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The Ohio State University, Ph.D., 1973
Geography

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AN ANALYSIS OF COGNITIVE AND OBJECTIVE CHARACTERISTICS OF THE CITY:
THEIR INFLUENCE ON MOVEMENTS TO THE CITY CENTER

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of the Ohio State University

By
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The Ohio State University
1973

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CHAPTER I

COGNITION AND URBAN STRUCTURE

Introduction

The cognitive representations which people form of urban areas and subsequently use in their way-finding or movement in these areas have attracted much attention in recent years. These representations are the internal reflections of the objective environment\(^1\) and are based on the interaction of man with the environment. This interaction is a two way process shaped by the form of the objective environment and the economic, social, physical, and psychological characteristics of the individual.\(^2\) The objective environment consists of both specific and complex features (e.g., large building and changing density of houses) and the distance separation between features (spatial relations); the observer selects, organizes, and gives meaning to a limited number of the features and spatial relations found in the objective environment.\(^3\) This selection of features is

\(^1\)The objective environment consists of features which are external to individuals and which can be photographed.


accomplished by means of a perceptual process—a process that depends on sensory input. Organization and meaning are given to the features through the process of cognition—the processes which transform the sensory input into a useful form such as an urban image. The major function of the image or internal representation of the

---

4. The concept of perception is variously defined in the literature. Tolman provides an all inclusive definition which states the concept includes:

a) sense perception in which the stimuli are all then and there present to the senses as well as the perceptions of objects some of whose parts are merely inferred or remembered.

b) instances of spatial, temporal, aesthetic, mathematical, or other such relations as may be immediately given along with the objects themselves as ways of getting from one object to another.

c) entities of which the actor is not then and there consciously aware.


5. Cognition is defined as including all the modes of knowing such as perceiving, thinking, imagining, reasoning, judging, learning, and so on. See F. H. George, Cognition (London: Methuen and Co., Ltd., 1962), p. 11. Also see Roger A. Hart and Gary T. Moore, The Development of Spatial Cognition: A Review, Place Perception Report, No. 7 (Worcester, Massachusetts: Graduate School of Geography, Clark University, 1971).

6. The urban image is defined as the internal representation or model of the environment (however it is internally arranged) as the individual knows and understands the objective urban environment. The term is equivalent to that of cognitive representation.
environment so constructed is to permit spatial mobility\textsuperscript{7} which is said to be guided by a set of expectations of what one will see and interpret within the environment.\textsuperscript{8} Orderly spatial mobility across populations is the result of the development of the common or overlapping urban images which individuals with similar characteristics possess.\textsuperscript{9}

The urban environment in which man operates is really not the objectively defined urban environment of the early urban geographer.\textsuperscript{10} Instead, man operates within a "cognized urban environment" which is related to the "actual urban environment" such that the features which exist in the "actual urban environment" are incorporated to some degree in the "cognized urban environment."\textsuperscript{11} Geographers have traditionally studied the contents of man's environments, the spatial relations (distances) of his environments, and man's behavior in environments of all types--urban, rural, exotic, etc. They have developed

\textsuperscript{7}Spatial mobility is a type of behavior. A more widely used term for spatial mobility is spatial behavior which can be defined as a goal-directed movement through space. For a wider discussion of spatial behavior see Reginald G. Golledge, "Process Approaches to the Analysis of Human Behavior," (Columbus, Ohio: The Ohio State University, Department of Geography, Discussion Paper No. 16, 1970).


\textsuperscript{9}Lynch, "The Image of the City," p. 7, pp. 124-126. Greater comment concerning the common images is made in the next section.

\textsuperscript{10}For a discussion of this see U. Neisser, Cognitive Psychology (New York: Appleton Century Crofts, 1967); also see Ronald Briggs, "Cognitive Distance in Urban Space" (unpublished Ph.D. dissertation, The Ohio State University, 1972).

\textsuperscript{11}Carr and Schissler, "The City as a Trip," p. 35.
generalized models of the arrangement of urban elements and have learned that all cities do not have the same arrangement of urban elements. Since it may be assumed that man stores information about the city in such a way that responses concerning elements of representations can be arranged into cognitive maps which resemble maps of the objective environment, geographers can use their generalized models as a starting point and begin to examine the contents and spatial relations of man's cognized urban environment and the relationship of these factors to his behavior in the actual city. In this fashion, they can seek answers to the questions of planners, architects, and other social and behavioral scientists concerning the effect of the physical arrangement of urban features on the urban image of individuals. The present study is addressed to this problem: i.e., the investigation of the effects of the arrangement of occurrences in the physical environment on the cognitive representations of these elements and on consequent spatial behavior. In this way it is hoped that the answers to the following two questions may be found:

(1) Are the same urban features equally important as potential way-finding clues to observers regardless of the spatial structure of the city?

(2) Do particular urban structures facilitate or hinder the development of urban images?

Cognitive urban representations are not directly observable. However, as it has been previously stated, a major function of an

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12 Throughout this study, the terms "elements," "features," and "cues" are used interchangeably. At various times they are used with the adjectives "urban," "environmental," and "city."
urban image is to permit spatial mobility (a behavior). It appears reasonable to assume therefore, that urban images can be inferred by studying the spatial behavior of individuals in cities. A method which requires a specific behavior—that of selecting a route to the city center—is used to provide information concerning differences in the importance of selected urban features as potential way-finding clues. Similar methods are used to obtain information concerning differences in the perception of distance and memory of features which occurred along a route. This information provides the opportunity to assess which of the structures facilitates image development. The operationalization of the method and the hypotheses are described in Chapter II. The remainder of this chapter discusses the concept of spatial cognition and the relevant studies or urban cognition.

The Concept of Spatial Cognition and the Macro-Environment

How do people come to know large scale environments such as their city or any city? The answer to this question is at present only fragmentary, but considerable work has been done on the related concepts of cognition and perception. Some of this work focuses on the topic of space. Piaget and Werner have provided us with similar theories involving a developmental-structural process which explains how individuals gain an understanding of the basic concept of space. From this


work, it has been suggested that individuals come to know or develop cognitive representations of large scale environments in much the same fashion as they develop representations of space in general. The primary purposes of these representations are (1) to facilitate the individual's location and movement within the physical environment and (2) to provide the individual with a frame of reference for understanding and relating to this environment.¹⁵

The following explanation is limited to the discussion of how a person comes to know an urban environment, i.e., how does he develop representations of the city. The major ideas used have come from combining the notions of field theory,¹⁶ and several expositions of perception¹⁷ and its role in gaining environmental knowledge.¹⁸

It is first necessary to make several assumptions concerning the perceiving organism and the environment. The perceiving organism in this instance is a sighted, verbal adult who is a newcomer to a particular city. By working with adults it is possible to avoid a lengthy discussion of the stages of child development and intelligence

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¹⁵Hart and Moore, The Development of Spatial Cognition, p. 45.


¹⁷Hart and Moore, The Development of Spatial Cognition.

¹⁸Forgus, Perception: The Basic Processes; Vernon, The Psychology of Perception; George, Cognition.
which are better explained in Piaget and others.\textsuperscript{19} Since it is difficult to separate the roles of vision and verbal symbolization in cognitive development, the assumption that the "adult" has both these faculties is made.\textsuperscript{20} In addition, it is assumed that the "adult" has had some previous acquaintance with one or more cities. The last assumption involves the individual's recognition of the urban environment as distinct from other environments. The city contains buildings, landmarks, paths (roads), districts, and boundaries which are typical of all cities, as well as a few unique factors, e.g., a monument to a former president, a named commercial establishment which is referred to by name rather than by function, etc.\textsuperscript{21} Environmental features are regularly associated in both a sequential and hierarchical fashion.\textsuperscript{22} Tolman defines these features as nodes and then describes three types of nodes—(1) \textit{end nodes} which form origin and destination points, (2) \textit{link nodes} which form means for reaching the end nodes, and provide cues for spatial mobility, and (3) \textit{potential nodes} which have not as yet functioned as end or link nodes, but whose existence is known to the organism. Tolman defines a route as a sequential

\textsuperscript{19}Piaget and Inhelder, \textit{The Child's Conception of Space}.


\textsuperscript{22}This discussion follows from those by E. C. Tolman, \textit{Purposive Behavior}, and Briggs, "Cognitive Distance in Urban Space," pp. 53-57.
association linking two end nodes by a link node. The hierarchical associations depend on the arrangement of nodes into subordinate and supraordinate goal nodes. Briggs has further discussed the hierarchical arrangement of nodes and incorporated all but one of Lynch's elements of urban images into this system. The common occurrence of such environmental features and associations in urban places leads the "adult" to form certain expectations of the city environment.

The different cognitive processes (perceiving, learning, remembering, imagining, conceiving, judging and reasoning) operate with varying degrees of importance, and at varying times, when considering how a person gets to know a city. It has been stated that external behavior by which internal representations are inferred is dependent upon perception and the interaction of perception and the other cognitive processes.23 (see Figure 1). This notion implies different levels of perception varying from early passive sensory stimulation to later active information extraction, matching of new and old information, and dynamic changing of stored information. No attempt is made to discuss which specific cognitive process or level of perception operates in forming city images; instead, the notion of interacting processes and levels is accepted and the major focus turns to the resulting spatial images.

Given the above considerations it is generally hypothesized that the adult, when located at some point in the city, begins to form

FIGURE 1
THE RELATIONSHIP BETWEEN THE COGNITIVE PROCESSES OF
PERCEPTION, LEARNING, THINKING AND BEHAVIOR

This figure is partially adapted from Forgus, Perception: The Basic
Process, p. 4.
a cognitive representation of that city. In other words, he begins to form a mental plan which is a reflection in his mind of the spatial placement of local objects in relation to each other and to himself. This cognitive representation has a reference system which spatially orients the individual in some systematic manner to the environment. According to the developmental-structural theorists, there are three stages in the system of orientation. In the earliest stage, egocentric orientation, the individual locates objects in the environment with respect to himself (away from, toward, etc.). The second stage finds the individual using a fixed system of orientation in which objects are located with respect to other objects at fixed locations. Finally in the last stage, the individual locates objects with respect to an abstract system. Some doubt has been raised questioning whether or not individuals ever fully operate on a co-ordinate reference system in a city.

The writer, like Appleyard, believes that an adult in a city uses all three stages of reference simultaneously in his mental plan of the spatial arrangements of objects. An individual views certain locations as goals whether he is interested in the location itself or some activity it offers. Then using a polar system of reference with

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his location at one end and the goal at the other end, the individual begins to think about what physically occurs between the two end points. In this way the individual builds a number of route maps.\(^{27}\) These representations contain end points joined by some line of transportation (supports or roads) and are punctuated with a few objects which serve as perceived fixed reference points. It is hypothesized that with time the individual forms field or spatial maps by integrating the network of route maps into a whole. The field map, often called a "comprehensive map"\(^{28}\) or "spatially dominant map,"\(^{29}\) includes representations of experienced objects and routes and mentally constructed spatial relations both between different objects and different routes, and between the elements and routes. In addition the cognitive maps\(^{30}\) may contain expectations of objects, routes and so on deriving from the individual's previous experience with these elements whether or not the present environment confirms the expectations.\(^{31}\) According

\(^{27}\) Although this procedure has not been totally confirmed, it is supported by the previously cited work by Shemyakin, "Orientation in Space," pp. 86-255; Vernon, The Psychology of Perception; Tolman, Purposive Behavior, and Chein, "The Environment as a Determinant of Behavior," pp. 115-127.

\(^{28}\) Tolman, "Cognitive Maps in Rats and Men," Psychological Review, 60 (1948), pp. 189-208.


\(^{30}\) A cognitive map is defined as a cartographic interpretation or formalization of cognitive representation.

to Tolman, this cognitive map determines what if any behavioral response the individual will make, i.e., selection of a particular route to work, etc.32

Cognitive interaction with the environment does not end with the acquisition of a mental map. Instead, the individual continues adapting his internalization of the external world through the processes Piaget calls assimilation and accommodation. Here assimilation refers to the incorporation of the external world into already structured schemas33 while accommodation refers to the readjustment of the schemas to the external world.34 Thus the individual perceives objects, routes, and spatial relations that are new to his environment as well as changes between those objects, routes, and spatial relations he noticed earlier. This should not be taken to mean that the individual comes to know the entire urban environment. The urban environment is rich in sensory stimulation and presents much information simultaneously.35 Therefore, the individual practices perceptual selectivity and constructs his internal representation of the environment through selected fields of attention.


33The word "schema" is sometimes used by Lee ("Psychology of Living Space," pp. 11-36) to mean mental map or cognitive map as it is in this instance. The term is more correctly used to imply sensory input as is explained below.

34Hart and Moore, The Development of Spatial Cognition, pp. 7-20.

In summary, it is felt the individual internalizes the urban environment by first differentiating specific locations and parts of the environment from his initial global view of the city (based on his previous experience) and then integrating the different locations and parts into an abstract reference system of his own. The individual then uses his "cognitive map" as a guide for his mobility in the urban environment and alters it as new environmental information occurs. It is my contention as well as that of Vernon's that the process of cognitive mapping is relatively stable in adults who have the capacity to form spatial relations. She states:

"Thus when we learn to find our way about a neighborhood we develop images and ideas about the relative position and distance in roads, houses, and natural features. For instance, we know that when we come to such and such a crossroads we must turn right and proceed until we reach a certain house (which we image), and then branch left and so on. Most people can acquire such patterns of images and ideas; and they also learn to relate them to plans and maps which symbolize those topological relationships." 36

Although the process of cognitive mapping is similar for most individuals in urban environments, the resulting cognitive maps differ. Each individual is unique, and therefore, his urban image which is based on his interaction with the environment is also unique. It is necessary, however, that enough overlap exists in the characteristics and the experiences of individuals such that the existence of a common image results. Without this common image, orderly movement within the environment would be impossible. 37 Since individual

members of groups with similar characteristics tend to have similar urban images, it is possible to isolate the differences in urban images which are related to environmental differences such as those of urban structure by studying the urban images of members of groups with common characteristics.

The research concerning urban images conducted by geographers, planners, and psychologists elaborates on the general concepts of mental maps, environmental perception, and urban cognition. The following review of the relevant literature provides valuable insights into the common images of the city, the cognitive process, and the roles of the individual and the environment in general.

Cognition and Perception in Urban Research

Efforts in this area vary greatly in subject matter. The work of Gould, Stea, and Blaut emphasize the concepts of mental maps. Michelson and Petersen examine environmental preferences based on


40J. M. Blaut, "Studies in Developmental Geography," Place Perception Research Reports, No. 1 (Graduate School of Geography and Department of Psychology, Clark University, Worcester, Massachusetts).


the individual's perceptions of particular urban environments. Recent studies by Brown and Wolpert relate spatial behaviors such as residential movements to the individual's evaluation of place utilities and his action space, two concepts which again belong to the perceived environment. Still another topic remains in this growing literature, that which deals primarily with the cognitive structure of the urban environment. As this work is most meaningful in the present research, a more detailed discussion follows.

Research in the cognitive structure of urban areas can be conveniently divided into a number of major themes. The studies by Lee and Golledge, Briggs, and Demko exemplify the first theme which involves the perception of distance or spatial separation. Their objectives included discovery of (1) the accuracy with which individuals locate points within a familiar environment, (2) the relationship between the "perceived" and real world distances, and (3) any consistent directional or distance biases associated with specific points and their relationship to certain types of urban behavior. The results of the Lee and Golledge et al. studies indicated that (1) at that time


no overall generalization could be made in regards to relations between objective and perceived distance, and (2) familiarity with the environment had an influence on the perceived distances between points in space. In a third study, Lowrey studied distance perceptions with respect to ten types of urban facilities which differed in their frequency of occurrence in the environment and their frequency of use by the individual respondents. He concluded neither frequency affected the respondent's distance judgements. 47

A second set of studies concentrates on the perception of social-physical constructs such as the neighborhood. These studies may also be thought to investigate the mental images individuals have of distinct spatial entities or subdivisions of cities. In a study conducted in Cambridge, England, Lee 48 asked housewives to draw a line around the part of the city they considered their neighborhood. From the neighborhood schema Lee found that the "neighborhood" was a salient experience for individuals. 49 Each image was unique, but related in an orderly fashion to the physical environment and to the personality of the possessor. In this instance, the physical


49 Lee's use of the words "schemata" and "schema" is varied. In this instance he uses "neighborhood schemata" as equivalent to "neighborhood image" or as an internalized model of neighborhood. At other times he refers to the "schema" in the vein of sensory input. This practice of using different meaning for schema is not limited to Lee or even to geographers who appear to misuse the term. For examples of its use, see Lee, "The Psychology of Living Space," pp. 11-36, and Vernon, The Psychology of Perception.
environment was represented by a ratio of the actual number of facilities such as houses and shops found in the schema to the number existing in the locality which was defined as an area of a half mile radius around the individual's home. The personality of the possessor was identified by six variables: (1) social class, (2) age, (3) length of residence, (4) place of work, (5) mobility, and (6) social involvement (defined as the interaction with people and facilities in the area). In relating the mental images to these variables, Lee was able to summarize the neighborhoods for groups of similar individuals and define like areas of the city. One of the most interesting conclusions Lee made was that individuals appear to perceive their neighborhoods in terms of the space and not the population they encompass. Thus, it is possible to conclude that individuals do internalize spatial organization and use this internalized reflection in their spatial interactions. Studies by Zannaras and Ladd also investigated neighborhood schemas. In general their work confirmed many of Lee's ideas on neighborhoods.

de Jonge also investigated neighborhood images. Unlike the other studies mentioned above, de Jonge ignored the social and psychological characteristics of the people. He concentrated on the actual


visual form of the environment in terms of the visible detail in residential structures (architecture) and road layout. In interviewing residents of both structurally simple and complex neighborhoods, de Jonge concluded that way-finding was equally difficult in the given environments. Since it has been stated that mobility in an environment is related to the image or internal representation of that environment, de Jonge's statement implies cognitive representation of extremely homogeneous environments as well as that of extremely heterogeneous environments is difficult. This comment is one of the few examples in the literature in which images of two types of an environmental form (neighborhood) are compared.

