprehensive theory of reading and mathematics performance. One without the other provides only a partial explanation; however, together they are complementary, and as such constitute a very powerful explanatory model.

While the individual effect of socioeconomic status on reading and mathematics is negligible, in a recursive model socioeconomic status does influence aptitude, and aptitude is a strong predictor of math and reading achievement. It does have a similar, although not as powerful, impact on basic skills. Although the direct effect is insignificant, when the indirect effect is taken into account, socioeconomic status becomes a significant factor in both the recursive and nonrecursive models. Only by examining its indirect effect can

we see its importance.

This thesis has examined the relative impact of a child's socioeconomic status, academic aptitude, and basic skills upon literacy and numeracy. By using a structural equation model it was possible to examine the relative influence of each of the indicator variables on each of the outcome variables, both in recursive and nonrecursive models. On the basis of this data analysis a number of research questions were addressed. These are taken up next.

Discussion and Interpretation of Major Findings

The following discussion will review the results of the study with respect to the six research questions posed on page twelve of Chapter I.

The first research question asks: How responsive are the psychometric and basic skills factors to changes in family environment? From the analysis it would appear that the psychometric model is responsive to changes in family environments; furthermore, the relationship is moderately strong. In other words, children from privileged backgrounds have a greater opportunity for learning things at home which will reflect success with the school curriculum. There is no attempt however, to determine exactly what these influences are. When controlling for the effect of a child's academic aptitude the relationship between their socioeconomic status

and the basic skills acquired as a result of schooling is statistically significant, although weak. While the direct effect of socioeconomic status is only moderately significant, the total effect is substantial. The total effect is powerful, not because of its direct effect; rather, because of its total effect via academic aptitude. Both the academic aptitude and the basic skills models are very dependent on the child's socioeconomic status and the more privileged the home, the more likely the child will meet with academic success.

The second research question asked: Does family environment affect basic skills achievement over and above the effects of scholastic aptitude? The analysis indicates that a family's socioeconomic status does affect basic skills achievement beyond the effects of academic aptitude. Both the direct and indirect effects are significant which means that the family environmental effects are powerful and an important predictor of achievement even when controlling for the individual's academic aptitude.

The third research question asked: When controlling for the impact of the psychometric and basic skills measurement models on reading, does family background have any effect? In terms of the direct effect on literacy the socioeconomic status of the family, when controlling for academic aptitude and basic skills, is not statistically significant; however, the child's socioeconomic status accounts for reading

performance via academic aptitude and basic skills and when such indirect effects are taken into account the effects of socioeconomic status via these intervening variables is significant. Even when controlling for academic aptitude and basic skills, the socioeconomic status model has a powerful indirect effect. Therefore, socioeconomic status governs academic aptitude and basic skills which, in turn, affect reading.

The fourth research question asked: Does family background have effects on mathematics achievement over and above the effects of the psychometric and basic skills models? Like reading, the socioeconomic status of the family appears to have a powerful indirect effect on mathematics achievement. Likewise, socioeconomic status governs academic aptitude and basic skills which, in turn, affects mathematics achievement.

The fifth research question asked: Does the psychometric model have independent effects on literacy and numeracy over and above the effects of family background and the basic skills? The findings show that the direct effect of the psychometric model on math, when controlling for socioeconomic status and basic skills, is powerful. Similar results have been found for reading. The indirect effect of the psychometric model is also significant; however, its indirect effect on reading is greater than its indirect effect on math.

The final research question to be addressed by this study

asked: Does the basic skills model have independent effects on literacy and numeracy over and above the effects of the family background and psychometric models? The research shows that the direct effect of basic skills on math, when controlling for socioeconomic status and academic aptitude, is powerful and of greater significance than the direct effects of the psychometric model. Similar results have been found for reading. It is not possible for basic skills to have an indirect effect because there is no intervening variable.

Conclusions

An important point to be made before concluding this study is that the theory of literacy and numeracy competency has been formulated as a model or a set of mathematical equations. Models are representations, not the real thing. They describe the structure of something; in this case the structure of literacy and numeracy in the early grades (3 4). They are simplifications of the enormous complexity among the stimuli or observables in the field settings where literacy and numeracy development actually occurs. The stimuli in these field settings have been grouped into concepts at a much higher level of generality then the observables themselves. In fact, some higher order concepts such as aptitude are themselves composed of lower order concepts such as verbal ability, quantitative reasoning and perception.

