CULTURAL FACTORS AND THE STRUCTURE OF NUMERICAL ABILITIES

by

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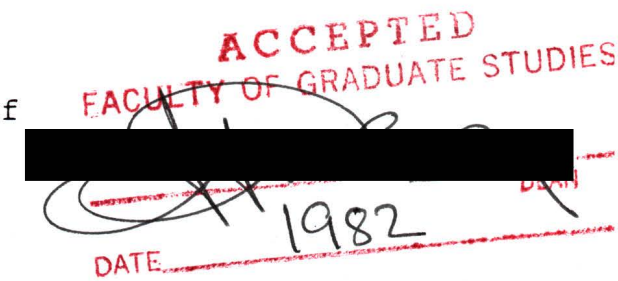

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ABSTRACT

The purpose of the present study was to find the similarities and differences in the pattern of numerical abilities for native Indian and non-Indian children. Differences of the test mean scores for each group and factors contributing to them (e.g., degree of acculturation, language, schooling, socio-economic background) have also been investigated.

The subjects included 113 non-Indian children and fifty Canadian Indian children. Non-Indian children were selected from George Jay and Victoria West elementary schools in Victoria, and Princess Royal School in Nanaimo. The Indian subjects were from Princess Royal School in Nanaimo and North Oyster School in Ladysmith. The age range of all the subjects was from nine to fourteen years.

Five tests relating to numerical abilities were administered to each subject in the classroom except for North Oyster. These tests are Raven's Standard Progressive Matrices, Modified Paper Formboard Test, Mill Hill Vocabulary Scale, Comprehensive Test of Basic Skills: Arithmetic, and Draw-a-Person technique.

Statistical analysis employed was to find if there was any significant difference on the mean scores between Indian and non-Indian children. The results have

shown that there were no significant differences on their mean scores with the exception of Mill Hill Vocabulary Scale. Correlation-coefficients and factor analysis were also employed to find the relationships between these tests. Only one general factor emerged for each group. Thus, the discussion of this study was concentrated on the comparisons of mean scores, and particularly the contributing factors.

It was concluded that Indian children could perform as well as non-Indians, if the appropriate language remedial program was applied immediately on school entry.

It is recommended that for better design of a cross-cultural study, matching the socio-economic backgrounds and the age range of the subjects should not be overlooked.

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CHAPTER I

INTRODUCTION

In the last few decades, there have been numerous studies done by psychologists and educators about general intelligence of Native Indian children, in comparison with that of white children. Different forms of intelligence tests which include verbal, non-verbal, paper-pencil, and performance tests have been employed by the testers. Some reports indicated that Indian children had lower scores on general intelligence tests when compared with white children at the same age levels. Indian children also scored lower on the subtests of these IQ tests which encompassed numerical and verbal items (Cropley & Cardy, 1975; Taylor & Skanes, 1976). However, some researchers pointed out that there was no significant difference or only small differences on perceptual or non-verbal IQ tests between the performance of Indian and white children (Taylor & Skanes, 1976; Vernon, 1969; Bowd, 1973).

As described by Piaget, Hebb, and Bruner, the experiences of children and environmental stimulation in early childhood have decisive effects upon their later intellectural development. Being reared in a different cultural background from white society, Indian children are considered likely to develop different patterns of numerical abilities from white children. The purpose of this investigation is to attempt

to discover whether there are similarities in the structure of numerical abilities for Indian and white children. The levels of numerical abilities achieved in each group will also be investigated. Generally non-verbal tests will be used. The effects of schooling, cultural background, and verbal quality of the tests will be taken into account in the interpretation of test results.

Also to be considered are the following factors which could affect Indian children's academic performance:

1. inappropriate conclusions made by some investigators who used tests with heavy verbal loadings and verbal directions to do cross-cultural comparisions;

2. lack of current data regarding numerical abilities of Indian children.

Definitions of Principal Terms

The definitions of basic terms are:

Cognitive Abilities

This term refers to the various cognitive concepts and skills an individual develops under the influences of cultural environment. Cognitive abilities include the thoroughness and discriminativeness of an individual's perceptions, the possession and range of practical skills, and the thinking skills and adaptability to new situations (Vernon, 1969).

Numerical Abilities

This term is defined as special aptitudes for numerical tasks which include the abilities to form, retain, and use associations between numerical or non-verbal symbols (Burt, 1949). These abilities are prone to be affected by environmental influences. They also closely relate to general ability.

Ability and Achievement

According to Vernon (1969, p. 26), achievements refer to the more specialized skills which are taught in school or other places, and which depend greatly on the effectiveness of instruction and practice, on the child's interest, motivation and his adjustment to school and teacher. Intelligence (or general ability) refers to the more generalized thinking capacities which can be applied in any kind of learning, and these are developed as much by home and out-of-school as by school experiences.

"g" Factor

This term has been used in Spearman's and Vernon's study. It was used to stand for general intelligence or general ability. It is the ability to rearrange a set of related data, and to combine them into a coherent relational whole. In other words, this is the ability to synthesize explicitly perceived relations.

Cultural Environment

This term refers to the particular culture in which an individual is reared. The operation of environment not only decides the amount and the kind of experiences an individual acquires, but points the direction toward which an individual develops. In other words, people growing up in different cultures not only have different opportunities of education from school, home, or neighborhood, but develop different patterns of behavior and perceptual responses under cultural influences (Anastasi, 1958).

CHAPTER II

REVIEW OF THE LITERATURE

Nature of Numerical Abilities

According to Vernon (1969) and, earlier, Blackwell (1940), numerical abilities include the abilities to recognize, compare, classify, and manipulate numerical, verbal, spatial data and apply general principles to particular cases. In other words, rote memory and deductive reasoning play very important roles in the functioning of numerical abilities. Those psychologists interested in the structure of numerical abilities tried to define the factors underlying the numerical abilities by using factor analysis. Most of the studies indicated that there was a high correlation between numerical abilities and general intelligence (Blackwell, 1940; Sutherland, 1941; Barakat, 1951; Vernon, 1961; Wrigley, 1958). After the removal of "g" factor, there is a group factor covering the different branches of mathematics (Barakat, 1951; Wrigley, 1958). The results of Wrigley's study also pointed out that verbal, numerical, and spatial group factors were isolated. Verbal ability had little connection with mathematical ability. However, Sutherland (1941) in the study of children's ability of solving numerical problems, found that general intelligence, verbal and numerical factors contributed equally to solving particular arithmetic problems. Vernon (1961) also stated that though verbal and numerical abilities were usually

separable, they tended to have some extent of overlap, over and above "g". Thus, using factor analysis to study the structure of abilities, the results might be considerably different depending upon the tests and the samples selected. Vernon said:

> Factorists are too apt to interpret factors on the basis of their own subjective analysis of the nature of the loaded tests, and to assume that their subjects, even at a very different mental level, tackle these tests by the same mental processes as they do. (1961, p. 153)

Role of Factor Analysis

Factor analysis has been pervasively adopted by psychologists as a technique for studying human abilities. The advantage of this technique is that it reduces the number of variables from a large scale of tests to a relatively small number of factors, or common traits (Anastasi, 1961). The principle of it is to analyse the interrelationships of behavior data. All the techniques of factor analysis start with correlation-coefficients among tests, and end with a factor matrix, which shows the weight or the loading of each of the factors in each test (Anastasi, 1961).

There have appeared certain major different theories under which the technique of factor analysis was adopted. These are Spearman's two-factor theory, Thurstone's and Guilford's multi-factor theories, and Burt's and Vernon's hierarchical theories. Spearman proposed that the "g" factor was the only common factor in charge of all intellec-

tual activities. Besides that, there were some specific factors, each being responsible for a single activity. Spearman's two-factor theory was severely criticized by later factor analysts for neglecting 'group factors' which exist between general intelligence and specific factors and are responsible for a number of intellectual activities (Vernon, 1961).