The work of Lynch illustrates a third theme in cognitive urban research—the perception of the entire city. Lynch examined one visual quality of the American city—the legibility of the cityscape. Legibility refers to the ease with which parts of the city can be recognized and organized into a coherent pattern. As such, legibility has important ties to the mental images people form and use in way-finding. These images are structured around the five elements of imageability of a city that possess visual dominance. These elements include (1) paths (channels of movement—roads, etc.), (2) edges (linear elements not used as paths such as boundaries), (3) districts (medium to large sections of the city), (4) nodes (strategic points in a city such as junctions or intersections, concentrations of a land use activity), and (5) landmarks (simply defined physical objects such

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53 Lynch, Image of the City.
as buildings, signs, etc.). The studies by Gulick\textsuperscript{54} and de Jonge\textsuperscript{55} extended and confirmed the Lynch notions on legibility while those by Harrison and Howard\textsuperscript{56} and Steinitz\textsuperscript{57} have further explored the Lynch notions on meaning.

Two studies by Appleyard\textsuperscript{58} also confirmed the Lynch notions. Appleyard claimed that cities are internalized in either a sequentially or a spatially dominant map structure. Lynch's paths and nodes were considered as sequential elements while his landmarks, districts, and edges constituted spatial elements. An examination of the image maps drawn by respondents interviewed in Ciudad Guyana showed the individuals also used the attributes of form, visibility, personal use, and significance in structuring their cognitive maps. Appleyard noted an extremely interesting occurrence in his study. On a number of maps, he found evidence of inferential structuring. In other words, he found some persons included elements which they expected to exist in the city, but which were not actually present in the city, Appleyard concluded these expectations depended upon a person's previous


\textsuperscript{55}de Jonge, "Images of Urban Areas," pp. 266-276.


\textsuperscript{58}Appleyard, "City Designers," pp. 422-452 and "Styles and Methods," pp. 100-117.
experience of cities and his internalized rules concerning the spatial relationships of environmental phenomena.

Carr and Schissler\textsuperscript{59} also commented on an individual's expectations as to what he will see when driving on an urban road. According to them, these expectations are a result of previous similar experiences and the individual's general learned model of the city. The individual is ready to perceive those elements which have a high probability of occurrence in the immediate environment in which he finds himself. Specifically, Carr and Schissler asked how people's representation of a trip through the city is related to their expectations and their patterns of looking and how these are related to the form of the city. Here, the form of the city was simply defined as what actually appeared along the elevated expressway, the test route, in Boston. In the study, subjects were first asked to list what features they expected to see on a trip to the city center via the elevated expressway. The authors also tested vision or the time spent looking on the trip and the memory of the trip. Vision was determined by measuring eye movements in the field for some subjects and in the laboratory for all subjects. Memory was tested by a variety of methods—free recall, verbal, and graphic recall of sequences of events, and detailed descriptions of three scenes which were most vivid in the mind of each subject. The sample involved four groups—drivers, commuters, passengers, and passengers with eye movement equipment attached to their heads.

\textsuperscript{59}Carr and Schissler, "The City as a Trip," pp. 7-35.
In analyzing the various test results, Carr and Schissler offered some important conclusions. Firstly, they stated that all groups in the sample generally remembered the same things from the route. Familiarity with the route did not change what was remembered; instead, it affected the frequency with which things were remembered. Thus, Carr and Schissler concluded perceptual selectivity is related to what actually appears in the environment, an individual's past experiences in similar environments, and his general learned model of the city. In a more recent study, Jones verified the idea that individuals have certain expectations of the environment and become somewhat frustrated and disoriented when these are missing.

The above studies vary greatly in their approaches to the study of urban images. Some focus on the locational relationships while others focus on the content of the urban environment represented in the mental structures of the city. They do, however, share several important findings. Man relates to the environment through factors involving location and meaning. The common characteristics and experiences men share promote common images. The perception of the urban environment is definitely related to the actual environment. Or, more precisely, since most of the studies focus on the specific features included in the urban images, the specific features included in these images are related to those features which appear in the actual environment. This observation stands for both areal and linear (sequential) urban images. While most studies focus on specific urban

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60 Jones, "Urban-Path Choosing Behavior," pp. 11-4-1 to 11-4-10.
elements, none have tried to relate the phenomena in cognitive representations to the generalized models of the arrangement of city elements as suggested in the geographical, sociological, and planning literature. Despite the repeated mentioning of the importance of the actual environment in the development of urban images and the speculation concerning the effects of the various arrangements of urban elements, there has been no empirical test of the role the various objectively defined physical structures of the city play in the development of cognitive structures of cities. The present study is offered in an attempt to provide some empirical knowledge on this topic.
CHAPTER II
THE CONCEPTUALIZATION AND IMPLEMENTATION OF THE STUDY PROBLEM

Problem Statement

The conclusion that perception of the environment is definitely related to the actual urban environment has prompted several designers to make statements promoting particular ideas in urban design. Their intentions are aimed at urban design which is "legible" and promotes emotional security among its residents.\(^1\) While all cities contain similar features, not all cities exhibit the same spatial arrangement of these features. In the course of discussing the mental image of the city, several have wondered about the possible effects of varied urban structure on image development.\(^2\) Empirical studies, however, have largely ignored this topic which is the main focus of the present study. Specifically, the thesis seeks to examine the role the spatial structure of the city plays in the development of mental images of the city as evidenced in a particular type of behavior, i.e., movement to the city center. The problem is approached from two fronts--(1) examining the difference, if any, in the importance attached to the same environmental features as potential way-finding clues in various urban structures and (2) investigating the differences in the

\(^1\) Lynch, *Image of the City*, pp. 2-12; p. 127.

perception of distance in the various urban structures as an indication of the ease of image facilitation. The following conceptualization of the study problem examines the concepts of urban structure, the interaction between the structure and man, and the relationship of these to spatial behavior and spatial images.

**Conceptual Model For Studying the Role of City Structure in Image Development**

In the study of urban cognition, there are four component parts (A) the city or urban environment, (B) the characteristics of the individual, (C) spatial mobility (behavior), and (D) the image of the city. The interaction (AB) between the environment (A) and the characteristics of the individual (B) as evidenced through past spatial mobility (C) produce the image (D) which in turn affects further mobility (C). Figure 2 depicts the overall relationship of these components. Each of the components will be discussed in relation to its role in the present study.

**The Spatial Structure of the City**

All cities contain similar features such as roads, buildings, signs, and so on. The major variations between cities are a result of the spatial arrangement of the features of the city. Several characteristics influence this arrangement: (1) "objective characteristics," (2) "subjective characteristics," and "other characteristics." The

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3"Subjective" characteristics are those characteristics which are open to a highly individualistic and affective interpretation. "Objective characteristics" are those items whose external form are commonly defined in a matter of fact way by the majority of individuals.
FIGURE 2
A CONCEPTUAL MODEL RELATING THE COMPONENTS OF URBAN COGNITION

Objective Characteristics

Subjective Characteristics

Other Characteristics

(A)
URBAN ENVIRONMENT
(DEFINED AS CITY STRUCTURE)

(AB)
INTERACTION OF INDIVIDUAL WITH URBAN ENVIRONMENT

(B)
CHARACTERISTICS OF THE INDIVIDUAL

(C)
BEHAVIOR: SPATIAL MOBILITY BASED ON EXPERIENCE AND EXPECTATION

(D)
IMAGE
CONTENT/MEANING
LOCATION/Spatial RELATIONS

Notes:
*See Figure 3 for details.
*See Figure 4 for details.
"other characteristics" include time and scale. The size of the city affects the number of activities found in the city such that the larger the city, the greater the number of activities in that city. The size of the city also affects the physical layout of the city and hence the arrangement of its activities. Older cities also differ from newer cities especially since the location of activities of the older city may be a result of spontaneous growth whereas zoning boards or planners often control locations in the new cities. Cities that are both large and long-lived may have several cores of similar activity dispersed throughout their area. This can be seen as the response of the form of the city's changing population distribution. City size and history may affect the visual consistency of a city or the level of confusion found in a city. While the effect of scale and time may be considerable, the present study accepts its existence without pursuing a detailed explanation of its influence. Interest instead focuses on the "subjective" and "objective" characteristics pictured in Figure 3.

Of the six characteristics which represent city structure, three are "subjective" characteristics resulting from the mutual existence of the three "objective" characteristics which define the locality as a city and whose spatial arrangement distinguishes the city from other cities. The "subjective" characteristics include (1) visual consistency, (2) distinctiveness of features and areas, and (3) level of cacophony or confusion. The "objective" characteristics which include (1) the arterial network structure, (2) the land use pattern, and (3) distinct neighborhoods or districts are the major factors of
FIGURE 3
THE CHARACTERISTICS OF CITY STRUCTURE

(a) OBJECTIVE CHARACTERISTICS

1. ARTERIAL NETWORK $\rightarrow$ 2. LAND USE STRUCTURE
3. NEIGHBORHOOD STRUCTURE

(b) SUBJECTIVE CHARACTERISTICS

1. VISUAL CONSISTENCY
2. DISTINCTIVENESS OF FEATURES
3. LEVEL OF CACOPHONY OR CONFUSION

(c) OTHER CHARACTERISTICS

1. TIME-CITY AGE
2. SCALE-CITY SIZE

*See text for the explanation of the links between and within the types of characteristics.
FIGURE 4
THE CHARACTERISTICS OF THE INDIVIDUAL: EXAMPLES
OF EACH MAJOR TYPE

PSYCHOLOGICAL
- intelligence
- cognitive processes
- preferences
- placing needs
- exploration needs
- learned model of the city
  etc.

PHYSICAL
- sight
- sound
- smell
- touch
- taste
- ambulation
- body height
  etc.

SOCIAL
- social class
- education
- residency
- urban experience
- ethnic-cultural values
- shops patronized
  etc.

ECONOMIC
- income
- occupation
- ownership of automobile
- ownership of house
  etc.

age - as life cycle stage
sex - as a cultural norm
concern. The arterial network consists of the major and minor traffic arteries which link locations, land uses, and districts. Neighborhoods or districts are small part of the city which are internally consistent and distinct from the surrounding areas. Dominant land uses are generally defined so as to represent the major activity in the area, e.g., commercial, industrial, etc. The three characteristics are inter-dependent. Land use may account for neighborhood distinctiveness or vice versa. The arterial system may set off parts of the city so that they are distinct. Also, the arterial system may be the result of land use activity or the cause of land use activity. The urban transportation literature has not satisfactorily isolated the causal link between the land use and traffic structures. Some researchers claim arterial development spurs land use development while others believe the opposite action holds. The major point of concern to the immediate problem is neither the existence of these features nor the causal link, but the actual spatial arrangement of these features. It is the arrangement that differs among cities and prompts questions concerning the best city design for enhancing the formation of accurate urban images by city dwellers.

From the work of Lynch, it is evident that people do perceive the "objective characteristics" which represent city structure and

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include these characteristics in their images of the city.\textsuperscript{5} The five elements of imageability which Lynch discovered in the common images include (1) "paths," (2) "edges," (3) "districts," (4) "nodes," and (5) "landmarks." These elements are equivalent to some of the "objective characteristics" or related to one or more of the characteristics:

(1) Paths - channels along which the observer moves. They may be streets, transit lines, railroads, etc. (Paths are then roughly equivalent to the arterial network structure.)

(2) Edges - linear elements not used as paths. Examples include shore lines, railroad cuts, or any other feature which forms a boundary. They can also be the lines between two districts of the city. (Edges may occur around district structures and land use structures.)

(3) Districts - medium to large sections of the city, conceived as having a two-dimensional extent. The districts are recognizable as having some common identifying character. (Districts then are like neighborhood structures.)

(4) Nodes - points, strategic spots, intensive foci of activity. Examples - junctions, crossing of paths, break in path, or simply concentrations based on use or other physical character. (The examples in Lynch's definition relate nodes to all three structures in the objective characteristics of the city.)

(5) Landmarks - these are point references which can not be entered within. Examples - building, sign, store, mountain, store fronts. (These are specific rather than generalized land use features, but they are sometimes related to the land use structure; e.g., stores described as "commercial land use activity").

Since it has been established that individuals do include elements which represent city structure in their images of the city, the

\textsuperscript{5} Lynch, \textit{Image of the City}, pp. 46-90.
remaining problem is to isolate the effect that the various forms of
city structure have on image development. To test the effect of form
variety, it is necessary to find several different city forms. Each
city is unique, but enough overlap exists between cities so that
geographers who have studied the physical form and the interrela-
relationships of segments of cities have been able to describe several common
spatial structures. Existing in this literature are three physical
models of urban structure based on the arrangement and transition of
land use: (1) concentric zonal (hereafter referred to as either
concentric or zonal), (2) sector, and (3) multiple nuclei.6

The concentric model postulates a central core surrounded by a
circular arrangement of land use. The commercial uses of the inner-
most zones are separated from the residential uses of the outer zones
by a zone of mixed commercial, industrial, and residential uses. In
the sector model, there is again a central core, but here the indivi-
dual land uses originate at the core and expand outward along the major
arterials in a wedge-like fashion. One land use type generally domi-
nates the entire sector. The third model is variously defined so that
it ranges from a non-predictable spatial form containing several com-
mercial, industrial, and residential nuclei to one consisting of a

mixture of concentric-sectoral patterns. Sometimes, as in this study, the multiple nuclei form is interpreted as a spatial model falling between the extremes of the other two models and is called a mixed model (hereafter, the term mixed model is used for this form) (see Figure 5). These models provide a variety of city forms based on the spatial arrangement of land use. Naturally, reality causes distortions in such abstractions, however, it is possible to find cities whose internal structure approximates the abstract formulations.

A general perusal of the land use plans of several cities located near Columbus, Ohio, isolated three cities that appeared to approximate the abstract models of city form. The cities selected included Newark, Marion, and Columbus, Ohio. Newark and Marion are small to middle sized cities roughly equivalent in population while Columbus is substantially larger. With respect to the land use patterns, Newark portrays a sectoral form; Marion, a zonal form; and Columbus a mixed form.®

7 The spatial model is one of several categories of city models. The concentric and spatial models are spatial models, while the multiple nuclei model is either a spatial model when thought to be a mixture of the concentric and sectoral models or a natural model when described as a non-predictable form. See Ralph Thomlinson, Urban Structure: The Social and Spatial Character of Cities (New York: Random House, 1969).

8 1970 population estimates: Newark - 41,258; Marion - 37,630; and Columbus - 533,418.

FIGURE 5
INTERNAL STRUCTURE OF THE CITY: CLASSIC MODELS AND VARIATIONS

(a) Concentric Zona Theory
(b) Sector Theory
(c) Multiple Nuclei

(d) Socio-economic Pattern of City
(e) Urban Land Use Pattern by Isard

Key:
1. Central Business District
2. Wholesale Light Manufacturing
3. Low-class Residential
4. Medium-class Residential
5. High-class Residential
6. Heavy Manufacturing
7. Outlying Business District
8. Residential Suburb
9. Industrial Suburb
10. Commuter's Zone
11. Recreational Space, Parks

Source for the classic models (a, b, c): Harris and Ullman, "The Nature of Cities," pp. 7-17.

Berry states overlaying the zonal and axial pattern causes uniformity in cells. Bands are uniform around the city; sectors are uniform to the edge. Although the cells are based on socio-economic data, they are not independent of relationships with land use. Berry, "Internal Structure of the City," pp.111-117.

Isard, Location and Space Economy, p. 279.

Isard uses density as opposed to class for defining residential land use.
As a further test of the differences in city structure, a land use index, "M," based on the ratio of computed $X^2$ values was defined. The ratio is defined as:

$$M = \frac{X^2 \text{ for sectors}}{X^2 \text{ for zones}}$$

The $X^2$ was used to test between the land use proportions actually in each zone and sector and the proportions expected if the land use proportions in each zone and sector corresponded to those for the city as a whole. For this test, each city was first divided into eight zones with the first zone encompassing the central business district and the remaining seven zones radiating out to the edge of the plan in equal gaps. Then each city was divided into eight sectors oriented so as to straddle the major transportation arteries (see Appendix A for map divisions). A $X^2$ statistic which is higher for zones than for sectors indicates a tendency for land uses to be distinguished by sectors. The land use index, "M," represents the degree of zonality in the city structure. Values of "M" are defined as:

$$M = 1: \text{equal distribution of zonal and sectoral pattern}$$
$$M < 1: \text{greater variation in land use patterns by zones}$$
$$M > 1: \text{greater variation in land use patterns by sectors}.$$

<table>
<thead>
<tr>
<th>City</th>
<th>$X^2$ for Sectors$^a$</th>
<th>$X^2$ for Zones</th>
<th>$\frac{X^2 \text{ for Sectors}}{X^2 \text{ for Zones}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newark</td>
<td>1727.63</td>
<td>794.05</td>
<td>2.176</td>
</tr>
<tr>
<td>Marion</td>
<td>1529.39</td>
<td>1741.93</td>
<td>.878</td>
</tr>
<tr>
<td>Columbus</td>
<td>1978.13</td>
<td>1327.90</td>
<td>1.489</td>
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</tbody>
</table>

$^a$df. 35, all values p > .05 significance.
The values of the land use index were placed along a continuum which permitted visual inspection of the degree of zonality for each city. The city of Marion was slightly more zonal than the other two cities in form. Newark had a sectoral form. Columbus was slightly more sectoral than mixed in form. Its degree of zonality, however, fell approximately mid-way between that of the other two cities. Thus, Columbus appeared to have a mixed structure relative to those of the cities of Marion and Newark. Although the city of Marion did not have a structure that was exactly opposite that of Newark, the two cities did appear on opposite sides of the indifference point (M = 1). Although all the cities had structures which either approached the indifference point or had sectoral tendencies, it was decided that the three cities had enough differences in their structures to merit investigation of the effect of their structural differences on urban images. It was also decided to retain the terms "concentric," "sectoral," and "mixed" as descriptors of the cities' structural forms.

FIGURE 6
LAND USE CONTINUUM BASED ON RATIO: $X^2$ FOR SECTORS/$X^2$ FOR ZONES
The Characteristics of the Individual

The characteristics of the individual influence what he sees or interprets in the environment and what eventually becomes part of his image of the city. Figure 2 shows four types of characteristics belonging to an individual. Although all the characteristics influence an individual's actions, some of them are more meaningful than others in the development of city images. Of the physical characteristics vision and physical mobility seem most important. Arnheim discusses the part vision plays in thinking.\textsuperscript{10} A child's first interaction with the environment is enactive; the child sees the environment and its separation of objects through his actions.\textsuperscript{11} The enactive approach is believed to last throughout the individual's life although it is later joined by iconic and symbolic operations.\textsuperscript{12} All the psychological characteristics are extremely influential. George defines the cognitive processes to include perception, memory, conception, judgment, reasoning, learning, etc.\textsuperscript{13} In other words, these are the characteristics which permit the individual's intelligent commerce with the environment. Tolman cites the individual's need for


\textsuperscript{12}Appleyard, "Notes," p. 100.

