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The Influence of Educational Ability on Cognitive Mapping Ability: A Study of School Children in Halifax, Nova Scotia

Gilbert Ronald Oikle
Wilfrid Laurier University

THE INFLUENCE OF EDUCATIONAL ABILITY ON COGNITIVE MAPPING ABILITY: A STUDY OF SCHOOL CHILDREN IN HALIFAX, NOVA SCOTIA

by

GILBERT RONALD OICKLE

B.A. Waterloo Lutheran University, 1967

B.Ed. Dalhousie University, 1968

M.A. Dalhousie University, 1974

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ABSTRACT

The purpose of this thesis is to find how a child's cognitive abilities affect his cognitive map. Most of the earlier studies concentrated on socio-economic factors as the main factors affecting cognitive mapping, either ignoring cognitive ability or giving it minor consideration. This study surveyed a group of children ages 12 to 15 years in a Junior High School in Halifax, Nova Scotia.

The study revealed that cognitive ability significantly affected the forms of the cognitive maps of the students, but was not a significant factor in influencing the elements placed on the cognitive maps. Children of high achievement and I.Q. affected the quality of various forms of the cognitive maps. However, more work could be done in the area of which particular factors of cognitive ability affected which aspects of cognitive mapping.

ACKNOWLEDGMENTS

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A very special thanks goes to my wife, Tannis, who encouraged me to complete this thesis, deciphered my writing, typed this thesis and looked after a family. To my family I dedicate this work.

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Chapter 1

INTRODUCTION

The purpose of this thesis is to find how a child's cognitive activities and intellectual skills[1] affect his cognitive map of his environment. A cognitive map of an environment is our internal spatial image of that environment (Ittelson and Proshansky, 1974, p. 121). One way cognitive maps can be studied is by having an individual translate his spatial images, in the form of a physical map, on a piece of paper. The paper maps can thus be considered as representations of the individual's cognitive maps.

There have been a number of studies that have explored the cognitive maps that individuals in various ethnic groups have of their neighbourhoods (Ladd 1970, Maurer and Baxter 1972). These studies mainly explored what influence age, sex, ethnic, cultural and social factors had on the cognitive maps of children. There have also been a number of studies that explore a person's preferences for an area and their preferences are then shown in the form of a cognitive map (Gould 1974). This

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[1] For the purposes of this study cognitive activities and intellectual skills are defined as those skills measured by school records which include I.Q. scores, verbal test scores, and any other scores that pertain to the child's cognitive processes.

study does not intend to explore the area of preferences. Research dealing with the influence of the individual's cognitive activities and intellectual skills on his cognitive map has been neglected by many researchers.

Ittelson and Proshansky (1974, p. 14) state

> "People develop selective and unique conceptions of the cities they live in, their schools and hospitals, the route they take to work; these in turn influence how they use, move about in, and, indeed, feel about space.

They go on to say

> It is this cognitive structuring of the environment that enables us to organize our world in a recognizable and manageable way. Unless we were able to schematize the environment in terms of mental images, we could hardly hope to live in it with any degree of predictability, although it is quite obvious that we are continually having to correct our distortions against reality. But even with these built-in errors, only because we can code, structure, and store perceived information phenomenologically; that is, in a mental setting, can we order it physically. It is this internalized environment that gives form to the visible world."

Place learning is an important aspect of the learning process, whether it is learned in the formal atmosphere such as the classroom, or informally, in front of the television set. Blaut and Stea (1973, p. 227) suggest

> "The general learning process related to place learning includes first a stimulus or complex of stimuli that set the stage for learning, or make it possible for learning to occur; second an organism, in this case a human child, who is to

> learn some response to stimuli; third an inferred cognitive process within the central nervous system that codes and stores the experience and recombines its elements in line with previous experience already in storage--a process that is linked by such words as 'memory' and 'thinking'; fourth a response that is to be learned or to be attached to the stimuli; fifth a reward or reinforcement for the behavior, ...; sixth some criterion of 'learning' allowing us to say that learning has, in fact, occured."

A cognitive map is one aspect of a child's understanding of place.

Yi-Fu-Tuan (1975) states that mental maps (cognitive maps) do have a function in geographic knowledge and behavior. (1) Mental maps prepare us to communicate spatial information effectively; (2) They allow mental practice, that is, the symbolic rehearsal of a physical activity; (3) Mental maps are a mnemonic device; (4) Mental maps, like real maps, are a means to structure and store knowledge; and finally (5) Mental maps are images.

In the previous quotations the learning process was involved in some aspect of the development of cognitive maps. Since the understanding of places or spatial activity is an important aspect of geography, one area of study is to determine which specific learning processes are important in the development and interpretation of a person's cognitive map.

The author of the thesis is a high school teacher and therefore has a special interest in developing methods of geographic research in the area of education. Since the author has a working knowledge of the City of Halifax School System, the study will center on that area (see Map 1, p. 5).[2]

Through experience as a teacher I believe that there are certain aspects of a person's intellectual awareness that affect his ability to work with spatial information. I have worked with students ages fourteen to twenty from various socio-economic backgrounds who have not been able to interpret or explain spatial content from a map, air photograph or from their own environment. These students did not have any particular learning disability that would affect spatial understanding. Since socio-economic factors or learning disabilities did not appear to have a significant effect on the students' interpretation of spatial content I believe that one of the possible areas of explanation is their cognitive activities and intellectual skills.

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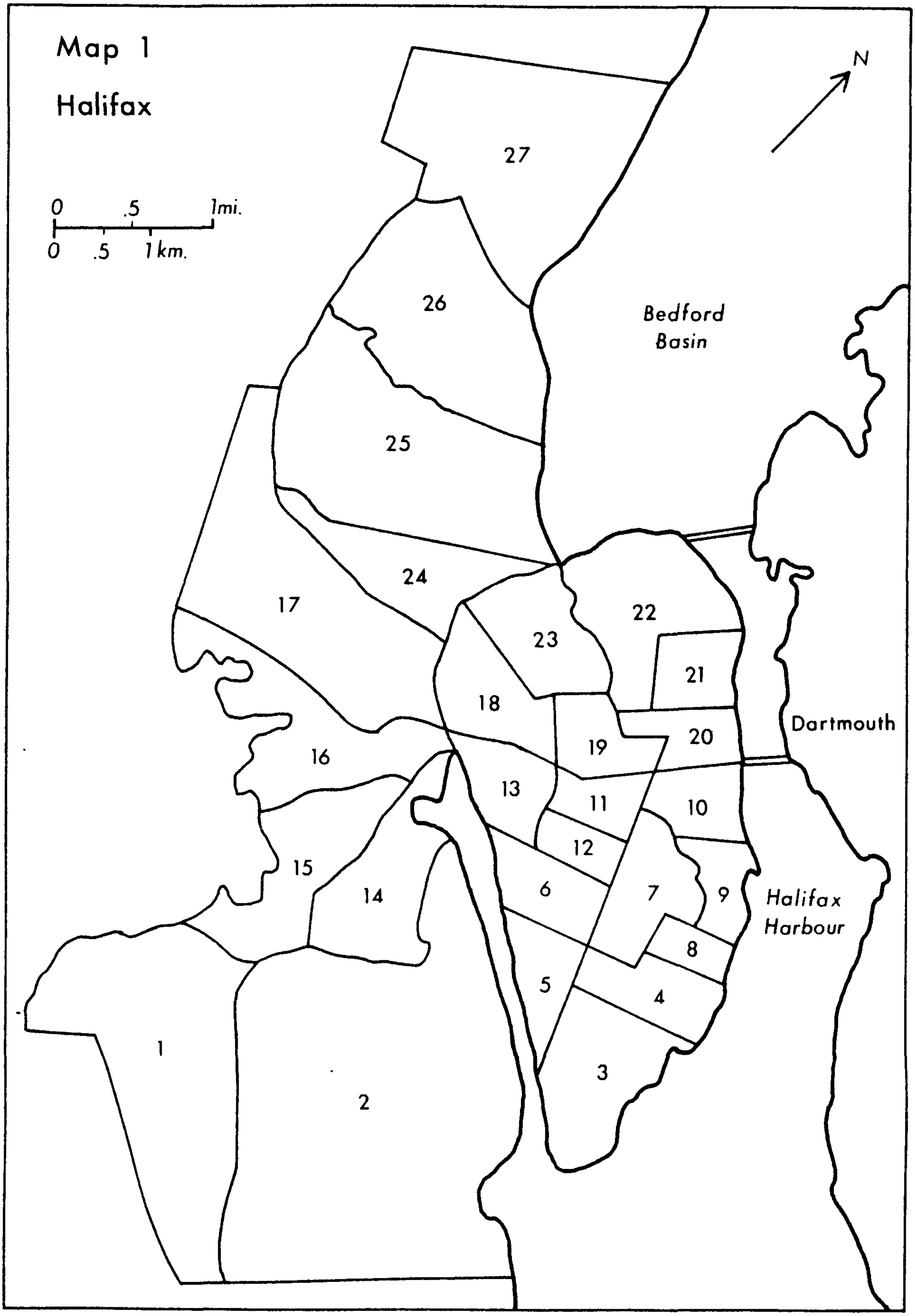
[2] The City of Halifax School System (see Map 1) is the area defined by the Nova Scotia Department of Education as School System One, Halifax City, Municipality of Halifax. All schools within the boundary shown are the responsibility of the Halifax Board of School Commissioners.


Map 1
Halifax
0 .5 1mi.
0 .5 1km.
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Bedford Basin
Dartmouth
Halifax Harbour
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One situation where knowledge of the processes of cognitive maps in humans is important is the school age population. Since it is this age group in society where a significant amount of both physical and psychological development takes place.

Statement of Purpose

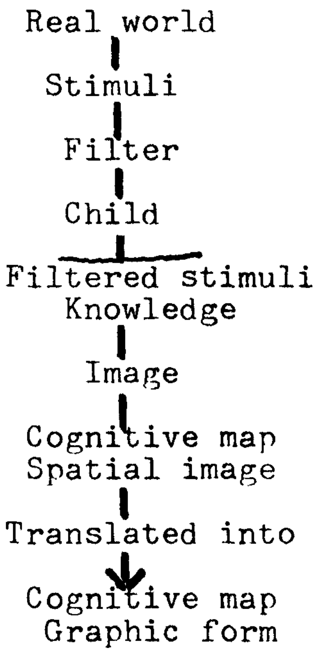

Figure 1

In Figure 1 a child receives stimuli from the real world. This information is usually filtered or influenced by various aspects of the environment. A child may be influenced by buildings of various shapes and not see buildings of other shapes. This information is also filtered by internal aspects of the child before it becomes knowledge and is stored in the brain. This information is stored as an image. If a child is asked to describe his image of his environment it is in the form of a cognitive map or spatial image. This spatial image can be translated into a graphic form; and this graphic form is called a cognitive map.

One of the questions suggested by Figure 1 is "What is the relationship between a child's cognitive activities and intellectual abilities as reflected by I. Q. scores, verbal test scores, mathematical test scores, reading test scores, map-making skill tests and other factors available from the record card of individual children, and a child's conception of an image and cognitive map of an area as seen in his graphic map?" This question may be broken down into two parts, both of which are examined in this study. The first part investigates whether cognitive activities and intellectual skills affect the nature of the environmental knowledge acquired by the child, while the second attempts to determine if cognitive ability and intellectual skill affect the nature of the graphical representation of the cognitive map produced.

Importance of Study

Stea and Blaut (1973, p. 233) state

> "Spatial learning has been neglected as much by educators as by psychologists engaged in the study of learning. Primary and secondary

> classes still spend an overwhelming amount of time on the non-spatial aspects of geography; cartography as such is often not taught at all, and maps serve as an (often, as they are used, dispensible) adjunct to other aspects of study - when they are not being used merely as colouring exercises. The emphasis is still upon information conveyed by our major mode of communication: the printed word."

Since reading and map work both use symbolic languages a child's ability to construct cognitive maps may be related to the reading process. It may be possible through this study to get at some of the problems in spatial learning in children.

Eliot (1972, p. 210) states that "there is the need to investigate the ways in which the possession of spatial ability maps impair other kinds of learning."

In the same article Eliot (1972, p. 210 - 211) states

> "More recently, Symmes (1971) found that boys with high spatial ability were more likely to have difficulty learning to read. In short, we need further research about the ways in which possession of certain abilities may interfere with or complement different kinds of learning.
>
> A third opportunity for research activity is the study of spatial visualization. Spatial visualization, or the ability to perceive and to imagine spatial arrangements from different viewpoints, may be fundamental to children's learning to make and read maps."

Blaut and Stea (1971, p. 393) in another article support the need for research in spatial learning by stating

> "Our findings suggest that geographic learning is clearly if not completely distinguishable from social learning. Here is a very good argument for the distinctive function of geography as a school subject and science. This special function may emerge from some ancient and primitive 'sense of place', or some abyssal proto-geography. But it is discovered anew whenever a child plays hide-and-seek, or loses his way, or stubs his toe."

This type of study has interdisciplinary value. Psychologists have been deeply involved in the processes of spatial learning. "Obviously, most psychologists are not concerned with map skills per se, but relevant abilities that they have studied include the development of frames of reference, spatial orientation, measurement, manipulation ability and symbolization" (Meyer 1973, p. 27).

Finally, very little has been prepared about the processes involved in cognitive maps; therefore, this research may be beneficial to further research in the area of cognitive maps.

Delimitation of Study

This study is limited to the children of the City of Halifax School System (see Map 1, p.5) specifically schools in Census Tract 17. The age groups to be studied are 12 years old and 15 years old. These children would be in Grades VII and IX respectively. The reasons for choosing these age groups will be discussed in The Procedure. In Halifax there are approximately two thousand students in each of these age groups, divided almost evenly between males and females. The form, the non-spatial data and the spatial data of the cognitive map will be compared to information about the child's intellectual abilities that are available from the school records.

The Organization of the Thesis

The thesis is organized as follows:

Chapter 2 - Review of the Literature

This will focus on papers that refer to the structural aspects of images with the aim of developing and answering the question "What is the effect of cognitive activities and intellectual skills on the child's cognitive map? The Review tries to cover a broad range of cognitive mapping from the theoretical to the practical. The sources of materials are books, periodicals, reviews and theses, covering a range from the best known works to obscure articles. An attempt was made to cover a representative range of written work on cognitive mapping.