Thus, literacy and numeracy has been explained, not in terms of concrete observable stimuli but, rather, in terms of higher level concepts. This is usually the level at which modelling takes place, because it is at this higher level of abstraction that the researcher can impose logical unity. The observables such as test items on a test battery constitute a rich data base; one which is valuable in terms of detail. Models on the other hand are much poorer in detail, but richer in terms of logical unity. This is why the criticism that models are not "realistic" is valid. But such criticism misses the mark since models, by definition, are not real. They are metaphors. Rather than mirroring reality in all its mind boggling complexity, they stand back from the detail, as it were, in order to reduce the features of reality to a more manageable form for purposes of prediction and control. If prediction is impossible there is no knowledge.

The fit of the prediction equations in this thesis was remarkably good. It is rare for the fit of educational models to the data to be as good as the one's reported here. Around 60 percent of the variance was being accounted for in each outcome. Nevertheless, the magnitude of the residuals suggest that important variables may have been omitted; that is, the models may have been misspecified, but probably not seriously so.

The structure of Literacy and Numeracy consists of

socioeconomic status, academic aptitude and basic skills acquired as a result of schooling. There may also be other minor intervening variables; however, it is impossible to take every stimuli into account. From this study it would appear that it is not possible to acquire an accurate profile of an individual's learning style unless all three of the socioeconomic status, psychometric, and basic skills models are considered. One without the other offers only a partial profile. The socioeconomic model appears to be the weakest which means that the schools can compensate for individual differences within this model. In comparing the psychometric model with the basic skills model it would appear that the former is the more powerful of the two. The basic skills model was more powerful in math but academic aptitude governs the basic skills thereby rendering it more powerful.

The findings indicate that the psychometric and basic skills models are clearly complementary. Although, the direct effects of the psychometric model were substantially attenuated in the presence of the basic skills model, the indirect effects of the psychometric model on literacy and numeracy via the basic sills were substantial. The aptitude of the child governed reading and math performance directly; but it also conditioned the basic skills i.e what is learned in school, which in turn had powerful direct effects on reading and mathematics. It was the power of this indirect effect which

gave aptitude a total effect which was more powerful overall than that of basic skills.

Theoretical Implications

It would appear that effects of the psychometric and the basic skills models on literacy and numeracy are significant, even when controlling for the effects of home background resources. This finding lends an empirical basis to measurement theories developed by theorists and psychometricians which has been absent in the past. In placing students on school programs, or in evaluating student ability and achievement, teachers must take both variables into account while allowing for differences in the socioeconomic status of the students. Teachers must be cognizant of the properties and significance of both variables. Both aptitude and basic skills are key components of children's competencies in comprehending reading and mathematical symbols, and while these may not be regarded as novel findings, this thesis was the first to address this question. The research did what it was designed to do; namely, sensitize the reader to the elements of the basic structure underlying the development of literacy and numeracy. In this way the research helped to clarify our formal understanding of the structure of school achievement.

Practical Implications

Extensive assessment which incorporates both aptitude and achievement testing appears to be the most logical method of creating an accurate profile of individuals' learning style. Yet, this is probably impractical since the amount of testing that would be incurred would be excessive ... even if teachers had the time and qualifications to administer and mark such tests. One answer to this dilemma might lie in computerized adaptive testing. This form of testing has several advantages in that it eliminates tester bias, provides individual interactive assessment, and is tailored to the specific needs of the individual thereby eliminating unnecessary questions. As well, computerized adaptive testing is more likely to capture and maintain the attention of the individual than a traditional pencil-and-paper test.

In an adaptive test one or more items are administered to the individual; scored according to their response; and based upon their answer either easier or more difficult questions are provided. Items to be administered are neither too difficult or too easy and are chosen from a bank of questions determined to be most appropriate for the individual.

A computerized adaptive test which, first asks several questions about the individual's socioeconomic status, groups the child accordingly, and then assesses the individual's academic potential and actual achievement levels, would

provide a comprehensive profile of the individual. From this profile appropriate programs could be developed which address the specific needs of the individual. Such programs could be computer generated based upon a list of national norms. Each child could then be placed on a program which would maximize that individual's academic potential.

Research Suggestions

This research opens the doors to many fields of study. Because of its unique quantitative, longitudinal data dealing with socioeconomic status, academic aptitude, basic skills, and literacy and numeracy, it invites a great deal of future research.