\textsuperscript{13}George, \textit{Cognition}, p. 11.
exploration and placement. These characteristics help explain the individual's need for a system of spatial relations between objects in the environment, and therefore, the existence of such relations in his image.

The social characteristics of the individual also affect his image of the city. Lee found the characteristics which depict social involvement (1) number of friends and relatives in area, (2) number of local shops patronized, and (3) number of local club memberships) were important in images of the neighborhood. Other characteristics which were important in Lee's study included (1) length of residence, (2) social class, (3) age, and (4) location of husband's workplace. Problems of intercorrelation between the social characteristics sometimes hide the effects of a particular characteristic. However, Lee's work and that of others tends to favor the importance of the characteristics which imply participation in the environment, e.g., length of residence, shopping locations, etc.

The income of the individual may affect his image of the city. It is hard to determine the effect of income apart from that of the complementary social characteristics on image. However, is is possible to envision the existence of a "pot-of-gold" district on the mental

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map of a low income individual and that of "poverty alley" on the spatial image of a wealthier individual. In such cases, it is possible that little else will be known about the area represented in the image.  

The characteristics of the individual are, therefore, many in number. Each individual is unique and therefore, his mix of characteristics is also unique. However, it is possible to find groups of individuals who possess a common subset of characteristics. The members of such groups tend to have remarkably similar images of the city. By selecting a sample from a group of individuals who possess a common subset of characteristics, the researcher can (1) obtain common urban images, (2) maximize the effect of the environmental differences in urban image development, (3) minimize the number of different individual characteristics and their effect on the urban image, and (4) investigate the interaction between the form of the environment and a few of the individual characteristics which appear to be most meaningful in urban image development.

A group of college students provides an example of a uniform sample with respect to many of the individual characteristics such as age, social class, income, education, intelligence, etc. This sample also accommodates variation of the individual characteristics which convey participation in the environment. Four such characteristics

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17Income is often subsumed under social class or occupation. Thus its effect may be hidden. It is possible to view income as a barrier which may limit a person from experiencing parts of the city.
are of particular interest in the present study (1) length of residence in a large urban place, (2) urban experience, (3) downtown shopping propensity, and (4) navigational experience. These characteristics are thought to have the greatest effect on spatial images of the city.

Spatial Behavior and Spatial Images

Spatial mobility and spatial images are not independent of each other. The causal direction of the link is debatable. The image depends upon mobility; mobility (a specific behavior) depends upon the image. One of the general conclusions from the work of Piaget and his followers is that an adult's representation of space results from his movement in the physical environment rather than from his perceptual "copying" of the environment. According to Prokopf, purposeful mobility in a city is a result of one's image of the city. Carr and Schissler combine the effects of both in describing an individual's

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18 The characteristic was operationalized by a three way classification (a) 0 years, (b) 0-3 years, and (c) more than 3 years. The place was defined as Columbus.

19 Defined as the place where the individual spent most of his life up to age 18: (a) rural, (b) small city, or (c) urban/suburban environment.

20 Based on the location where the individual does most of his shopping: (a) downtown or (b) shopping center.

21 Indicated by the agreement or disagreement expressed to the statement, "I find traveling in an urban area confusing."

22 Hart and Moore, The Development of Spatial Cognition, pp. 7-23.

motor excursion into the city. They claim the individual's actions are based upon his image of the city and his previous experiences in similar environments. The causality is not of major importance in this study. Instead, the writer accepts the idea that the internal representation of the city can be inferred from external behavior in urban settings and focuses on the urban image.

Much of the work involving images of the city suggests urban images consisting of two parts (1) location/spatial relations and (2) content/meaning. Each urban image contains a variety of objects whose meaning may be defined with respect to the objects' function, history, general significance, etc. Each object has a location in the city and enters into spatial relations occurring between it and the other contents of the image. The locational attribute or spatial relations of objects may exist in a person's urban image even if he has no visual image of the object.

Each of the parts of the image can be operationalized in such a manner to permit investigation of how the various forms of cities affect the factors. It is possible to view the contents of a city as possible clues in a way-finding task. A respondent is asked to consider whether or not a particular object along a route is important.

24 Carr and Schissler, "The City As A Trip," p. 33.
26 Harrison and Howard, "The Role of Meaning," p. 408.
27 Appleyard, "Notes," p. 98.
enough to be described to a stranger seeking to follow the same route to a given point in space. The question can be repeated in a variety of urban forms and the answers compared. Additionally, the respondent can be asked to locate a set of features with respect to a particular point in the city. He may indicate his reasons for giving a particular distance response. Again, the procedure can be repeated in several urban forms and the results compared.

Each of the components pictures in Figure 2 enters into the present study. Three varied urban forms are selected to represent city structure. The study sample permits the possibility of holding many individual factors constant and examining only a few which are thought to be of greater consequence. The urban image is operationalized in a fashion which elicits information arising from spatial mobility experiences. The next section describes the hypotheses of the study.

**Hypotheses**

The hypothesized relationships shown in Figure 7 concern the effect of both city structure and personal characteristics on image development. The two variables—cue importance and accuracy of identification/image—of the study represent the two parts of the image. The mean cue importance assigned by individuals to environmental features (cues) as potential way-finding clues is defined as the "meaning" of the environment. The spatial relations aspect is represented by the mean accuracy of the individuals' perceptions of the city as exhibited in both the slide and field trip experiments. Slides were used to obtain the accuracy of each individuals' perception of a given scene relative to its (a) distance zone from the city
A CONCEPTUAL MODEL RELATING URBAN IMAGE VARIABLES, CITY STRUCTURES AND PERSONAL CHARACTERISTICS

FACTOR

CITY STRUCTURE:
I - SECTOR
II - ZONAL
III - MIXED

HYPOTHESES SET A

IMAGE (A)
CUE IMPORTANCE

HYPOTHESES SET B

PERSONAL CHARACTERISTICS:
1. Length of Residence
2. Urban Experience
3. Downtown Shopping Propensity
4. Navigational Experience

HYPOTHESES SET C

IMAGE (B)
ACCURACY OF IDENTIFICATION/IMAGE

HYPOTHESES SET D

VARIABLE

KEY:

Causal Link Discussed

Causal Link Not Discussed
center, (b) land use classification, and (c) linear distance from the city center. The field trip experiment was used to obtain information concerning the accuracy of each participant's (a) prior anticipation and (b) later recall of the cues which occurred along the field trip route.

The variables are examined by means of two sets of hypotheses. For each variable, the first set of hypotheses (Sets A and C) concerns the differences in the means of the measures for different spatial structures. The observations are grouped by the factor, city structure, and the hypothesis that the means are equal is tested.\(^{28}\) The second set of hypotheses (Sets B and D) involve grouping the measures by personal characteristic factors and testing their effect on image development. Although it is possible to test the effect of the interaction between city structure and the personal characteristics, no hypotheses concerning their joint effect are made at this time.\(^{29}\) A discussion of each of the proposed hypotheses follows.

Hypotheses Concerning the Importance of Cues as Potential Way-Finding Clues

Set A

1. City structure significantly explains the variations in the mean importance assigned to the environmental features as potential way-finding clues by a sample of respondents.

\(^{28}\)Analysis of variance is used to test the hypotheses: \( H_0: \mu_1 = \mu_2 = \mu_3; H_1: \mu_1 \neq \mu_2 \neq \mu_3. \)

\(^{29}\)This possibility is allowed in a two way analysis of variance design. The usual assumption is one of no interaction.
2. The features of "land use" will have the highest means in the zonal structure; "traffic" features will be most important in the sector model.

3. City structure has a greater discriminatory power than any of the personal characteristics examined.

The basis for Hypothesis A1 is found in the reported relationship between the actual and imaged environment. If the relationship is accepted, then it can be said that city structure plays a significant role in the exposure and grouping of features both in the actual environment and in the individual's mind. Since city structure summarizes the operationalization of urban space and features, it can be used as a succinct representation of the urban environment for use in studying images of different city forms.

The basis for Hypothesis A2 is found in the design of the city structure models. In the concentric structure, each zone consists predominantly of one land use type. Therefore, as an individual moves from the periphery to the city center, he will experience several land use changes along the route. Given that the land uses on the route reflect the zonality of the city as a whole, it is plausible to expect these changes to be dominant. The arterial network forms the basis for the sectoral structure. Each sector starts at the core and expands outward. The sector consists theoretically of one type of land use bounded between streets or traffic arteries which separate it from adjoining sectors. Since land use is fairly uniform within the sector and presumably along the arterials, the individual experiences no

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30 Carr and Schissler, "The City As a Trip," pp. 7-35.
profound land use changes on his trip to the city center. Therefore, one would expect the traffic features to be more salient.

Hypothesis A3 has its origins in the conclusions offered by Carr and Schissler concerning the importance the actual environment has in image formation. They state the actual environment largely determines what is seen and remembered.31 Aided by the findings of others, this relationship dominates any relationship reported concerning the influence personal characteristics have in the image process.32 Following this, it is felt that city structure will account for more of the variation in the mean importance measures than will any of the individual characteristics.

Set B

1. Of the personal characteristics considered, the length of residence in a large urban place will be most meaningful in discriminating between cue importance over all features.

2. Individuals who reported experiencing confusion while driving in an urban area will exhibit higher mean importance scores for "traffic" features than will individuals who reported no confusion.

Of the many possible individual characteristics a researcher can select, the length of residence is most often chosen for studies of urban images. Appleyard and Steinitz cite the factor as meaningful with respect to an individual's knowledge of the existence of features and

31 Ibid., p. 32.

activities in the city. Golledge, Briggs, and Demko report its influence in the perception of urban distances. From the studies, it appears the length of residence is a surrogate for use of the city. Actual activity information such as number of visits to shopping centers, parks, downtown, museums, and so on may give a better insight into the individual's knowledge and use of the city. Lacking such detailed information, it appears an approximate picture can be gained by substituting the length of residence. Based on the results of other studies, it is felt that the length of residence in a large urban place will perform better than the other personal factors in distinguishing differences in mean importance (Hypothesis B1).

The basis for hypothesis B2 is found in the implication that individuals who experience difficulty in driving in urban areas will conscientiously seek out the traffic features in the environment; these features include traffic lights, street direction signs, street signs, etc. Since more time will be spent in actively seeking these features in the environment, it is felt that the traffic features will be rated more important by these individuals than those who experience little or no difficulty.


35Although not everyone lived in Columbus, Ohio, it was the only city everyone in the sample knew. The people who did not live in Columbus lived within 40 minutes or less of the city and commuted into Columbus to attend classes and to shop.
Hypothese Concerning the Accuracy of Perception

Set C

1. City structure significantly explains the variations in mean accuracy for the perceptions of the city obtained from both the slide presentations and the field trips.

2. The concentric or zonal structure facilitates mental image formation (that is, the zonal structure discriminates best between perceived accuracy of location and therefore, should have higher accuracy values than the other two cities).

3. City structure has a greater discriminatory power than any of the personal characteristics examined.

The thinking underlying Hypothesis C1 is similar to that for Hypothesis A1. City Structure summarizes the organization of urban space and features. Thus, it also summarizes the spatial relations of features within the urban environment. The responses for the slide experiment depend on knowledge of the entire urban area whereas those for the field trip experiment depend on knowledge of routes. The hypothesis is equally applicable to the responses from both experiments. For the slide experiment responses, it is felt that city structure will significantly explain the variation in mean accuracy of the individual's perceptions of a given scene relative to (a) its distance zone from the city center; (b) its land use classification; and (c) its linear distance from the city center. The scenes represent all areas of the city and many are located off the main route of travel. It is also believed city structure will explain the variations in mean accuracy of the individuals' responses on the field trip experiment. In this instance, the variations involve the differences in the individuals' prior anticipation and later recall of cues occurring along a
route relative to the total number of cues they reported noticing while being driven on the route. The latter measures are similar to those used by Carr and Schissler.

Individuals seek to simplify, structure, and stabilize the dynamic complexity of the urban environment. The circle provides a simple skeleton on which to represent features which occur in an area of space. Existing evidence reveals people tend to distribute various urban phenomena concentrically about a central core. The writer's feeling is that the concentric city is best understood by a majority of people when thinking abstractly about cities and urban phenomena. In this study, all the respondents were more familiar with City III (Columbus), the mixed structure, than with City II (Marion), the zonal structure. Therefore, if the accuracy measures are higher for City II, hypothesis acceptance is straightforward. If the measures vary, it might be wise to investigate the joint effects of residency or urban experience and city structure.

Hypothesis C3 follows from the thinking underlying Hypothesis A3. Again, the dominant role the environment plays in perception has been reported in the literature. Thus, it is plausible to expect the factor, city structure to account for more of the variation in the

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37 Arnheim discusses the simplicity of the circle in visual thinking, pp. 275-283.

38 Kevin R. Cox, "Spatial Schemata: A Conceptualization and Application to Intra-Urban Space," (paper presented at AAG Meetings, Boston, Massachusetts, April, 1971).
mean importance measures than will any of the individual characteristics.

Set D

1. Of the personal characteristics considered, the length of residence in a large urban place will be most meaningful in discriminating between the mean accuracy of the responses obtained from the slide presentations and field trips.

2. The individuals with the greatest urban experience will have the most accurate perceptions, i.e., the most accurate means.

3. Individuals who reported experiencing confusion when driving in an urban area are less able to form accurate mental images or to retain such images than individuals who reported no confusion.

4. Individuals who patronize shops in the city center have more accurate distance perceptions with respect to the city center than individuals who patronize shopping centers.

Golledge, Briggs, and Demko mention the influence of the length of residence on distance perception. They claim a definite difference exists in the estimates provided by individuals with less than one year and those with three years of residence. Given its wide acceptance in the literature, it is felt that the length of residence will perform better than any of the other personal characteristics in distinguishing between the responses for the slide and field trip experiment. It is assumed that the findings concerning the effect of different periods of residency on the perception of distance will confirm those of Golledge, Briggs, and Demko. The perceptions from the field trip experiment consist of measures involving anticipation and memory.

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of features on the route. If it is permissible to make an analogy between length of residence and commuting, the length of residence will influence the number of features anticipated and recalled. Carr and Schissler found commuters used greater detail in describing a route and also remembered more features than others.\textsuperscript{40} One expects similar findings with greater familiarity as represented in a longer period of residence.

The second hypothesis in this set follows from Appleyard's statement "The wider our urban experience and the more conventional the structure of the city, the quicker and more accurate will be our acquisition of knowledge."\textsuperscript{41} The characteristic urban experience is less specific than the length of residence since it doesn't involve temporal existence within a particular city, but rather temporal existence within a type of environment. The three types of environmental experiences considered in this study are (1) rural, (2) small city, and (3) urban/suburban place (metropolitan area) exposure. To repeat, the major difficulty with this characteristic is the urban knowledge inculcated by the media.

It is further hypothesized that individuals who reported experiencing confusion when driving in an urban area will have difficulty in estimating distances accurately (Hypothesis D3). Congested and/or confused areas in the city will cause these people difficulty

\textsuperscript{40} Carr and Schissler, "The City As A Trip," p. 25.

\textsuperscript{41} Appleyard, "Notes," p. 98.
such that they will tend to overestimate distances more than will people who reported experiencing no confusion. The tendency for all individuals to overestimate distances toward the center of the city is explained as the result of increased congestion in this direction by Colledge, et al. The writer feels this tendency will be exaggerated by those who reported experiencing confusion. It is also expected that the differences in the two groups of individuals will be greater for the linear estimates of distance than for the identification of the distance zone in which the scene is located. In the case of the field trip experiment, it is felt that those individuals who experience confusion will anticipate and remember fewer features than will other individuals.

It is also hypothesized that individuals who patronize shops in the city center have more accurate distance perceptions with respect to the city center than do individuals who patronize shopping centers. In several studies, it has been shown that distances toward the city center are overperceived to a greater degree than distances away from the city center. It has been suggested that differences in the travel and shopping behavior of individuals affect the individuals' familiarity with parts of the city. These differences in familiarity are thought to account for differences in the estimates of distance. Thus, it is conceivable that individuals who shop 'downtown' are more

\[\text{42} \text{Colledge, et al., "The Configuration of Distance," p. 64.}\]
\[\text{43} \text{Lee, "Perceived Distance," p. 40-51.}\]
familiar with the city center and the distance between it and other parts of the city.

The hypotheses to be tested concern the influence of the factors city structure and four selected personal characteristics on two perceptual variables. The variables include (1) the perceived mean importance assigned to environmental cues with respect to their potential as way-finding clues and (2) perceived mean accuracy exhibited with respect to spatial (field) and strip (linear) knowledge of the city. The operationalization of the hypotheses is explained in the design and procedure section of this chapter.

Method

Subjects

Participants consisted of a sample of one hundred and ten Ohio State University students who responded to a classified advertisement placed in the Lantern, the daily student newspaper on the Columbus campus. The sample selection was based on the availability of five hours minimum participation time. Each subject was paid $1.25 per hour. Thirty-three subjects from this sample completed an optional field trip experiment.

Experimental Design

Typically, the laboratory of the geographer has been the "all

44 Ten additional subjects were selected to participate, but were dropped from and analysis when they failed to complete the work requested of them.

45 A National Science Foundation Doctoral Dissertation Grant made payment of subjects possible.
out-of-doors" with its great myriad of environmental stimuli and relationships, while that of the psychologist has been the testing room with its somewhat sterile nature in terms of the operating environmental stimuli and relationships. The study problem, investigation of the role of the spatial structure of the city in the development of the mental image of the city, demand attention from both "laboratory" approaches. The complexity of the real world makes it difficult to ascertain "the precise nature of the environmental display which in fact has been presented to the observers, as well as the degree of equivalence which exists among observers." Yet, it is desirous to be able to make conclusions which are applicable to the real world especially in a study which questions the effect of the real city on the image in hopes of providing information helpful to future designers of cities. Given these conditions, it becomes apparent that it is necessary to devise a method of

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FIGURE 8
A MODEL OF ENVIRONMENTAL PRESENTATION

General Model | Definition | Example in Study
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Real World | Reality of Urban Environment (City) | Field Trip (City)
Decreasing Information, Increasing Abstraction

Iconic Model | Represents Properties At Different Scale | Slides Decreasing Information, Increasing Abstraction

Analogue Model | Represents One Property By Another | Map Scale Model

Symbolic Model | Represents Properties By Symbols | Mathematical Expression

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*a This figure is based on discussions by Ackoff, Scientific Method cited in Haggatt, p. 20, and Craik, The Comprehension of the Everyday Environment, pp. 27-37.

*b If all properties were represented at a minimum scale, a table model would be an iconic model. The scale model in the study is a combination of the iconic and analogue models.