Chapter 3 - Presentation and Preliminary Analysis of Data

The study was done in Census Tract 17 (see Map 1, p. 5) of the City of Halifax, Nova Scotia. Students from a Junior High School in that area were selected for the study. They were given a series of tests and assignments. The data was collected together with information from their school records. The value of the data and collection techniques are discussed.

Chapter 4 - Factor Analysis of the Cumulated Data

The various groups of data discussed in Chapter 3 were factor analyzed to condense the information to find dominant elements. The results of the various factor analyses are discussed separately.

Chapter 5 - The Relationship Between the Cognitive Maps and Cognitive Ability

Here the results of partial correlation procedures to find the relationship between the cognitive maps and ability are discussed. The results of each partial correlation procedure are discussed separately.

Chapter 6 - The Conclusion

The trends of the previous chapters are discussed under the headings of (a) Summary of Major Findings, (b) Recommendations and (c) Implications of Further Research.

Chapter 2

REVIEW OF THE LITERATURE

Introduction

A notable feature of the social sciences in the 1960's was the beginning of the growth of studies in cognitive mapping. Geographers became interested in how people developed a knowledge of space. This type of study is just one of the many types of studies in the area of space perception, which is "only part of a more general trend in modern geography, mainly the 'behavioral revolution' " (Downs, 1970, p. 68).

There are three major areas of research - (a) the structural approach, (b) the evaluative approach and (c) the preference approach. The approach of this thesis is the structural approach. Downs (1970, p. 71) states that

> "There must be some mental basis for the storage of relevant information from the environment. We are therefore working on the assumption of limited finite capacity for such information storage. Given this, we can ask several basic questions, all of which are centered on the concept of the image. What information is stored in our minds? How is it stored; that is, how is it structured? What is the relationship between the image (or stored information) and the real world from which the image is abstracted? What is the process of abstraction determined by?"

One of the major studies in structural basis of mental images is Lynch's The Image of the City. One of Lynch's objectives was to have the inhabitants of Boston, Jersey City and Los Angeles recognize and organize their areas into coherent patterns.

In this Review of the Literature the thesis will focus on papers that attempt to answer the previous questions asked by Downs (1970).

"The mental map portrays only a portion of the real world, since it is impossible for man to have first-hand experience or even second-hand knowledge of all parts" (Pocock 1971, p. 321). Pocock (1972) states that this is done by mental filtering and coding of sensory data, p. 115. "Mental coding is done with regard to both non-locational ('whatness') and locational ('whereness') aspects of the environment, information being accumulated through first-hand experience and second-hand knowledge" (Pocock 1972, p. 115). The cognitive mapping of a child will be associated with this experience and knowledge. The amount of first-hand experience and second-hand knowledge accumulated by the child may be determined in part by his cognitive activities and intellectual skills.

The mental map is not only restructured in area and fragmented, it is also an ego-centered projection. Pocock (1971, p. 322) states that it is "a function of the physiological, sociological make-up of the individual". Elsewhere he also suggests that "although each person's mental image is unique, degrees of conformity permit the recognition of common or group images. This fact, plus the patterned behavior of man acting as if in response to common images, provide both the validity and utility of the analysis of mental maps". One of the problems with the earlier studies is the comparison of different socio-economic areas. The people from higher socio-economic areas usually had more detailed cognitive maps than people from lower socio-economic areas because of their increased mobility. One area of study that has had limited research is the comparison of cognitive mapping and mental activities holding socio-economic areas constant.

The Cognitive, Psychological and Educational Studies in Perception and Cognitive Mapping

The major point of this section of the Review of the Literature is the factor of the stages of development of children, especially those stages of development affecting perceptual skills and spatial visualization. The children who were selected for this study are between the ages of 12 and 15 years. Children of this age group should have developed these perceptual skills. Spatial visualization and perceptual skills are aspects of learning that have involved psychologists and others in learning theory for the last sixty years.

Efforts to define spatial reasoning, however, must be seen as part of a large scale expression of interest throughout contemporary psychology during the 1960's. The work has been done mainly by Jerome Bruner, Andrien Pinard, Monique Laurendeau, John Flavell and Jean Piaget.

According to Jean Piaget, a Swiss psychologist, the ability to conceive dimensions, distances, systems of co-ordinates that underlies spatial thinking is the outcome not solely of repeated visual perception, but also, and perhaps more importantly, associated actions repeated in many settings and with many objects. In discussing the evolution from perceptually dominated space to the achievement of a conceptualized space Piaget (1956, p. 193) argues

> "To discover one's own point of view is to relate it to other viewpoints, to distinguish it from and to relate it to other viewpoints, to distinguish it from and to co-ordinate it with them. Now perception is quite unsuited to this task, for to become conscious of one's own viewpoint is to liberate oneself from it. To do this requires a system of true mental operations, that is, operations which are reversible and which are capable of being linked together."

Piaget through numerous experiments recognized four stages in the development of intelligence: sensorimotor, preoperational, concrete organizational, and formal operational. Each group is based on a child's ability to do various skills in the area of spatial visualization. These stages are important because the children in this study should be at the stage which allows for full development of spatial visualization. Each of the four stages are discussed to clarify why it is important for the students to achieve the stage of formal operational.

The sensorimotor period (stage 1) extends from birth to age two when a child develops symbolic language. The formation of preoperational space (stage II) extends from age two to age seven and is divided into two sub-stages: IIA - a symbolic and preconceptual thought (from two to seven) and IIB - intuitive partially regulated thought (from four to seven). Children at this age "have difficulties with spatial representation because they lack the cognitive organization which will permit them to do more than restructure their own point of view." (Eliot 1970, p. 267). They cannot separate various objects from a group of objects.

By the concrete operational space (stage III) from seven to twelve, the child has achieved a cognitive organization or system of mental operations so that he can organize ideas into logical structures. The sub-stages are sub-stage IIIA (Seven or eight) the appearance of concrete operations and sub-stage IIIB (nine to twelve) the organization of operations into logical structures. "Piaget contends that the discovery of perspective or different viewpoints come about when a child no longer regards an object as an entity in isolation, or through his becoming aware of the relations which link objects to other viewpoints or orientations" (Eliot 1970, p. 267).

The formal operational space (stage IV) is the final stage of adolescence and beyond as the person enters into areas of abstraction.

Piaget's work has been verified and extended by Laurendeau and Pinard. In 1970 they published a book about their study in Montreal testing the child's first spatial concepts. The study consisted of five tests to show the existence of stages of intellectual development, the internal consistency of the tests, the existence of an initial topological structure and the role of cognitive egocentrism in the development of structures. The tests were given to fifty children aged 2 to 12 at various age levels. At each age level subjects were distributed according to sex, father's occupation, and level in school (or number of children in pre-school family) so as to reproduce exactly the proportions established by the French-Canadian population of the city of Montreal. Laurendeau and Pinard (1970) state that "knowledge of space may in fact occur at different levels - levels which are not always easy to define or distinguish, and whose informational value may vary considerably" p. 8.

In summary, the results of their tests agree very closely with Piaget's concept of stages of development. The child goes from the stages of topological space (qualitative relations, neighbourhood, separation, ordinal relationship) to projective space (concept of the straight line) until he reaches metric (or Euclidian) space (concepts of distance in which the equivalence of figures depends on their mathematical equality). By the time the child reaches the age of seven he has passed into the stage of metric (or Euclidian) space.

Another aspect of the study was the egocentric attitude, in which a child perceives the world from a single viewpoint not being able to distinguish between his own perspective and that of others. This attitude begins to disappear by the age of eight. Towler (1971) found the same results when he studied a group of students in kindergarten to Grade VI, ages five to thirteen years, in Indiana. This is important because children should be at a stage of development where they are able to receive as much information about their environment as they are intellectually able to receive. The information they receive should not be influenced by the factor of immature development.

Vernon (1966, p. 391) states regarding perception and intelligence stages

> "There is little doubt that the percepts of children, even if initially a function of the immediate sensory data and of innate

> perceptual tendencies such as those postulated by the Gestalt psychologists, are molded and adapted in the light of acquired information by thought processes and by learning through experience."

Certain perceptions may be innate "but it cannot be supposed that there is an innate capacity to perceive, comprehend and utilize all the objects which confront the child; such knowledge must be learned." (Vernon 1966, p. 392). Vernon suggests the idea of a major difference between perception and intelligence from his work with adults "but children must acquire general and organized knowledge about the nature of the environment as a whole. They must also develop the capacity to alter and select, and to perceive rapidly and accurately, dependent in part on maturation but also assisted by learning" (Vernon 1966, p. 392).

In another study by Holloway (1967, p. 10) the three stages of children's drawings are discussed. They are (1) synthetic incapacity, (2) intellectual realism and (3) visual realism.

> "An example of synthetic incapacity is a drawing of a man by a boy ages 3 and 1/2 years who draws a large head to which are appended four strokes, two representing the arms and two the legs, as well as a small trunk separated from the limbs. The head contains two eyes, a nose, and mouth, but the latter is placed above the former. This is a representation of space which neglects euclidian relationships (perspectives with projections and sections) and which has hardly begun constructing topological relationships and even these only where the simplest slopes are involved. The stage of intellectual realism

> is exemplified in the drawings which show everything that is there; not just what is visible from a particular point of view."

Towards the age of eight or nine a type of drawing appears which tries to take into account perspective, proportion and distance. A child's perception develops before his ability to project these images in a drawing that has the shape or form of reality. Even though a child has the intellectual skills, if he is not fully developed he would not have the ability to produce a complete cognitive map.

Kidd and Rivoire (1966, p. 99 - 100) in discussing Lowenfeld's work in the area of developmental stages in space stated that

> "Seven to nine year olds, schematic stage - the most important and basic experience of the child's spatial development was the discovery ot order in space relationships. In other words, whenever the child related himself to others saw himself as a part of the environment, his first common experience of space had occured, and was expressed by the drawing of everything on a common base line.
>
> In nine to eleven year olds, Lowenfeld saw a stage of drawing realism, a stage characterized by the formation of groups, lack of co-operation with adults, a greater awareness of self with regard to sex, and the drawing of more than simple geometric figures or schematic representations. At this stage the child becomes aware of the concept of overlapping - that a tree growing from the ground will partly cover an area of the sky - but has difficulties in spatial correlations because of his egocentric attitude and lack of co-operation. Such a child has not fully developed a visual percept of depth but

> certainly has taken a first step toward such a concept.
>
> In the eleven to thirteen year olds a pseudorealistic stage occurs and another psychologically important development enters the picture. It is with approaching adolescence that these preferences crystallize; in this stage of development perception of perspective begins to form."

In conclusion, a child cannot be expected to have certain skills or to perform certain tasks until he is ready. Seven years of age appears to be the youngest age at which children should be tested. Above seven they have developed perceptual skills that will give the tests more validity. Ages nine and twelve, based on the studies, should give results that are based on developed perceptual skills. The children in this study, ages twelve to fifteen, should be fully developed and therefore immaturity in perceptual development should not be a factor.

Cognitive Studies and Geography

Studies in cognitive mapping and spatial behavior have been mainly done by Roger Hart, Roger Downs, James Blaut and David Stea. Yi-Fu-Tuan has written articles noting the confusion over terms that have developed from the various studies in spatial behavior.

Downs and Stea (1972, p. 9) have defined cognitive mapping as "a process composed of a series of psychological transformations by which an individual acquires, codes, stores, recalls, and decodes information about the relative locations and attributes of phenomena in his everyday spatial environment."

The individual receives such a wide variety of spatial information from so many complex sources that the information must be filtered, condensed and stored. This process is cognitive mapping. One point that Downs and Stea make is "however we must make it perfectly clear that a cognitive map is not necessarily a 'map' " (1973, p. 11). The term "map" is used as an analogue when working in the area of cognitive mapping. We cannot be sure that cognitive mapping will be the same as cartographic mapping. It is important to have other methods of studying cognitive maps beside a comparison to a cartographic map. One method is to have the children give a written or oral description of their area.

Downs and Stea (1973, p. 11) also say we have to be careful because some "representation may be heavily content loaded - that is, they may stress what is being represented and not the way in which it is being represented. Instead, we should be concerned with the nature of signature of relative space as it is concerned and constructed by the individual." If an individual draws a cognitive map of an area and omits part of the area further study or evaluation may be necessary. The omitted area may be an area that the individual does not like (factory) or an area he fears (crime), yet he knows that area. The cognitive map of this individual should be evaluated with factors known. This is the only way to see how relative and absolute space differ.

When comparing intergroup and individual differences in cognitive mapping there are three underlying factors that must be kept in mind. Downs and Stea (1973, p. 21) state

> "First the spatial environment contains many regular and recurrent features. Second, people share common information - processing capabilities and strategies. The capabilities are associated with the innate, physiological parameters of human information processing while the common strategies are learned methods of coping with the environment. Third, spatial behavior patterns display similar origins, destinations and frequencies."

The second factor is the important one in this study. What are the innate parameters of human information processing?

The sources of information are sensory modalities (visual, tactile, olfactory and kinaesthetic), direct sources, second-hand sources and inferential sources. These sources of information are quite evident, but what effect does the individual's cognitive ability have in organizing, arranging and using the information about his environment?

Stea and Blaut (1972, p. 51) "recent studies in the field have focused largely on the analysis of behavioral products which presumably reflect the existence of cognitive maps and much less on the process itself, a process which we shall refer to as cognitive mapping."

In the article Toward a Developmental Theory of Spatial Learning Stea and Blaut (1973) present a brief historical sketch of cognitive mapping processes. The topic was associated with the birth of scientific psychology in 1879. The degree of interest shown by psychologists in the area of behaviorism has varied considerably over the years. Since Boulding's The Image (1956) there has been an increased interest in cognitive mapping especially environmental behavior.

Parallel to studies in psychology, geography was interested in man/land relations. The studies in environmental behavior were associated with environmental determinism. When environmental determinism fell on disfavour with geographers studies in environmental behavior were also abandoned. During the 1960's interest in environmental behavior returned as a way of describing the man/land relationship.

The works of Piaget, Inhelder, Tolmon and Lewin became frameworks for studies in cognitive mapping.