One of the most important implications of the current study is for interdisciplinary research involving the collaboration between reading specialists, cognitive psychologists, geneticists, neurologists, etc. It would appear that a collective, interdisciplinary effort would meld various theoretical perspectives and empirical evidence often found lacking in a purely educational approach. Such interdisciplinary approaches should be included in future model building.

Another significant implication of this study is for researchers to be concerned about 'over-testing'. Testing should be conducted with a specific goal in mind and instruments should be reliable and valid. For example; assessments

should be conducted to examine particular learning styles and to analyze strengths and weaknesses; not as a justification for placement in a special education class. Researchers should also be careful that each test administered assesses something different. That is, the tests measure exactly what they promise rather than being redundant measures of the same trait i.e. academic aptitude or achievement. The individual administering the instrument should be a qualified diagnostician and thoroughly familiar with the test. One way of eliminating tester bias is to develop computerized testing methods which allow for direct interaction between the individual and the instrument.

Studies such as this one are important in that they lend an empirical basis to an otherwise purely theory driven approach to education. They also supply a measure of accountability to a system which has traditionally been trendy and non-scientific. Further studies should deal with larger populations and add further variables to the current model. It is only when education has been examined from an empirical basis does it become possible to account for learning and the relative contribution of individual and confounding factors.

Bibliography

Anderson, R.C., & Freebody, P. (1979). Vocabulary Knowledge (Tech. Rep. No. 136). Urbana: University of Illinois, Center for the Study of Reading.

Antonak, R.F., King, S., & Lowy J.J. (1981). Otis-Lennon mental ability test, the Stanford achievement test, and three demographic variables as predictors of achievement in grades 2 and 4. Journal of Research in Education, 75, 366-373.

Antonak, R.F. (1988). Relationships between group IQ and scholastic achievement at grades two, four, and six. Educational Research Quarterly, 12 (2).

Beebe, M.J. (1990). Literacy theories informing the teaching of reading: the transition to whole language instruction. In S. Norris, & L. Phillips (Eds.), Foundation of Literacy Policy in Canada, pp. 147-164. Detselig Enterprises Ltd. Calgary, Alberta.

Beers, J., & Henderson, E. (1977). A study of developing orthographic concepts among first graders. Research in the Teaching of English, 11(2), 133-148.

Bloom, B.S. (1976). Human characteristics and school learning. New York: McGraw-Hill Book Company.

Bollen. K.A., & Stine, R. (1990). Direct and indirect effects: Classical and bootstrap estimates of reliability. In C.C. Clogg (Ed.), Sociological Methodology (pp. 115 - 140). Oxford: Blackwell.

Bond, E. (1960). Teaching the Child to Read (3rd ed.). MacMillan. New York.

Borg, W.R. & Gall, M.D. (Ed.),(1983). Educational research: An introduction. New York: Longmans.

Bransford, J.D., & Nitsch, K.E. (1978). Coming to understand things we could not previously understand. In J. Kavanaugh & W. Strange (Eds.), Speech and Language in the Laboratory, School, and Clinic. Cambridge, MA.: MIT Press.

Bulcock, J.W. (1982). Project Summary. The Structure of Elementary School Achievement. Unpublished paper, St. John's: Memorial University of Newfoundland.

Bulcock, J.W., Whitt, M.E., & Beebe. M.J. (1991). Gender differences, student well-being and high school achievement. Alberta Journal of Educational Research, 37 (3), 209-224.

Carver, R.P. (1990). Intelligence and reading ability in grades 2-12. Intelligence, 14, 449-455.

Chall, J.S. (1958). Readability: An Appraisal of Research and Application. Columbus: Ohio University Press.

Clarke-Stewart, K.A., & Apfel, N. (1978). Evaluating parental effects on child development. Review of Research in Education, 6, 47-119.

Clarke, M.M. (1976). Young Fluent Readers. London: Hienemann Educational Books.

Cochran, J.M. (1989, May). The Best of all Worlds. Instructor, 158 (9), 38-42.

Cooper, C.R., & Petrosky, A.R. (1976). A psycholinguistic view of the fluent reading process. Journal of Reading, 20, 184-207.

Cronbach, L.J., & Snow, R.E. (1977). Aptitudes and Instructional Methods. New York: Irvington.

Curtis, M.E., & Glaser, R. (1982). Changing conceptions of intelligence. In D.C. Berliner (Ed.) Review of Research in Education. Washington, D.C.: The American Education Research Association.