*c There is no example of this type used in the present study.
presenting the urban environment which permits (1) reducing the complexity of reality, (2) uniformity in what is seen by observers, and (3) making conclusions which apply to the real world. A model for such a method appears in Figure 8.

The first column in the figure shows the types of models which are used in coping with real world complexity. Iconic models represent properties of the real world at a different scale; analogue models represent one property by another; symbolic models represent properties with symbols. Each model, moving from the iconic to the symbolic, represents an increase in the level of abstraction as well as a decrease in the amount of information conveyed. The third column shows one method of operationalizing the presentation of the real urban world to observers while attempting some control over the mix of environmental stimuli which interact with the observers at each stage. Prior to discussing the design of each of the four displays it is necessary to discuss the method used in selecting the environmental features to be included in the displays.

**Selection of Cues for Use on the Environmental Displays**

A preliminary study was conducted to determine what environmental features were noticed by city dwellers. Responses to the question "What types of features do you notice on your way to school or work?" were solicited from twenty respondents located in the city.

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of Columbus. Approximately seventy recognizable characteristics were mentioned by the respondents. These responses were used to construct a scale of environmental cues. The scale of environmental cues, which included sixty features (e.g., stores, buildings, signs, etc.), was developed by conducting a content analysis of the free flowing responses of the respondents and then including all items that were mentioned by three or more people and (2) adding a number of features mentioned in previous studies of roadside and city images51 (see Figure 9). Responses to the scale question "How often do you notice the following features as you travel to the city center?" were solicited from a second group of respondents consisting of forty-one college students. This group was similar in make-up to that used in the actual study. The response mean was calculated for each feature. All the cues which had a mean equal to or greater than 3.00 (thus, the feature was noticed at least occasionally) were included in at least one of the four displays. A number of additional features were incorporated into the design of the four environmental displays. These features included generalized land use, a number of landmarks specific to each city, and a wider range of specific kinds of buildings (e.g., hospital, hotel). A discussion of the design of the four displays beginning with that of the map display follows.

FIGURE 9
ENVIRONMENTAL CUE SCALE

How often do you notice the following features as you travel to the City Center? Please circle the appropriate number.


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1. Shopping centers
2. Railroad tracks
3. Direction signs
4. School buildings
5. Banks
6. Churches
7. Motion theaters
8. Restaurants
9. Open space areas such as parks or green space
10. Speed limit signs
11. The city skyline
12. Traffic congestion
13. Traffic lights
14. Street width changes
15. Billboards
16. Bridges
17. Neon lights in business areas
18. Rivers
19. Hills
20. Freeway system
21. Number and spacing of freeway exits
22. Industrial buildings (factories)
23. Public buildings
24. Residential quality changes
25. Residential density changes (spacing of houses)
26. Smog
27. Buildings become more numerous and closer together
28. Major department stores
29. Slums
30. Construction work

*This figure includes the features which solicited the most responses.

This feature had a mean of 2.83; all other features had means above 3.0.
1. Maps

The maps were fashioned according to the generalized structure of the three cities discussed earlier in the chapter and simply labelled City I, City II, and City III. Each map was printed in black and white zip-a-tone patterns on a sheet of paper 11 x 17 inches in size. The environmental features shown included six land uses (1) low density residential, (2) high density residential, (3) commercial, (4) industrial, (5) open space, and (6) institutional), traffic lights, railroads, streams, and streets. The varying physical sizes of the cities resulted in two different scales (1) Cities I and II, 11/16 inches represented 1500 feet; (2) City III, 11/16 inches represented 3000 feet). Each map had a key and a direction symbol as well.

2. Models

The models were built of styrofoam on a 4 x 4 feet plywood base. Both color and vertical exaggeration were used to differentiate the seven land use classifications (see Table 2). The vertical exaggeration was selected to represent the average height of the respective land use features in the actual city. Other environmental features included on the models were traffic lights represented by yellow map tacks, street direction signs painted in white on the black streets, railroad crossings, freeways, and a number of specific features printed in black on white thumb tacks. The thumb tacks were stuck into the colored styrofoam or base at the appropriate points. A total of thirty-four different types of features such as churches, banks, and so on appeared on each model. In addition, each
model included a number of features that were unique to the particular city, e.g., the capitol building in City III (for a complete listing see the check list for models included in Appendix F).

Like the maps, the models were labelled City I, City II, and City III. Each model had a key, direction symbol, and a scale (1) City I, 1000 ft. equals 1.6 in.; (2) City II, 1000 ft. equals 1.5 in.; and (3) City III, 1000 ft. equals 1 in.). Each model was placed on a separate standing table of the same size as the model. A removable frame of plywood and clear mylar which stood two inches above the base covered each model. This apparatus allowed each participant to trace routes directly above the base.

<table>
<thead>
<tr>
<th>Land Use Classification</th>
<th>Color</th>
<th>Height Above Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low density residential</td>
<td>Yellow</td>
<td>Level with base</td>
</tr>
<tr>
<td>High density residential</td>
<td>Yellow</td>
<td>1/2 in.</td>
</tr>
<tr>
<td>Downtown commercial</td>
<td>Red</td>
<td>1 1/2 in.</td>
</tr>
<tr>
<td>Arterial commercial</td>
<td>Red</td>
<td>1/2 in.</td>
</tr>
<tr>
<td>Industrial</td>
<td>Black</td>
<td>1/2 in.</td>
</tr>
<tr>
<td>Institutional</td>
<td>Blue</td>
<td>1 in.</td>
</tr>
<tr>
<td>Open space</td>
<td>Green</td>
<td>Level</td>
</tr>
</tbody>
</table>

3. Slides

The slide display consisted of thirty-nine slides--twelve each for City I and II and fifteen for City III (for a list of the slides and examples, see Appendix C). The slides were taken throughout the city, both in the core areas, along the major arteries, and in
industrial areas. Thus, they are representative of the entire city space in each city. The slides represent the city at a reduced scale; as such, they include all the features of the previous displays as well as features depicting spatial density and quality of street and ground conditions. The projected size of the slide was 2 x 2 feet. Time in view was one minute per slide.

4. Field Trip

The final display is the actual city. Actually the extent of the field condition was limited to two main arteries and the core of the city or the central business district.\textsuperscript{52} In each city the field condition included heavily traveled streets and quiet residential streets. Many different features were included in the visual area of the participants.\textsuperscript{53}

Experimental Procedure

The goal of the experimental procedure was to provide information on (1) the importance assigned to the environmental features as potential way-finding clues and (2) the accuracy of the perceptions of spatial and linear knowledge of the city. To this end, each subject was asked to perform several tasks. By way of illustrating the procedure, one subject's progress thought the tasks

\textsuperscript{52}Originally, it was felt that the participant should have a choice of route. Difficulties in time of trip, length of trip, current drivers licenses, and insurance responsibility resulted in a pre-planned route which was the same for each participant. The writer did the driving.

\textsuperscript{53}A hypothesis testing the effects of the display appears in Appendix D.
will be described below. A copy of the materials the subject used appears in the appendix.

Subject #1 entered a small seminar room. The writer told him that the experiments in which he was going to participate were designed to study what people remembered about a city from driving along the many possible routes going from the periphery into the central business district and would consider important enough to use when relating the trip to a stranger who might wish to follow their selected route into 'town.' After this introduction, the subject filled out a questionnaire requesting such personal characteristics as age, sex, residential history, shopping information, etc. He was then presented with maps of City I, II, and III accompanied by checklists. He was told to select a route to the downtown starting from a point on the periphery of the city. After selecting the route and tracing it with a pencil, the subject was asked to check his route against the list of nine environmental features. If a particular feature appeared on the route, he was to give it a rating on a five point scale with five verbal anchors (1) not important, (2) not very important, (3) indifferent, (4) important, (5) very important) indicating how important that feature would be if he were trying to relate the route to a stranger who desired to

\[\text{54 The writer was assisted by two research assistants in the collection of the data.}\]

\[\text{55 The distance between the anchor terms was assumed to be equal.}\]
trace his journey to the central business district or into "town" (in other words, the subject was to rate each feature in terms of its potential as a way-finding clue). If the features did not appear on the route selected, the subject left it blank. Subject #1 repeated this procedure for the remaining two cities. There was no set order for marking the maps, i.e., the subject could choose to do any map first, etc.

On the following day, Subject #1 entered a cartography laboratory where the models were displayed. He received instructions similar to those outlined above and proceeded to repeat the route selection and rating tasks. This time, however, he drew the route on the mylar frame with a water-base marking pen. The check list contained thirty-four features common to each city and a varied number of unique features specific to a particular city. Subject #1 again performed the task three times, once for each city.

Photographic slides were made of the subject's route selections before removal of the route from the mylar frame.

On the third day, the subject returned to the seminar room. He was presented with a packet of materials containing (1) a slide information sheet (listing (a) seven land uses, (b) distance zones, and (c) a scale with ½ in. representing 1 mile); (2) an instruction sheet, and (3) a booklet for his responses for each slide. The subject viewed each slide, assigned it a land use classification, and a distance zone location, and drew a line representing the linear
distance the slide was from the city center. If the slide occurred within the city center or the subject questioned his ability to draw a representative line, he included a numeric mileage figure (e.g., 0 miles, 2 miles, 1.1 mile, etc.). After finishing these tasks, the subject was instructed to rate the features which appeared in the slide by the appropriate space in the booklet with respect to its importance in his identification decision. The subject again used the five point scale with the five verbal anchors used in the map and model tasks. In all the subject saw and rated thirty-nine slides for the three cities (for listing see Appendix C).

On the fourth and final day, Subject #1 took a field excursion into a city as a passenger. Before the trip started, the subject was informed of the route and asked to list the features in the order in which he expected to see them along a given route. On the trip, the subject was instructed to list the features he noticed

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56 Although the rating was given in terms of the cue's importance in the location decision, the rating may be taken as a potential way-finding clue rating. In this instance, the subject is actually seeking the location of a given slide and the items which he uses in identifying the land use and location are probably the ones he would use in describing the place to a stranger wishing to locate the scene.

57 Recall the slide breakdown: 12 each for City I and II; 15 for City III.

58 Only 33 subjects participated in the field test. Each of the participants took only one field trip in either City I, II, or III. The breakdown by City is: City I-7, City II-7, City III-19.
and to rate them on the five point scale he previously used. The writer drove the route at a speed of 15-30 miles per hour. At the completion of the trip, the subject listed the items he noticed from memory. 59

**Derivation of Variable Measures**

The variables in the study, cue importance and accuracy of perception, represent percentages. These values were derived from the raw data provided by the subjects. The derivation procedures will now be explained.

**Cue Importance**

Recall that on the maps and models displays, each respondent was asked to rate the features which appeared on the route he selected on a five point scale with five verbal anchors (1) not important, (2) not very important, (3) indifferent, (4) important, (5) very important) indicating how important the features would be if he was trying to relate the route to a stranger who desired to trace his journey into 'town.' The anchors were assumed to be an equal distance apart. For the analysis, the importance ratings for the features were transformed into an interval scale where the rating was defined as a proportion of the total importance possible. The transformation can be explained by the following formultion.

---

59 In order to check for effects related to the order in which the displays were presented to the subjects, the sample was divided into four groups. Each group worked with a different ordering of the displays such that each display was first for one of the groups. A test of the order effect appears in Appendix g.
(for maps)

Let \( R \) = rating given to cue

\[
\begin{align*}
\text{n} & = \text{number of times a particular feature appearing on the route can be rated; for maps n=1.} \\
\text{s} & = \text{highest rating that can be given to a single feature (very important=5)}
\end{align*}
\]

If \( R = 4 \) for cue 'traffic lights,' n=1

then \[
\frac{R}{n \times 5} \times 100 = \frac{4}{1 \times 5} = 80\% \tag{1}
\]

If a cue did not appear on the route selected by the respondent, it was assigned a -0 value and dropped from the analysis. 60

The procedure for the model display was similar in form. The checklists for the models display had thirty-four common environmental features and a varied number of features unique to each of the cities to be rated. For analytical purposes, the features were grouped into a total of ten cue types--nine types for the thirty-four common features and one type for the unique features. The composition of the types is shown in Table 3. The importance proportions were derived for the composite cue types appearing on the selected route according to the following procedure.

(for scale models)

Let \( R \) = rating given to cue

\[
\begin{align*}
\text{n} & = \text{number of times a particular feature appearing on route can be rated; n = 1 for every feature included in cue type that appears on route.}
\end{align*}
\]

---

60. The program used to analyze the data MANOVA reads "-0" values as missing data. This observation is then dropped for the cue being considered.
<table>
<thead>
<tr>
<th>Cue Type</th>
<th>Number of Features Included</th>
<th>Description of Features Included in Each Cue Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>3</td>
<td>Elementary, High School, State School</td>
</tr>
<tr>
<td>Traffic</td>
<td>4</td>
<td>Traffic lights, street direction signs, railroad crossings, freeway evidence</td>
</tr>
<tr>
<td>Land use</td>
<td>7</td>
<td>Low density residential, high density residential, downtown commercial, arterial commercial, industrial, institutional, open space</td>
</tr>
<tr>
<td>Church</td>
<td>1</td>
<td>Church</td>
</tr>
<tr>
<td>Bank</td>
<td>1</td>
<td>Bank</td>
</tr>
<tr>
<td>Stream</td>
<td>1</td>
<td>Stream</td>
</tr>
<tr>
<td>Park/Cemetery</td>
<td>2</td>
<td>Park, cemetery</td>
</tr>
<tr>
<td>Distinctive</td>
<td>13</td>
<td>Theater, department store, insurance building, hotel/motel, high rises/dorms, library, car dealer building and lot, post office, utility, medical building, Ohio State University Buildings</td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shopping</td>
<td>1</td>
<td>Shopping center</td>
</tr>
<tr>
<td>Center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique</td>
<td>4 (City I)</td>
<td>Examples: Westinghouse Co., Continental Co.</td>
</tr>
<tr>
<td></td>
<td>11 (City II)</td>
<td>Examples: YMCA, Harding Home, Granary</td>
</tr>
<tr>
<td></td>
<td>19 (City III)</td>
<td>Examples: BBF, Capitol, Art Gallery</td>
</tr>
</tbody>
</table>

*aAlso represents the highest number of times the cue type can be given a rating.*
5 = highest rating that can be given to a single feature (very important = 5)

\[ \frac{\sum R}{n \times 5} \times 100 = \text{cue importance} \quad (2) \]

If the respondent's ratings for the cue type traffic are: traffic lights = 4; railroad crossing = 2; street direction = 3; freeway marker = 1

then \[ \frac{\sum R}{n \times 5} \times 100 = \frac{4 + 2 + 3 + 1}{4 \times 5} \times 100 = \frac{10}{20} \times 100 = 50\% \]

Or if the respondent's selected route had no freeway information, his importance score for the cue type traffic using the ratings above for the three features would be

\[ \frac{\sum R}{n \times 5} \times 100 = \frac{4 + 2 + 3}{3 \times 5} \times 100 = \frac{9}{15} \times 100 = 60\% \]

If the cue type did not appear on the route, it was again assigned a -0 value and dropped from the analysis.

For the slide display, n was set equal to the number of times a cue type occurred in the city (see Table 4 for cue type composition). The approximate 1-5 ratings were summed for each respondent and his cue importance score was found with formula two above.

There was no missing information for the slide display since respondents were restricted to rating four listed items for each slide. 61

The field trip ratings required a slightly different formula for transformation due to the variations of the lists provided by the respondents. The listing was completely open, that is, no checklist was provided. Some respondents wrote everything they noticed on the list; others wrote only the features they thought

61 Each listing had a fifth space--other--to be filled in by the respondent. Few respondents wrote in a fifth cue, therefore, the write-in cues were not used in the analysis.
TABLE 4
COMPOSITION OF THE CUE TYPES FOR SLIDE DISPLAY

<table>
<thead>
<tr>
<th>Cue Type</th>
<th>Number of Occurrences by City</th>
<th>Description of Features Included in Each Cue Type (Examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Traffic</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Use</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street and</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*This definition of land use differs from the rest of the displays. Since respondents had previously identified the land use type in the slide, this option was used to gain insight into the importance of land use as a locational clue.*
<table>
<thead>
<tr>
<th>Cue Type</th>
<th>Maximum Number of Mentions by City</th>
<th>Descriptions of Features Included in Each Cue Type (Examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traffic</strong></td>
<td>12 16 26</td>
<td>Traffic lights, street signs, direction signs, freeway, railroad</td>
</tr>
<tr>
<td><strong>Street and Ground Conditions</strong></td>
<td>9 5 9</td>
<td>Curb, presence of sidewalks, street material, condition of street, construction, trash, poles</td>
</tr>
<tr>
<td><strong>Spatial</strong></td>
<td>6 1 10</td>
<td>Spacing of buildings, height of buildings, spacing of houses, sizes of lots-parking, house</td>
</tr>
<tr>
<td><strong>Land Use</strong></td>
<td>9 4 17</td>
<td>Residential--low and high density, commercial--down-town and other, industrial, institutional, open space</td>
</tr>
<tr>
<td><strong>Large Buildings</strong></td>
<td>14 14 27</td>
<td>Factory building, supermarket, school</td>
</tr>
<tr>
<td><strong>Specific Commercial Establishments</strong></td>
<td>35 22 29</td>
<td>Names commercial establishment, e.g., Long's, Lazarus</td>
</tr>
</tbody>
</table>
were important. A comparison of the ratings on each list indicated all features included were given a rating. The lists with the largest number of features mentioned had ratings between the values 1-5. The shorter lists lacked values of 1. Therefore, the assumption was made that the missing features, if they had been listed, would have been given a rating of 1 (not important). Given this assumption, it was decided to let n equal the largest number of times a cue type was mentioned in the respective city by a respondent. Then the importance values were found with the following procedure.

(for field trip)

Let \( R \) = rating given to cue

\[ n = \text{number of times a particular cue type appearing on the route can be rated; } n \text{ varies} \]

\[ s = \text{number of times a cue type was mentioned by the respondent} \]

\[ s = \text{highest rating that can be given to a single feature (very important)} \]

then \( \frac{(n-s) + \sum R}{n \times 5} \times 100 = \text{cue importance score} \) \hspace{1cm} (3)

For example, if respondent #4 in City I mentioned the cue type traffic twelve times and this was the maximum number of mentions for the cue type, letting \( n = 12, s = 12, \sum R = 43 \)

then \( \frac{(n-s) + R}{n \times 5} \times 100 = \frac{(12-12) + 43}{12 \times 5} \times 100 = \frac{43}{60} \times 100 = 71.66\% \)

Examples of each cue type for the field trip appear in Table 5. Notice that a cue can be rated each time it appears on the route in the field trip. This was not true for the maps and models where the cue traffic light could be rated only one time even if it occurred ten times on the route.
For the slides, recall that each respondent was asked to identify the land use classification for each slide and to give its distance zone location. Each response was either correct or incorrect. There were a total of twelve correct responses for Cities I and II and fifteen for City III. The accuracy measures for this information represent the proportion of correct responses and were calculated as follows.