> "The subject matter was originally conceptualized as 'environmental perception' but it soon became apparent that the basic problem was neither perception as studied by psychologists nor environmental determinism in any of the forms promulgated earlier by geographers, but rather

> environmental cognition - and notably its most intriguing element, cognitive mapping." (Stea and Blaut 1973, p. 54).

The average adult "upon direct environmental experience and its cognitive effects" (Stea and Blaut 1973, p. 58) is able to partake of the full meaning of experiences of his environment. The child, however, is denied this experience because he is in an adult world.

> "The development of the child's knowledge, or his cognitive mapping abilities, appears to antedate extensive first-hand dynamic experience with the larger environment. We will argue that this knowledge is acquired through the observation and manipulation of surrogates for direct experience, through acquisition of the ability to 'model' the real world. But sensorimotor interaction is a necessary precedent and a most important prior experience" (Stea and Blaut 1973, p. 54).

Stea and Blaut (1974) in studies have shown that children at the age of three are able to solve all essential problems of mapping. Through play and limited experience the child can learn about his environment. However, Stea and Blaut (1973) did not suggest what cognitive processes are necessary in spatial learning, except for the sensorimotor processes.

In a study by Davol and Hastings (1967) reading ability and socio-economic level had significant effects on the measure of spatial relations in a child. The socio-economic factors were measured by the type of school, while the reading ability was a measure of reading achievement and general intellectual ability.

Consequently, there appears throughout the literature the basic idea that cognitive mapping is the product of development and learning. As Downs and Stea (1973, p. 221) mentioned "There is no Zeus' forehead of geography from which such cognitions emerge full-blown; they are the product of the collated experience of the mobile human being, the result of development and learning." If the process of the development of cognitive mapping is developed and learned then the individual must have the capacity or capabilities to assimilate, interpret and decode the images he receives. Is this ability the result of the various cultural factors or a mental ability that is developed in the child, or a combination of both factors? This is a question that this thesis seems to answer.

Selected Studies in Cognitive Mapping

We have selected for review only the major works in the area of cognitive mapping. One of the best-known is Lynch's The Image of the City. This study is important as many of the procedural ideas and research methods of a number of other studies originate here. The study was mainly concerned with people's images of a city. The cities studied were Boston, Jersey City and Los Angeles. Lynch's sample of the population for study was very small, interviewing only thirty persons in Boston and fifteen each in Jersey City and Los Angeles. This small sample was asked for description, location, sketches, and imaginary trips of their respective city. The analysis was supplemented by a photographic recognition test, by field trips and requests for directions from people in the streets. However, the sample was too small for any major conclusions.

Appleyard (1970) built on Lynch's theme by looking at the ways in which people structured cities, and in particular to see whether different groups in the same city would structure it in different ways. Appleyard selected groups of citizens from Ciudad Guayana in Eastern Venezuela. Respondents were grouped to ensure that each number of respondents was classified according to age, sex and education. They were asked to draw a map of their city as a whole between a steel mill and San Felix and to draw a map of their local area. The respondents' maps were subjectively categorized. One important conclusion of this study is that the "differences in the structuring of population groups appear to be due more to cognitive differences, travel mode, and familiarity than to other personal variables" (Appleyard 1970, p. 116).

Maurer and Baxter (1972) examined the different images of the neighbourhood and city among black, anglo and Mexican-American children. This study's main aim was to explore children's imagery or "mental pictures" of their world. The community selected was Harrisburg, Texas. The neighbourhood was poverty-level deep within the city of Houston. The ninety-one respondents ranged from ages seven to fourteen and were interviewed to obtain various demographic data before being requested to draw a map of their neighbourhood.

The major value of Maurer and Baxter's article is in the area of research methods. They suggest a great deal of information is needed about each subject, that too many interviewers can lead to bias results, and finally "that rather large and systematic differences appear in children's perception and imagery of their environment" (Maurer and Baxter 1972, p. 337).

Florence Ladd (1970) studied one ethnic group, black youths, to see how they characterize their neighbourhood. Ladd wanted to "(1) develop an understanding of areas subjectively defined as neighbourhoods by urban adolescent boys through their graphic representations of their neighbourhoods; (2) to discover the socially and psychologically significant aspects of the 'contents' of their neighbourhoods as reflected in their maps; and (3) to explore the potential informational value of map drawings to social scientists and planners who need varieties of data on the significance of urban living to persons of different age, ethnic and socio-economic groups" (Ladd 1970, p. 74 - 75). Ladd's study followed two approaches - to have the students describe verbally their neighbourhoods, and to have them draw a map of their neighbourhood. The maps were categorized into four groups taking into account form and content elements. Various other aspects were also assessed. There was a considerable degree of variation among the maps which reflected individual differences among the subjects. Ladd states "We need more information on subjects' cognitive styles, intellectual abilities, and neighbourhood activities in order to develop better understanding of map features and variations" (Ladd 1970, p. 96).

The final study to be discussed is that of Stea and Blaut (1972). They studied spatial learning in Puerto Rican children. Four strata of Puerto Rican society were studied. One of the tests was to see how children can read aerial photographs by "each child being asked to identify (name or point to) whatever they saw in the photographs, to supply a Gestalt name for one preselected area within each photograph, and finally, to name the aerial photograph" (Stea and Blaut 1972, p. 229). The major finding of this article is the young age at which children are able to read aerial photographs and have an understanding of place. Clearly, spatial learning is an important aspect of learning among children.

The above-mentioned selected studies are not only important as research methods, but they seem to stress the need for further study of the reason for differences in "cognitive mapping". It will be seen that studies lacked any serious concern with children's intellectual abilities.

Measurements of Cognitive Mapping

One of the major problems in the evaluation of cognitive mapping is with measurements. There are two kinds of measurement possible - (a) the form of the cognitive map and (b) the content of the cognitive map. The measurement of cognitive mapping is very subjective. The papers discussed here "attempt to establish a framework within which measurements of the behavioral outputs of mental representations may be given psychological and geographical meaning" (Stea 1969, p. 228).

Lynch's measurement of cognitive mapping of content is probably the most widely used. Most of the other studies - Ladd (1970), Maurer and Baxter (1972), Appleyard (1972) - used some variation of Lynch's content measurement. Lynch divides content into five separate categories - path, edge, node, district and landmark. Paths are roads or paths of movement. Edges are boundaries of various types that separate different areas. Boundaries could be major highways, a river or an abrupt change in the skyline between short and tall buildings. A node is a point or a major intersection, a focal point. A district consists of areas with distinctive neighbourhoods. Other authors include number of streets and number of landmarks and home location as part of the map content.

The form of map is the organization of the map. Ladd (1970) categorizes the maps into four groups -

Group I - Drawing is pictorial. The subject represents houses, other buildings, and elements which might be part of a street scene. (Example given in Map 5, p. 54).

Group II - Drawing is schematic. It contains lines or areas which are not clearly connected to each other. It is poorly organized. (Example given in Map 6, p. 55).

Group III - Drawing resembles a map. It seems well-organized, that is, the connections between areas are clear. It could be used for orientation to the area. (Example given in Map 7, p. 56).

Group IV - Drawing resembles a map with other identifiable landmarks which would make the area recognizable. Connections between the areas are clear. Could be used for orientation to the area. (Example given in Map 8, p. 57) (Ladd 1970, p. 79 - 81).

Ladd had four people acting as judges to classify the maps. Other map form items include an estimate of area, accuracy of streets, map orientation, and complete or partial maps.

Appleyard (1970) grouped the maps according to type of element and level of accuracy. The main levels used in the maps were sequential (roads) or spatial (individual buildings, landmarks, or district). These two major groups were divided into four sub-groups each. The maps were then grouped by the population type who drew them. Maurer and Baxter (1972) divided the maps according to categories and elements of the children's imagery.

Stea mentioned the following are important measures of cognitive maps:

"(1) Establishment of hierarchies - some places are more important than others, for whatever reasons;

(2) Boundedness - the space conceived ends somewhere;

(3) Objects and places are located within the space, and can be conceived as 'points' more or less clearly defined;

(4) The points exist in some relation to each other; that is, one can speak of

(a) distance between points
(b) bearing from one point to another
(c) routes from one point to another, which includes the changes in direction taken in following the routes;

(5) Connectedness between points ......" (Stea 1969, p. 229 - 230).

In conclusion most of the measurements in the studies of cognitive mapping are based on subjective methods. If careful analysis and standards are used subjective measurements can be very reliable.

Related Studies in Map Skills

Most of the articles in this section of the review are not directly related to cognitive mapping, but they are important as they discuss the child's ability to construct and read maps. Rushdoony's (1968, p. 213) article states "prior to 1960 most of the research on children's ability to read maps at the elementary school level was in the form of survey or diagnostic testing". There were a few articles written about map construction; and during the 60's research looked at the child's ability to construct maps. The studies basically discovered that children could do map work at a very early age. Blaut and Stea (1974) demonstrated that children can clearly represent a cognitive map at the age of three. The concept of mapping is a very important part of human life.

Towler and Nelson (1968) found in their study that most children do not develop a concept of scale before the ages of ten or eleven. Drumheller (1968) in his discussion on children and mapping states there is a developmental timetable for the emergence of spatial relationships. His main work is in the area of the development of map skills, but one aspect of his timetable is in the area of the development of perceptual map space. Drumheller found in his study of maps drawn by different age groups that developmental stages defined by Piaget were important. Drumheller noted that the ability to recall spatial perception is rooted in intellectual abilities possessed by individuals.

From the Review of the Literature there appears to be a need to try to find what factors influence cognitive mapping.

Chapter 3

PRESENTATION AND PRELIMINARY ANALYSIS OF THE DATA

Sources of Information

From the previous chapter it will be apparent that most studies comparing the cognitive maps of different groups concentrated on ethnic not economic factors. Educational factors, cognitive activities and intellectual skills were either only mentioned as possible important components in the formation of cognitive mapping or as an area that needed further research.

To isolate the importance of cognitive activities and intellectual skills it is necessary to ensure that the social and economic factors are held constant. This problem was approached by finding a group of subjects with homogeneous social and economic backgrounds. Another important criterion for group selection was the availability of personal information on each subject pertaining to social, economic, cognitive activity and intellectual skills. The two criteria of availability and sources of individual information could be met by a group of students from the same school system. The students would not only be available as a group for study, but the individual records would be the same in format and reliability.

Since the author of this thesis is a teacher for the Halifax Board of School Commissioners, arrangements were made to do a study of a group of students from the City of Halifax. Halifax is a small city of 125,000 people that has developed a hierarchy or neighbourhood structure based on income, employment and educational levels. There are 21,434 students enrolled in schools in the education system of Halifax.

The students were selected from schools in Census Tract 17 (see Map 2, p. 38) because this is a homogeneous and stable area. This statement is based on the following information from Statistics Canada 1971 Census Tract Bulletin. In Census Tract 17, 90% were born in Canada, over 80% of the population has origins in the British Isles, 94% speak only English, the remaining 6% are bilingual, 70% in area over five years of age, 5% from same metropolitan area, major occupations were sales, teaching, government and skilled workers and 65% of the dwellings are owner occupied. This area also has distinctive boundaries as shown in Map 3, p. 39. Before annexation into the City of Halifax it was a distinctive part of the County of Halifax called Fairview. This suburban community had developed a distinctive community or neighbourhood feeling. Most studies have looked at the differences between neighbourhoods or areas. The use of this area should result in holding constant a number of factors. The children should have similar stimuli and should have similar socio-economic backgrounds. The study is then able to concentrate on relationships between cognitive activities and intellectual skills of the children and their cognitive maps.

The only school which could fulfill the criteria of a large enough population for a sample and selected students from the area defined in Map 2, p. 38 was Fairview Junior High School. The age groups selected for study were twelve years and fifteen years old in Grades VII and IX respectively. There were two thousand children in each of these age groups in the City of Halifax.[3]

The selection of children ages twelve and fifteen (especially age twelve) is based on a number of factors. Grade VII and IX would give a good cross-section of students at various stages of development and progression within a school. There have been numerous studies of children working with mapping concepts at earlier ages (Blaut and Stea 1974, have worked with children at age 3). However, based on the work of Piaget

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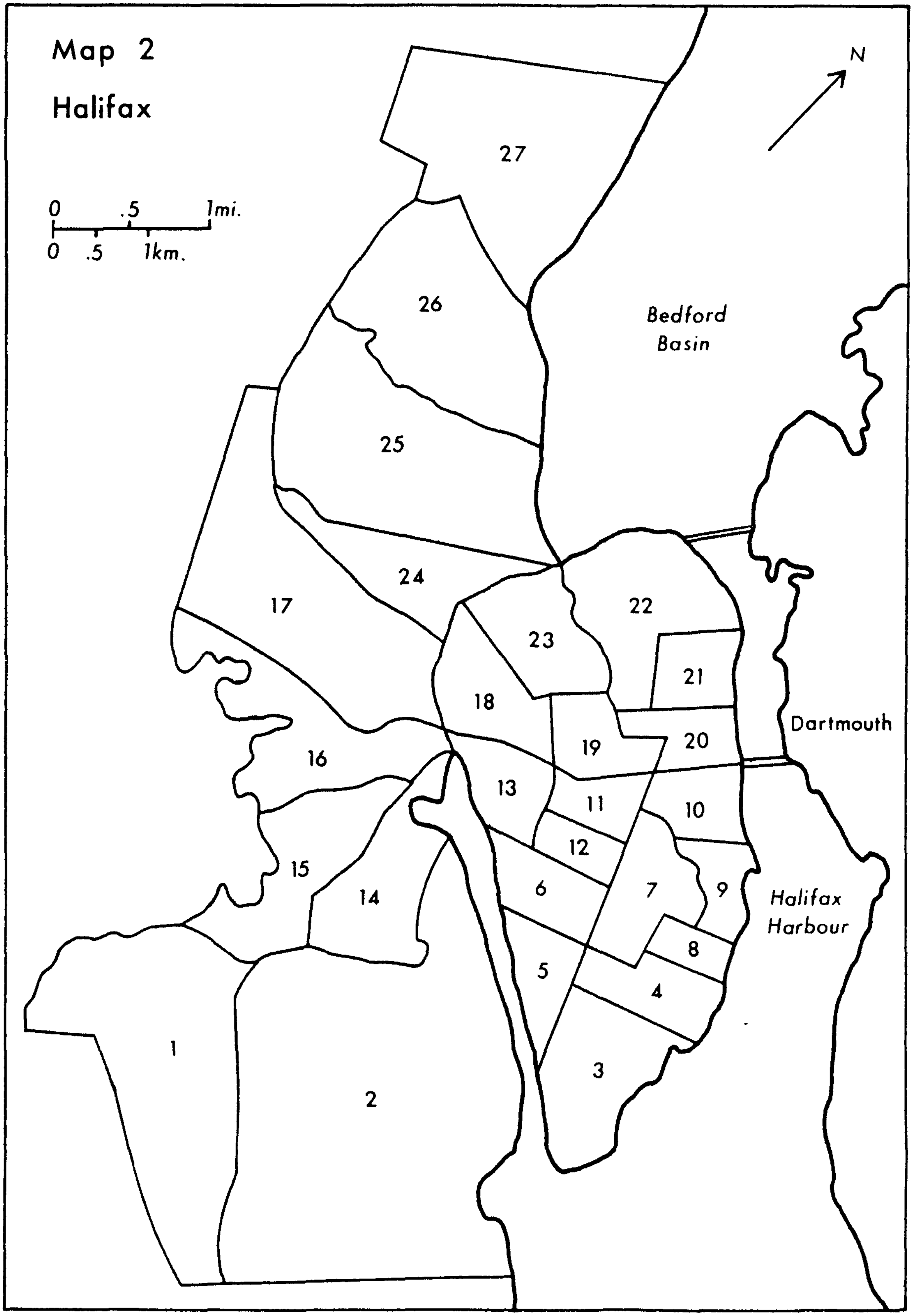
[3] This information is based on data from the 1971 Census Tract Bulletin of Halifax, The Directory of Schools for Nova Scotia 1975 - 76, Metro Development Plans of Halifax and information from the Halifax Board of School Commissioners.