Theories about Structure of Abilities

Vernon, who adopted some viewpoints from Spearman and Burt, has described the patterns of human ability as a hierarchy. At the top of this hierarchy is "g". After the removal of "g", the rest of the major group factors can be divided into two parts: the verbal-numerical-educational (V:ed) on the one hand, and on the other hand the practical-mechanical-spatial-physical (K:m). Below the major group factors are minor group factors within which V:ed is divided into verbal and number subfactors, and K:m splits into mechanical information, spatial, and manual subfactors. Below the minor group factors are specific factors. Vernon supplemented later that in the hierarchy of human ability, V:ed or K:m does not cover all the minor group factors. Some factors may split from "g" directly without passing through V:ed or K:m, for instance, scientific ability.

Vernon's hierarchy of the structure of ability was widely accepted by British psychologists, though American psychologists claimed that independent primary factors were

the components of human ability. Giving fifty-six tests to 240 college students, Thurstone distinguished a dozen group factors which he designated as "Primary mental abilities" (Butcher, 1968). Guilford proposed a three-dimensional intellect model which contained 120 units, functioning independently. According to Guilford (1967), all the intellectual activities are classified with regard to contents (i.e., symbolic, semantic), operations (i.e., convergent production, divergent production), and products (i.e., units, classes, relations, transformations). Butcher (1968) commented that Guilford's theory had the advantage of being systematic and scientific. Nevertheless, Vernon (1964b) pointed out that Guilford's factors were too narrow and specific and that there was less predictive value in any situation. The relationship between Guilford's Structure of Intellect Model and Piagetian developmental theory will be described in the later section. Guilford's intellectual processing, which consists of the basic psychological processes involved, the kind of material used, and the resulting format of the processed information, showed some facets of cognitive development in human beings just as Piaget mentioned.

Vernon (1961) indicated that most of the American studies have been done with the selection of homogeneous samples from colleges, high schools, so that the results fell into independent primary factors. Anastasi (1948)

cited an army study done during World War II. The result showed that there was a high correlation between numerical, verbal and spatial tests. Also, high correlations between two numerical tests and mechanical tests have been found in the same study. Thus, the existence of a "g" factor in the structure of ability was supported further. Thomson (1939) stated that the structure of the mind was composed of a number of 'bonds' which operated under the interaction of innate heredity and cultural environment. Vernon supported Thomson's view by this statement: "factors over, and above g arise, partly perhaps from hereditary influences, but mainly because an individual's upbringing and education imposes a certain grouping on his bonds." (1961, p. 31, 32) V:ed is a strongly unified group factor. It is hardly broken down into minor group factors due to the standard education society offers to all the members (Vernon, 1961). Whether V:ed will be broken down into smaller specific factors, such as number, verbal, reasoning, memory, depends upon the school or home in which the individual is raised. However, K:m is not so affected by cultural environment as V:ed (Anastasi, 1948).

Vernon's hierarchical model has the advantage of arising from heterogeneous samples. Thus, it is more appropriate than multi-factor theories in the study of numerical abilities cross-culturally where a large variance in test scores might reasonably be anticipated.

Developmental Theories about Human Ability

Piaget used the terms 'cognitive development' or 'mental growth' to clarify his viewpoints about human intelligence. He maintained that the biological functions in the process of intellectual development of human beings remained the same, but the structures, by which he meant the logical processes available and the way these were organized, changed frequently (Butcher, 1968). According to Piaget, the structures of intelligence were changing qualitatively from stage to stage, in which each successive structure incorporated the preceding one and formed a kind of hierarchical development. The new concepts children acquired at each stage, and the qualitative change between stages would bring out new problem-solving capabilities.

Even though the theory proposed by Piaget and his followers concerning intelligence was severely criticized by experimental psychologists on methodological grounds, their contributions in helping people understand the functioning of human intelligence cannot be overlooked. Besides, it is possible to find some degree of connection between the Piagetian approach and those theories emphasizing the structure of abilities by the method of factor analysis.

In spite of different terms used to define inherited capabilities in the various theories, Piaget's 'biological functions' encompasses a similar meaning to Hebb's and Vernon's 'intelligence A', and Cattell's 'Fluid Intelligence'.

Piaget stressed that mental growth happened under reorganization of schemata from stage to stage, in which environmental factors and early experiences had great impact upon the rate of intellectual development. Vernon mentioned the importance of environment and education upon changes of group factors in his hierarchy of abilities. However, he did not support the viewpoint held by Garrett about aging and mental growth differentiating group factors (Vernon, 1961).

Cattell agreed to the existence of general intelligence. However, he separated it into two components: fluid and crystallized intelligence. Crystallized intelligence means the ability to apply some prior, fundamental, general ability to meet current needs; while fluid intelligence implies adaptation to new situations (Butcher, 1968). These viewpoints are quite similar to Piagetian reorganization of schemata. By contrasting crystallized and fluid intelligence to his hierarchy of abilities, Vernon (1969) pointed out that crystallized intelligence was close to "g" with a considerable mixture of the V:ed factor; while fluid ability could be regarded as "g" with a slight mixture of spatial ability. Vernon also mentioned the advantage of combining mental development with factorial approaches in Cattell's theory, and the disadvantage of his presuming fluid ability to be immune to cultural influences and being able to be tested by 'culture-free' tests (1969, p. 25).

Age and the Structure of Abilities

In a study of children at three age levels, nine, twelve, and fifteen, Garrett, Bryan, and Perl (1935) found that the intercorrelations among verbal, memory and number tests decreased with age from nine to twelve and twelve to fifteen. Similar results were shown in Clark's and Reichard's studies in 1944. Garrett concluded that there was a steady drop in correlation among tests including verbal, numerical, and spatial concepts from age eight to eighteen. He also presumed that the general ability was breaking down into special aptitudes with increasing age. The "g" factor was the basic element in the structure of abilities of children in elementary school. It was less important at high school and college level (Garrett, 1946). Vernon supported this point by this statement: "It is doubtful whether group factors differentiate merely as a result of aging or mental growth. Rather, their pattern or structure changes according to the type of education and training." (1961, p. 25)

Learning plays an important role in the process of developing different abilities. Ferguson (1954) pointed out that some special abilities must be acquired before children obtain subsequent abilities. MacArthur said, "The more specific abilities, low in the hierarchy, are more dependent upon particular experiences, which the child may or may not have had." (1968, p. 45) Hence, children

growing up in different cultures, which demand different kinds of learning at a certain age, might develop different patterns of ability (Ferguson, 1954).

In a study of Newfoundland fisherman, Ferguson (1954) found that many of them achieved low scores on tests of abstract thinking which were developed for use in urbanized cultures, while they scored well on skills in boat building or fishing. In his classic study, Gordon (1923) who studied the intelligence of canal-boat and gypsy children found that there was a sharp decline in IQ with age, that is, the correlation between IQ and age was negative. In a recent study of the linguistic abilities of children living in isolated areas of Labrador, Taylor and Skanes (1975) found that there were significant differences between the verbal and performance IQ of most of the subjects. The authors stated that it might be due to the nature of the test which included some verbal items not appropriate to the children living in isolated areas. Environmental demands might also contribute to this difference. These studies tell us not only different cultures produce different patterns of ability, but a person being referred to as "intelligent" in one culture might be regarded as less so in the other culture due to different standards in classifying abilities.

Research about Cognitive Abilities of Native Indians

Too often people dealing with Indian education take misinformation for granted. They believe that Indians are poor, low achievers, good only at artcrafts, and have language problems. They accept that Indian children's under-achievement is related to the children themselves and the characteristics they carry with them, such as lack of competitiveness, shyness, and lack of time concept, which are valued by Indian culture (Bowd, 1978). Thus, these people would make some suggestions about how to improve Indians to adapt to school or white society, rather than try to understand and appreciate cultural differences between Indians and whites. These beliefs imply that what Indians have in their culture is not good enough (Hawthorn, 1967), and too often these suggestions are based on stereotypes about Indian life and misunderstanding of Indian behavior in the classroom (Bowd, 1978).