Let \( C \) = number of correct responses

\[ P = \text{total correct responses possible for city} \]

then \[ \frac{C}{P} \times 100 = \text{accuracy} \] (4)

if \( C = 6 \), \( P = 12 \)

\[ \frac{6}{12} \times 100 = 50\% \]

Each respondent was also asked to locate the slide with respect to its linear distance in miles away from the city center. This information was used to provide a measure reflecting a respondent's overperception or underperception of the actual distance separation. This measure was obtained by taking the absolute difference between the perceived distance and the actual distance. Positive values were interpreted as an overperception of the distance between the two points.

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There were seven land uses from which to select an answer: (A) Commercial, (B) Neighborhood Grocery Store, (C) Residential-Single Family, (D) Residential-Apartments, (E) Industrial, (F) Institutional, (G) Park. The distance zone designations were (1) CBD/Inner City, (2) Between CBD/Inner City and Suburban, (3) Suburban.
The final accuracy measures to be derived were for the field trip. In both the anticipation and memory information the measures obtained were proportions of the total number of features a respondent mentioned on the actual trip. For example, if Respondent #1 in City I anticipated 20 cue types (A), remembered 30 (R) and noticed 40 (T), his accuracy measures were

\[
\text{Anticipated: } (A/T) \times 100 = (20/40) \times 100 = 50\% \quad (4)
\]

\[
\text{Remembered: } (R/T) \times 100 = (30/40) \times 100 = 75\% \quad (5)
\]

The derived measures were used as dependent variables in an analysis of variance format to test the proposed hypotheses.

**Data Analysis**

Due to the nature of the data, several forms of analysis of variance were used in analyzing the data. The usual analysis of variance format would involve three groups of subjects, one for each city structure in the study. In such a format, there would be two levels of individual characteristics—(1) the set of abilities and attitudes particular to an individual and (2) the set of characteristics shared with members of the group. The effect of the latter set on city structure can be tested with relative ease simply by grouping by the personal characteristics; i.e., making one basis of classification equivalent to the personal characteristics. The former set is more troublesome. In the behavioral sciences, differences between individuals (experimental units) are often quite large relative to differences in classification effects (e.g., city
structure) which the researcher is trying to evaluate. This can result in a masking or compounding of the true extent of the classification differences. For example, in a study similar to the present study, the differences between the cities could be greatly influenced by differences in the map reading abilities of the three participant groups. Fortunately, there are methods for handling the problem of individual differences. The individuals can be pretested for abilities and attitudes that may affect the results of a study. This alternative can not rule out all individual differences, but it may be sufficient for a particular problem. Where complete control over such differences is deemed necessary, the same individuals may be used for the entire study. That is, the same individuals may provide responses for all levels (3) of the classification basis (city structure). This alternative presents a new problem—correlated data for city structure obtained from the same group of subjects. Again, several alternatives are possible for coping with the correlation. These include (1) making the assumption that the correlation is negligible or of no practical interest and proceeding with the usual analysis of variance, (2) testing the correlation between the response profiles for individuals and then making a decision, and (3) using an approximate analysis of variance designed to handle repeated measures on the same individual. All three strategies have been used in the present study and will be explained in turn.

Analysis of variance is used to test the significance of the difference of means for a number of different populations. It can be used in testing for a relationship between an interval scale and one or more nominal scales. The simplest form of one-way design involves one basis of classification (factor) which may have several categories (levels). For example, the factor city structure has three levels. The factor is the independent variable. The interval scale observational data constitute the dependent variable. In this study, the dependent variables are cue importance scores and the accuracy scores. The analysis of variance permits dividing the variation observed in experimental data into different parts, each part assignable to a known source. In the usual case the variance is divided into two parts, the within and between sums of square. The within or unexplained sum of squares refers to the variation which is left unaccounted by the categorized variable. The variation between the categories as divided by the variation within the categories determines how closely the two variables are related. Each of the sums of squares when divided by the appropriate degrees of freedom gives an independent estimate of variance. The test in the analysis of variance involves the comparison of these two estimates of $\sigma^2$. The $F$ or ratio of the between $\sigma^2$ to the within $\sigma^2$ provides the criterion for evaluating the effect of the independent variable. The analysis of variance can be expanded to include two or more classifications. Classification of the data
by city structure and residency is one example.  

The second strategy involves computing a correlation matrix from the individuals' data profiles. The approach allows investigation of the correlation between response profiles for different cues within each city and between response profiles for the same cue between cities. The sample size of responses for individual cues on the maps and models displays varies between the range 50-100; that for slides is a constant 110. Depending upon the response size, significant r values range between .184 to .273 (for samples 110 to 50) for .05 level of significance and from .243 to .354 for a .01 level of significance. The number of significant correlation values was greater for the same cue between pairs of cities than for the different cues within each city.

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64 For more detailed explanation of analysis of variance see Hubert M. Blalock, Social Statistics (New York: McGraw Hill, 1960); Niner, 1962.

65 The absence of particular cues on some of the selected routes led to the different response sizes for the cues.

66 "Table of Values of 'r' at the 5% and 1% levels of significance," Allen R. Edwards, Experimental Design in Psychological Research (New York: Rinehart and Co., 1950), p. 408.

67 Although the "r" values were significant, the majority of the values were small. Blalock discusses the problems of significant, but low correlation values. He states that it is better to be cautious in accepting the existence of a relationship between two variables when the correlations are low (Blalock: Social Statistics, p. 305). In view of these comments, it is possible to arbitrarily select a higher "r" value as the acceptable significant value. No precedence exists in the literature of urban images for making this decision. In geography, a .50 coefficient of determination is often viewed as an acceptable value for correlation ("r" = .707). Adapting this strategy greatly reduces the number of significant F-values.
Samples of the correlation matrices of the cue importance response profiles appear in Tables 6, 7, and . Additional correlation matrices appear in Appendix G. Based on the results of the correlational analysis, a decision to perform a repeated measures analysis of variance was made.

There are two forms of analysis of variance that handle repeated measurements on the same individual. The first form treats each individual score as the mean for that cell. Essentially, it treats a one-way classification as a two-way classification with the individuals becoming the second factor. This factor then has as many levels as individuals in the sample, e.g., 110. It is evident that as the sample size increases, the number of cells becomes unwieldy. Available machine analysis of variance programs generally require 100 or fewer non-empty cells. Thus, this alternative was not used. Instead, a second form which allows repeated measures on several independent groups was used. Essentially, this means grouping the data simultaneously by city structure and a personal characteristic in the same manner as a regular two-way classification. The difference is that the repeated measures form separates

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69 The BMD Series requires 85 or fewer non-empty cells; the MANOVA Program requires 100 or fewer non-empty cells.

### TABLE 6

**CORRELATION MATRIX OF CUE IMPORTANCE FOR MAP DISPLAY**

(Between Cities I and III)

<table>
<thead>
<tr>
<th>CUES</th>
<th>Low Density Residential</th>
<th>High Density Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Open Space</th>
<th>Institutional</th>
<th>Traffic Lights</th>
<th>Railroad Crossings</th>
<th>Streams</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

\[ a \] Significance at .05 level. (Significance taken from Edwards, *Experimental Design*, p.408.)

\[ b \] Numbers in parentheses refer to degrees of freedom.
### TABLE 7

**CORRELATION MATRIX OF CUE IMPORTANCE FOR MODEL DISPLAY**

(Between Cities I and II)

| CUE TYPES | Schools | Traffic | Land Use | Church | Bank | Stream | Park/Cen- | Large | Shopping | Center | Unique | Features |
|-----------|---------|---------|----------|--------|------|--------| etary    | Build- |         |        |        |          |
|           | 1       | 2       | 3        | 4      | 5    | 6      | 7        | 8      | 9       | 10     |        |          |
| 1         | .389\(^a\) | .227    | .034     | .283   | .211 | .101   | .192     | .159   | .269\(^a\) | .083   |        |          |
|           | (38)\(^b\) | (74)    | (74)     | (72)   | (60) | (73)   | (42)     | (74)   | (70)     | (64)   |        |          |
| 2         | .629\(^a\) | .299\(^a\) | .091    | .143   | .323\(^a\) | .206 | .065     | -.035  | -.090   |         |        |          |
|           | (110)   | (110)   | (107)   | (91)   | (108) | (61)   | (110)    | (100)  | (97)     |        |        |          |
| 3         | .759\(^a\) | .129    | .072     | .281\(^a\) | .352\(^a\) | .278\(^a\) | .112     | .102   |         |        |        |          |
|           | (110)   | (107)   | (91)    | (108)  | (61) | (110)  | (100)    | (97)   |        |        |        |          |
| 4         | .323\(^a\) | .177    | .142     | .262   | .305\(^a\) | .072   | .193     |         |         |        |        |          |
|           | (99)    | (85)    | (100)   | (57)   | (103) | (92)   | (91)     |        |        |        |        |          |
| 5         | .201    | .034    | .317\(^a\) | .358\(^a\) | .287\(^a\) | .238\(^a\) |         |        |        |        |        |          |
|           | (86)    | (99)    | (58)    | (101)  | (91) | (92)   |          |        |        |        |        |          |
| 6         | -.011   | -.118   | .266     | .128   | -.016 |        |         |        |        |        |        |          |
|           | (56)    | (32)    | (59)    | (53)   | (53) |        |          |        |        |        |        |          |
| 7         | .160    | .177    | .229     | .009   |        |        |         |        |        |        |        |          |
|           | (35)    | (58)    | (51)    | (54)   |        |        |          |        |        |        |        |          |
| 8         | .473\(^a\) | .238\(^a\) | .287\(^a\) |        |        |        |         |        |        |        |        |          |
|           | (101)   | (91)    | (92)    |        |        |        |          |        |        |        |        |          |
| 9         | .491\(^a\) | .088    |        |        |        |        |         |        |        |        |        |          |
|           | (46)    | (50)    |          |        |        |        |          |        |        |        |        |          |
| 10        |        |         |          |        |        |        |         |        |        |        |        | .173\(^a\) (97) |

\(^a\)Significant at .05 level. (Significance taken from Edwards, Experimental Design, p. 408)

\(^b\)Numbers in Parentheses refer to degrees of freedom.
TABLE 8
CORRELATION MATRIX OF CUE IMPORTANCE
FOR SLIDE DISPLAY
(Between Cities II and III)

CUE TYPES

<table>
<thead>
<tr>
<th></th>
<th>Traffic</th>
<th>Land Use</th>
<th>Spatial Features</th>
<th>Street &amp; Ground Conditions</th>
<th>Large Buildings</th>
</tr>
</thead>
</table>
| 1     | 1  
| 2     | .634^a  | .296^a   | .322^a           | .366^a          | .300^a          |
| 3     | .799^a  | .370^a   | .884^a           | .660^a          | .210^a          |
| 4     |         |          |                  | .638^a          | .300^a          |
| 5     |         |          |                  |                | .181            |

^aSignificant at .05 level with 110 degrees of freedom; r = .254 is also significant at .01 level.
the within sums of squares and the between sums of squares into correlated and uncorrelated parts (observations on independent units; observations on the same units). The correlated $\sigma^2$ becomes the error term for the mean squares which involve the same subjects. The uncorrelated $\sigma^2$ becomes the error item for the mean squares which involve different groups of subjects.

Interpretation of the results for the hypotheses of interest involve examination of significant F-values, the number of significant F-values observed for the different cue types when grouped by the factors of city structure and the personal characteristics. The results of the analyses variance tests appear in the following chapters. The cue importance results are reported in Chapter III and the accuracy results from the slide and field trip experiments in Chapter IV.
CHAPTER III

IMPORTANCE OF ENVIRONMENTAL FEATURES AS POTENTIAL WAY-FINDING CLUES

In this chapter, the findings based on the mean importance of the environmental features or feature types as potential clue in way-finding are discussed in terms of the hypotheses set forth in the previous section. The design of the study requires separate analyses for each environmental display. Therefore, a detailed description of the results for each environmental display follows the general comments for each hypothesis in Sets A and B.

Hypothesis A1

Hypothesis A1 states that city structure significantly explains the variations in the mean importance assigned to the environmental features or cues as potential way-finding clues by a sample of respondents. Importance measures were obtained for a total of thirty-one cues or cue types which appeared on the four environmental displays (see Table 9). City structure differentiates significantly for eighteen of the thirty-one possible cue types. From the table, a few general findings are evident. Traffic features, which appeared on all the displays, tend to be significant on each display. The cue type "land use" is not significant when the available choice of cues is larger and not restricted to land use features. The basis for this may be found in the fact that people usually do not give directions in terms of "land use" descriptions when the environment provides specific features such as "large buildings," etc. This idea is
TABLE 9
SUMMARY OF SIGNIFICANT F-VALUES BY DISPLAY WHEN IMPORTANCE MEASURES ARE GROUPED BY CITY STRUCTUREa

<table>
<thead>
<tr>
<th>Environmental Cue or Cue Type</th>
<th>Displays</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MAPS</td>
</tr>
<tr>
<td>low density residential</td>
<td>4.166</td>
</tr>
<tr>
<td>high density residential</td>
<td>16.891</td>
</tr>
<tr>
<td>commercial</td>
<td>NSb</td>
</tr>
<tr>
<td>industrial</td>
<td>NS</td>
</tr>
<tr>
<td>open space</td>
<td>NS</td>
</tr>
<tr>
<td>institution</td>
<td>25.901</td>
</tr>
<tr>
<td>traffic</td>
<td>NSc</td>
</tr>
<tr>
<td>railroad crossing</td>
<td>5.921</td>
</tr>
<tr>
<td>stream</td>
<td>8.367</td>
</tr>
<tr>
<td>land use</td>
<td>NS</td>
</tr>
<tr>
<td>schools</td>
<td>NS</td>
</tr>
<tr>
<td>church</td>
<td>6.357</td>
</tr>
<tr>
<td>bank</td>
<td>10.672</td>
</tr>
<tr>
<td>park/cemetery</td>
<td>5.532</td>
</tr>
<tr>
<td>large buildings</td>
<td>7.252</td>
</tr>
<tr>
<td>shopping center</td>
<td>NS</td>
</tr>
<tr>
<td>unique</td>
<td>NS</td>
</tr>
<tr>
<td>spatial features</td>
<td></td>
</tr>
<tr>
<td>street, ground conditions</td>
<td>6.928</td>
</tr>
<tr>
<td>quality</td>
<td>38.645</td>
</tr>
<tr>
<td>specific commercial</td>
<td>NS</td>
</tr>
<tr>
<td>establishments</td>
<td></td>
</tr>
</tbody>
</table>

Total number of different cues: 21

Total number of cues on display: 9 10 5 7 Total 31

Total number of significant F values: 5 6 4 3 18

aDegrees of freedom for slides—110, 2; field trip—30, 2; df varies for maps and models—see Tables 10 and 12.

bNot significant.

cThe cue "traffic" represents "traffic lights" only on the maps; when "traffic lights" and "railroad crossings" are combined as in the other displays, F=3.293—significant at .05 level.

dSignificant at .05 level; all others significant at .01 level.
supported by the significant F values obtained for the feature type "large buildings" for all displays on which it appears. When the importance measures are examined in a two-way classification for the purpose of controlling the effects (1) of the personal characteristics of the individual and (2) the correlation arising from repeated measures on the same individuals, the number of significant F-values differentiated by city structure remains unchanged.\textsuperscript{1} Since the features on each display are not the same, it is also necessary to discuss the results of the hypothesis by display.

Maps

On the map display, the city-types differ significantly with respect to mean importance for five of the nine environmental features: (1) "high density residential land use," (2) "low density residential land use," (3) "institutional land use," (4) "railroad crossings," and (5) "streams" (see Table 10 for F values). Two of the five features are land use features whose spatial existence appears in the definition of the classic spatial structures. The third land use feature, "institutional land use," has no definite spatial pattern in urban space; instead, institutional features are superimposed on the existing structure. "Railroad crossings" and "streams" are environmental features which have an indirect effect on the land use patterns.