Map 2
Halifax
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Bedford Basin
Dartmouth
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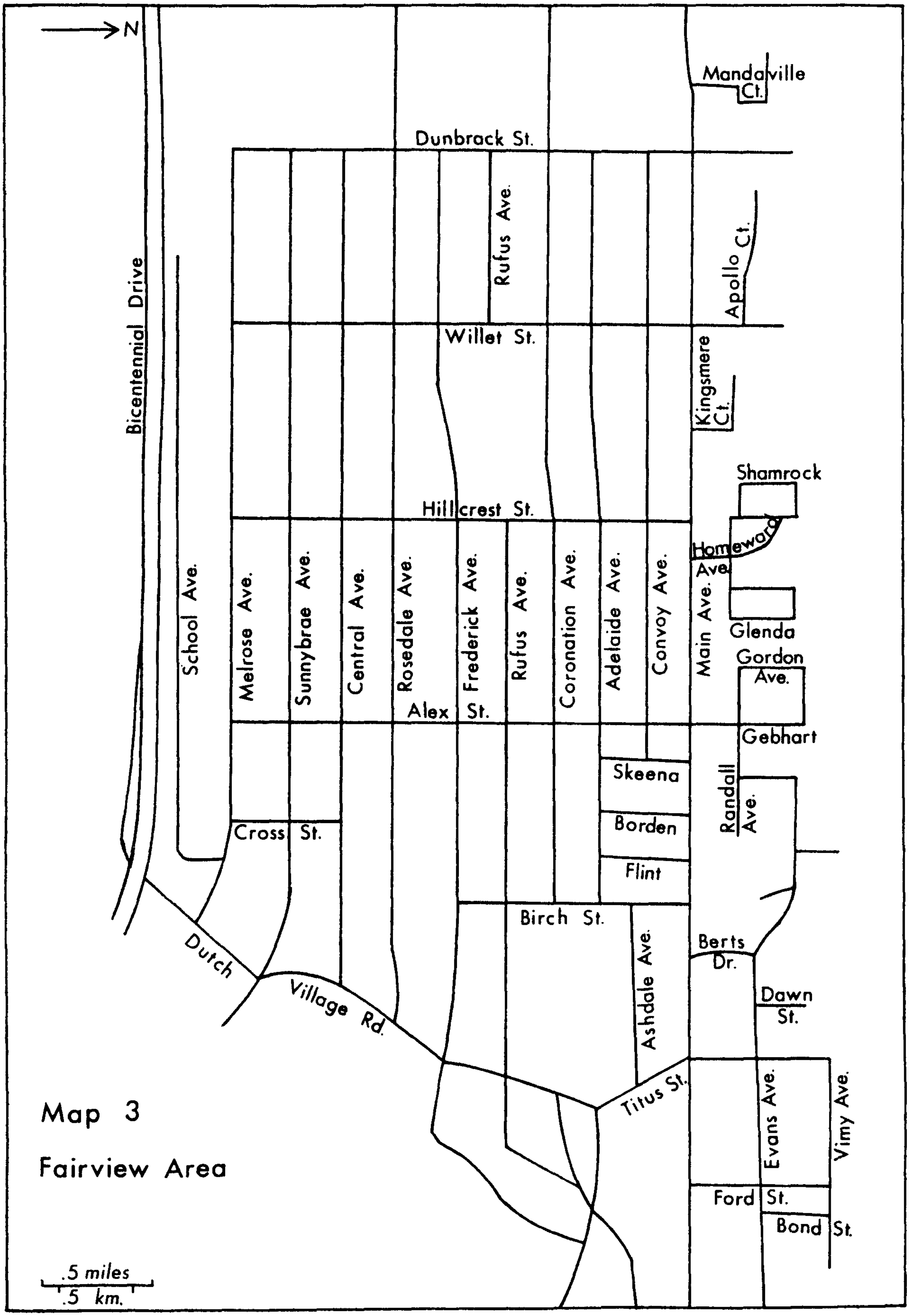


Map 3

Fairview Area

(1971), Laurendeau and Pinard (1970), children can successfully handle metric (or Euclidian) space by the age of seven years.

Piaget (1971), Laurendeau and Pinard (1970) and Towler (1971) have noted that egocentrism is no longer a dominant factor in the majority of children after a certain age. "Egocentrism is the cognitive state in which the world is perceived from a single viewpoint, there being no differentiation between one's own perspective and that of others" (Towler, 1971, p. 894). The twelve and fifteen year old students would have developed beyond that stage. These students would also be in the early adolesence development stage; therefore, have developmental stages in common. They would also be in the same social environment at school. The twelve year olds would be in the beginning of Junior High School, which is Grade IX.

The two age groups were also selected because both groups would be within the same school; therefore, they would have common socio-economic backgrounds and the same teachers and teaching methods. The students were selected by classes from the different grades. Since the classes were grouped by reading ability this would assure that students of the highest to lowest ability were included in the study. A sample of one hundred Grade VII students and ninety-four Grade IX students were selected from Fairview Junior High School.

The sample was composed of 33.5% of the student population of Fairview Junior High School. The sex breakdown of the sample is shown in Table 1.

TABLE 1

THE SEX BREAKDOWN OF THE SAMPLE BY GRADE LEVEL [4]

	Male	Female	Total
Grade VII	65	35	100
Grade IX	48	46	94

The records of each student were available and these included personal and academic data. The cards were uniform and up-to-date. The information from the records will be discussed on page .

Methods of Securing Information

The record cards were checked to remove from the study students who had obvious and identified learning or perceptual difficulties. Halifax has an extensive Special Education and Testing Department; therefore, most students having the usual or standard

[4] The Grade VII classes had a larger proportion of male students by chance. The classes were selected to include students of various reading abilities and to try to achieve a one-to-one ratio would have resulted in getting students from either high or low reading groups.

learning difficulties would have been found and tested.

The next step was to find out if the children in the same environment get the same information about that environment. This is very important because it is necessary to see if all students are receiving the same information. This was done by giving the students a slide test of their neighbourhood. The children were shown a set of twenty slides of the area and asked to identify the items. The second step was to show the children a set of twenty slides and ask them to pick out key items from a list of places given. This test was used to see if the children have the same knowledge of their area. If a small number of students did poorly on the slide test then perhaps for reasons of being new to the area, or personal reasons they should not be part of the study. This was necessary to try to keep the sample as homogeneous as possible.

The students were then given a paper and asked to describe in writing the Fairview area. They were asked to include physical, cultural and distinctive features. A supplementary question was "What feelings do you have about your neighbourhood? Why?" This question was added to further gather information about the Fairview area. If a student had a strong positive or negative feeling about his neighbourhood then the question about feelings could add more information about

Fairview. The students were given forty-five minutes to complete this task. To remove tension students were told this test and other tests pertaining to their knowledge of Fairview would not be marked and recorded.

The next step was to have the children draw a cognitive map of their neighbourhood. This map was drawn on an 18 x 24 inch piece of paper so as to allow the child the freedom to draw the map as large or as small as is practical. Based upon my experience as a teacher, the students were given one hour to complete this task. This would remove any unnecessary tension or rushing of the assignment. They were told to include streets, physical features, cultural features and features they considered prominent and/or important.

Only students who did very poorly on the cognitive map were then given a map-making skill test to look for sensorimotor problems or emotional or neurological problems. These students could then be removed from the study, as a student with a notable learning disability should not be part of the sample. Since the major purpose of the study is to see what effect intellectual skills and cognitive activities have on cognitive maps students with a learning disability would be adding another variable that could not be controlled or easily evaluated. The test consisted of a three-dimensional model of a physical area similar to their own environment from which the children made a map. The main purpose of this test would be to test the child's ability to map a two-dimensional shape from a three-dimensional model. Models have been used by Piaget (1971) and Laurendeau and Pinard (1970) as one method of testing a child's spatial ability. There was no need to remove any students from the study.

The Results of the Slide Test of the Fairview Area

As previously mentioned the students were shown two sets of twenty slides of physical, economic and cultural features of the Fairview area. The slides were divided into two sections - (a) identifying slides by sight without any written information and (b) identifying slides by having a list of places given. The combined scores of the slides are shown in Table 2.

The slide test was marked out of a total of twenty. There are no half scores because the marks were rounded to the next highest number. The marks range from 10 to 20. No student made less than 10, or 50%. When expressed as a percentage the students tested had a good knowledge of their neighbourhood with over 85% of the Grade VII pupils and over 95.6% of Grade IX pupils making a score of 75% or better. The students appear to receive the same information about their neighbourhood. Since socio-economic factors will be held

TABLE 2

TABLE OF SLIDE TEST SCORES OF STUDENTS
BY GRADE

	10	11	12	13	14	15	16	17	18	19	20	Total Number of Students per Grade
Number of Grade VII Students per Slide Test Score	1	4	2	4	4	9	17	24	26	8	1	100
Number of Grade IX Students per Slide Test Score	--	2	--	1	1	9	16	21	22	18	4	94
Mark as a percent	50	55	60	65	70	75	80	85	90	95	100%	

Constant any differences in the cognitive maps should be due to intellectual differences and not differences in information about their neighbourhood. Since no student made a mark of less than 50% there did not appear to be any need to remove any students from the study as a result of the slide tests. These slide test marks would be used as one of the surrogates of their knowledge of the Fairview area.

Results of the Written Description of the Fairview Area

The students were given a piece of paper and asked to describe the Fairview area. A supplementary question was also asked about their feelings about the Fairview area. The students' descriptions were analyzed. From each description words were selected and listed that described the physical features, cultural features, distinctive features and the students' personal feelings about Fairview. In Table 3 the type, number, rank and percentage of elements taken from the descriptions are listed. This information is included as a source of comparison with the type of information that was included on the student's map. There is also an indication of what items the students consider important in their lives. The type of element is divided into physical, social, economic and residential.

A number of the elements where there are two or more examples such as elementary schools, corner stores, apartments, churches, playfields, bus stops and traffic lights have been collapsed into one item. The reason for this is mainly in the case of elementary schools, churches, apartments, playfields, corner stores either a specific place was mentioned, a number of examples given or just the term "elementary school" was mentioned. For traffic lights and bus stops no locations were given. In most cases involving these items specific locations were used when the cognitive maps were drawn. The total number of items possible for each element is 194.