Davis, F.B. (1968). Research in comprehension in reading. Reading Research Quarterly, 3, 499-545.

Durkin, D. (1970). A language arts program for first grade children: Two year achievement report. Reading Research Quarterly, 5(4), 334-565.

Durkin D. (1966). The achievement of pre-school readers: Two longitudinal studies. Reading Research Quarterly, 1(4), 5-36.

Farr, R. (1969). Tests of reading readiness and achievement: A review and evaluation. Reading Aids Association. Newark, DE.

Fennema, E., & Behr, M.J. (1980). Individual differences and the learning of mathematics. In R.J. Shumway (Ed.), Research in Mathematics Education. Reston, VA.: National Council of Teachers of Mathematics (ERIC Document reproduction Service No. ED 187 563).

Fey, J.T. (1980). Mathematics education research on curriculum and instruction. In R.J. Shumway (Ed.), Research in Mathematics Education. Reston, VA.: National Council of Teachers of Mathematics (ERIC Document Reproduction Service No. ED 187 563).

Goodman, K.S. (1986). Basal readers: A call for action. Language Arts, 63, 358-363.

Goodman K.S. (1968). The psycholinguistic nature of the reading process. In K.S. Goodman (Ed.), The Psycholinguistic Nature of the Reading Process (pp. 15-26). Detroit: Wayne State University Press.

Goodman, K., & Burke, C. (1980). Reading Strategies: Focus on Comprehension. New York: Holt, Rinehart, & Winston.

Harris, A.J. (1979). Child development and reading. Readings on reading instruction, (Ed.) Harris, A.J. and Sipay, E.R.. New Yrok: David McKay Company, Inc. 1972.

Heise, D.R., & Bohrnstedt, G.W. (1970). Validity, invalidity, and reliability. In E.F. Borgatta, & G.W. Bohrnstedt, (Eds.), Social Methodology. pp. 104-129. San Francisco: Jossey-Bass.

Holdaway, D. (1979). The Foundations of Literacy. Sydney: Ashton Scholastic.

Holdaway, D. (1984). Stability and Change in Literacy Learning. London: The Althouse Press, The University of Western Ontario.

Huck, C.S. (1977). Literature as the content of reading. Theory into Practice, 16, 363-371.

Kennedy, E.C. (1981). Methods in Teaching Developmental Reading. Itasca, ID: F.E. Peacock.

Kerlinger, F. & Pedhazur, E. (1967). Educational attitudes and perceptions of desirable traits of teachers. Final report. New York: New York Univiversity.

King, E.M., Hieronymus, A.N., Lindquist, E.F., & Hoover, H.D. (1982). Canadian tests of basic skills: Teacher's guide. Scarborough: Nelson Canada.

Klare, G.R. (1974-75). Assessment readability. Reading Research Quarterly, 10, 62-102.

Kohn, M. (1977). Class and conformity: Reassessment. Paper prepared for the Conference on Research Perspectives in the Ecology of Human Development, Cornell University, Ithaca, N.Y.. In Clarke-Stewart, K.A., & Apfel, N.. Evaluating Parental Effects on Child Development.. Review of Research in Education, 6, 1978.

Kuusinen, J., & Leskinen E. (1988). Latent structure analysis of longitudinal data on relations between intellectual abilities and school achievement. Multivariate Behavioral Research, 23, 103-118.

Lorge, I. & Chall, J.S. (1963). Estimating the size of vocabularies of children and adults: An analysis of methodological issues. Journal of Experimental Education, 32, 147-157.

Lustberg, R.S., Motta, R., & Naccari, N. (1990, April). A model using the WISC-R to predict success in programs for gifted children. Psychology in the Schools, 27, 126-131.

Marek, E.A. (1981). Correlations among cognitive development, IQ and achievement of high school biology students. Journal of Research in Science Teaching, 18(1), 9-14.

Marjoribanks, K. (1987). Individual-environment correlates of children's mathematics achievement. Educational Studies, 13(2), 115-123.

Mason, J.M. (1983). An examination of reading instruction in third and fourth grade. The Reading Teacher, 36, 906-913.

Melvin, M.P. (1979). Psycholinguistics and the teaching of reading. The Elementary School Journal, 79, 227-283.

Meuhl, S., & DiNello, M.C. (1976). Early first grade skills related to subsequent reading performance: A seven year follow up study. Journal of Reading Behaviour.