\textsuperscript{1}The two-way results reported are those which account for both effects (1) and (2) mentioned above. The measures were also submitted to a regular two way analysis of variance analysis which only accounts for effect (1). The major difference between this analysis and that which considers both effects is that the latter results in lower values for the F's although the actual number of significant F-values for city structure remain unchanged.
TABLE 10
SUMMARY OF ANALYSIS OF VARIANCE RESULTS FOR MAP DISPLAY

<table>
<thead>
<tr>
<th>Cues</th>
<th>City Structure</th>
<th>Length of Residence</th>
<th>Urban Experience</th>
<th>Downtown Shopping Propensity</th>
<th>Navigational Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>df d F</td>
<td>df d F</td>
<td>df d F</td>
<td>df d F</td>
<td>df d F</td>
</tr>
<tr>
<td>1. low density residential</td>
<td>2,265 4.166b</td>
<td>2,265 .824</td>
<td>2,265 3.318b</td>
<td>1,266 2.454</td>
<td>1,266 1.759</td>
</tr>
<tr>
<td>2. high density residential</td>
<td>2,216 16.891c</td>
<td>2,216 2.363</td>
<td>2,216 .686</td>
<td>1,217 4.795b</td>
<td>1,217 5.817b</td>
</tr>
<tr>
<td>3. commercial</td>
<td>2,326 2.945</td>
<td>2,326 .766</td>
<td>2,326 3.611b</td>
<td>1,327 .467</td>
<td>1,327 4.212b</td>
</tr>
<tr>
<td>4. industrial</td>
<td>2,259 1.251</td>
<td>2,259 .517</td>
<td>2,259 .227</td>
<td>1,260 .419</td>
<td>1,260 .002</td>
</tr>
<tr>
<td>5. open space</td>
<td>2,203 1.890</td>
<td>2,203 .976</td>
<td>2,203 .366</td>
<td>1,204 .001</td>
<td>1,204 .093</td>
</tr>
<tr>
<td>6. institutional</td>
<td>2,127 25.901c</td>
<td>2,127 .439</td>
<td>2,127 1.705</td>
<td>1,128 .376</td>
<td>1,128 .053</td>
</tr>
<tr>
<td>7. traffic lights</td>
<td>2,327 .665</td>
<td>2,327 2.845</td>
<td>2,327 .275</td>
<td>1,328 .541</td>
<td>1,328 4.529b</td>
</tr>
<tr>
<td>8. railroad crossings</td>
<td>2,308 5.921c</td>
<td>2,308 2.307</td>
<td>2,308 .337</td>
<td>1,309 2.057</td>
<td>1,309 1.777</td>
</tr>
<tr>
<td>9. stream</td>
<td>2,248 8.367c</td>
<td>2,248 .144</td>
<td>2,248 .207</td>
<td>1,249 .869</td>
<td>1,249 .198</td>
</tr>
</tbody>
</table>

Total number of significant F's: 5 0 2 1 3

**a** Degrees of freedom vary due to missing data related to the presence or absence of items along selected routes.

**b** Significant at .05 level.

**c** Significant at .01 level.
Further insight regarding the differences in the importance of these features may be gained from examining the mean cue importance for each city. From Figure 7, it appears the means of City I (Newark) and City III (Columbus) are similar to each other and different from that of City II (Marion) for railroad crossings and streams. Although all three city structures had these features, the difference may be the result of the real city upon which City II is based. City II (Marion) is an abstracted model of a city which is an exchange point for two railroads in one of the heaviest railroad districts in the United States. The stream in City II appeared at the extreme edge of the map and had only a few routes crossing it. In the other cities, streams crossed or paralleled several routes, some of which were located near the central part of the city. The graph of the means also shows City III (Columbus) is separate from I (Newark) and II (Marion) with respect to the residential and institutional land use cues. Again, the difference may be the result of the real city (III) for which the map is an abstraction. City III has a greater number of institutions than does I and II. The residential cues are not as easily explained. Across city types, the cue "low density residential land use" is least important in City III, while that of "high density residential land use" is most important in City III. The difference may be the result of a size factor. City III had relatively speaking a greater proportion of its area in "high density residential land use" than did Cities I and II. Also, due to scale problems, the map of City III did not extend to the limits of the real city; therefore, a
FIGURE 10
GRAPH OF MEANS OF CUE IMPORTANCE WHEN CLASSIFIED BY CITY STRUCTURE FOR MAP DISPLAY

Means

80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0

Cues A B C D E F G H I

KEY - Cues  Symbols
A. Low density residential  ☀ City I
B. High density residential  ○ City II
C. Commercial
D. Industrial
E. Open space
F. Institutional
G. Traffic lights
H. Railroad crossings
I. Stream

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smaller area of "low density residential land use" occurred along the routes.

The cities do not differ significantly with respect to cue importance for the features (1) "traffic lights," (2) "open space," (3) "commercial," and (4) "industrial land use." The cue importance means for these features are quite similar for the three city types. Visual inspection of the graph suggests the means for these features are higher than those for the features which are significantly differentiated by city type. Adding the three means for each cue (one for each city) and getting an average mean produces a ranking in which the means for the four non-significant cues are higher than those for the five significant cues. This result promotes the idea that the four features are thought to be dominant in all city structures by the respondents and are therefore rated highly important; whereas, the remaining five features, though not as dominant, are more apt to serve as distinguishing features along the route, which when taken together are reflective of the structure of the city.  

The importance measures were also examined in a two-way classification for the purpose of investigating the effects of the personal characteristics. The results of the two-way analysis in which the cue importance measures were cross-classified by city structure and each of the personal characteristics in turn reveal that city structure

2Some routes exhibit land use changes in bands along their lengths, while others have a single land use along their entire length. When a large number of routes are selected, the differences in their composition tend to reflect the overall city structure.
differentiates significantly between the cue importance measures for the same five features as did the single classification. These results also show a significant relationship between two personal characteristics and a single cue. The personal characteristics of downtown shopping propensity and navigational experience significantly explain the differences in the measures for the feature "high density residential land use." These characteristics specifically refer to the individuals' use of and experience with the central parts of the city. "High density residential land use" is most often found in the center of the city. Thus, it is not surprising to discover an existing relationship between the importance measures for this feature and the personal characteristics depicting city center knowledge (see Table 11).

Scale Models

The F values for the models indicate city structure differs significantly with respect to six types of environmental cues: (1) "traffic," (2) "church," (3) "bank," (4) "stream," (5) "large buildings," and (6) "park/cemetery" (see Table 12). City structure does not discriminate between cue importance for four types of environmental cues: (1) "schools," (2) "land use," (3) "shopping centers," and (4) "unique features."3 (see Table 12).

Graphing the cue importance means provides further insight into the similarities and differences between the city structures with

---

3Recall that the cue types on the models are in some instances composites of several individual features. See Table 3, Chapter II, for a complete description of each type.
### TABLE II
SUMMARY OF TWO-WAY CLASSIFICATION RESULTS FOR MAP DISPLAY

<table>
<thead>
<tr>
<th>City Structure (CS) and</th>
<th>City Structure (CS) and</th>
<th>City Structure (CS) and</th>
<th>City Structure (CS) and</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Residence (R)</td>
<td>Urban Experience (UE)</td>
<td>Downtown Shopping Propensity (DSP)</td>
<td>Navigational Experience (NE)</td>
</tr>
<tr>
<td><strong>Cue Type</strong></td>
<td><strong>CS (CSxR) R</strong></td>
<td><strong>CS (CSxUE) UE</strong></td>
<td><strong>CS (CSxDSP) DSP</strong></td>
</tr>
<tr>
<td>1. low density residential</td>
<td>3.630^a</td>
<td>3.688^a</td>
<td>3.646^a</td>
</tr>
<tr>
<td>3. commercial</td>
<td>5.045</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. industrial</td>
<td></td>
<td>5.045</td>
<td>4.934</td>
</tr>
<tr>
<td>5. open space</td>
<td></td>
<td></td>
<td>6.891</td>
</tr>
<tr>
<td>6. institutional</td>
<td>27.713</td>
<td>27.233</td>
<td>35.920</td>
</tr>
<tr>
<td>7. traffic lights</td>
<td>5.045</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. railroad crossings</td>
<td>5.045</td>
<td>4.934</td>
<td>5.048</td>
</tr>
</tbody>
</table>

^aSignificant at .05 level, all others are significant at .01 level.
TABLE 12
SUMMARY OF ANALYSIS OF VARIANCE RESULTS FOR MODEL DISPLAY

<table>
<thead>
<tr>
<th>Bases of Classification</th>
<th>City Structure</th>
<th>Length of Residence</th>
<th>Urban Experience</th>
<th>Downtown Shopping Propensity</th>
<th>Navigational Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cue Types</td>
<td>df&lt;sup&gt;b&lt;/sup&gt; F</td>
<td>df F</td>
<td>df F</td>
<td>df F</td>
<td>df F</td>
</tr>
<tr>
<td>1. school</td>
<td>2,196 1.743</td>
<td>2,196 1.913</td>
<td>2,196 1.081</td>
<td>1,197 .237</td>
<td>1,197 5.081&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2. traffic</td>
<td>2,327 8.293&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,327 .580</td>
<td>2,327 .192</td>
<td>1,328 2.708</td>
<td>1,328 .158</td>
</tr>
<tr>
<td>3. land use</td>
<td>2,327 1.341</td>
<td>2,327 .159</td>
<td>2,327 .045</td>
<td>1,328 12.823&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,328 .456</td>
</tr>
<tr>
<td>4. church</td>
<td>2,295 6.357&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,295 .256</td>
<td>2,295 2.084</td>
<td>1,296 8.393&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,296 .951</td>
</tr>
<tr>
<td>5. bank</td>
<td>2,299 10.672&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,299 .774</td>
<td>2,299 .439</td>
<td>1,300 5.609&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,300 .800</td>
</tr>
<tr>
<td>6. stream</td>
<td>2,248 12.263&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,248 .721</td>
<td>2,248 .124</td>
<td>1,249 1.336</td>
<td>1,249 .952</td>
</tr>
<tr>
<td>7. park/cemetary</td>
<td>2,182 5.532&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,182 .871</td>
<td>2,182 .084</td>
<td>1,183 1.008</td>
<td>1,183 1.342</td>
</tr>
<tr>
<td>8. large buildings</td>
<td>2,318 7.252</td>
<td>2,318 .307</td>
<td>2,318 .081</td>
<td>1,319 5.888&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,319 .129</td>
</tr>
<tr>
<td>9. shopping center</td>
<td>2,151 .592</td>
<td>2,151 1.502</td>
<td>2,151 .316</td>
<td>1,152 1.736</td>
<td>1,152 1.442</td>
</tr>
<tr>
<td>10. unique features</td>
<td>2,314 .365</td>
<td>2,314 .899</td>
<td>2,314 .328</td>
<td>1,315 7.939&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,315 .223</td>
</tr>
</tbody>
</table>

Total number of significant F's | 6 | 0 | 0 | 5 | 1

<sup>a</sup>Significant at .01 level.

<sup>b</sup>Degrees of freedom vary due to missing data related to the presence or absence of feature along selected routes.
respect to the importance assigned to particular cue types as potential way-finding cues (see Figure 11). The graph suggests greater similarity in mean cue importance exists between City I (Newark) and III (Columbus) for all cue types except churches and shopping centers. For the latter cues, City I (Newark) and II (Marion) are more similar with respect to mean cue importance. Reality again provides a plausible explanation for the non-conforming cue-importance means. Both City I and II had a unusually large number of visually-dominant "churches" along the prominent city-center routes. "Churches" were both fewer in number and less visually dominant along the major routes in City III. "Shopping centers" which appeared in City III often occurred within the built-up urban area, and were therefore, less visually dominant than those in Cities I and II. Thus it may be assumed, respondents assigned lower importance ratings to these features in City III because they lacked visual dominance and were, thus, less likely to be very useful as clues in way-finding.

The results of the two-way analysis in which the measures were classified by both city structure and each of the personal characteristics in turn confirm the significant relationship between city structure and cue importance for the same six cue types. When the importance measures are examined by both city structure and the personal characteristic "downtown shopping propensity," a significant relationship between the personal characteristic and cue importance appears

---

4 The cue importance means for "unique features" in Cities II and III are almost equal.
FIGURE 11
GRAPH OF MEANS OF CUE IMPORTANCE WHEN CLASSIFIED BY
CITY STRUCTURE FOR MODELS DISPLAY

Cue Types A B C D E F G H I J

KEY - Cues Types
A. Schools  F. Stream
B. Traffic  G. Park/Cometary
C. Land use  H. Large buildings
D. Church  I. Shopping Center
E. Bank  J. Unique features

Symbols
City I  City II  City III
<table>
<thead>
<tr>
<th>Cue Type</th>
<th>City Structure (CS) and Length of Residence (R)</th>
<th>City Structure (CS) and Urban Experience (UE)</th>
<th>City Structure (CS) and Downtown Shopping Propensity (DSP)</th>
<th>City Structure (CS) and Navigational Experience (NE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. schools</td>
<td>6.986</td>
<td>6.971</td>
<td>7.087</td>
<td>7.065</td>
</tr>
<tr>
<td>2. traffic</td>
<td>6.986</td>
<td>6.971</td>
<td>7.087</td>
<td>7.065</td>
</tr>
<tr>
<td>3. land use</td>
<td>12.816</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. church</td>
<td>5.128</td>
<td>5.220</td>
<td>5.282</td>
<td>4.762*</td>
</tr>
<tr>
<td>5. bank</td>
<td>8.327</td>
<td>8.213</td>
<td>8.399</td>
<td>8.319</td>
</tr>
<tr>
<td>7. park/cemetery</td>
<td>4.129*</td>
<td>4.193*</td>
<td>4.170*</td>
<td>4.178*</td>
</tr>
<tr>
<td>9. shopping center</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. unique features</td>
<td></td>
<td></td>
<td></td>
<td>4.132*</td>
</tr>
</tbody>
</table>

*Significant at .05 level, all others at .01.
for four cue types: (1) "land use," (2) "church," (3) "large building," and (4) "unique features." These features are frequently found in the central parts of the city. Thus, it is plausible to expect differences in the importance assigned to the features by respondents who patronize the city center and those who don't. In all three city structures, the respondents who shopped downtown consistently rated these features more important as way-finding clues than did those who patronized outlying shopping centers.

Slides

For the slide display, the respondents were actually trying to locate a scene with respect to the city center from the features in the slide scene. Thus, as the respondents assigned a rating to the features in terms of their importance in the location task, they were actually engaged in a type of way-finding behavior. The results of the analysis indicate city structures differ significantly with respect to mean importance for four of the five cue types: (1) "traffic," (2) "spatial," (3) "street and ground conditions," and (4) "large buildings." There is no significant relationship between city structure and the importance measures for the cue type "land use" (see Table 14).

The cue type "land use" is thought to be most important in all three structures. In fact, its mean cue importance is so similar that it does not serve as a distinguishing feature between the city types (see Figure 12). The graph of the cue importance means shows City I (Newark) differs greatly from Cities II (Marion and III (Columbus) with respect to the cue types traffic and street and ground
### TABLE 14
SUMMARY OF ANALYSIS OF VARIANCE RESULTS FOR SLIDE DISPLAY

<table>
<thead>
<tr>
<th>Bases of Classification</th>
<th>City Structure (CS)</th>
<th>Length of Residence</th>
<th>Urban Experience (UE)</th>
<th>Downtown Shopping Propensity (DSP)</th>
<th>Navigational Experience (NE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cue Type</strong></td>
<td><strong>df</strong></td>
<td><strong>F Values</strong></td>
<td><strong>df</strong></td>
<td><strong>F Values</strong></td>
<td><strong>df</strong></td>
</tr>
<tr>
<td>1. traffic</td>
<td>2, 327</td>
<td>23.001&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2, 327</td>
<td>3.082&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2, 327</td>
</tr>
<tr>
<td>2. land use</td>
<td>.891</td>
<td>1.180</td>
<td>.313</td>
<td>2.707</td>
<td>.009</td>
</tr>
<tr>
<td>3. spatial features</td>
<td>6.928&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.216&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.840</td>
<td>.135</td>
<td>7.337&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>4. street and ground conditions</td>
<td>38.645&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.308&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.283</td>
<td>.217</td>
<td>3.714&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>5. large buildings</td>
<td>47.668&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.133</td>
<td>1.661</td>
<td>.049</td>
<td>1.170</td>
</tr>
<tr>
<td><strong>Total number of significant F's</strong></td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

<sup>a</sup>Significant at .05 level.
<sup>b</sup>Significant at .01 level.

### TABLE 15
SUMMARY OF TWO-WAY ANALYSIS RESULTS FOR SLIDE DISPLAY

<table>
<thead>
<tr>
<th>Bases of Classification</th>
<th>City Structure (CS) and Length of Residence</th>
<th>City Structure (CS) and Urban Experience (UE)</th>
<th>City Structure (CS) and Downtown Shopping Propensity (DSP)</th>
<th>City Structure (CS) and Navigational Experience (NE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cue Type</strong></td>
<td><strong>CS (CSxR) R</strong></td>
<td><strong>CS (CSxUE) UE</strong></td>
<td><strong>CS (CSxDSP) DSP</strong></td>
<td><strong>CS (CSxNE) NE</strong></td>
</tr>
<tr>
<td>2. land use</td>
<td>7.013</td>
<td>6.94</td>
<td>6.464</td>
<td>6.459</td>
</tr>
<tr>
<td>3. spatial features</td>
<td>35.113</td>
<td>34.065</td>
<td>34.260</td>
<td>34.650</td>
</tr>
</tbody>
</table>

<sup>a</sup>All values are significant at .01 level.
FIGURE 12
GRAPH OF MEANS OF CUE IMPORTANCE WHEN CLASSIFIED BY CITY STRUCTURE FOR SLIDE DISPLAY

Means
70
65
60
55
50
45
40
35
30
0

Cue Types
A  B  C  D  E

KEY - CUE TYPES
A. Traffic
B. Land use
C. Spatial features
D. Street and ground conditions
E. Large buildings

Symbols
City I
City II
City III
conditions. The separation of City I (Newark) from the other two cities may result from the fact that traffic arteries have a greater organizational role in the sector structure than in the other two city types. City I and City II have fewer large buildings than does City III; thus, the higher mean values for the cue type in City I and II indicate the feature has greater importance for way-finding in these city structures than it does in City III. This conclusion is supported by the arguments of Appleyard\(^5\) and Carr and Schissler\(^6\) for the significance of the singularity and visual dominance of the environmental features.

The results when controlling for the personal characteristics of the respondents are similar to those discussed for the map and model display. The relationship between city structure and the importance measures remains significant for the four cue types mentioned in the one-way analysis. In the two way analysis for city structure and the personal characteristics, length of residence in a large urban place, a significant relationship occurs between the length of residence and the mean importance of the cue type "spatial features." Inspection of the mean cue importance for the two-way analysis reveals a consistent pattern across the three city types. The respondents with the least urban residential history (0 years) give the cue type "spatial features" its lowest mean importance score, while those of

\(^6\)Carr and Schissler, "The City as a Trip," pp. 7-35.
the intermediate residence category (0-3 years) assign the feature its highest mean importance score. The importance of the feature drops with increasing residence (3 years or more). The results seem to suggest to the writer that individuals are more aware of relationships between "spatial features" and distance in a particular urban place during a period of time in which they are actively learning about a city environment. This awareness decreases with increased exposure to the city in question. Furthermore, based on the fact that all the respondents had experience with cities previous to the study, it appears this awareness or knowledge of spatial features and distance relationships is not readily transferred from the experienced city to the newly encountered urban setting.7

Field Trip

On the field trip display, the city structures differ significantly with respect to mean importance for three feature types: (1) "traffic," (2) "spatial features" and (3) "large buildings." They do not differ significantly for the remaining four feature types: (1) "street and ground conditions," (2) "land use," (3) "quality," and (4) "specific commercial establishments" (see Table 16). Graphing the cue importance means reveals the cue types "large buildings" and "traffic" are less important as way-finding clues in City III (Columbus) than in City I (Newark) and City II (Marion). Again, the ideas of singularity and visual dominance in the urban environment may explain the differences in the importance of these features in

7More comments on the suggestion will be made later.
### TABLE 16
SUMMARY OF ANALYSIS OF VARIANCE RESULTS FOR FIELD TRIP DISPLAY

<table>
<thead>
<tr>
<th>Bases of Classification</th>
<th>City Structure</th>
<th>Length of Residence</th>
<th>Urban Experience</th>
<th>Downtown Shopping Propensity</th>
<th>Navigational Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>df</td>
<td>30, 2</td>
<td>30, 2</td>
<td>30, 2</td>
<td>31, 1</td>
<td>31, 1</td>
</tr>
<tr>
<td>Cue Type</td>
<td>F Values</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. traffic</td>
<td>5.687&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.105</td>
<td>9.951&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.802</td>
<td>1.187</td>
</tr>
<tr>
<td>2. street and ground conditions</td>
<td>.584</td>
<td>1.274</td>
<td>.186</td>
<td>3.261</td>
<td>.241</td>
</tr>
<tr>
<td>3. spatial features</td>
<td>4.437&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.064</td>
<td>1.543</td>
<td>.716</td>
<td>1.553</td>
</tr>
<tr>
<td>4. land use</td>
<td>.546</td>
<td>.110</td>
<td>.418</td>
<td>1.835</td>
<td>1.647</td>
</tr>
<tr>
<td>5. quality</td>
<td>.097</td>
<td>.693</td>
<td>1.160</td>
<td>.703</td>
<td>.689</td>
</tr>
<tr>
<td>6. large building</td>
<td>3.765&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.880&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.464</td>
<td>1.654</td>
<td>.010</td>
</tr>
<tr>
<td>7. specific commercial establishment</td>
<td>.187</td>
<td>1.252</td>
<td>1.083</td>
<td>.165</td>
<td>1.198</td>
</tr>
<tr>
<td>Total number of significant F's</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>a</sup>Significant at .05 level.