There is a good deal of variety among the elements mentioned in the descriptions. There are a number of dominant elements which are mentioned by over 75% of the students in the study. Housing is ranked number 1 and apartments ranked number 8 as this area is mainly a residential area with a ribbon of commercial development and a few scattered corner stores. Schools are ranked 2, 5 and 6 as these are major elements in the lives of most adolescents. Their own school is ranked number 2 with the elementary school which they came from ranked number 6 and the high school where most of them will be going in a year or two ranked 5th. The grid pattern of the streets and their physical alignment with the hilly terrain of Fairview explains the items

TABLE 3

THE TYPE, NUMBER, RANK AND PERCENTAGE OF EACH ELEMENT POSSIBLE FROM THE DESCRIPTION OF THE FAIRVIEW AREA

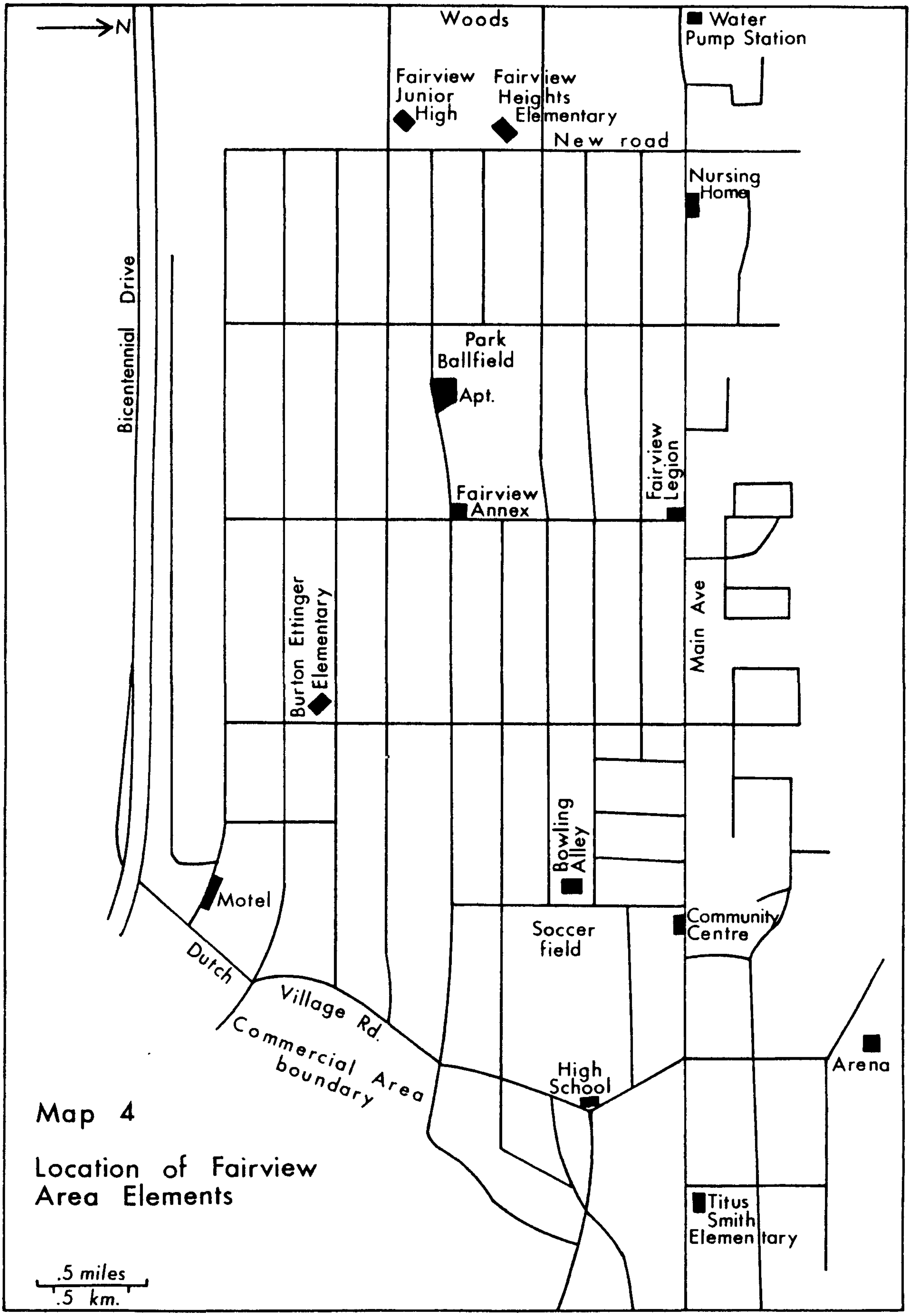
Rank	Item	Number	Percentage Possible
1	Housing	161	82.9
2	Fairview Junior High School	160	82.4
3	Streets running across	159	81.9
4	Avenue up and down	158	81.4
5	High School	157	80.9
6	Elementary School	156	80.4
7	Corner store	147	79.7
8	Apartments	146	79.2
9	Hill	144	74.2
10	New road - a boundary	117	60.3
11	Woods area top of Fairview	103	53.0
12	Main Street commercial area	102	52.5
13	Bicentennial Highway	93	47.9
14	Dutch Village Road	92	47.4
15	Main Street as a boundary	91	46.9
16	Ball field	90	46.9
17	Churches	88	45.3
18	A large area	77	39.6
19	Park area	75	38.6
20	Arena	66	34.0
21	Well-kept homes	64	32.9
22	Play fields	63	32.4
23	Nursing home	49	25.2
24	Bowling alley	47	24.2
25	Trailer court	43	22.1
26	Actual location of ball field	40	20.6
27	Bus stop	34	17.5
28	Motel	32	16.4
29	Community centre	28	14.4
30	Traffic lights	14	7.2
31	Area rocks	6	3.0
32	Legion	2	1.0
33	Water pump station	1	0.5

ranked 2, 3 and 9. The grid pattern can be seen on the map on page 50 . The hilly terrain starts at Dutch Village Road and peaks at the woods above Dunbrack Street and Fairview Junior High School.

There are a number of other distinctive features in the Fairview area that the students mentioned as important elements of the area - ball field, nursing home, trailor court and motel. These elements are very distinctive features in the Fairview environment. It is interesting that traffic lights and bus stops were mentioned as elements in the students' environment. The traffic lights are found only in the Main Street area and they are important enough in the lives of fourteen students to be distinctive. As these students are not of age to drive cars, bus stops are important elements in the lives of thirty-four students.

There is no distinctive pattern or clustering of types of elements mentioned. Items ranked 9, 10, 11, 13, 14 and 15 are the biggest cluster of types of elements. These are associated with the physical environment. The hilly area and the roads which form a distinctive boundary around the Fairview area are mentioned. On Map 4, page 50 the elements mentioned in the descriptions (where possible) are shown.

A breakdown by grade level of the elements mentioned in the description of Fairview is found in



Map 4

Location of Fairview Area Elements

Table 4. There is very little difference between students in Grades VII or Grade IX for the first nine ranked elements. These elements are common and important to both grade levels. Except for churches (ranked 17th) more elements are mentioned by Grade IX students than by Grade VII students.

The purpose of the verbal description of the Fairview area is to solicit from each student additional information about his cognitive map. A verbal description is, like a paper map, another way for the student to translate his cognitive map into a measurable medium. The verbal description is also another method of discovering what information each student has about the Fairview area. The verbal description will be compared with the form of the cognitive map.

The Drawing of the Cognitive Maps

The students were given a sheet of 18 x 24 inch paper on which they were to draw a cognitive map of the Fairview area. The sheets allowed the students to draw their cognitive maps as large or small as they wished. They were told to include streets and any features they considered important in Fairview. They had one hour to complete the task.

The Form of the Cognitive Map

The first step in analyzing the cognitive maps was to find some way that the maps could be grouped, since

TABLE 4

THE RANK, TOTAL NUMBER OF ELEMENTS AND NUMBER OF ELEMENTS BY EACH GRADE LEVEL FROM THE DESCRIPTION OF FAIRVIEW

Rank	Item	Total	Grade VII	Grade IX
1	Housing	161	79	82
2	Fairview Junior High School	160	82	78
3	Streets running across	159	73	86
4	Avenue up and down	158	72	86
5	High School	157	80	77
6	Elementary School	156	81	75
7	Corner store	147	73	74
8	Apartments	146	67	79
9	Hill	144	61	83
10	New road - a boundary	117	44	73
11	Woods area top of Fairview	103	40	63
12	Main Street commercial area	102	43	59
13	Bicentennial Highway	93	26	67
14	Dutch Village Road	92	27	65
15	Main Street as a boundary	91	25	66
16	Ball field	90	28	62
17	Churches	88	41	47
18	A large area	77	42	35
19	Park area	75	30	45
20	Arena	66	23	43
21	Well-kept homes	64	23	41
22	Play fields	63	24	39
23	Nursing home	49	15	34
24	Bowling alley	47	10	37
25	Trailer court	43	17	26
26	Actual location of ball field	40	19	21
27	Bus stop	34	11	23
28	Motel	32	10	22
29	Community centre	28	11	17
30	Traffic lights	14	6	8
31	Area rocks	6	4	2
32	Legion	2	0	2
33	Water pump station	1	0	1

there was a great deal of divergence between the cognitive maps. There are numerous studies that give various ways of forming descriptive categories for cognitive maps. The method used by Ladd (1970) seems to be most useful and practical for this study. Ladd used four categories or groups for separating the cognitive maps. They are

Group I - Drawing is pictorial. The subject represents houses, other buildings, and elements which might be part of a street scene. (Example given in Map 5, p. 54).

Group II - Drawing is schematic. It contains lines or areas which are not clearly connected to each other. It is poorly organized. (Example given in Map 6, p. 55).

Group III - Drawing resembles a map. It seems well-organized, that is, the connections between areas are clear. It could be used for orientation to the area. (Example given in Map 7, p. 56).

Group IV - Drawing resembles a map with other identifiable landmarks which would make the area recognizable. Connections between the areas are clear. Could be used for orientation to the area. (Example given in Map 8, p. 57) (Ladd 1970, p. 79 - 81).

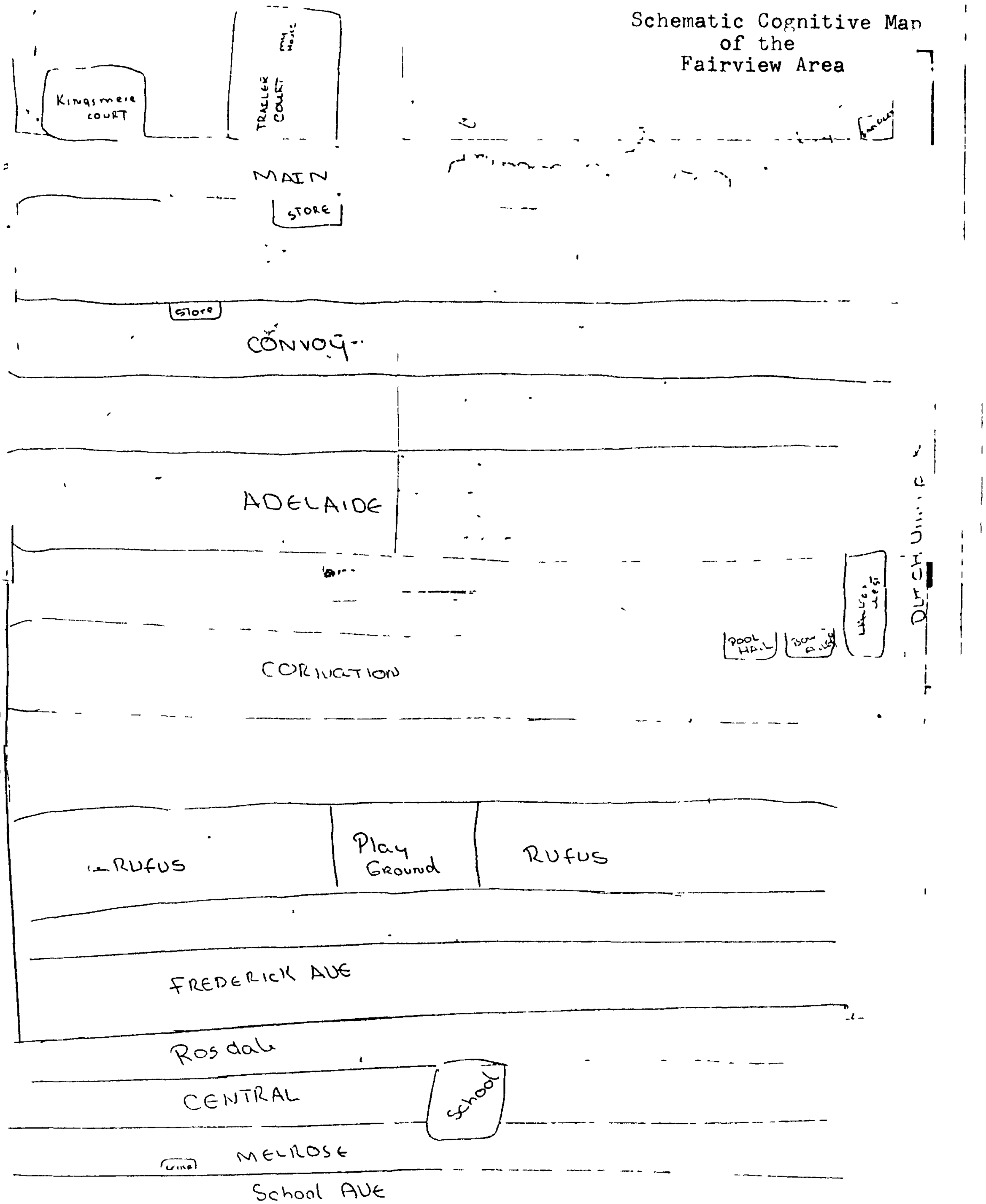
The cognitive maps in this study were put into one of the four categories. Examples of the four types of cognitive maps are shown on pages 54 to 57 inclusive. The results are shown in Table 5.

Map 5

Pictorial Cognitive Map
of the
Fairview Area

Map 6

Schematic Cognitive Map
of the
Fairview Area



Map 7

Group 3 Cognitive Map
of the
Fairview Area

Map 8

Group 4 Cognitive Map of the Fairview Area

TABLE 5

THE NUMBER OF COGNITIVE MAPS IN THE FOUR CATEGORIES BY THE STUDENTS' GRADE LEVEL

Group	Grade VII	Grade IX	Total
I	9	6	15
II	50	25	75
III	32	44	76
IV	9	19	28

In Table 5 there are more Grade IX students than the Grade VII students in categories 3 and 4. The extremes are Group I - a poor type of cognitive map and Group IV - the best type of cognitive map, and they have the lowest totals. The Grade IX students have more Group IV cognitive maps. This can probably be explained by their increased maturity. They would also have more practice at skills related to map-making.

After classification the cognitive maps were analyzed for other features. The maps were divided into two categories - incomplete or complete. In numerous cases the cognitive maps were incomplete in that they did not cover the whole area of Fairview. The cognitive maps may have been well-done, but areas were missing. This usually depended on the location of the student's home or his grade level.

The next step was to record the areas that were missing from the incomplete cognitive maps. From all of the maps nine categories of missing areas were designed. The students had a better idea of the Dunbrack area of Fairview than of the Dutch Village Road area. This can be explained by the fact that the schools are found in the Dunbrack area; therefore, the students are more familiar with the area. Grade IX also had more complete cognitive maps with fewer areas missing.

The organization of the map seemed to be important as some students drew their maps on the paper lengthwise, while other students drew their maps width-wose. The shape of the Fairview area lends itself to a lengthwise orientation on a piece of paper.

Fairview is a distinctive area with four major boundaries; therefore, the cognitive maps were checked for the location and distinction of the boundaries. Each boundary was given a positive score depending on whether or not it was shown. The next step was to record the number of streets each student had marked on the map. There are forty-five streets. The streets were then ranked 1 to 5 (1 being poor) for their arrangement. This ties in very closely with the grouping of the cognitive maps. This served two purposes - (a) a map with streets should be usable to be of value and (b) this analysis acted as a check for the grouping of the maps.