Naglieri, J.A. (1980). McCarthy and WISC-R correlations with WRAT achievement scores. Perceptual and Motor Skills, 51, 392-94.

Nagy, W.E., Herman. P.A., & Anderson, R.C. (1986). Learning words from context. Reading Research Quarterly, 22, 233-253.

Nelson, K. (1978). Semantic development and the development of semantic memory. In K.E. Nelson (Ed.), Children's Language (Vol. 1). New York: Gardner Press.

Newman, J. (1985). Whole Language: Theory in Use. Portsmouth, NH: Heinemann.

Otto, J. (1982). The new debate in reading. The Reading Teacher. 36, 14-18.

Phelps, L., & Branyan, J. (1990, July). Academic achievement and nonverbal intelligence in public school hearing impaired children. Psychology in the schools, 27, 73-94.

Psacharopolous, G., & Velez, E. (1993, April). Educational quality and labour market outcomes. Sociology of Education, 66, 130-145.

Reccord, M.M. (1988). A comparison of reading achievement patterns using a case study approach. St. John's. Memorial University of Newfoundland.

Rudman, M.K. (1976). Children's literature: An issues approach. New York: Longman

Scarr, S. (1981). Testing for children: Assessment and the many determinants of intellectual competence. In J. O'Sullivan, Cognitive-motivational components of illiteracy. Unpublished abstract of study. American Psychologist, 36, 1159-1166.

Sexton, L.C., & Treolar, J.H. (1982). Cognitive and Perceptual Measures as Predictors of Fourth Grade Achievement. Psychology-in-the-Schools, 19(1), 122-28.

Smith, F. (1973). Psycholinguistics and Reading. New York: Holt, Rinehart & Winston.

Song, I.S., & Hattie, J., (1984). Home environment, self-concept, and academic achievement: A causal modeling approach. Journal of Educational Psychology, 76(6), 1269-1281.

Sowder, L.K. (1980). Concept and principle learning. In R.J. Shumway (Ed.), Research in Mathematics Education. Reston, Va.: National Council of Teachers of Mathematics (ERIC Document Reproduction Service No. ED 187 563)

Spearitt, D. (1972). Identification of subskills of reading comprehension by maximum likelihood factor analysis. Reading Research Quarterly, 8, 93-111.

Stahl, S.A. (1980) Words, words, words: A psychosemantic framework for evaluating vocabulary instruction. Unpublished qualifying paper, Harvard University Graduate School of Education.

Stanley, J.C., Keating, D.P., & Fox, L. (1974). Mathematical talent discovery, description, and development. Baltimore: Johns Hopkins University Press.

Stanovich, K.E., Cunningham, A.E., & Feeman, D.J. (1984, Spring). Intelligence, cognitive skills and early reading progress. Reading Research Quarterly, 19(3), 278-303.

Thorndike, R.L. (1973) Reading comprehension education in fifteen countries: International studies in evaluation III. Stockholm: Almqvist & Wiksell.

Thorn, E.A. (1974). Teaching the language arts: Speaking, listening, and writing Toronto: Gage.

Torrey, J.W. (1969). Teaching language arts. Toronto: Gage.

Trabasso, T. (1981). On the making of inferences during reading and their assessment. In J.T. Guthrie (Ed.), Comprehension and Teaching: Research Reviews. (pp. 56-76). Newark, DE.: International Reading Association.

Tremans-Ziremba, Malonie; Michayluk, Julian and Taylor, Lorne (1979). An Examination of Some Predictors of Reading Achievement in Grade Four Children. Reading Improvement, 16-17, 260-266. New York: David McKay Company, Inc.

Wigfield, A., & Asher, S.R. (1978). Age differences in children's referential communication performances: An investigation of task effects. Technical report No. 96. Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Illinois Univ., Urbana. Center for the Study of Reading.

Wigfield, A., Rudorf, E.H. & Graham, R.T. (1979). Why should the child want to learn to read? In R.E. Shafer (Ed.), Applied linguistic and reason. (pp. 23-38). Newark, DE: International Reading Association.

Williams, T. & Batten, M. (1981). The quality of school Life. Hawthorn, Victoria: The Australian Council of Educational Research.

Assessment Instruments

King, E.M., Hieronymus, A.N., Lindquist, E.F., & Hoover, H.D. (1982). Canadian tests of basic skills: Multilevel edition. Scarborough: Nelson Canada.