Native Indian children in schools are sometimes described by teachers as being low in learning capacities, motivation, and academic achievement. This may be because they are frequently from lower socio-economic backgrounds and, additionally, they have different attitudes, values and personality characteristics as a result of different cultural background. As Hawthorn indicated, "When Indian and non-Indian children appear at school initially their expectations are different, they perceive things differently,

their familiarity with the material phenomena of school is different and their behavior is governed by differing sets of rules." (1967, p. 127) Indian children find that they are "caught between two cultures". Usually they have to adjust themselves to the expectations of school and teachers who assume that every student has acquired some of the basic skills which are typical of middle class white students on entry to the schools. Besides that, they are sometimes faced with a language barrier. English not being their mother tongue, they are usually unable to learn at the same speed as white children, when instructions are in English. According to the Hawthorn report (1967), Indian children receive little feedback on their verbal responses from their parents. Also their lack of books or other verbal stimulation plus the lack of opportunities to participate in conversation may impede their verbal development and skills which are very important in the process of learning in a school situation. Vernon (1969) claimed that poverty of verbal stimulation and inadequacies of the mother-tongue which shapes the child's perceptions and conceptualizations of the world, would hinder the child's intellectual development. The immense quantity of verbal content in the contemporary instruction could further contribute to the slower learning rate of Indian children at school.

Regarding the motivation of Indian children, the Hawthorn report (1967) pointed out that there were no

studies which proved that Indian children were initially less motivated to succeed than the non-Indian. However, a sharp decline in motivation for achievement was found among Indian children after a few years in school. According to the Hawthorn report, the reasons might relate to experiences of failure and lack of support from significant adults.

Research done among native Indians indicated that Indian children scored lower on the tests with high loading on the V:ed factor. MacArthur (1968, 1969) administered a group of intelligence tests to six samples from Eskimo, Indian-Mètis, and white children, age 9 to 12 and 12.6 to 15.6 years. The results showed that conservation, certain other Piaget-type tasks, and the tests of reasoning from non-verbal stimuli were least affected by differences between native and white backgrounds. But V:ed group tests were highly affected by cultural differences. Similar results were obtained by Cropley and Cardy in 1975, who intended to relate acculturation to the extent of cognitive competence of Canadian Indians. They gave three different kinds of cognitive tests to white children in regular schools, Indian children in regular schools, and Indian children in residential schools. They found that the white children surpassed both Indian groups on abstract, verbal reasoning in English. They surpassed residential school children on non-verbal reasoning, and scored similarly to all the Indian children on concrete nonverbal skills. The difference

in the performance on these tests between regular school children and residential school children may imply that the early contact with the white society and an early intervention are very important in the acquisition of cognitive competence for Indian children.

Taylor and Skanes (1976b) examined the intelligence of Inuit and white children with digit span memory tests and Raven's Matrices. They found that Inuit children scored considerably lower than white children on short-term memory and rote learning in the early grades, but the difference decreased rapidly with age. The same study also indicated that Inuit children had better performance on Raven's Matrices than white children. The authors presumed that the inferior performance of Inuit children on the Digit Span Memory test might be the result of the lack of experience in dealing with numbers on entering school. They also claimed that schooling was an essential factor that contributed to the difference between the white and Indian children in MacArthur's study. In attempting to minimize the differences in the backgrounds between the two groups, the same year Taylor and Skanes (1976a) matched socioeconomic status and grade placement of the Inuit and the white children in their study of cognitive abilities. They found that there were no significant differences on tests of verbal-educational ability or inductive reasoning. Their studies brought out the important fact that choosing

the Indian and white children from similar environments and matching their school experiences might reduce the influence of some confounding factors which influence the test results.

The evidence of some research showed that American Indian children performed relatively close to white children on non-verbal tests or performance tests (Garth & Smith, 1937; Havighurst & Hilkevitch, 1944; Havighurst, Gunther, & Pratt, 1946; Jameson & Sandiford, 1928; MacArthur, 1968, 1969; Cropley & Cardy, 1975). In a classic study, administering four different kinds of tests, including Pintner Non-Language Mental Test, Pintner-Paterson Scale of Performance Test, National Intelligence Test, and Pintner-Cunningham Primary Mental Test, to the southern Ontario Indians, who studied in day schools or residential schools, Jameson and Sandiford (1928) found that Indian children on the non-language and performance tests scored only slightly lower than the white children. The authors suggested that the intelligence ranking of Indian children had to depend on what kinds of intelligence tests were used.

Havighurst and Hilkevitch (1944) used the Grace Arthur Point Performance Scale on six tribes of American Indians, age 6 to 15 years. They tried to find out the intertribal and intratribal differences in intelligence quotients and the confounding factors contributing to them, such as degree of acculturation or schooling. The tribes were Sioux, Navaho, Papago, Hopi, Zuni, and Zia. The results of the tests showed that Hopi children scored higher than white

children. Sioux, Topawa (Papago), Zuni, Zia, Shiprock (Navaho) and Navaho mountain groups performed as well as the white children. Hickiwan, Guvo (Papago) and Ramah (Navaho) scored considerably lower than the other groups. The authors concluded that acculturation and schooling might be part of the factors influencing the scores each tribe obtained. They also suggested that performance tests of intelligence would be more valuable for educational or vocational guidance for Indian children, than those tests requiring the same level of language ability as possessed by white children. MacArthur (1969) supported this with a similar statement that non-verbal tests would be better in assessing the intellectual potential of Eskimo and Indian-Mètis pupils for school achievement.

Conceptual and Perceptual Abilities

According to Piaget's developmental theory, sensory stimulation and kinaesthetic experience in the first few years are very important for children's intellectual development (Vernon, 1969). Children's later conceptual development will be constructed on the basis of these perceptual acquisitions. Growing up in a predominantly poorer environment, being short of those objects important in aiding the intellectual development of children, such as books and toys, Indian children would be likely to develop more slowly on conceptual abilities. Vernon (1969) administered a group of tests to 90 Indian and Eskimo boys, age 10.1-11.2, and found that all subgroups were weak when

compared to the English norms on conservation of quantity, length, and area as well as on time concepts, on concepts of left and right, also on number concepts. But they are only slightly inferior in logical inclusions. Their relatively high scores on spatial tests and superiority on drawing tests suggest their mechanical aptitudes.

In cross-cultural studies of the ethnic groups, cultural factors might still be very influential on cognitive development (Dasen, 1972). Having done a study of mechanical aptitude with Indian boys from different communities, with different levels of acculturation, Bowd (1973) indicated that Indian children's spatial-mechanical ability was high in spite of their linguistic limitation in English. The advantage of living in a more permissive, flexible family which gives more freedom or opportunities to get in touch with physical environment, might be one of the reasons for their superior mechanical ability.