After the number of streets and arrangement of streets was organized the number of streets correctly placed was calculated. It was possible for a student to have seventeen streets included in the map, but only fourteen of them were correctly placed. This was followed by a further check of having the streets ranked by percentage correct (see Table 6).

TABLE 6

STREETS RANKED BY PERCENTAGE CORRECT

Rank	Number of Streets	Percentage Correct
1	over 33.78	over 75%
2	22.6 - 33.78	50 - 74%
3	11.26 - 22.5	25 - 49%
4	5.4 - 11.25	12 - 24%
5	under 5.4	under 12%

This ranking was followed by a recording of the total number of boundaries recorded as compared to the earlier recording of what specific boundaries were put on the cognitive maps.

There was one final calculation about streets from the cognitive maps. Many of the maps were incomplete because only part of the Fairview area was shown. If the total Fairview area had forty-five streets then the students' maps appeared to be poorly done because only part of the cognitive map was completed. One way of checking on the accuracy of the cognitive maps was to compare the number of streets in the incomplete cognitive maps with the actual number of streets in that portion of the map of Fairview. If the student had shown an area with ten streets and he had correctly included nine of them he had 90% of the streets correctly placed. This was one more method for ensuring an understanding of the cognitive maps. Many of the collections of data about streets from the cognitive maps may have seemed redundant, but they all serve major functions. The functions are (1) they serve as a check for accuracy by having the data collected in different forms and with different goals and (2) they will give accurate data for further analysis.

The final collection of data on the form of the map was the total count of the number of landmarks placed on the map by the student. (See Appendix C for further explanation).

Non-Spatial Data From the Cognitive Maps

The total number of landmarks found on each cognitive map were placed in eight categories. This gave a non-spatial collection of data for further analysis from each student.

The eight categories were

(1) number of residential areas - houses, apartments
(2) number of social areas - churches, schools
(3) number of commercial areas - stores, take-out food places
(4) number of recreational areas - arenas, parks, ballfields

(5) number of physical features - woods
(6) number of traffic features - lights, bus stops
(7) their home shown
(8) number of services shown - banks, doctors, veterinarians.

The landmarks were included if they were in the proper area. There was no problem in assessing the data as any student who placed a landmark in the map appeared to be very familiar with the landmark. The category receiving the most response was "the number of social areas". This can be explained by the number of schools and churches in the area. The total number of landmarks range from a low of 0 to a high of 30.

Spatial Information from the Cognitive Maps

This collection of data is associated with the non-spatial material. The items which were categorized as non-spatial data were recorded as individual spatial items. There were forty-seven different items placed on the 194 cognitive maps. As mentioned earlier these forty-seven items ranged from a low of 0 items on one of the cognitive maps to a high of 30 on another. Each map was analyzed and every landmark was recorded on the side of the map. Then each different item was listed on a sheet of paper and assigned a number. In this case one to forty-seven. In this way the information from the cognitive maps was turned into a binary matrix for further analysis.

INFORMATION RECORDED FROM THE CUMULATIVE RECORD CARDS OF THE STUDENTS

Cognitive Information from the Students' Cumulative Record Cards

The students' school record cards were checked for information about their cognitive activities or intellectual abilities. This was a very stable neighbourhood and the school is only five years old. All the records and tests are very up-to-date and were recorded by the same staff. If any discrepencies have taken place in the testing of the children the chance of error in the methods of testing would be rectified by the fact that any errors are consistent for all students. Since the tests are only surrogates of the students' cognitive abilities, then one individual score is not as important as the collective results of all the sample.

The group tests of intelligence on all of the students in the study was the Lorge-Thorndike Intelligence Test. "A series of tests of abstract intelligence defined as the ability to work with ideas and the relationship among ideas" (Noll, p. 298). These students took the verbal and non-verbal battery of tests. According to Noll, studies of the results of Lorge-Thorndike Intelligence Tests have high validity and reliability at this level, level 3 (Grades 4 - 6). The students took the tests in Grade 6. "The level 3 tests are available in two equivalent forms - A and B. The verbal sub-tests include sentence completion, verbal classification, arithmetical reasoning and vocabulary. The non-verbal sub-tests utilize only pictorial, diagrammatic or numerial content; they comprise Figure Classification, Number Series and Figure Analogies" (Anastasi, p. 218).

Studies have shown both tests measure different functions. "The chief strengths of the tests stem from the sound theoretical, rational underlying choice of content, the size and representativeness of the standardization sample, the high reliability of the I.Q.'s and the generally superior quality of test construction procedures followed in developing the tests" (Anastasi, p. 220).

The other standardized test results that were collected from the cumulative record cards was the Metropolitan Achievement Tests which consist of a battery of tests that are available from Grade I to Grade IX. The achievement test covers general academic curricula in a school system. The test scores that were used in the study are reading, arithmetic, social studies and stanine (which is a rank on a standard scale of 0 to 9) in reading and arithmetic. The social studies test consists of various kinds of maps, tables, graphs and conclusions from data presented. According to Anastasi (p. 446 - 447) the results of Metropolitan Achievement Tests have shown to be very valid. The other information about the students' cognitive ability came from their test scores recorded by the internal school examinations and the slide test scores. The internal test scores are science mark, arithmetic mark and art mark. All of the test results covered most aspects of a student's cognitive ability. They are also diversified enough to cover a wide range of testing and test results. This range of test results should also help to eliminate the possible bias found in the reliance of one single type of test results as an indication of a student's cognitive ability.

Social-Economic Information from the Cumulative Record Cards of the Students

As the Review in Chapter 2 indicated the socio-economic factors of an individual played a very important role in a number of the other studies about cognitive maps. In this study socio-economic factors are important only as control factors. The students' cumulative records had a detailed collection of their socio-economic characteristics. The site location of the home was one of the factors collected from the cards by use of addresses. These were plotted on a map and recorded in two forms, as a six-figure grid reference for home location and as a two-figure grid reference showing the general area of the home. The homes in the Fairview area are basically of the same economic structure and age. There is a slight deviation as the homes increase in value and appearance towards the top of the hill. The location of the students' homes may be important economic factors.

Income information of a family can be a very difficult item to collect. This information is not recorded on a cumulative record card. "How much does your father/mother earn?" is probably a very undiplomatic question to ask a student. There is also the aspect that this study was being conducted in a public school system and public relations is a very important factor. The cumulative record cards did record the parents' occupations; therefore, these could be used as surrogates for income. The range of salary could be indicated. This neighbourhood, using parents' occupations as an indication, was middle-class. The home was the next socio-economic factor recorded. The type of home was one of the socio-economic data looked at. The types of homes - houses, trailors, apartments and townhouses. This information was found on the record cards of the students. The addresses were checked with a land-use map to verify the record cards. The rating for the value of the homes was achieved by a field survey of the area, real estate information and city assessment information. The homes were then rated 1 to 3 according to value, location and type.

The next items recorded were associated with the family. The number of sisters and brothers were recorded and the student's rank in the family (youngest, middle, oldest or only child). The length of residency was first determined by their birthplace. This was recorded as born or not born in Halifax. There was no direct information regarding their length of residency in the Fairview area. This information was collected by checking the cumulative record cards to find which schools the students had attended. If a student enrolled in a Fairview area school in "Primary" then the record would be checked to see if the student spent his/her entire school life in the Fairview area. Also any new student would have his/her old schools and enrollment data in a Fairview area school recorded.

The socio-economic information gives a fair coverage of each student's background (for further explanation see Appendix A).

Conclusion

As mentioned earlier in the type of tests to be used and data to be gathered a special test was to be given to students with poor cognitive maps. This was not necessary as a study of other information and other tests done by the school revealed that none of the students had any apparent sensory difficulty in making a map. The information gathered covered a wide range of data for further analysis.

Chapter 4

FACTOR ANALYSIS OF CUMULATED DATA

The information collected was very varied. One way to condense the information and to find dominant elements is to use a factor analysis procedure. This technique was used on each of the sets of data for each student. The sets are (1) socio-economic data, (2) cognitive ability data, (3) the verbal description of the Fairview area, (4) the form of the cognitive maps, (5) the non-spatial information from the cognitive map and (6) the spatial information from the cognitive maps. The results of the factor analysis are given separately. In all factor analyses a cutoff eigenvalue of 1.000 was used.

Socio-Economic Data

The socio-economic data was condensed into five factors, which explained a cumulative percentage of trace of 68.4% (see Table 7).

TABLE 7

FACTORS FOR SOCIO-ECONOMIC DATA

Factor	Eigenvalue	Percent of Trace	Cumulative Percent of Trace
1	3.8	25.6	25.6
2	2.4	16.5	42.1
3	1.5	10.0	52.2
4	1.3	9.2	61.4
5	1.0	7.0	68.4

Table 8 lists the eleven types of socio-economic data and the factor loadings to +.50 or -.50 for each piece of data. The location of the student's home was that given by a two-figure grid reference. The types of homes, quality of dwelling and parent's occupation are associated with economic factors. The total number of brothers and sisters, rank in the family, age, sex and birth place are social factors. Each Grade VII or IX had a class number which was determined by the reading ability of the student. A student in class number 1 or 2 had average or better reading ability for his grade level. It will be recalled that students were selected for this study from all class numbers.

The students described by factor 1 (which explains 25.6% of the variation) will have the following characteristics: a tendency to live in the same area, to be in the same grade level and class number one. This factor will be called "home location".

The students described by factor 2 (which explains 16.5% of the variation) have the following characteristics: parents have high incomes and similar occupations, students are older, not born in Halifax and are female. This factor will be called "higher status older female". The students described by factor 3 (which explains 10.0% of the variation) have

TABLE 8

FACTOR LOADINGS FOR SOCIO-ECONOMIC DATA

	Factor 1	2	3	4	5
1 - two-figure grid reference, location of home	.95				
2 - parents' occupations		.65			
3 - type of home					.50
4 - quality of dwelling				-.77	
5 - total number of sisters and brothers			.54		
6 - rank in the family			.59		
7 - born in Halifax		-.60	.58		
8 - grade level	.85				
9 - age		.69			
10 - class number	-.91				
11 - male		-.77			

the following characteristics: were born in Halifax, brothers or sisters and have a similar family rank. Factor 3 will be called "family structure".

Factor 4 (which explains 9.2% of the variation) describes a student who lives in a poorer dwelling. This factor will be called "poor quality of dwelling".

The final factor 5 (which explains 7.0% of the variation) describes a student who comes from a single family home which is classified as "housing type 1".

Cognitive Ability Data

The cognitive ability data was condensed into three factors which explain 83.6% of the total variation. In Table 9 are the factors and the breakdown of the eigenvalues and trace percents of the variation explained.

TABLE 9

FACTORS FOR COGNITIVE ABILITY DATA

Factors	Eigenvalue	Percent of Trace	Cumulative Percent of Trace
1	6.5	59.7	59.7
2	1.6	14.8	74.6
3	1.0	9.0	83.6

In Table 10 are listed the eleven types of cognitive ability data and the factor loadings to +.50 or -.50 for each variable. The information used in the cognitive ability data had a varied range of marking systems (see appendix B for explanation of cognitive ability data).

In factor 1 (which explains 59.7% of the variation) a student has a high level of achievement on non-verbal I.Q. and the achievement test. Factor 1 will be called "high level achievement".

In factor 2 (which explains 14.8% of the variation) we have a student with the characteristic of low science achievement. This factor is called "science achievement".

TABLE 10

FACTOR LOADINGS FOR COGNITIVE ABILITY DATA

	Factor 1	2	3
1 - I.Q. scores			-.59
2 - verbal I.Q. scores			.73
3 - non-verbal I.Q. scores	.94		
4 - achievement test reading scores	.95		
5 - achievement test arithmetic scores	.90		
6 - achievement test social studies	.84		
7 - science mark	-.57	-.73	
8 - arithmetic mark	-.79		
9 - art mark	-.74		
10 - stanine in arithmetic	-.84		
11 - stanine in reading	-.84		

The students typified by factor 3 (which explains 9.0% of the variation) will have low average I.Q. scores, but a high verbal I.Q. score. This factor will be called "I.Q.".

Forms of Cognitive Maps

The data from the forms of the cognitive maps were reduced from sixteen variables to four factors. The four factors explained 63.2% of the variation (see Table 11).

TABLE 11

FACTORS FOR FORMS OF COGNITIVE MAPS

Factors	Eigenvalue	Percent of Trace	Cumulative Percent of Trace
1	4.5	28.4	28.4
2	2.3	14.9	43.3
3	1.7	10.8	54.2
4	1.4	8.9	63.2

The thirteen types of data and factor loadings above +.50 and -.50 from the forms of the maps are listed in Table 12.

The students' cognitive map characteristics described by factor 1 (which explains 28.4% of the variation) have the following in common: the map will be incomplete, the bottom part was not complete on the map, similar number and ranked arrangement of streets, lacking in the percent of streets correct, boundaries, landmarks, percent of streets correct for area shown and misspelling of streets shown. Factor 1 will be called "inaccurate partial maps".

In factor 2 the student's cognitive map (which explains 14.9% of the variation) will be of type 3 and the number of streets will be correctly placed. This will be called "accurate maps".

The student's cognitive map described by factor 3 (which explains 10.9% of the variation) lacks

TABLE 12

FACTOR LOADINGS FOR FORMS OF COGNITIVE MAPS

	Factor 1	2	3	4
1 - Maps incomplete	.74			
2 - Areas that are missing	.52			
3 - Types of cognitive maps		.56		
4 - Organization of map	-.58			
5 - Boundary Bicentennial Highway				.74
6 - Dunbrack Street Boundary			-.75	
7 - Number of streets	.60			
8 - Ranked arrangement of streets	.62			
9 - Number of streets correctly placed		.73		
10 - Streets ranked by percent correct	-.70			
11 - Number of boundaries	-.82			
12 - Number of landmarks	-.85			
13 - Percent of streets correct for area shown	-.54			

the Dunbrack Street boundary. This factor will be called "negative Dunbrack".

Factor 4 (which explains 8.9% of the variation) of the students' cognitive maps will have one main characteristic - they will have the boundary Bicentennial Highway.

Non-Spatial Information from the Cognitive Maps

The data from the non-spatial material of the cognitive maps were reduced from eight variables to four factors. These four factors explain 71.99% of the cumulative percent of trace (see Table 13).