Thorndike, R., & Hagen, E (1980) Canadian cognitive abilities test: Multilevel edition levels A-H, form 3, Scarborough: Nelson Canada

APPENDIX A

THE PARENT QUESTIONNAIRE

INSTITUTE FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

HOME LIFE

For the past two and a half years your grade four child has been helping us to conduct a study about the development of children's reading and mathematical abilities. Now we are asking you to help us. We are trying to find out what parents can do to help their children in school.

Most of the items on the next eight pages state either that HOME IS A PLACE WHERE something happens to your child, or THE WHOLE FAMILY likes to do certain things together. We want you to say whether you Definitely Agree, Mostly Agree, Mostly Disagree, or Definitely Disagree with the items.

Please read each item carefully and tick (✓) the place which best describes what your family does. Don't forget that you have to put HOME IS A PLACE WHERE... or THE WHOLE FAMILY...in front of each item for it to make sense.

Please answer every question.

All the answers you give are confidential.

Thank you for your help.

HOME IS A PLACE WHERE...

	Definitely Agree	Mostly Agree	Mostly Disagree	Definitely Disagree
1. children should go to bed at a fixed time on school nights	☐	☐	☐	☐
2. children should never be hit (or spanked) as punishment	☐	☐	☐	☐
3. children should not be paid for helping with household chores	☐	☐	☐	☐
4. children should not be assigned regular chores	☐	☐	☐	☐
5. children should be expected to let their parents know if the rules are too strict	☐	☐	☐	☐
6. "children should be seen, but not heard"	☐	☐	☐	☐
7. children must learn to do as they are told	☐	☐	☐	☐
8. my children can make up their own minds about many things	☐	☐	☐	☐
9. the whole family is expected to be present for the evening meal	☐	☐	☐	☐
10. every member of the family has an equal chance to talk at the table	☐	☐	☐	☐
11. the children are not allowed to borrow other family member's belongings without permission	☐	☐	☐	☐
12. the father contributes much more than the mother to household finances	☐	☐	☐	☐

HOME IS A PLACE WHERE...	Definitely Agree	Mostly Agree	Mostly Disagree	Definitely Disagree
13. the mother does most of the housework	☐	☐	☐	☐
14. if both the father and mother were in full-time employment both would share equally in caring for the home and family	☐	☐	☐	☐
15. the husband has the final say when husband and wife disagree about child rearing	☐	☐	☐	☐
16. the mother is responsible for attending parent-teacher meetings	☐	☐	☐	☐
17. the children go to their mother for help with homework	☐	☐	☐	☐
18. the father sees that homework is completed	☐	☐	☐	☐
19. the mother should get the children off to school	☐	☐	☐	☐
20. the father should pick up the child in the event of illness or accident at school, or emergency school closure	☐	☐	☐	☐
21. the father deals with the teacher or principal when the children have a problem at school	☐	☐	☐	☐
22. the mother encourages the children to take out of school activities	☐	☐	☐	☐
23. the father usually takes the children to their out of school activities	☐	☐	☐	☐
24. the father usually takes the children to the doctor or the dentist	☐	☐	☐	☐
25. the mother settles any problem the children may have with the neighbours or with other children	☐	☐	☐	☐
26. most weekends the father spends more time with the children than the mother	☐	☐	☐	☐
27. the mother spends more time during the week with the children than the father	☐	☐	☐	☐
28. never a day goes by without the father spending some time with the children	☐	☐	☐	☐
29. the father has always done most of the reading to the children	☐	☐	☐	☐
30. the father should be more involved in bringing up the children	☐	☐	☐	☐
31. plans have already been made to finance the children's schooling beyond the high school level	☐	☐	☐	☐
32. the children are expected to go on to college or university	☐	☐	☐	☐
33. the children are expected to write letters and thank you notes	☐	☐	☐	☐