Methodological Problems in Cross-Cultural Research

In cross-cultural studies, psychologists compared the common elements existing in various cultures, by applying the criteria of behavior considered common, to relative internal characteristics within these different cultures (Berry, 1969). For this comparison among different cultures, the kinds of tests one uses, and problems of language, motivation, child's experiences and socioeconomic backgrounds, all have to be taken into account. In the hope of

obtaining reliable and comparable data in cross-cultural research, some attempts have been made by psychologists to construct so called "culture-free" tests. These kinds of tests are intended to minimize the influences of specific skills or information not shared by all the children in every culture and give each child an equal chance. The influence of personality factors more likely to develop in one culture than in another should also be reduced (West & MacArthur, 1964). Nevertheless, it is not possible to develop a test totally unrestricted in its cultural reference. Anastasi (1958) indicated that the difference between "culture-free" and other tests is only the question of degree. Thus, paper-pencil tests may be inappropriate for some Indian children. The performance tests or non-verbal tests may still carry some elements appearing in white culture but not existing among Indian cultures. The amount of schooling and degree of acculturation are especially influential on Indian children's test performance. Since cultural environments have an import influence on which direction an individual might develop, it is not very easy to make an objective judgement of Indian children's ability with the tests designed in white society by white people. In the meantime, the reliability of the test result is inevitably in question. Lane pointed out: "There may well be cultural attributes in Indian school children which influence their performance and their opportunities but our

knowledge of them is sketchy, subjective, and impressionistic." (1972, p. 353)

Thus, instead of either trying to eliminate cultural content in tests, or claiming the possibilities of offering "equal chance" on intelligence tests for children coming from different cultural backgrounds, psychologists and educators should understand how cultural and environmental factors influence children's test performances. In this way, there will be a greater chance of making more appropriate and objective conclusions rather than jumping to wrong conclusions upon judging test results when the researchers are doing cross-cultural comparisons.

CHAPTER III

DESIGN OF THE STUDY

This is an exploratory field study. The purpose of exploratory research, as Kerlinger (1967, p. 388) argues, is to discover if there are significant variables in the social or cultural environment, to find the relations among variables including behavior, and to lay the base for later, systematic research. Therefore, instead of specific hypotheses, general hypotheses indicating the research expectations of the investigation are proposed.

General Hypotheses

1. There will be no significant differences between the scores of Indian and non-Indian children on non-verbal tests (Raven's Progressive Matrices, Modified Paper Formboard Test, Draw-a-Person Technique).

2. There will be no significant differences between mean scores of Indian and non-Indian children on a spatial test (paper Formboard test).

3. There will be no significant differences between mean scores of Indian and non-Indian groups on test of field-independence cognitive style (Draw-a-Person).

4. Non-Indian children will score significiantly higher than Indian children on the numerical tests (Comprehensive Test of Basic Skills: Arithmetic). Besides

verbal quality of numerical tests, heavy verbal content in textbooks as well as in classroom instructions in current education will depress the scores for children from different cultural backgrounds.

5. Non-Indian children will score significantly higher than Indian children on a verbal test (Mill Hill Vocabulary Scale).

6. For each Indian and non-Indian group, boys will have higher mean scores than girls on Progressive Matrices, Modified Paper Formboard test, Draw-a-Person technique, Arithmetic Concepts and Applications, while girls will perform better than boys on Mill Hill Vocabulary Scale and Arithmetic computation. There will be no significant differences on Arithmetic Total Score between boys and girls.

Method

Description of the Sample

For the purpose of doing cross-cultural comparisons, a sufficiently large number of subjects for each group was used. The subjects included 113 non-Indian children and 50 Canadian Indian children, chosen regardless of sex. Age range of all the subjects was from nine to fourteen years old. The average age of the non-Indian group (mean age 12.3) is slightly higher than that of Indian children (mean age 11.2).

There was no grade restriction for selection of the Indian sample, because of the high drop-out rate of Indian children between grade six and eight (Hawthorn, 1967; Sterling, 1975), and the general one to two year grade retardation (Vernon, 1969; Sterling, 1975). The grade range of the Indian group was from grade three to seven. Non-Indian children of equivalent age were selected from grade five to seven.

As to selection of samples, random sampling was considered impractical in view of the relatively small numbers of available subjects. Two Vancouver Island schools in Nanaimo and Ladysmith (Princess Royal School and North Oyster School), which have a larger Indian population compared to other local schools in that area, were selected for testing by arrangement with the Office of Indian Education Programs in Nanaimo.

Princess Royal School. Fourteen boys and 8 girls (mean age 12.2) ranging from grade four to grade seven were tested. This school is located one mile from Nanaimo city center. The latter community has a population of approximately 50,000. One hundred and fifty students, from kindergarten to grade seven, attend Princess Royal School. Native Indians, who make up one-half of the school population, are all from the same reserve one mile away, and belong to the Westcoast Salish.

The majority of Indian parents were employed in the forest industry, such as logging, sawmilling, and other related activities. According to the school principal, the parents of the Indian children were often unemployed, depending upon the season of the year.

A significant proportion of these native children came from single-parent homes and were raised by their mothers. English was the only language of communication used by all the subjects at home, although their vocabulary was often considered deficient at school entry by teachers. The English used by native children was described as non-standard English by the school principal. It differed from the English used by the teachers and middle-class white people. A small proportion of children living with grandparents could understand native language as well.

In view of the location of the reserve, there was a large extent of contact, either socially or culturally, between Indian and non-Indian people.

A remedial program for the Indian children having language deficits was operated by the school. Six Indian children being tested by the writer were in this Distar Reading Program. A cultural program which taught Indian children native language, Indian history, arts and crafts, was also in effect.

North Oyster School. Twelve native Indian boys and 8 Indian girls (mean age 10.5) were selected from this school. Their grade levels range from three to five. Two hundred and twenty children, 25% of whom are Indians, are registered at this school. The school is located in a rural area, four miles from Ladysmith city center. The latter town has a population of 5,000 including outlying areas. Indian children at this school come from the reserve five miles away, and belong to the Westcoast Salish.

There was much more unemployment among native Indians than among whites. Most Indians are employed in the forest industry. Therefore, seasonal unemployment is usually high. The parental occupations varied considerably, and included loggers, farmers, small businessmen, and fishermen.

Although certain business contacts exist, because of the isolated location of the reserve, the degree of acculturation is considered to be less than for the children attending Princess Royal School.

English was reported as the only language used by Indian children at home and at school. However, it is not the same as the standard English used by a majority of white middle-class children. A Distar Reading Program for compensating the language deficits of some Indian children was operated by the school. Most of the Indian subjects tested were in this program. In addition, the school also

operated a cultural program which conveyed Indian language, history, arts and crafts to Indian children through volunteer native people.

The Indian sample in this study also included eight native Indian children studying in Victoria West and George Jay elementary schools in Victoria. These subjects were in the same classes as the white sample, and were tested at the same time. Their results were included together with the entire Indian group when comparisons between means of the whole Indian and white groups were made. According to teachers, many of these children came from single parent homes and lived on social welfare.

Non-Indian sample. The second sample consisted of 73 boys and 40 girls, all of whom were non-Indian. They were selected from two elementary schools, Victoria West and George Jay, located in the average-to-lower socioeconomic areas of Victoria, and thirty-one additional children attended Princess Royal School in Nanaimo. The employment of the parents of white children at Princess Royal School was similar to that of the Indians. The occupation varieties relate to forest products, and unemployment showed considerable seasonal variation.

The parental occupations of the non-Indian sample in Victoria were more varied in comparison with those of the Indian sample elsewhere. However, except for a small

proportion of white-collar workers (e.g., teacher, office worker, bank teller), the majority of occupations held by parents of the white children are classed as skilled or semi-skilled.

Comparisons of mean age between Indian and non-Indian, as well as between two Indian groups, are shown in Table 1. Children of North Oyster School were significantly younger than the children from Princess Royal School and the non-Indian group.

Test Battery

Tests were selected with attention to the likely role of cultural factors biasing children's performance. Where possible, non-verbal tests were used to decrease verbal effects on the test scores among the Indian group. Reliabilities and validities of the tests were also considered although data with culturally different subjects is limited.