TABLE 13

FACTORS FOR NON-SPATIAL INFORMATION FROM THE COGNITIVE MAPS

Factor	Eigenvalue	Percent of Trace	Cumulative Percent of Trace
1	2.2	27.5	27.5
2	1.3	16.8	44.4
3	1.1	14.4	58.8
4	1.0	13.0	71.9

The eight types of non-spatial information and the factor loadings above +.50 and -.50 are shown in Table 14. The non-spatial information is basically a collapsing of the spatial data into groups.

The cognitive maps shown by factor 1 (which explains 27.5% of the variation) are high in commercial and recreational areas and service areas. Students, being very active at this age, are very interested in these items as they are places for them to go and meet friends. There are usually organized recreational activities for them. Factor 1 will be called "commercial-recreational".

TABLE 14

FACTOR LOADINGS FOR NON-SPATIAL INFORMATION FROM THE COGNITIVE MAPS

	Factor 1	2	3	4
1 - Number of residential areas				-.69
2 - Number of social areas			.55	
3 - Number of commercial areas	.79			
4 - Number of recreational areas	.80			
5 - Number of physical features		.65		
6 - Number of traffic features		.78		
7 - Their home shown			.66	
8 - Number of service places	.59			

The cognitive maps shown by factor 2 (which explains 16.8% of the variation) are high in physical and traffic features. The physical features are important as they outline the area of Fairview. The woods surround the school. The traffic is associated with the streets, lights and stop signs; and since the students travel throughout the area, these items become an important part of their lives. Factor 2 will be called "physical and traffic features".

The cognitive maps described by factor 3 (which explains 14.4% of the variation) show the homes of the students and social areas. This factor is determined by the location of the student's home, church and school. These factors are closely related to the life of the family. This factor will be called "home-social".

The fourth factor describing the non-spatial material found on the cognitive maps (which explains 13.1% of the variation) have a lack of residential areas. Factor 4 will be called "negative residential areas".

Spatial Information from the Cognitive Maps

The spatial information from the cognitive maps included all places the students put on their cognitive maps. There were forty-seven different places. The forty-seven places were reduced to ten factors. The variance explained by the factors is shown in Table 15.

The items with a factor loading above +.50 and -.50 are shown in Table 16. The rest of the items were omitted from the list.

Each factor will not be discussed separately, nor will any name be given to the factors because of the low factor loads. Only factors 1, 2, 5 and 6 have a loading above +.50 or -.50. Factor 1 can be distinguished by the fact that items that loaded above +.50 can be found together. St. Pius School, ball

TABLE 15

FACTORS FOR THE SPATIAL INFORMATION
FROM THE COGNITIVE MAPS

Factor	Eigenvalue	Percent of Trace	Cumulative Percent of Trace
1	5.8	12.4	12.4
2	3.1	6.6	19.1
3	2.0	4.4	23.6
4	2.0	4.3	28.0
5	2.0	4.3	32.3
6	1.8	4.0	36.3
7	1.6	3.5	39.9
8	1.6	3.4	43.3
9	1.5	3.2	46.6
10	1.4	3.1	49.7

field and playground are in one area; while Halifax West High School, soccer field, Kentucky Fried Chicken and Dairy Queen are in another area. The rest of the items are scattered throughout Fairview. Factor 2 is explained by the location of the new road and the Baptist Church; but lacks the Bible Chapel. The rest of the factors do not have any distinctive factor loadings.

Verbal Description of the Fairview Area

The verbal description information was condensed from a total of 44 statements about Fairview to four factors (see Table 17).

TABLE 16

FACTOR LOADINGS FOR THE SPATIAL INFORMATION ON THE COGNITIVE MAPS

	1	2	3	4	5	6	7	8	9	10
St. Pius School	.56									
Ball field	.59									
Playground	.59									
Halifax West School	.57									
Kentucky Fried Chicken	.54									
Esso Service station						-.50				
Community centre						-.51				
Fairview United Church	.50									
Dairy Queen	.51									
New road		.61								
Bible Chapel		-.68								
Baptist Church		.57								

TABLE 17

FACTOR INFORMATION FROM VERBAL DESCRIPTION OF FAIRVIEW AREA

Factor	Eigenvalue	Percent of Trace	Cumulative Percent of Trace
1	3.9	8.9	8.9
2	3.7	8.4	17.3
3	3.4	7.7	25.1
4	2.5	5.7	30.8

The statements with a factor loading above +.50 or -.50 are shown in Table 18.

In factor 1 (which explains 8.9% of the variation) the verbal descriptions lacked information mainly about schools. This factor will be called "no schools".

Factor 2 (which explains 8.4% of the variation) is mainly a division between attitude of like or dislike of the Fairview area and why. Very few students dislike Fairview. This factor will be called "attitude towards Fairview".

Factor 3 (which explains 7.7% of the variation) describes Fairview as an area with the characteristic of a nursing home. The main factor load was the nursing home. This factor will be called "nursing home".

Factor 4 (which explains 5.7% of the variation) describes Fairview but fails to include mention of the

TABLE 18

FACTOR LOADINGS FOR THE VERBAL DESCRIPTION OF THE FAIRVIEW AREA

Item	Factor 1	2	3	4
Elementary	-.53			
Junior High School	-.64			
Nursing home			.60	
Woods on top				-.56
Like area		-.50		
Dislike area		.51		
Don't like people		.50		

woods at the top. This factor will be called "no woods at the top of Fairview".

Conclusion

The factor analysis programme was used on each set of data to condense the data into major groups to get a common unit for each set of data - the factor scores. The factor scores for each set of data on each student in the study could then be used to see what relationships there are between the different sets of data. The findings will be discussed in Chapter 5.

Chapter 5

THE RELATIONSHIP BETWEEN COGNITIVE MAPS AND COGNITIVE ABILITY

In this chapter the effects of the relationship between cognitive activities and cognitive maps will be examined. In many previous studies socio-economic factors were found to be important elements in the formation of the person's cognitive map. However, in this study, these factors will be held constant so that the relationship between cognitive activities and cognitive maps can be studied. The data used are the factor scores of each of the students from the factor analyses discussed in the previous chapter.

Four sets of partial correlations were run on the data collected. They were

(a) Verbal description with cognitive ability holding socio-economic factors constant

(b) The form of the cognitive map with cognitive ability holding socio-economic factors constant

(c) The non-spatial elements from the cognitive map with cognitive ability holding socio-economic factors constant

(d) The spatial elements from the cognitive map with cognitive ability holding socio-economic factors constant.

The results of the correlations will be discussed separately.

The Effect of Cognitive Ability on the Verbal Description of the Fairview Area

The format of the data was to have a partial correlation on each of the factors of the verbal description with each of the three factors of the cognitive ability while holding all of the socio-economic factors constant. In Table 19 are the results of the effects of cognitive ability on the verbal description of the Fairview area while controlling for socio-economic factors.

The students who are high achievers appear to affect the verbal description of the Fairview area controlling for the socio-economic factors. Three of the correlations where the level of significance is higher than that which could be explained by chance are no schools (-.13), attitude towards Fairview (-.11) and nursing home (.15). The high achievement students included schools in their verbal descriptions of the Fairview area. The low achievement students did not consider schools an important factor in their description of the Fairview area even though schools are a major part of their lives. Such students also have a more negative view of the Fairview area as they dislike Fairview. The correlation of the other factor - no woods at the top of Fairview - could be contributed to chance. The high achievement students also included

TABLE 19

EFFECTS OF COGNITIVE ABILITY ON THE VERBAL
DESCRIPTION OF THE FAIRVIEW AREA
WHILE CONTROLLING FOR SOCIO-ECONOMIC FACTORS

Cognitive Ability	Verbal Description			
	No Schools	Attitude towards Fairview	Nursing Home	No Woods at Top of Fairview
High achievement	-.13* [1]	-.11*	.15*	-.06
Science achievement	-.10	-.00	-.04	-.03
I.Q.	.17**	-.12*	.15*	-.20**

* Significant at the .05 level

** Significant at the .01 level

1 - Partial correlation co-efficients

the nursing home in their descriptions. The students with high science achievement did not have any significant effect on the verbal description of the Fairview area.

The students with the high I.Q. factor had a significant influence on all the verbal description of the Fairview area. The I.Q. factor significantly influenced the verbal description factors of no school (.17), attitude towards Fairview (-.12), nursing home (.15) and no woods at the top of Fairview (-.20). The high achievement factor had a very important effect on the verbal description of the Fairview area. The verbal descriptions of these students were very well done and included most of the major and minor points about the Fairview area. Schools which are a major part of their lives are mentioned. Fairview is a subdivision built on the side of a gentle sloping hill. The top of the hill beyond the location of the last street is a wooded area. This wooded area is directly behind the school and is a natural boundary between Dunbrack Street and the Bicentennial Highway and, as such it is a very prominent physical feature. Low I.Q. students did not mention this as a major factor in their description of the Fairview area.

The high I.Q. students also have a more positive attitude towards their neighbourhood as they like Fairview. They also mentioned the factor "nursing home". The nursing home is a prominent building located on Main Street, yet it is not a prominent landmark in the Fairview community. The high I.Q. students mention in their verbal descriptions elements that can be found in all areas of Fairview when compared to the low I.Q. students.

In summary the students' cognitive abilities appear to play a significant role in the students' verbal descriptions of the Fairview area. The high science achievers do not significantly influence the verbal descriptions of Fairview.

Since the ability to read, write and interpret are major factors in tests, it is not surprising to find that cognitive ability plays a major part in the student's verbal description of Fairview.

Effects of the Cognitive Ability of the Students and the Forms of the Cognitive Maps

The format used in describing the partial correlation between cognitive ability and the forms of the cognitive maps will be the same as found in Table 19. In Table 20 are the results of the effects of cognitive ability on the forms of the cognitive maps of the Fairview area while controlling for socio-economic factors.

The effects of cognitive ability on the form of the cognitive map are very evident in Table 20. High achievement students significantly influenced the factors of inaccurate map (.1292), accurate map (.1468) and no Bicentennial Highway (-.2662). The inaccurate map was determined by the completion of certain areas of Fairview. The area was usually determined by the student's home. For example, a cognitive map of a student living in the top half of Fairview may only include the upper area of Fairview. The inaccurate maps were usually very well done. The high achievement students had a significant effect on the number of inaccurate maps. The high achievement students also influenced the accurate maps drawn. Many of the inaccurate partial maps were classified as map type 3 or 4 which are well-drawn maps. The boundary of Bicentennial Highway was also placed on the maps by high achievement students. High achievement students affected the form of the cognitive maps.

Science achievement students influenced the form of the cognitive map by having the tendency to produce good complete maps. High science achievement students did not significantly influence the location or lack of location of boundaries on the cognitive maps.

The high I.Q. factor influenced the following factors in the form of the cognitive map - inaccurate map (.13), accurate map (.15) and no Bicentennial

TABLE 20

EFFECTS OF COGNITIVE ABILITY ON THE FORMS OF COGNITIVE MAPS WHILE CONTROLLING FOR SOCIO-ECONOMIC FACTORS

Cognitive Ability	Form of the Cognitive Maps			
	Inaccurate Map	Accurate Map	Negative Dunbrack Boundary	No Bicentennial Hwy.
High achievement	.12*	.14*	.01	-.26**
Science achievement	-.16*	.16*	.03	.06
I. Q.	.13*	.15*	.06	-.19**

* Significant at the .05 level

** Significant at the .001 level

Highway (-.19). This factor is similar to high achievement factors in that they both significantly influence the inaccurate map and accurate map by having the Bicentennial Highway included on their map.

In summary, cognitive ability of a student appears to affect the form of the cognitive map. The type of cognitive map drawn and the completeness of the map drawn is significantly influenced by all three of the cognitive ability factors of high achievement, science achievement and high I.Q. This finding was not apparent in many of the earlier studies as they studied only the effect of social conditions on cognitive mapping.

Effects of the Cognitive Ability of the Students on the Non-Spatial Information Found on the Cognitive Map

The information about the effects of the cognitive ability of the students on the non-spatial information of the cognitive maps will follow the same format as used in the previous data. In Table 21 are the results of the analysis. The non-spatial information refers to the map content of the various spatial data that was put on the cognitive maps. In Table 21 the cognitive ability of high achievement significantly affects only one of the non-spatial information factors - physical - traffic (.13). High achievement students

TABLE 21

EFFECTS OF COGNITIVE ABILITY ON THE NON-SPATIAL INFORMATION OF THE COGNITIVE MAPS WHILE CONTROLLING FOR SOCIO-ECONOMIC FACTORS

Cognitive Ability	Non-Spatial Information			
	Commercial-Recreational	Physical Traffic	Home-Social	No residential Area
High achievement	-.04	-.13*	-.00	.03
Science achievement	.14*	.08	-.05	.02
I. Q.	-.09	-.04	-.03	-.11

* Significant at the .05 level

** Significant at the .01 level

did not place physical and traffic elements on their maps. The other non-spatial information factors of commercial-recreational (-.04), home-social (-.00) and no residential areas (.03) were not significantly affected by cognitive ability.

Science achievement also only significantly affected one of the non-spatial information factors - commercial-recreational (.14). Science achievement students added commercial-recreational elements to their maps. The other non-spatial factors were not significantly influenced by cognitive ability.

The I.Q. cognitive ability did not significantly influence the non-spatial elements that were placed on the cognitive maps.

The non-spatial information map content was not significantly influenced by the cognitive ability of the students. This aspect of map content does not appear to be significantly influenced by cognitive ability.

Effects of the Cognitive Ability of the Students on the Spatial Information Found on the Cognitive Maps

The information about the effects of the cognitive ability of the students on the spatial information of the cognitive maps will follow the format used in the previous analyses. In Table 22 are the results of the data.