HOME IS A PLACE WHERE	Definitely Agree	Mostly Agree	Mostly Disagree	Definitely Disagree
34. the children bring leisure reading books from school	☐	☐	☐	☐
35. the children keep their rooms tidy	☐	☐	☐	☐
36. the children are expected to wash their hands and brush their teeth without being told by the time they are in grade 4	☐	☐	☐	☐
37. the children have been encouraged to play sports	☐	☐	☐	☐
38. the children expect a reward for bringing home a good report card	☐	☐	☐	☐
39. the children have hobbies (e.g., collect-stamps, coins and other things, build models, play a musical instrument, knit, sew, etc.)	☐	☐	☐	☐
40. it is insisted that the children speak correctly	☐	☐	☐	☐
41. the children are not allowed to "talk back"	☐	☐	☐	☐
42. we do not mind how well the children do in school	☐	☐	☐	☐
43. the children are expected to do something useful at all times	☐	☐	☐	☐
44. the children must look out for themselves	☐	☐	☐	☐
45. the children have the right to voice their own opinions	☐	☐	☐	☐
46. the children keep busy without having to be attended to	☐	☐	☐	☐
47. the mother handles the "kids" while the father attends to other things	☐	☐	☐	☐
48. the children bring books from the public library	☐	☐	☐	☐
49. we subscribe to children's magazines (Owl, World, Highlights, Sesame Street magazine etc.)	☐	☐	☐	☐
50. an encyclopedia and/or a dictionary is available for the children's use	☐	☐	☐	☐
51. there are lots of books for the children	☐	☐	☐	☐
52. we have always read to our children on a regular basis	☐	☐	☐	☐
53. we like to talk to the children about the books we read to them	☐	☐	☐	☐
54. we like to talk to the children about the TV programs we watch together	☐	☐	☐	☐

HOME IS A PLACE WHERE...	Definitely Agree	Mostly Agree	Mostly Disagree	Definitely Disagree
55. the children like to play word games such as I spy...,scrabble, 20 questions and crossword puzzles	☐	☐	☐	☐
56. the children like to solve puzzles (e.g. jigsaw puzzles, brain teasers, mazes, Rubick's cube etc.)	☐	☐	☐	☐
57. the children like to play board games such as Snakes and Ladders, Sorry, Monopoly, Trivial Pursuit, Clue, Checkers, etc.	☐	☐	☐	☐
58. the children like to play card games such as Go Fish, Snap, Old Maid, Crazy Eights, etc.	☐	☐	☐	☐
59. the children take part in competitions (e.g. music festivals, church choirs, colouring contests, etc.)	☐	☐	☐	☐
60. the children learn to look after themselves (to cook, to sew, to set table, wash dishes, etc.)	☐	☐	☐	☐
61. the children learn to care for their things (to make beds, tidy their rooms, put toys away after use, etc.)	☐	☐	☐	☐
62. the children learn to care for pets (dogs, cats, birds, fish, etc.)	☐	☐	☐	☐
63. the children learn to fix things (bikes, toys, books, etc.)	☐	☐	☐	☐
64. the children like to plant things (vegetables, flowers, shrubs, trees, etc.)	☐	☐	☐	☐

THE WHOLE FAMILY...	Rarely	Occasionally	Frequently	Most of the time
65. watches educational TV programs together (Electric Company, 3-2-1 Contact, Mr. Rogers, Newton's Apple, etc.)	☐	☐	☐	☐
66. goes to plays, concerts, movies together	☐	☐	☐	☐
67. visits different communities, museums, exhibitions together	☐	☐	☐	☐
68. participates in sports such as skating, swimming, skiing together	☐	☐	☐	☐
69. goes on holidays together	☐	☐	☐	☐
70. visits other countries together	☐	☐	☐	☐
71. goes on hikes, picnics, berry picking or nature walks together	☐	☐	☐	☐
72. visits zoos, parks, marine exhibits, historical buildings together	☐	☐	☐	☐
73. entertains adult visitors together	☐	☐	☐	☐

THE WHOLE FAMILY ...	Rarely	Occasionally	Frequently	Most of the time
74. has family get togethers with friends or relatives	☐	☐	☐	☐
75. visits other provinces together	☐	☐	☐	☐
76. visits local places of interest such as Cape Spear, the Cabot Tower, the University Marine Laboratory, etc.	☐	☐	☐	☐
77. attends local events such as the craft fair, the horticultural show, the Pope's visit, a Royal visit, etc.	☐	☐	☐	☐
78. attends live sporting events such as hockey games, softball games, swim meets, etc.	☐	☐	☐	☐
79. attends church together	☐	☐	☐	☐
80. reads aloud to one another	☐	☐	☐	☐

Please indicate (✓) what you do when your child behaves in each of the following ways.