Test of general intelligence - Standard Progressive Matrices (RPM). The Progessive Matrices is designed to measure "g", or general reasoning ability. It includes sixty Matrices from which a part has been removed. The subject has to choose one from six or eight alternatives and use it to complete a design or "matrix". The items are grouped into five series of increasing difficulty. This test is administered with no time limit. Anastasi (1961) indicated that the retest reliability of the

Table 1

A Comparison of Mean Age Between Groups

(Indian vs. Non-Indian vs. Schools)

Princess Royal			North Oyster			p
Mean Age (months)	SD	N	Mean Age (months)	SD	N	
146.64	14.02	22	126.00	11.01	20	<.05
Princess Royal			**Non-Indian Group**			
Mean Age	SD	N	Mean Age	SD	N	
146.64	14.02	22	147.56	12.02	113	N.S.
Non-Indian Group			**North Oyster**			
Mean age	SD	N	Mean Age	SD	N	
147.56	12.02	113	126.00	11.01	20	<.05

Progressive Matrices applying to moderately homogeneous groups of older children and adults varies between .70 and .90. Correlations with both verbal and performance tests of intelligence range from .40 to .75, tending to be higher with performance than with verbal tests. Studies with different occupational and educational groups showed moderate concurrent validity.

As Anastasi stresses, the Progressive Matrices has the advantage of requiring less culturally restricted information and being essentially non-verbal and unspeeded.

Test of verbal ability - Mill Hill Vocabulary Scales (MHV). This test includes thirty-two test items and two practice items in multiple-choice form. It contains a list of stimulus words, each of which is followed by six response words. The subject has to choose the response which matches the meaning of the initial word. There is a fifteen minute time limit. However, this provides more than adequate time for most children to complete the test. Since this test requires specific knowledge of English vocabulary, significant cross-cultural differences are anticipated. However, the main reason for selecting the MHV is that it is a short group test. Raven (1960) indicated high retest reliabilities for Mill Hill Vocabulary Scales from .87 to .98 depending on the age group. Employing Junior Set A of Mill Hill Vocabulary Scale in a cross-cultural study involving Indian

children, Bowd (1973) found internal consistency reliabilities that ranged from .70 to .83.

Test of reasoning arithmetic and rote arithmetic - Comprehensive Tests of Basic Skills: Arithmetic, 1978 Edition (CTBS: ARITH 1, 2, 3, & TOTAL). This test is designed to measure basic arithmetic skills. It includes four subscales: computation, concepts, applications, plus a total scale score. Level 2 (Form S), which is suitable to children from grade 4.5 to grade 6.9, was used. It is a test with time limit. Riedesel (1972) administered Forms Q and R to a large sample of subjects at an interval of six weeks, finding Kuder-Richardson 20 reliability coefficients for subtests that ranged from .79 for problem solving to .96 for computation. The K-R 20 reliabilities for total scores ranged from .94 to .96. The correlation coefficients ranged from a low of .65 at grade three on applications to a high of .91 at grade seven on computation.

Test of spatial ability - Modified Paper Formboard (PFB). This test includes two practice items and 30 test items (Bowd, 1973). It is designed to measure the ability of thinking spatially in two dimensions. Each test item encompasses a geometrical figure and a few shaded pieces of different shapes. The subject has to draw the lines on the geometrical figure that the shaded pieces can be fitted in to make the whole. There is a moderate time limit,

15 minutes, for the test administration. Likert and Quasha (1948) found that there was a reliability of .85 for one form, and .92 when two series of the Minnesota Paper Form-board Test, from which the present open-ended form was modified, were administered to 290 senior high students. Bowd (1971) found that there was a Kuder-Richardson reliability ranging from .80 to .92 when the Modified Paper Formboard Test was administered to Indian children age 12-14. Vernon (1969) found a moderate "g" and considerable practical and spatial loadings on his own open-ended practical formboard test. The same author also found that Indian and Inuit children scored lower than white children on a similar form of this test. However, he concluded that the scores on this type of test were less depressed than on verbal types of tests because of cultural factors.

Test of field-independence cognitive style - Draw-a-Person (DAP). Draw-a-person technique is designed to measure children's field-independence cognitive style, a pattern of abilities which some psychologists have argued relates to spatial-mechanical skills (Vernon, 1969). Children's drawings are classified into five categories according to how they show details of body concept. There is no time limit. Bowd (1975) found that there were moderately high correlations (r=.48) between scores on the Draw-a-Person technique and Raven's Progressive Matrices when these tests

were administered to fifty-three kindergarten children. The author also found moderate correlations (r=.37) between DAP and CEFT in the same test administration.

Procedure

All the testing for the Indian and non-Indian samples was completed within a three week period, from May 27 to June 17. Five of these tests were administered in two mornings by the experimenter and with the supervision of the class teacher, at each of these schools with the exception of North Oyster School. The conditions of the testing at North Oyster School will be described later. At Princess Royal School, tests were administered to white and Indian children from different grade levels. Testing procedures as laid down by test manuals were followed.

Factors likely to affect the validity of test results negatively at the North Oyster school were noted and as a consequence these data have been excluded from full analysis.

All the tests were administered in one morning because of preferential time indicated by the school. Instead of a regular classroom, the school library which had limited space, was used for the testing. All the Indian children within the required age range were gathered together and tested by the present writer. Class teachers were not able to supervise because they were required in their classrooms.

The negative attitude of the Indian children at North Oyster School towards the test and their lack of cooperation

made test administration very difficult. The first three tests (DAP, RPM, PFB) proceeded adequately. The children lost interest and became impatient during the last two tests (MHV & CTBS). Some even showed resentment because they could not participate in activities which were continuing in their regular classrooms.

A significant number of scores were noted which were considered likely to be invalid. Factors affecting the scores, such as negative attitude, lack of motivation and interest, and difficulties with supervision, made the test results of this Indian group suspect. Consequently, the comparisons of mean scores on the tests between Indian and non-Indian groups in the next chapter, will be based on the Indian children from Princess Royal School only and the full non-Indian sample.

CHAPTER IV

RESULTS

The principal results of this study relate to between-group differences of Indian and non-Indian children on a series of tests related to numerical aptitude. Sex differences in determining within-group differences are also examined.

Mean scores and standard deviations for all dependent variables in each group of subjects were calculated.

"t" tests were used to determine significant differences between the mean age of the non-Indian group and that of Indian groups, as well as between two Indian groups. "t" tests were also used to test for significant differences between the mean scores of the Indian group and non-Indian group on all dependent variables, and to determine significance of differences between mean scores of boys and girls on all dependent variables for both Indian and non-Indian groups.

Pearson product-moment correlation coefficients were calculated between all psychological test scores for both groups of subjects. The .05 level of probability was set as the criterion for determining the significance of results.

Comparisons of Mean Scores: Indian and Non-Indian Groups

All the significance of the differences of mean scores were determined by the two tailed "t" test. The objective of this study is to explore the factors underlying these

differences, however directional predictions were not considered warranted.

The comparisons of dependent variables between Indian and non-Indian children were made with twenty-two Indian subjects from Princess Royal School only, and the whole non-Indian sample because of the lack of confidence in data from North Oyster School. Mean scores and standard deviations of these twenty-two Indian subjects and non-Indian children are shown in Tables 2 and 3.

No comparisons of the test results between Indian children at North Oyster and the non-Indian group were made. A difference significant at the .05 level for MHV was obtained between these Indian children and the non-Indian subjects. However, no significant differences of mean scores were found between Indian subjects of Princess Royal School and non-Indian group on RPM, PFB, ARITH 1, ARITH 2, ARITH 3, ARITH Total, and DAP. The results of "t" test on these dependent variables are presented in Table 4.