TABLE 22

EFFECTS OF COGNITIVE ABILITY ON THE SPATIAL INFORMATION OF THE COGNITIVE MAPS WHILE CONTROLLING FOR SOCIO-ECONOMIC FACTORS

Cognitive Ability	Spatial Information				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
High Achievement	-.04	.00	.12*	.01	-.03
Science Achievement	.00	-.03	-.07	.10	.03
I. Q.	-.05	-.06	-.13*	-.16*	-.02

.... Continued

TABLE 22, Continued

Cognitive Ability	Spatial Information				
	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
High Achievement	-.18**	-.14*	-.10	-.02	-.00
Science Achievement	.08	.08	.03	-.04	.01
I. Q.	-.20**	-.12*	-.11*	-.07	-.10

* Significant at the .05 level

** Significant at the .01 level

The spatial information is the same data that was used to obtain the non-spatial data. There appears to be a similarity between the spatial and non-spatial data as only 26.6% of the spatial information and 16.6% of the non-spatial information are affected by the cognitive ability factors. The spatial information factors were not named as some of the factors had factor scores that were above +.50 or -.50.

The cognitive ability of high achievement significantly influenced the spatial information factor of Factor 3 (.12), Factor 6 (-.18) and Factor 7 (-.14). The science achievement students did not significantly influence any of the spatial information factors. The students with high I.Q. significantly influenced the spatial information factors of Factor 3 (-.13), Factor 4 (-.16), Factor 6 (-.20) and Factor 7 (-.12). The students with high I.Q. placed more elements on their cognitive maps than students with low I.Q.'s. All of the significant relationships except for factor 3 are negative relationships. The spatial information data are the elements that have been placed on the map. The students did not place many elements on the map, and the few students that did place elements on the map had higher achievement and I.Q. scores than the students that omitted elements from the map. This is probably the reason why there is a significant negative relationship or lack of elements found on the maps.

In summary, cognitive ability does not appear to significantly affect the spatial information that is placed on the cognitive map.

Chapter 6

SUMMARY OF MAJOR FINDINGS

There was a considerable degree of variety in the cognitive maps of the Fairview area. The students came from different parts of the study area and in many cases this was shown by the number of partial maps drawn - maps which were very good but only showed a part of Fairview. The types of maps reflected a considerable range of ability covering both grade levels.

In Table 23 is a summary of Tables 19 to 22 inclusive. The responses are in percentages because there are four factors used in Tables 19, 20 and 21 and ten factors used in Table 22. By putting the data into percentages, it should be easier to compare the levels of significance of the four sets of partial correlations.

The students' cognitive ability was the most significant factor in the verbal description of the Fairview area. This was a written description which probably accounts for the fact that students with high levels of cognitive ability did better.

The form of the cognitive maps which is the way the students drew the cognitive maps is also affected by the students' cognitive ability. These

TABLE 23

A SUMMARY OF TABLES 19 TO 22 AND THE PERCENT LEVELS OF SIGNIFICANCE

Type of Information	Cognitive Ability	Percent Level of Significance			
		.05	.01	Not Significant	Total
Verbal description	High achievement	75		25	100
	Science achievement			100	100
	I.Q.	50	50		100
Forms of maps	High achievement	50	25	25	100
	Science achievement	50		50	100
	I.Q.	50	25	25	100
Non-spatial information from maps	High achievement		25	75	100
	Science achievement		25	75	100
	I.Q.			100	100
Spatial information from maps	High achievement	20	10	70	100
	Science achievement			100	100
	I.Q.	40	10	50	100

forms of the maps includes its shape, format, roads, boundaries and arrangement. The high achievement cognitive ability students significantly influenced (25% at the .01 significance level and 50% at the .05 significance level) the forms of the cognitive maps. These students had high scores from the Metropolitan Achievement Tests in reading, mathematics and social studies. These scores showed that ability in these areas was a significantly more important factor in the forms of the cognitive maps than the students' socio-economic backgrounds.

Science achievement was also an important factor affecting the cognitive maps of the students. It was, however, not a major factor. Science achievement students did not do as well as the other high achievement students. This is surprising as students who are high science achievers are usually very perceptive and thorough. In the form of the cognitive map, science achievement students did do as well as the other types of cognitive ability students.

The factor of I.Q. was highly effective in the forms of the cognitive maps drawn. At the .01 significance level they were effective 25% of the time and at the .05 significance level they were effective 50% of the time.

One factor of the form of the cognitive map that was significantly affected by the high achievement, science achievement and high I.Q. students is called "the inaccurate partial map factor". The word "inaccurate" stands for a cognitive map covering the whole Fairview area. These maps covered only a portion of the Fairview area; therefore, they were also called "partial maps". The partial area covered however was complete. The students of better cognitive ability had good cognitive maps of their area of Fairview.

The students of high cognitive ability significantly affected the "accurate form" of the cognitive map. They drew cognitive maps that included most of the aspects that are expected in a good map. The maps could be used to find locations in the Fairview area. The high achievement and high I.Q. students also included the important boundary of Bicentennial Highway. This highway is not only a major boundary, but is also a significant factor in the verbal description of the Fairview area.

The cognitive ability factors played a highly significant role in the form of cognitive maps that were drawn by the students. The cognitive ability of the student influenced the form of the cognitive map, and the verbal description of the Fairview area. Map content was not significantly affected by cognitive ability.

This finding differs from the results of work done by the studies previously discussed in the Review of the Literature by Ladd (1970), Appleyard (1970), and Maurer and Baxter (1972). They found socio-economic factors to be a very important factor in the forms of the cognitive maps that were drawn. These studies place little emphasis on the cognitive ability of the student. Most of the other studies were done in areas that could be classified as low socio-economic areas. Socio-economic factors may have over-shadowed the students' cognitive ability. This study was done in a middle-class area where the cognitive ability was not over-shadowed by socio-economic factors. The students in this study would have a better opportunity to do well in tests of cognitive ability and would have a much greater range of opportunities.

The non-spatial and spatial information found on the cognitive maps was not significantly affected by cognitive ability. These two factors are the same information, studied in two different formats. As discussed earlier the spatial information is the individual landmarks that were placed on the maps and the non-spatial data is the grouping of the spatial data into eight categories. Therefore, the results of the partial correlation using these two sets of data should have been similar. The factor of I.Q. was more significant than the factors of high achievement and science achievement.

The major relationships that are found in the study show that cognitive ability affects various aspects of cognitive maps of the students in this study. The high achievement students and high I.Q. students affect the verbal description of the Fairview area. They, as a group, had mentioned more elements in their verbal description than lower achievement or lower I.Q. students. The students who are better in all areas included items in their descriptions that daily affected their lives, such as the school and the physical surroundings of school - the woods. They may have a positive attitude towards their school because they are achieving more in the educational environment than the poorer student. In addition, the poorer student also had a negative attitude towards the Fairview area. That students of high achievement and high I.Q. mention the nursing home is not surprising as it is quite a prominent building on one of the major streets, Main Avenue. This part of the study was a written exercise and in general students of high cognitive ability usually do better on written work than do students of low cognitive ability. They know how to write a good description. Interviewing or giving objective tests would have been other methods of getting the verbal description of Fairview. The results may have been different.

One area of study in cognitive mapping is the elements or map content found on the cognitive maps. The non-spatial and spatial data refer to the elements. High cognitive ability was not a major factor in significantly influencing the location of various elements on the cognitive maps.

In summary, the major findings of the study are

(1) Cognitive ability significantly affects the type of maps drawn by the students.

(2) Cognitive ability significantly affects the student's description of his neighbourhood.

(3) Cognitive ability significantly affects the quality of a map that represents only a part of a person's neighbourhood.

(4) The quality of drawing showing a part of a neighbourhood may be more important to some students than drawing a map of the whole neighbourhood.

(5) The number of roads, houses and important places (map content) was only significantly affected by the cognitive ability of I. Q.

Recommendations

Cognitive ability appears to affect the types of cognitive maps that are drawn by individuals as shown by this study. This study only included a group of students from one school in the City of Halifax; however, these students were from similar socio-economic backgrounds. From the results of the findings the following ideas are being recommended:

(1) As in a number of other studies individual interviews would have been beneficial in this thesis - especially in the area of getting information about incomplete maps.

(2) A similar study in other types of socio-economic groups using the same criteria would have been useful. This could be used for comparison.

Implications for Further Research

This thesis only studied the effect that cognitive ability has on cognitive maps. There are other areas for further research. This study did not isolate the exact effect that the cognitive ability had on individual aspects of the cognitive maps which is a very important area for future study.

There is also the aspect of research in the area of sex differences. Is there a difference between the cognitive maps drawn by males and by females? The quality of the partial maps was usually good; therefore, further study is necessary to find out why only part of an area is important to one person, while the whole area is important to another person. This could only be done if maps of similar classification were used.

There is a definite need for more work in the area of research into why students would draw only a portion of a larger neighbourhood. Students may have different concepts of what they consider to be the area of their neighbourhood.

In geographic studies there is a need for an understanding of spatial concepts. Further research in cognitive mapping may benefit geographic research and education as the major problem may be that students have not been taught how to study their spatial surroundings.

Appendix A

Listing and description of socio-economic variables used in the study.

VARIABLES	DESCRIPTION WHERE NECESSARY
Six-figure grid reference for home location	
Two-figure grid reference showing general area of home	
Parents' occupations	Occupations were grouped by income ranges - ranges were coded 10 - 30.
Type of accommodation	(1) House (2) Trailor (3) Apartment (4) Townhouse
Quality of dwelling	Rated 1 (highest) - 3 (lowest)
Number of brothers	
Number of sisters	
Total number of brothers and sisters	
Student's rank in the family	(1) Youngest (2) Middle (3) Oldest (4) Only child
Length of time living in neighbourhood determined by school records	Grade VII - 1 to 8 years Grade IX - 1 to 10 years
Where they were born	1 if born in Halifax 0 if born outside of Halifax
Grade level	Grade VII Grade IX
Age	12 to 16 years

VARIABLES	DESCRIPTION WHERE NECESSARY
Class number	Each grade would have a numeral designation (e.g. 7 - 1, 7 - 2. This was determined by reading ability. 7 - 1 highest ability and 7 - 6 lowest ability).
Sex	1 if male 0 if female

Appendix B

Listing and description of cognitive ability variables used in the study.

VARIABLES	DESCRIPTION WHERE NECESSARY
I. Q. scores	These ranged from a low of 64 to a high of 132
Verbal I. Q. scores	These ranged from a low of 61 to a high of 141
Non-verbal I. Q. scores	These ranged from a low of 67 to a high of 123
Achievement test reading scores	The achievement scores are based on a mark out of 100 (maximum)
Achievement test math scores	See above
Social Studies achievement test scores	See above
Science mark	This is an assessment mark based on a rating system of ability and mark. These marks ranged from a low of 22 to a high of 49.
Arithmetic mark	See Science marks
Art mark	See Science marks
Stanine in reading	Rank 0 - 9 (0 is lowest) (9 is highest)
Stanine in arithmetic	Rank 0 - 9 (0 is lowest) (9 is highest)
Mark on slide test of neighbourhood	Marks ranged from a low of 10 to a high of 20

Appendix C

Listing and description from the forms of the cognitive map variables used in the study.

VARIABLES	DESCRIPTION WHERE NECESSARY
Maps	1 - incomplete 0 - complete
Areas missing on maps	These were numbered (1) South of Hillcrest (2) West of Main Ave. (3) East of Frederick Ave. (4) West of Rufus Ave. (5) East of Rufus Ave. (6) West of Coronation Ave. (7) South of Willett St. (8) South of Alex St. (9) East of Rosedale Ave.
Type of map	These were (1) Pictorial cognitive map (2) Schematic cognitive map (3) Group 3 cognitive map (4) Group 4 cognitive map
Organization of map	Scored 1 - paper lengthwise 2 - paper widthwise
Boundaries	There are four destinctive boundaries. If a boundary is shown it is recorded as 1. If it is omitted it is recorded as 0.
Number of streets	There were 45 possible streets
Arrangement of streets	They were ranked 1 to 5 (1 being poor)
Number of streets correctly placed	The number of correctly placed streets from the number of streets given - range 0 - 45

VARIABLES	DESCRIPTION WHERE NECESSARY
Streets ranked by percent correct	1 over 75 2 22.5 - 33.78 3 11.25 - 22.5 4 5.4 - 11.25 5 under 5.4
Number of boundaries	Range of 0 - 4
Number of landmarks	0 - 30
The percentage of streets correct for the area given	If the students had shown an area with 10 streets and he had included 9 of them he got 90% correct for that area
Percentage of misspelling of streets	If the students had 2 out of 10 streets misspelled it would be recorded 20%.

Appendix D

A sample of the original data used in the study.[1]

Socio-Economic Data

VARIABLES	STUDENT DATA
Six-figure grid reference	142149
Two-figure grid reference	43
Parents' occupations	20 (mechanic)
Type of accommodation	3
Quality of dwelling	2
Number of brothers	0
Number of sisters	0
Total number of brothers and sisters	0
Rank in the family	4
Length of time living in the neighbourhood	6
Where they were born	0
Grade level	Grade VII
Age	12 years
Class number	2
Sex	1

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[1] For further explanation see Appendices A, B, and C.

Appendix D, Continued

Form of the Cognitive Map Data

VARIABLES	STUDENT DATA
Streets ranked by percent correct	3
Number of boundaries	4
Number of landmarks	9
The percentage of streets correct for the area given	94
Percentage of misspelling of streets	0

Map Content by Group

VARIABLES	STUDENT DATA
Number of residential areas	0
Number of social areas	5
Number of commercial areas	0
Number of recreational areas	2
Number of physical features	1
Number of traffic features	0
Their home shown	1
Number of services familiar	0

Map Content by Item

(Total possible items - 47).

Home, Fairview Junior High School, Fairview Heights School, Fairview Annex School, Soccer field, Church, Fairview Villa, Pizza Parlour, woods area.

Appendix D, Continued

Educational Data

VARIABLES	STUDENT DATA
I. Q. score	106
Verbal I. Q. score	91
Non-verbal I. Q. score	120
Achievement test reading score	56
Achievement test mathematic score	67
Achievement test Social Studies score	72
Science Mark	33
Arithmetic mark	33
Art mark	37
Stanine in reading	6
Stanine in mathematics	6
Slide test of neighbourhood	17

Form of the Cognitive Map Data

VARIABLES	STUDENT DATA
Maps	1
Areas missing on maps	1
Type of map	1
Organization of map	2
Boundaries	1111
Number of streets	15
Arrangement of streets	2
Number of streets correctly placed	15

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