1. Do nothing or ignore
2. Discuss or talk about the situation
3. Scold or threaten
4. Ground/send to room/take away privileges
5. Physically punish/spank

	1	2	3	4	5
81. Does not come home when told	☐	☐	☐	☐	☐
82. Fights with brothers/sisters/friends	☐	☐	☐	☐	☐
83. Does not come home on time	☐	☐	☐	☐	☐
84. Refuses to own up after doing something wrong	☐	☐	☐	☐	☐
85. Teases/torments smaller children	☐	☐	☐	☐	☐
86. Talks back to mother/father	☐	☐	☐	☐	☐
87. Is defiant (e.g. refuses to go to bed when asked)	☐	☐	☐	☐	☐
88. Does not do as he/she is told	☐	☐	☐	☐	☐
89. Leaves belongings lying around	☐	☐	☐	☐	☐
90. Tells a lie	☐	☐	☐	☐	☐
91. Breaks something deliberately	☐	☐	☐	☐	☐

Please indicate (✓) how often these happen in the home

1. Never/rarely
2. Sometimes/occasionally
3. Often/frequently
4. Always/most of the time

	1	2	3	4
92. Bedtime rules are enforced	☐	☐	☐	☐
93. Mealtime rules are enforced	☐	☐	☐	☐
94. The TV is on during mealtimes	☐	☐	☐	☐

	1	2	3	4
95. The children eat everything on their plate	☐	☐	☐	☐
96. The children "talk back" to their mother	☐	☐	☐	☐
97. The children "talk back" to their father	☐	☐	☐	☐
98. The children interupt a conversation between adults.	☐	☐	☐	☐
99. I "give in" to what my child wants even though it is against the family rules	☐	☐	☐	☐
100. The children sleep in on school days	☐	☐	☐	☐

HOME BACKGROUND QUESTIONS
(Every question is confidential)

101. What is the present or last main occupation of the father or guardian?

Occupation:_____

102. What does he do in this job?_____

_____

_____

103. What is the present or last main occupation of the mother?

Occupation:_____

104. What does she do in this job?_____

_____

_____

105/106. How much education have the father and mother had?

	Father	Mother
Elementary School only	☐	☐
Some High School	☐	☐
Finished High School	☐	☐
Some College or University	☐	☐
Vocational School	☐	☐
Finished College or University	☐	☐
Other training (not degree or diploma; e.g. company sponsored course)	☐	☐
Advanced education, post-graduate degree (Master's, Ph.D., M.D., Ll.B., etc.)	☐	☐

107. How many children are there in the family?

Boys____Girls____

108. How many children are younger than the grade four child? ____ ____

109. How many children are older than the grade four child? ____ ____

How many of these do you have in your home?
(circle the number in each line)

110. telephone	0	1	2	3	4	or more
111. dishwasher	0	1	2	3	4	or more
112. microwave oven	0	1	2	3	4	or more
113. deep freeze	0	1	2	3	4	or more
114. tape recorder	0	1	2	3	4	or more
115. video cassette recorder (VCR)	0	1	2	3	4	or more
116. colour TV	0	1	2	3	4	or more
117. bedrooms	0	1	2	3	4	or more
118. bathrooms	0	1	2	3	4	or more
119. vehicles (e.g. autos, vans, trucks)	0	1	2	3	4	or more

120/121. How many hours does the father and mother work for pay each week? (check one)

	Father	Mother
1 – 19	☐	☐
20 – 29	☐	☐
30 – 34	☐	☐
35 – 39	☐	☐
40 – 44	☐	☐
45 or more	☐	☐

122/123. In the last six months has the father or mother had a job in which they were temporarily laid off?

	Father	Mother
Yes	☐	☐
No	☐	☐

124/125. At the present time what is the employment status of the father and mother?

	Father	Mother
Housewife/Househusband	☐	☐
Unemployed (looking for work)	☐	☐
Unemployed (not looking for work)	☐	☐
Self-employed	☐	☐
Employed (part-time)	☐	☐
Employed (full-time)	☐	☐

126. Parental status

	Father	Mother
Single parent	☐	☐

127. Comparing your family to others, how privileged are your children? (check one)

- Among the most privileged of children ☐
- Privileged ☐
- About average ☐
- Less privileged ☐
- Not privileged at all ☐

128. The answers to this questionnaire were given by:

- the mother ☐
- the father ☐
- both mother and father ☐

THE END

Have you tried to answer all the questions?

Thank you for your help.

Please return the questionnaire in the stamped addressed envelope provided.

SESA/IERD
Memorial University of Newfoundland
St. John's, Newfoundland
A1B 3X8