Hypothesis 1 was therefore supported. There were no significant differences between mean scores of Indian and non-Indian children on non-verbal tests which consist of RPM, PFB, and DAP. Hypotheses 2 and 3 which indicated that there would be no significant differences between mean scores of Indian and non-Indian children on spatial test (PFB) and test of field-independence cognitive style (DAP),

Table 2

Means and Standard Deviations for Non-Indian Children on All Dependent Variables

Variable	Mean	SD	N
RPM	39.86	9.17	106
PFB	17.09	6.35	106
MHV	15.61	4.28	106
ARITH 1	37.99	8.75	109
ARITH 2	17.59	4.12	109
ARITH 3	16.77	6.35	109
ARITH TOTAL	72.34	17.51	109
DAP	2.06	1.26	106

Table 3

Means and Standard Deviations for Indian Children of Princess Royal School on All Dependent Variables

Variable	Mean	SD	N
RPM	35.82	9.66	22
PFB	15.05	5.41	22
MHV	13.59	4.01	22
ARITH 1	35.48	10.09	21
ARITH 2	17.33	4.33	21
ARITH 3	15.76	5.00	21
ARITH TOTAL	68.57	18.21	21
DAP	2.14	1.32	22

Table 4

Significance of Differences of Means on All Dependent Variables Between Non-Indian Children and Indian Children of Princess Royal School

Variable	t	p
RPM	1.86	N.S.
PFB	1.41	N.S.
MHV	2.04	<.05
ARITH 1	1.18	N.S.
ARITH 2	0.26	N.S.
ARITH 3	0.69	N.S.
ARITH TOTAL	0.90	N.S.
DAP	0.27	N.S.

were supported as well. Hypothesis 4, which stated that non-Indian children would score significantly higher than Indian children on numerical tests was rejected (Table 4).

The only variable which presented significant difference between the two groups of children, as shown in Table 4, was MHV. The non-Indian group had a higher mean score than the Indian group. Hypothesis 5 was therefore supported.

Comparisons of Dependent Variables Between Two Indian Groups: Princess Royal School and North Oyster School

There were significant differences in mean scores between these two groups on all the dependent variables ($p < .05$). Indian children of Princess Royal School performed better than Indian subjects drawn from North Oyster School on all these tests. Table 5 presents means, standard deviations, and the range of raw scores on all the tests. Mean scores and standard deviations of Princess Royal School can be found in Table 3. "t" test results are reported in Table 6.

Comparisons of Sex Differences on Mean Scores Within Groups

Indian group. The summary of sex differences for Indian children is presented in Table 7. It indicates mean scores for both boys and girls as well as significance of differences on all dependent variables. No significant differences on mean scores were found between boys and girls for the Indian children.

Table 5

Means, Standard Deviations, and Range of Raw Scores for Indian Children of North Oyster School on All Dependent Variables

Variable	Range	Mean	SD	N
RPM	2-21	14.05	4.22	20
PFB	0-8	3.80	2.12	20
MHV	0-15	6.08	4.23	13
ARITH 1	0-18	9.76	6.06	17
ARITH 2	0-10	5.69	3.20	16
ARITH 3	0-11	4.87	3.31	15
ARITH TOTAL	6-32	20.47	8.43	15
DAP	3-5	4.30	0.80	20

Table 6

Significance of Differences of Means on All Dependent Variables Between Indian Children of Princess Royal School and North Oyster School

Variable	t	p
RPM	9.61	<.05
PFB	9.02	<.05
MHV	5.25	<.05
ARITH 1	9.71	<.05
ARITH 2	9.03	<.05
ARITH 3	7.35	<.05
ARITH TOTAL	10.62	<.05
DAP	6.49	<.05

Table 7

Comparisons of Means of Indian Boys and Girls on All Dependent Variables

Variable	Sex	Mean	SD	N	p
RPM	F	27.21	13.00	19	N.S.
	M	27.60	13.96	30	
PFB	F	8.84	6.31	19	N.S.
	M	11.17	7.05	30	
MHV	F	10.65	5.11	17	N.S.
	M	11.84	5.45	25	
ARITH 1	F	27.71	15.28	17	N.S.
	M	24.14	14.50	29	
ARITH 2	F	13.06	5.72	17	N.S.
	M	12.50	6.96	28	
ARITH 3	F	11.29	6.14	17	N.S.
	M	11.85	7.00	27	
ARITH TOTAL	F	52.06	25.68	17	N.S.
	M	49.89	27.34	27	
DAP	F	3.00	1.37	19	N.S.
	M	3.03	1.65	30	

Non-Indian group. Table 8 presents comparisons of mean scores between boys and girls for the non-Indian group. There were no significant differences on mean scores between boys and girls on all the dependent variables except for ARITH 1. Girls scored higher than boys on ARITHMETIC COMPUTATION ($p < .05$) for the non-Indian group.

Comparisons of Correlations Between Dependent Variables for Princess Royal School and the Non-Indian Group

Correlation coefficients were computed between all dependent variables for Indian children attending Princess Royal School and for the non-Indian sample. The Correlation matrices for each of these groups are presented in Tables 9 and 10.

Most of the tests correlated moderately to highly with one another for each group. No significant relationships were found between RPM and ARITH 1, PFB and MHV, and DAP and ARITH 1 for the Indian group. For the non-Indian group, all the tests correlated significantly with one another at the .01 level, except that the correlations between MHV and DAP only reached the .05 level.

Table 8

Comparisons of Means of Non-Indian Boys and Girls on All Dependent Variables

Variable	Sex	Mean	SD	N	p
RPM	F	39.43	10.41	37	N.S.
	M	40.09	8.51	69	
PFB	F	16.86	6.76	37	N.S.
	M	17.22	6.16	69	
MHV	F	15.84	4.09	37	N.S.
	M	15.49	4.41	69	
ARITH 1	F	40.13	7.05	40	<.05
	M	36.75	9.42	69	
ARITH 2	F	17.78	4.39	40	N.S.
	M	17.48	3.98	69	
ARITH 3	F	17.78	6.37	40	N.S.
	M	16.19	6.31	69	
ARITH TOTAL	F	75.65	16.53	40	N.S.
	M	70.42	17.89	69	
DAP	F	1.89	1.20	37	N.S.
	M	2.14	1.29	69	

Table 9

Correlations Between Dependent Variables for the Indian Group of Princess Royal

	RPM	PFB	MHV	ARITH 1	ARITH 2	ARITH 3	ARITH TOTAL	DAP
RPM	-							
PFB	0.76**	-						
MHV	0.45*	0.37	-					
ARITH 1	0.40	0.61**	0.61**	-				
ARITH 2	0.71**	0.74**	0.67**	0.74	-			
ARITH 3	0.63**	0.65**	0.63**	0.82**	0.89**	-		
ARITH TOTAL	0.56**	0.69**	0.67**	0.96**	0.89**	0.94**	-	
DAP	0.46*	0.45*	0.51*	0.39	0.45*	0.52*	0.47*	-

* P <.05
** p <.01

Table 10

Correlations Between Dependent Variables for the Non-Indian Group

	RPM	PFB	MHV	ARITH 1	ARITH 2	ARITH 3	ARITH TOTAL	DAP
RPM	-							
PFB	0.69**	-						
MHV	0.26**	0.28**	-					
ARITH 1	0.46**	0.53**	0.33**	-				
ARITH 2	0.61**	0.53**	0.46**	0.63**	-			
ARITH 3	0.47**	0.54**	0.52**	0.79**	0.75**	-		
ARITH TOTAL	0.54**	0.59**	0.46**	0.93**	0.82**	0.93**	-	
DAP	0.44**	0.52**	0.25*	0.41**	0.37**	0.35**	0.42**	-

* $p < .05$
** $p < .01$

CHAPTER V

DISCUSSION

The objective of this study was to find the differences, if any, between children from different cultural backgrounds (Indian vs. non-Indian) using a series of tests relating to numerical ability, and the factors contributing to these differences. The samples included 113 non-Indian children selected from George Jay and Victoria West schools in Victoria, and Princess Royal school in Nanaimo. Fifty Indian children were selected from Princess Royal School in Nanaimo and North Oyster School in Ladysmith. However, only the twenty-two from Princess Royal school are used for cross-cultural comparisons. The North Oyster results are considered invalid; the correspondence of the socio-economic backgrounds and the age range between Indian and non-Indian samples was taken into consideration in the sample selection.

The emphases of this chapter will be on four main aspects:

1. summary of the results and discussion of the hypotheses;
2. discussion of the factors underlying between-group differences: degree of acculturation, mastery of English, schooling;
3. discussion of sex differences on test results;
4. limitations of the study and recommendations.