<sup>b</sup>Significant at .01 level.
FIGURE 13
GRAPH OF MEANS OF CUE IMPORTANCE WHEN CLASSIFIED
BY CITY STRUCTURE FOR THE FIELD TRIP DISPLAY

Means

70
65
60
55
50
45
40
35
30

Cue Types
A  B  C  D  E  F  G

KEY - Cue Types
A. Traffic
B. Street and ground conditions
C. Spatial features
D. Land use
E. Quality
F. Large Buildings
G. Specific Named Commercial Establishments

Symbols
✓ City I
○ City II
★ City III
way-finding. There is little separation in the cue importance means for the cue types which are not significantly differentiated by city structure. No two-way analyses are performed on the field trip data. Three independent samples participated in the field trip display, thus eliminating the problem of repeated measures. Secondly, the small sample sizes prohibited meaningful interpretation of two-way classifications.

The above discussion examined the results of the analysis for each display with respect to the hypothesis which claims city structure significantly explains the variations in the mean importance assigned to the environmental features or cue types as potential way-finding clues by a sample of respondents. The hypothesis was found to be true for eighteen of the thirty-one environmental cue types studied. The graphs of the cue importance means exhibit a depression of the mean values as the reality of the displays increases. Since the features or cue types differed somewhat on the four displays, it is difficult to make many generalizations other than those made at the beginning of this discussion concerning the significant F values for specific features across the displays.

Hypothesis A2

According to this hypothesis the "land use" cue type will be most meaningful for the concentric structure (City II, Marion), while

---

8Two-way classifications of the field trip data resulted in a number of empty cells. Under these conditions, interpretation is highly questionable.
the cue type "traffic" will be most important in the sector model (City I, Newark). The expected ordering of the cue importance means for "land use" is City II (Marion), II (Columbus), and I (Newark)—(from most important to least important). The obtained ordering for the cue type land use differs with environmental display in the following manner: (1) Maps--III, II, I; 9 (2) Models--III, II, I; (3) Slides--II, III, I; and (4) Field Trip--II, I, III. The expected ordering of the means for "traffic" is I (Newark), III (Columbus), II (Marion)—(from most important to least important). Again, the observed orderings with differ with environmental display. The observed orderings are (1) Maps--II, I, III; (2) Models--II, III, I; (3) Slides--II, III, I; and (4) Field Trip--II, I, III. Given the changes with displays, the interpretation of the results is somewhat complicated. The cue type "traffic" is consistently most important for the concentric structure (City II) across the four displays—a reversal of the hypothesized occurrence. Traffic generation may offer a possible explanation for the deviations of the observed and expected ordering of importance means. In concentric structures where land use changes occur along routes, one expects the land uses to be visually dominant. Often, however, each land use generates a different amount and type of traffic. Therefore, the cue type "traffic" may be more

---

9 The means for the six land use features were averaged into a composite "land use" cue type mean for comparative purposes.

10 The means for the two traffic features ("traffic lights," "railroad crossings") were averaged into a composite "traffic" cue type mean for comparative purposes.
salient than that of "land use" for the individual driver in the zonal structure. In the sector structure, "land use" is fairly constant throughout the sector; thus, one expects traffic generation to be fairly constant as well. This may result in the motorist's attention being diverted to other features in the environment.

For all the displays except the field trip, the cue type "land use" is least important in the sector city. This finding is consistent with the implied part of the hypothesis—that land use would be least important in the sector city. The cue type "land use" is most important for City II in the slide and field trip displays, but the expected ordering of importance (II, Marion; III, Columbus; and I, Newark) appears only for the slide display. Since the slides were taken throughout the city areas, this display more nearly represents the actual structure of the real city. Therefore, the observation of the expected order of importance for the slide display is heartening.

Hypothesis A3

The results confirm Hypothesis A3 which states that city structure has a greater discriminatory power than any of the individual characteristics examined. Several possible methods exist for interpreting the results: (1) comparing the proportion of cues which exhibit significant F values when grouped in turn by each city type and each personal characteristics;11 (2) comparing the proportion of cues with significant F values when cross-classified by city structure and

11 This method is the classic one-way analysis of variance where the importance measures are grouped by each of the factors in turn.
each of the personal characteristics; and (3) examining the number of times the $F$ value for city structure is greater than that for the personal characteristic when the importance measures are discriminated by both city structure and the personal characteristics at once.

Methods two and three have the advantage of permitting investigation of the hypothesis when the effects of city type and that of the personal characteristics are considered simultaneously. These methods also allow correction for the repeated measures effect. Their disadvantage, however, is that the field trip data is lost from the analysis due to empty cells which occur when the field trip data is cross-classified by city structure and personal characteristics. Thus, the advantage of method one is that it allows using all the data including that for the field condition. All three methodologies starting with method one are used in the following explanation of the results and in general, the end result is similar—the hypothesis is confirmed.

For each display, a larger proportion of the environmental cues exhibit significant $F$ values when discriminated by each city type than when discriminated by any given individual characteristic (see Table 17). For the map display, five of the nine features have significant $F$-values when classified by city type versus from zero to three for the personal characteristics. Six of the ten environmental cue types

---

12 This method represents the two-way classification which permits investigation of the main effects of city type and personal characteristics. The variation used here corrects for the effects of repeated measures on the same individuals.
<table>
<thead>
<tr>
<th>Display</th>
<th>City Structure</th>
<th>Length of Residence</th>
<th>Urban Experience</th>
<th>Downtown Shopping Propensity</th>
<th>Navigational Experience</th>
<th>Number of Cue Types/Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MAP</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>2. MODEL</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>3. SLIDE</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>4. FIELD TRIP</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total Significant F's</strong></td>
<td><strong>18</strong></td>
<td><strong>4</strong></td>
<td><strong>3</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
<td><strong>7</strong></td>
</tr>
<tr>
<td><strong>Total Possible over All Displays</strong></td>
<td><strong>31</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Possible (31)</td>
<td><strong>58.1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 18**

Summary of the number of significant F-values by display when cross-classified by city structure and personal characteristic.

<table>
<thead>
<tr>
<th>Display</th>
<th>City Structure (CS) and Length of Residence (R)</th>
<th>City Structure (CS) and Urban Experience (UE)</th>
<th>City Structure (CS) and Downtown Shopping Propensity (DSP)</th>
<th>City Structure (CS) and Navigational Experience (NE)</th>
<th>Number of Cue Types/Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MAP</td>
<td>5 CS R</td>
<td>5 CS UE</td>
<td>5 CS DSP</td>
<td>5 CS NE</td>
<td>9</td>
</tr>
<tr>
<td>2. MODEL</td>
<td>6 CS 0</td>
<td>6 CS 0</td>
<td>6 CS 4</td>
<td>6 CS 0</td>
<td>10</td>
</tr>
<tr>
<td>3. SLIDE</td>
<td>4 CS 1</td>
<td>4 CS 0</td>
<td>4 CS 0</td>
<td>4 CS 0</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Significant F's</strong></td>
<td><strong>15 CS 1</strong></td>
<td><strong>15 CS 0</strong></td>
<td><strong>15 CS 4</strong></td>
<td><strong>15 CS 1</strong></td>
<td><strong>9</strong></td>
</tr>
<tr>
<td><strong>Total Possible over All Displays</strong></td>
<td><strong>24</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Possible (24)</td>
<td><strong>62.5</strong></td>
<td><strong>62.5</strong></td>
<td><strong>62.5</strong></td>
<td><strong>62.5</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
have significant F-values when classified by city type as against from zero to five for the personal characteristics. The slide data yields significant F-values for four of the five cue types when the importance scores are grouped by city type versus from zero to three when grouped by personal characteristics. The field trip follows suit with significant F-values for three of seven cue types when classified by city type versus from zero to one significant value for the personal characteristic groupings.

In all, there are thirty-one different environmental feature types involved in the four displays. City structure differentiates significantly between mean cue importance for 58.1% (18 of 31) of the environmental cue types examined. The personal characteristics account for the following percentages across the four displays (1) length of residence in a large urban place—12.6% (4); (2) urban experience—9.7% (3); (3) downtown shopping propensity—19.4% (6); and (4) navigational experience—19.4% (6). Since the field trip display is not included in the two-way classifications of the data, there are only twenty-four different environmental feature types to be considered. Using the number of significant F-values as the criterion with which to judge Hypothesis A3, city structure again displays greater discriminatory power than any of the personal characteristics examined. The number of significant F values observed for each basis of classification is: (1) city structure—15 (62.5%), this remains constant across all the cross classifications; (2) length of residence—1 (4.2%); (3) urban experience—0; (4) downtown shopping propensity—5 (20.8%); and (5) navigational experience—1 (4.2%) (for breakdown by display
see Table 18).

Following method three, the F-values for city structure are almost always greater than those for the four personal characteristics across the displays of maps, models, and slides. The actual number of times this occurred for each display appears in Table 19.

The results for all three tests confirm the prominence of city structure in explaining the variations in the mean cue importance assigned to the environmental features. In fact, they also add support to the statements in the literature concerning the role of the actual urban environment in city images.13

Hypothesis Bl

Hypothesis Bl claims that of the personal characteristics examined, the length of residence in a large urban place will be most meaningful in discriminating the cue importance measures over all features. The results of the analysis confirm this hypothesis only for the slide display where the analysis produces three significant F-values for the cue types: (1) "traffic," (2) "spatial," and (3) "street and ground conditions." The most meaningful personal characteristic for the map display is navigational experience with three significant F-values for the features: (1) "high density residential land use," (2) "commercial land use," and (3) "traffic lights." For the models display, the personal characteristic downtown shopping propensity has a total of five significant F-values for the cue types.

TABLE 19
SUMMARY OF THE NUMBER OF TIMES THE F-VALUE FOR CITY STRUCTURE IS GREATER THAN THAT FOR THE PERSONAL CHARACTERISTIC WHEN DATA IS CROSS-CLASSIFIED BY CITY STRUCTURE AND PERSONAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Display</th>
<th>City Structure (CS) and Length of Residence (R)</th>
<th>City Structure (CS) and Urban Experience (UE)</th>
<th>City Structure (CS) and Downtown Shopping Propensity (DSP)</th>
<th>City Structure (CS) and Navigational Experience (NE)</th>
<th>Number of Cases</th>
<th>Total Number of Times Value Greater By Display</th>
<th>Total Possible If All Values For CS Greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Map</td>
<td>8\textsuperscript{a}</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>2. Model</td>
<td>8\textsuperscript{b}</td>
<td>8\textsuperscript{b}</td>
<td>8\textsuperscript{b}</td>
<td>8\textsuperscript{c}</td>
<td>10</td>
<td>32</td>
<td>40</td>
</tr>
<tr>
<td>3. Slide</td>
<td>5</td>
<td>5</td>
<td>4\textsuperscript{d}</td>
<td>5</td>
<td>5</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>

\textsuperscript{a}The F-value for "traffic lights" is less for city structure than for length of residence.

\textsuperscript{b}The F-values for "shopping center" and "unique features" are less for city structure than for the personal characteristics R, UE, and DSP.

\textsuperscript{c}The F-values for "shopping center" and "schools" are less for city structures than for this personal characteristic, DSP.

\textsuperscript{d}The F-value for "land use" is less for city structure than for the navigational experience.
propensity has a total of five significant F values for the cue types (1) "land use," (2) "bank," (3) "church," (4) "large buildings," and (5) "unique features." The personal characteristics length of residence and urban experience are equally meaningful for the field trip display with one significant F-value apiece.

Across the four displays, there is again a total of thirty-one environmental cue types to be differentiated. In this instance, the personal characteristics downtown shopping propensity and navigational experience each differentiate significantly for six of the thirty-one cue types, while the characteristics length of residence and urban experience differentiate significantly for four and three of the thirty-one features respectively. Thus, it appears the personal characteristics based on activity or actual use of the city are more meaningful in selecting and evaluating way-finding clues than the characteristics based on length or type of environmental residency which are often used as surrogates for interaction with the urban environment.14

Similar results occur when the data are cross-classified by both city structure and each of the personal characteristics in turn. Again, the hypothesis is confirmed only for the slide display, but this time only one significant value results for the length of residence classification. The characteristic downtown shopping propensity is again the most meaningful personal characteristic for the

14Steinitiz comments on residence as being a surrogate for use in that a longer residential history means greater opportunity to use and learn the city. He also uses the actual number of trips downtown as one of his personal characteristics. See Steinitiz, "Meaning and the Congruence," pp. 233-247.
models display with four significant values. The characteristics downtown shopping propensity and navigational experience vie for the honors each with one significant value for the map display. Since the field trip was dropped from this analysis, there are twenty-four environmental cues to be considered. In this case, the personal characteristic downtown shopping propensity appears to be most meaningful in discriminating between cue importance for the environmental cue types with six significant F-values across the three displays. The characteristics length of residence and navigational experience each have one significant F value, while the characteristic urban experience has no significant F value across the three displays. The cross-classification results also contribute to the conclusion that personal characteristics which depict activity or actual use of the city are most meaningful in urban images.

**Hypothesis B2**

The final hypothesis for this section investigates the relationship between the personal characteristic navigational experience and the cue importance means of the cue type "traffic." Recall that the characteristic navigational experience is operationalized by the agreement expressed to the statement "I find traveling in an urban area confusing." The respondents who agreed with the statement assigned greater mean importance values to the traffic features on all

15The term "traveling" was verbally explained as meaning driving. The statement immediately before this statement used the term driving when probing attitudes about automobile use in the city.
displays except the field trip than did those who disagreed with the comment (see Table 20 for a listing of the mean importance values by display). There are several possible explanations for the reversal of the magnitude of the cue importance means on the field trip display. Firstly, the author and not the respondents did the driving; thus, the respondents' concern with the traffic features may have been considerably lessened in the field test. It is unlikely that a passenger would be overly concerned with the traffic features unless he is an "edgy" passenger. Another explanation lies in the wealth of features at play in the field test. According to previous research, even drivers as compared to passengers spend a lot of time looking at features located off the road. One would expect this tendency to be especially true of passengers who are trying to evaluate features as potential way-finding clues. Traffic conditions may change with the time of day, the day of the week, and/or the season of the year. Thus, another explanation may be found in the difference between actually experiencing a traffic situation as in a field trip and imagining one in a static experiment. In the absence of "reality" the imagined importance of the traffic features may be unduly exaggerated by those who are uneasy about driving in urban congestion. The difference in the cue importance means of the two groups is not so great as to give much credulance to the last explanation; it is more likely that the first two reasons account for the reversal of the magnitude of the cue

16 Appleyard, Lynch, and Myer, The View From the Road, (Cambridge: MIT), 1964; Carr and Schissler, "The City as a Trip," pp. 7-35.
<table>
<thead>
<tr>
<th></th>
<th>Experience Confusion</th>
<th>Do Not Experience Confusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. MAPS</strong></td>
<td>68.88</td>
<td>68.77</td>
</tr>
<tr>
<td><strong>2. MODELS</strong></td>
<td>58.94</td>
<td>58.02</td>
</tr>
<tr>
<td><strong>3. SLIDES</strong></td>
<td>52.95</td>
<td>48.73</td>
</tr>
<tr>
<td><strong>4. FIELD TRIP</strong></td>
<td>39.95</td>
<td>46.92</td>
</tr>
</tbody>
</table>

*a Figures represent average mean for cues the "traffic lights" and "railroad crossings." The figures for the single cues are (1) "traffic lights"—84.39 and 79.41, in the order listed above; and (2) "railroad crossings"—53.27 and 58.14 respectively.

*b The field trip display data are not used in the analysis when the importance values are cross-classified by city structure and navigational experience. Composite means for the cross-classification analysis for "traffic" by display are (1) Maps—68.93 and 68.94; (2) Models—58.93 and 58.02; and (3) Slides—52.99 and 48.73 ("experience confusion" listed first).
importance means on the field trip display.

When examining the results by display, the hypothesis is confirmed. If, however, the individual display means are averaged to obtain a single cue importance mean for each group of individuals, the results tend to favor rejection of the hypothesis. The absolute difference in mean cue importance between those who experience confusion and those who don't is so slight that it is almost negligible (.4), though it favors those who do not experience confusion. That is, this group tends to rate traffic features as being more important than do those who experience confusion.