Summary of the Results and Discussion of the Hypotheses

In the present chapter, the essential comparisons between Indian and non-Indian groups are based on the test results of the samples selected from Princess Royal School and the entire non-Indian group. The reason for deleting the data of North Oyster School has been mentioned in the previous chapter. Hypotheses ONE, TWO and THREE will be discussed together. Hypotheses FOUR and FIVE will also be discussed together, while Hypothesis SIX will be discussed separately.

HYPOTHESIS ONE. There will be no significant differences between the scores of Indian and non-Indian children on non-verbal tests (RPM, PFB, DAP).

HYPOTHESIS TWO. There will be no significant differences between the mean scores of Indian and non-Indian children on a spatial test (PFB).

HYPOTHESIS THREE. There will be no significant differences between the mean scores of Indian and non-Indian children on a test of field-independence cogntive style (DAP).

There were no significant differences in the mean scores on Progressive Matrices, Modified Paper Formboard Test, and Draw-a-Person Technique, between Indian and non-Indian children. Indian children performed as well as non-Indian children on these non-verbal tests which contain

tests of general intelligence, spatial ability, and field-independence cognitive style (Table 4, page 40). Therefore, Hypotheses 1, 2, and 3 are supported.

The finding of no significant differences on tests of general intelligence between Indian and non-Indian children is supported by the research conducted by Taylor and Skanes (1976b), and Bowd (1973). Taylor and Skanes (1976b) examined the cognitive abilities of sixty-three Inuit and 176 white children from similar environments, ranging from grade two to six. They found that Inuit children scored higher than white children on Raven's Progressive Matrices.

Bowd (1973) administered tests relating to mechanical aptitude to Indian, Métis, and white boys, aged from twelve to fourteen, in order to find the differences on the level and structure of abilities influenced by the extent of acculturation. The result indicated that there were no group mean differences on the first factor which was defined as "g" because of its high loading on Raven's matrices. The high loadings of other spatial-mechanical tests on "g" factor suggest this "g" factor is more spatial than inductive. Thus, the author concluded that the superiority of Indian children's spatial-mechanical ability is likely to be found when culturally reduced tests are used.

The consistent results regarding Indian children's superior spatial-mechanical ability are also demonstrated in the studies of Vernon (1969); Gaddes, McKenzie, and

Barnsley (1968). Gaddes et al. (1968) administered four culture-reduced tests: Porteus Maze test, Draw-a-Man test, Cattell Culture Fair short form, WISC Block Design test to four groups of Indian and white children divided according to socio-economic strata and degree of acculturation. The equally competent performance of the Indian children suggests their mildly superior spatial ability, because the tests applied had more or less cultural relevant information.

The classic studies conducted by Dennis (1942), and Havighurst, Gunther, and Pratt (1946) indicated that some of the American Indian groups surpassed the white norms on the Goodenough Draw-a-Man test which is highly correlated with tests of reasoning, spatial aptitude, and perceptual accuracy for grade four children (Ansbacher, 1952). Wiltshire and Gray (1969) also pointed out that the reserve Indian sample were equal to or better than the white norms on Draw-a-Man test.

These findings in conjunction with the results of the present investigation, suggest that k:m factor (practical-mechanical-spatial-physical) in the structure of abilities is not so much affected by the cultural environment. Indian children are likely to perform as well as non-Indian children upon the tests less culturally biased.

HYPOTHESIS FOUR. Non-Indian children will score significantly higher than Indian children on the numerical tests (CTBS: ARITH).

HYPOTHESIS FIVE. Non-Indian children will score significantly higher than Indian children on a verbal test (MHV).

Hypothesis four is rejected. There are no significant differences between Indian and non-Indian children on the mean scores of Arithmetic Computation, Concepts, and Applications; and the Total Score (Table 4, page 40).

Hypothesis five is supported. The difference on the mean scores of Mill Hill Vocabulary Scale between Indian and non-Indian children is significant at the .05 level. Non-Indian children score slightly higher than the Indian children (Table 4, page 40).

According to Vernon's theory of the structure of abilities verbal and numerical abilities are separable, but tend to have a certain extent of overlap. Administering twelve tests to 395 students aged approximately nine years old, Schiller (1934) found that the correlation between arithmetic reasoning and computation was not higher than the correlation of both tests with four reading tests and tests of verbal "g". Vernon (1961) pointed out that the strong unification of the V:ed factor was caused by a rather uniform education offered by society. Moreover, the disadvantageous conditions to which children from culturally different environments are subjected, such as heavy verbal loadings of the textbooks, teachers' instructions, and numerical test content, plus the culture-bound information

in the test, lead to the assumption that Indian children would score lower than non-Indian children on the numerical tests and the test of verbal ability.

The results of a "t" test showed that non-Indian children were slightly superior to Indian children on the verbal test, while no significant differences were found on the numerical tests (Table 4, p. 40). In this part of the discussion, special attention will be paid to the characteristics of the socio-cultural background of these Indian children, so far as these are relevant to the academic tests. Those factors, which in all likelihood did most to influence test scores, such as socio-economic backgrounds, degree of acculturation, language, schooling, and the combinations of these, will also be discussed.

The Factors Underlying Between-Group Differences

Selection of the Sample from Similar Socio-Economic Backgrounds

Many studies demonstrate that children's performances on intelligence tests are closely related to socio-economic status of the subjects (Garth, 1923; Lesser, Fifer, & Clark, 1965; Anastasi, 1958). Intelligence tests are predominantly standardized on urban middle-class populations, since such groups are more apt to be selected in large numbers (Anastasi, 1958). Consequently, intelligence tests have a tendency to be overloaded with items which favor middle-

class children. Anastasi proposed that a lower-class environment was not conducive to the effective development of "intelligence" as it is defined according to western culture. Hence, matching socioeconomic status and the ages of the Indian and non-Indian groups is considered an important element in designing the study.

In this study, the majority of Indian and non-Indian children are from families classified at a low socio-economic level. Certain social and occupational phenomena associated with low socio-economic status (such as single parenthood, a high proportion of parental unemployment, a lower proportion of white-collar workers) appear uniformly in Indian and non-Indian samples.

Supportive research which has a similar sample arrangement was conducted by Taylor and Skanes. Matching socio-economic status and the grade placement of Inuit and white children, Taylor and Skanes (1976a) did not find significant differences on tests of either verbal-educational ability or inductive reasoning.

Degree of Acculturation

It is noted that the Indian children attending Princess Royal School have a great deal of contact with the white people, since their reserve is located within the city limits. The relationship between the degree of acculturation of culturally different children growing up in a predominantly white society, and their intelligence test performance, has

been investigated by Havighurst and Hilkevitch (1944); Cropley and Cardy (1975). In their study of intelligence of different American Indian tribes, Havighurst and Hilkevitch (1944) found the degree of acculturation and schooling related closely to Indian children's test scores. Cropley and Cardy also indicated that acculturation had a decisive impact upon the differing performances on cognitive tests of Indian children from residential schools and from regular schools. Early contact with the white society can not only help Indian children obtain certain cognitive skills, which are indispensable for school learning, but can also improve their language ability. Thus, their performance on the intelligence tests is enhanced by familiarity with the test items which are more or less culturally bound.

Language

The mean score of Indian children at Princess Royal School on Mill Hill Vocabulary Scale is only slightly lower than that of non-Indian children, although the difference reaches the .05 significance level (as shown in Table 4). According to the writer's investigation, only six out of twenty-two Indian subjects were in the remedial reading Program operated by the school at the testing date. Since English is their first language and they have close contact with white people, these factors may contribute to the adequate performance of Indian children on the verbal test.

Their language ability may also explain why there are no significant differences on numerical tests between Indian and non-Indian children in this study.

Schooling

The effects of schooling on school achievement and test performance of native Indians have been investigated by Vernon (1969); Havighurst and Hilkevitch (1944), Taylor and Skanes (1976). Taylor and Skanes (1976) found that Inuit children scored lower than white children on Digit Span Memory test, but the difference decreased rapidly with age. These authors concluded that the inferior performance of Inuit children at the beginning of school years was due to the lack of experiences in numbers.

Doob (1960) suggests that, whether or not school experience stimulates mental growth, there are many experiences relevant to test performance which can be transferred from the school situation. It is likely that children from culturally different backgrounds are disadvantaged in dealing with certain school tasks and intelligence tests on entering school. However, these disadvantages can be eliminated or reduced by using appropriate teaching methods and curricula based on the needs and pace of native children.

On first attending school, Indian children are just as motivated as white children to achieve academically. In view of their language deficit and their lack of experience of Euro-American culture, some children probably score

lower on intelligence tests than their white classmates. However, these deficiencies are not incapable of improvement, if the teachers are aware of the problems, and if a remedial program is applied immediately.

As they grow older, motivation for academic success drops in Indian children because of the following factors (and the interaction between them): increasing language difficulty which affects their school work, social alienation, the problem of self identity, and lack of support or encouragement from the significant adults. The alienation of the native Indians toward the school environment, mainly caused by the different cultural frame of reference, has been discussed in the Hawthorn report (1967), and the studies conducted by Lane (1972), and Couture (1967). The lack of academically successful models with native backgrounds for the Indian child to identify with, is also responsible for the decline of motivation.

Researchers unanimously argue that teachers have a great influence on children's school learning. Besides the ordinary guidance, teachers need to provide more attention and show more patience when they have some native children in their class. The teachers' recognition of Indian cultures as well as their understanding and accepting attitudes toward the Indian children's characteristics, would have a positive effect on Indian children's learning motivation and academic performance. A warm, accepting atmosphere,

well-planned teaching programs, sincere and responsible school personnel, might be the most significant factors relevant to the adequate performance of Indian children at Princess Royal School.

What Causes the Large Differences on Test Scores Between Indian Children at North Oyster and Princess Royal Schools?

The conditions advantageous to the Indian children at Princess Royal School for academic performance, do not benefit the native children at North Oyster equally. Comparison of their social backgrounds and the likely factors relating to the differences on the tests are discussed from the following aspects.

Acculturation

Limited contact with the white society is likely to restrain Indian children at North Oyster School from assimilating white culture. It indirectly affects their performance on intelligence tests which contain information relevant to Euro-American culture.

Language

The Indian children at both schools speak non-standard English according to the principals' reports. However, the evidence that approximately all the Indian subjects at North Oyster School are in the Distar Reading Program compared to five out of twenty-two Indian children at

Princess Royal, proves the latter have achieved better language skills. Inadequate language ability is considered as one of the essential reasons why the Indian children at North Oyster show a poor performance on these intelligence tests.

Schooling

In addition to the likelihood of inadequate language ability and not having enough contact with the white culture, the poor test performances of Indian children at North Oyster School may be associated with their standard of education. The prevalently negative attitude of the Indian children toward testing and school may reflect their frustrations caused by continuous failure and lack of faith in school. Two entirely different test results were obtained from these Indian schools, which have the same remedial and cultural programs. It is the writer's opinion that at North Oyster School, limited attention was paid to the Indian programs by the school personnel.

Age and Motivation

The other two factors which are likely to relate to the test performance of Indian children at North Oyster School are the age variable and motivation. The mean age of the Indian children at North Oyster School is 10.5 years, almost two years younger than the mean age of the Indian children at Princess Royal (see Table 1, page 30).

According to Ferguson's theory of abilities, human abilities are overlearned acquisitions. The abilities of children improve steadily with age, although they do not show marked change within a short interval.

The amount which the age difference between the two schools contributes to the test scores is uncertain. Comparison between the different age groups of the Indian children was not made because of the smallness of the sample. As the present research is a general exploratory study, it is possible to draw only a few conclusions. It is necessary to have more profound and pervasive investigations in this area before convincing conclusions can be drawn.

The generally low motivation and negative attitude toward the tests in the Indian subjects at North Oyster cast some doubt on the validity of the test results. Their low motivation may be due to testing arrangements discussed in the previous chapter; or it may be due to fatigue. Frustration due to the language difficulties, and their incapability in handling questions is probably the most acceptable explanation.

Sex Differences on the Test Results

HYPOTHESIS SIX. For each of the Indian and non-Indian group, boys will have higher mean scores than girls on RPM,

PFB, ARITH 2, ARITH 3, and DAP tests; while girls will perform better than boys on MHV and ARITH 1. There will be no significant differences on ARITH TOTAL score between boys and girls.

A number of studies have reported sex differences in aptitudes in the last few decades. These results are predominantly found in samples selected from high schools and the older age groups. The studies consistently point out that boys excel significantly on tests of spatial and mechanical aptitudes, on perceptual functioning, and on verbal or numerical reasoning tests (Anastasi, 1958; Witkin et al., 1954; Terman & Tyler, 1954; Lesser, Fifer, & Clark, 1965). However, girls surpass boys in verbal functioning and arithmetic computation (Anastasi, 1958; Wesman, 1949; Terman & Tyler, 1954). It is possible that besides biological factors, child rearing practice and the demands associated with sex roles are connected with the development of sex differences in aptitudes.

Unavoidably, cultural factors play a significant role in the development of sex differences in aptitudes. In studies of the perceptual abilities of the Eskimos, Berry (1966) did not find any significant sex differences. Other supportive studies are those of the cognitive abilities of the Eskimos, conducted by Witkin (1967), MacArthur (1967). They give similar results. These authors concluded that the ecological demands and the unisex upbringing in the

Eskimo communities are the most likely factors which act to eliminate sex differences in cognitive abilities.

In the present investigation, comparisons of sex differences of mean scores have been made for both Indian and non-Indian groups. Results show the Indian group had no significant sex differences on any of the test means (Table 7, page 44). For the non-Indian group, girls scored significantly higher on ARITH 1 (Computation) than the boys; no other significant differences were found (Table 8, page 46). As a result of these findings, hypothesis six was not supported in its entirety.

Study of sex differences in aptitudes are still at an exploratory stage. It is possible to obtain contradictory results, sometimes benefitting boys and sometimes girls, depending on the sampling procedures adopted. Most of the studies which indicate superiority of boys on spatial, perceptual, or numerical tests are made on samples selected from the high school or college level. In younger groups, it is difficult to detect sex differences in particular aptitudes. No matter which underlying factor (either biological functioning or sex role stereotyping or both) causes the sex differences in aptitude, these are most likely to appear at adolescence or adulthood.

Limitations of the Study and Recommendations

Like most cross-cultural studies, the present study is limited because of the smallness of the sample tested. Abandonment of the data of North Oyster School resulted in a smaller size of Indian sample than originally planned. Furthermore, the selection of the sample is limited to two elementary schools in Victoria and one in Nanaimo. The hazards common to most cross-cultural studies are found in the present study. Due to the restricted size of the sample, one can draw tentative conclusions only.

Certain important suggestions can be made based on the results of this investigation. The lack of significant differences between Indian and non-Indian children on the majority of the tests in this study suggests that matching the age and socio-economic status of the experimental subjects should be a major priority when cross-cultural studies are conducted. The use of tests which are less culture bound also makes the comparisons fairer to both groups. The degree of acculturation has to be taken into account in relation to differences in score. Indian children are quite likely to achieve the same level as white children on intelligence tests, at least in the elementary school years, provided appropriate remedial language programs are in operation. Awareness and concern for these problems of Indian children at school entry and

later stages seem indispensable pre-requisites for improving Indian education.

It would be desirable, in future, to have additional studies in this general area. In particular, a larger Indian sample would be secured, and better testing arrangements obtained for Indian children.

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