Summary

The results for the tests of the hypotheses which concern the mean cue importance assigned to the environmental cues and cue types as potential way-finding clues by a sample of respondents are summarized in Table 21. Summing across displays, only one hypothesis is confidently rejected— that which states the personal characteristic length of residence in a large urban place will be the most meaningful personal characteristic in discriminating between the cue importance means. In general, the results indicate city structure has an important role in urban images when considering the differences in the judged importance of environmental cues for way-finding purposes.
TABLE 21
SUMMARY OF THE RESULTS FOR THE HYPOTHESES CONCERNING THE IMPORTANCE
OF CUES AS POTENTIAL WAY-FINDING CLUES

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significance</th>
<th>F-values</th>
<th>Significance</th>
<th>F-values</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. City structure</td>
<td>significantly explains the variations in the mean importance assigned to the environmental features as potential way-finding clues by a sample of respondents.</td>
<td># of significant F-values of 31 possible for environmental cues combined across displays.</td>
<td>18 significant F-values observed.</td>
<td>Accept the hypothesis.</td>
<td></td>
</tr>
<tr>
<td>A2. The feature land use will have the highest means in the zonal structure; traffic features will be most important in the sector model.</td>
<td># of times expected ordering of cue importance means occurs.</td>
<td>Land use--2 of 4; traffic--0 of 4.</td>
<td>Reject the hypothesis, but with reservations for the cue type &quot;land use.&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3. City structure has a greater discriminatory power than any of the personal characteristics examined.</td>
<td># of significant F-values of 31 possible across four displays; # of 24 possible for 3 displays; # of times F for City Structure greater than that for personal characteristic (Inc. Non-sig.)</td>
<td>City structure--18, others--varies from 3 to 6; of 24, 15 and from 0-5; F for city structure greater than that for p.c. 86 times (of 96 possible F values for 3 displays).</td>
<td>Accept the hypothesis with all three methods.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1. Of the personal characteristics considered, the length of residence in a large urban place will be most meaningful in discriminating between cue importance over all features.</td>
<td># of significant F-values of 31 possible over all displays; of 24 for three displays.</td>
<td>Length of residence--4; other characteristics vary from 3-61 of 24, residence--1 and others vary from 0 to 5.</td>
<td>Reject the hypothesis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2. Individuals who reported experiencing confusion while driving in an urban area will exhibit higher mean importance scores for traffic features than will individuals who report no confusion.</td>
<td>Order of cue importance means for traffic; experience confusion, no confusion.</td>
<td>Order: No confusion, confusion. Absolute difference of means=.4 (for all displays). Individual displays: expected order observed.</td>
<td>Reject the hypothesis, but with reservations since difference is so small.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Land use--2 of 4; traffic--0 of 4.
CHAPTER IV
ACCURACY OF ENVIRONMENTAL PERCEPTIONS

In this chapter, the findings based on the mean accuracy of the individuals' perceptions of the city are discussed in terms of the hypotheses set forth in Chapter II. The general variable—mean accuracy of perception—represents the spatial relations aspect of the image (see Figure II, Chapter II; p. 25). Therefore, the two methods used in getting the data were designed to be somewhat analagous to the two styles of representing the spatial relations of a locality discussed by Shemyakin and Tolman. (1) One style involves setting up a general configuration or schema of interrelations between objects in a locality. (2) The second style involves tracing the route of movement through a locality. In responding to the slide display questions, the respondents approximated the behavior used in the first style, that is, they had to rely on either their cognitive representation of (1) the particular city in question or (2) of cities in general. Both these cognitive representations are built on a combination of actual knowledge of a particular locality and past experience with similar places. For the field trip display

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1Shemyakin, "Orientation in Space," pp. 86-255.
3Hart and Moore, The Development of Spatial Cognition, p. 59.
questions, the respondents approximated the behavior used in the second style, i.e., they gave ordered descriptions of what occurred along a particular route in a city while mentally tracing that route. Since the usual approach to studying images of the city requires respondents to draw maps of a locality, the representations of these two styles are variously called "survey maps vs. route maps," "spatial or field maps vs. strip or linear maps," "spatially dominant maps vs. sequentially dominant maps." Therefore, although it may be justifiable to refer to the data from the two displays as the respondents' survey and route perceptions of the city, the writer will use the terms "slide perceptions" and "field trip perceptions" to avoid any confusion that may arise from the difference in the methods used for obtaining the data. The discussion of the perception results will follow the same format used in Chapter III; a description of the hypothesis results will be followed by comments for each display where necessary.

Hypothesis C1

Hypothesis C1 states that city structure significantly explains the variation in mean accuracy for both the slide and field trip experiments of the city. In all, five accuracy measures were obtained, three for the slide display and two for the field trip. The resulting

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4 These terms are summarized in Hart and Moore, The Development of Spatial Cognition. Each set of terms is attributed to a specific writer. The terms are, however, used in several combinations by each individual.
F-values indicate that the city structures do differ significantly with respect to all five variables (see Tables 22 and 23). Since the data for the two displays differ in nature, specific comments concerning the results for each display follow.

**Slide Display**

The three accuracy variables for the slide display involve (1) the classification of land use, (2) the identification of distance zone from the city center, and (3) the estimate of the linear distance from the city center (for each slide). The land use variable, hereafter referred to as "land use accuracy," represents the correct identification of the major land use in a scene. The two distance variables give insight into the perceived association between a given land use in a scene and location in the city. The distance zone variable, "distance zone accuracy," represents the correct identification of the distance zone in which a scene is located. The city center serves as the orientation point for the three choices of zone (1) CBD (city center)/Inner city, (2) Between Inner City and Suburban, and (3) Suburban. In effect, the distance zone accuracy gives an indication of the respondents understanding of the relative distance to the city center. The linear distance variable represents the difference between the estimates of the linear distance and the actual linear distance to the city center. This variable which is hereafter referred

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5 The land uses used in the classification of the scenes appears in Appendix D with the copy of the respondents' work materials.
### TABLE 22
SUMMARY OF ANALYSIS OF VARIANCE RESULTS FOR THE SLIDE EXPERIMENTS

<table>
<thead>
<tr>
<th>Accuracy Variables</th>
<th>City Structure</th>
<th>Length of Residence</th>
<th>Urban Experience</th>
<th>Downtown Shopping Propensity</th>
<th>Navigational Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>df</td>
<td>F-values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use accuracy</td>
<td>8.344a</td>
<td>.399</td>
<td>.128</td>
<td>.098</td>
<td>.009</td>
</tr>
<tr>
<td>Distance zone accuracy</td>
<td>21.250a</td>
<td>.201</td>
<td>.339</td>
<td>.125</td>
<td>.668</td>
</tr>
<tr>
<td>Overperception of distance</td>
<td>85.755a</td>
<td>3.341b</td>
<td>6.003a</td>
<td>.242</td>
<td>3.301</td>
</tr>
<tr>
<td>Total number of significant F-values</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Significant at .01 level.

*Significant at .05 level.

### TABLE 23
SUMMARY OF ANALYSIS OF VARIANCE RESULTS FOR THE FIELD TRIP EXPERIMENTS

<table>
<thead>
<tr>
<th>Accuracy Variables</th>
<th>City Structure</th>
<th>Length of Residence</th>
<th>Urban Experience</th>
<th>Downtown Shopping Propensity</th>
<th>Navigational Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>df</td>
<td>F-values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipation Accuracy</td>
<td>7.638a</td>
<td>3.236</td>
<td>8.873a</td>
<td>4.950b</td>
<td>2.888</td>
</tr>
<tr>
<td>Memory Accuracy</td>
<td>9.065a</td>
<td>1.048</td>
<td>1.738</td>
<td>3.715b</td>
<td>2.080</td>
</tr>
<tr>
<td>Total number of significant F-values</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

*Significant at .01 level.

*Significant at .05 level.
to as the "overperception of distance" provides information concerning the perception of absolute distance to the city center.6

The responses on the variables are based on either the respondents' (1) actual experience within a particular city and therefore, his knowledge of a particular scene or (2) his general learned model of the form of the city which includes common associations between land use activity and distance from the center of the city. Since two of the cities used in representing city structures were unfamiliar to the subjects7 and most scenes in the third city were uncommon locations, it is felt that the respondents relied on their general notions of the city in responding. Some insight into this assertion is gained in the next section.

The analysis of the data confirmed the hypothesis, that is, the city structures do differ significantly with respect to the three variables (Table 24). This confirmation also stands when the data are cross-classified by both city structure and each of the personal characteristics in turn, in an effort to examine the effects of the personal characteristics and to control for the repeated measures problem. Again, the F-values for the three variables are significant

6In all three cities, the actual distance was overperceived; therefore, the variable is appropriately named as the overperception of distance.

7Of the 110 respondents, seven had a residential connection with the city of Marion and seven others with the city of Newark. Their situations of residence varied among three cases: (1) lived there prior to attending Ohio State University, (2) parents moved there after the respondents had established apartments in Columbus, and (3) lived with parents in the particular city and commuted into
### TABLE 24
SUMMARY OF TWO WAY CLASSIFICATION RESULTS FOR THE SLIDE EXPERIMENTS

<table>
<thead>
<tr>
<th>Bases of Classification</th>
<th>City Structure (CS) and Length of Residence (R)</th>
<th>City Structure (CS) and Urban Experience (UE)</th>
<th>City Structure (CS) and Downtown Shopping Propensity (DSP)</th>
<th>City Structure (CS) and Navigational Experience (NE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of Significant F-Values</td>
<td>CS (CSxR) R</td>
<td>CS (CSxUE) UE</td>
<td>CS (CSxDSP) DSP</td>
<td>CS (CSxNE) NE</td>
</tr>
<tr>
<td>land use accuracy</td>
<td>6.738</td>
<td>6.738</td>
<td>6.738</td>
<td>6.738</td>
</tr>
<tr>
<td>overperception of distance</td>
<td>81.223</td>
<td>80.562 3.364</td>
<td>78.353</td>
<td>78.855</td>
</tr>
</tbody>
</table>

*Significant at .05 level, all the rest are significant at .01.*
for city structure. Of the personal characteristics used in the cross-classification, however, only urban experience has a significant F-value, and this occurs for only one variable, "overperception of distance" (see Table 24).

Further insight on the discriminatory power of city structure can be gained by examining the individual means for the accuracy measures (see Table 25). (a) The mean for "land use accuracy" was highest for City II (Marion) and least for City III (Columbus), the most familiar city. The differences in land use accuracy among the three city types, however, is small. (b) For "distance zone accuracy," the respondents were most accurate for City I (Newark). Respondents were more accurate in their identifications for City II than for City III, although the difference in accuracy between City II and City III is small. (c) The estimates of the linear distance show that the actual distance was over-perceived in all three structures. "Overperception of distance" was least in City III and greatest in City II. The difference in accuracy between Cities I and II is small. Since the respondents were equally unfamiliar with Cities I and II, the closeness of their estimates may be the result of several occurrences: (1) the similarity in size of the two cities, and (2) the respondents reliance on their general learned model of the city. The estimate for City III is probably influenced to a greater degree by the respondents familiarity with the city.

Columbus (true for only three people). Many of the scenes in the cities of Marion and Newark were also uncommon locations; thus, it is believed that reliance on general images was again dominant.
### Table 25
SUMMARY OF ACCURACY MEANS FOR SLIDES WHEN GROUPED BY CITY STRUCTURE

<table>
<thead>
<tr>
<th>Accuracy Measures</th>
<th>City I (sector)</th>
<th>City II (concentric)</th>
<th>City III (mixed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>land use accuracy</td>
<td>85.7</td>
<td>89.8</td>
<td>84.2</td>
</tr>
<tr>
<td>distance zone accuracy</td>
<td>78.8</td>
<td>69.6</td>
<td>67.9</td>
</tr>
<tr>
<td>overperception of distance</td>
<td>3.394</td>
<td>3.535</td>
<td>.526</td>
</tr>
</tbody>
</table>

*a* For all cases.

*b* This figure represents the mean estimate in miles "overperception" for each city.
Length of residence in a large urban place, it will be recalled, is equivalent to residency in Columbus. Thus, by looking at the individual residence category means for City III, it is possible to further evaluate the effect of greater familiarity on the overperception of distance. The ordering of the means shows linear distance in City III was over-perceived most by the respondents with a residential history of 3 or more years in a large urban place and least by those in the 0-3 years category.\(^8\) The result prompts an extension of Steinitz's ideas concerning images of urban content. He claims the general images of a city are completely learned in a period of two years or less. After this period, changes in the urban image occur only when the image holders are forced to interact with new environmental elements. These new elements may then be added to the original urban image. Steinitz also reports a declining awareness of the city after a long period of time. He suggests this decline is due to either habitual use of one part of the city to the exclusion of the remainder of the city or the failure to assimilate new elements in the environment.\(^9\) This writer believes that another reason for the declining accuracy of urban images may be found in the retention of elements which once existed in the environment, but no longer do so. This reasoning is related to the belief that city images are based on expectations of the city

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\(^8\) The individual means for City III (Columbus) by residence category are: (1) 0 years residence, 1,111 miles; (2) 0-3 years residence, 1.055 miles; and (3) 3 years or more, 1.438 miles.

and past experiences with the city.\textsuperscript{10} Such an explanation may also apply in the perception of distance in the city. Since the respondents with the least overperception of distance had a residential history of 0-3 years, they may still be in the learning phase and therefore, somewhat more aware of distances in the city. The knowledge of respondents with 3 years or more residence in the city may have been retained from a predriver stage in life when the possibility for erroneous distance estimates were greater. Steinitz suggests native residents of a city learn the city during the teenage years.\textsuperscript{11} Often during this stage of life, these young adults ride buses or are driven to particular places by parents and others. The bus routes may be such that true distances between points are camouflaged due to turns, one-way streets, etc.\textsuperscript{12} Parents and others may choose routes which allow

\textsuperscript{10}This idea is found in the literature by Carr and Schissler and others; see Carr and Schissler, "The City as a Trip," pp. 7-35. Appleyard has reported cases of inferential thinking with respect to the existence of features in a city; see Appleyard, "Styles and Methods," pp. 100-117. The following episode provides another illustration of this occurrence. On the way to work, a person may always make a turn at a particular point. He reports that the sight of a certain building on the corner always signals his move into the turn lane. The individual changes jobs and no longer travels this route. The building is demolished. If the person is asked to describe the features that occur on his previous journey to work route, the individual may list the existence of his "signal" building, when in fact, it no longer exists.

\textsuperscript{11}Steinitz, "Meaning and the Congruence," p. 245.

\textsuperscript{12}Briggs looked at the differences of car owners and non-car owners with respect to two measures of distance-mile estimates and individual scale values. He found no difference between car owners and non-car owners for the ratio estimates. However, Briggs did report consistent differences between the two groups of individuals for the mile estimates. The non-car owners showed greater cognized distance than did car owners. In the present study, the distance measure, overperception of distance was based on an estimate of miles. Briggs' division of the sample into car owners and non-car owners does not
multiple purpose stops, avoid undesirable parts of the city, and so on; all of which may again lead to exaggeration of the true distance between places. Many of the respondents in this residential category spent their early teen-age years in Columbus. More exact explanations of differences in distance perception and the effect of residency await research specifically directed at a study of this relationship.

Field Trip Display

The two variables of concern on the field trip display are (1) the proportion of noticed features that were anticipated prior to the trip and (2) the proportion of noticed features which were remembered after the trip. Hereafter, the variables are referred to as (1) "anticipation accuracy" and (2) "memory accuracy," respectively. Previous to discussing the results, it should be recalled that three different samples, one for each city, participated in the field trip. The respondents in each sample were familiar with the city in which they took the trip.13

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12 provide any information concerning the respondents length of residence in Columbus or when they first started learning the nodes in Columbus. It is possible that all of Briggs' respondents spent their early teens in other cities. Both Briggs' results and the present results indicate the need for further research concerning differences in mobility mode and stages of urban learning. See R. Briggs, "Cognitive Distance in Urban Space," (unpublished Ph.D. dissertation, Ohio State University, 1973), pp. 146-150.

13 Thirty-three respondents participated in the field trip. The sample sizes were: Newark and Marion, each 7; and Columbus, 19. All except three respondents lived in Columbus at the time of the study. Of the three, only two had never lived in Columbus.
The results of the analysis confirmed the hypothesis that city structure significantly explains the variations in the anticipation and memory accuracies (see Table 23). The graph of the "anticipation" and "memory accuracy" means shows that the respondents for City I (Newark) were most accurate, while those for City III were least accurate (see Figure 14). A striking feature of the graph is the parallelism of the city structures for the two variables. This may be taken to imply that a systematic relationship exists between the anticipation and memory of features on a route across the city-types. The low values for City III (Columbus) may be related to the larger size of City III which in turn results in a greater average number of noticed features along a given route. The greater the average number of features, the greater the marginal rate of memory lapse, and the more confusion one would expect to result. Another possible cause may be the respondents' varied residential history which is thought to influence familiarity.\textsuperscript{14} The writer feels that the influence of the size factor is a more likely explanation. In either case, the size of the samples precludes a definitive statement.

Hypothesis C2

According to this hypothesis, the concentric structure facilitates image formation; that is, this structure is easier to image than the others and therefore, should exhibit greater mean accuracy values.

\textsuperscript{14} The varied residential situations for the individuals from Marion and Newark are listed in footnote 7 in this chapter.
FIGURE 14
GRAPH OF MEANS OF FIELD TRIP ACCURACY MEASURES
WHEN CLASSIFIED BY CITY STRUCTURE

KEY - Accuracy Measures
A. Anticipation Accuracy
B. Memory Accuracy

Symbols
⊙ City I
〇 City II
☆ City III
for both the slide and field trip experiments of the city.\textsuperscript{15} The expected order of the mean accuracy scores, then, is Cities II (Marion), III (Columbus), I (Newark). Although the concentric structure (City II) has the greatest mean for "land use accuracy," the expected order of the cities is never observed in either the slide or field trip experiments (see Table 25). The results can best be explained by examining the order of observed means for each of the five accuracy measures in the study.

(a) For "land use accuracy," the highest mean appears for City II, the concentric structure. The observed order of the means is II, I, and III. Thus, it appears that the respondents were most accurate in identifying land uses in City II and least accurate in City III. The actual difference between the means for Cities I and III is slight compared to the differences between the means for these cities and City II. The results support the hypothesized notion that the \textit{concentric structure} facilitates image formation with respect to "land use accuracy." The results are consistent with statements made by Cox\textsuperscript{16} and Jones.\textsuperscript{17} Cox reported the clear tendency toward a concentric distribution of certain urban phenomena by a sample of respondents similar to those in the present study. In the Cox study, respondents

\textsuperscript{15} The writer feels that greater accuracy can be taken as an indication of better urban images resulting from the ease of understanding the interrelations between land use and distance in a particular urban structure.


\textsuperscript{17} Jones, "Urban Path-Choosing," pp. 11-4-1-11-4-10.
were concerned with the distribution of social and economic phenomena relative to the city center rather than with actual land uses. These phenomena, however, are not devoid of land use associations; although the distance relationship between the implied land uses of the phenomena and the city core may be stronger than those between actual land use and the city core. Jones reported that respondents do have notions concerning the implicit relationship between land use and distance from the city center.

(b) "Distance zone accuracy" is highest for the sector structure. The observed order of the means (I (Newark), II (Marion), III (Columbus)) implies that the interrelation between land use and relative distance to the city center is better understood for City I than for the other cities. Spatial features such as density of buildings, size of lots, and so on are thought to be important in judging distance from the city center. In the sector structure, where land use is fairly uniform throughout each sector, changes in these features are continuous and display a somewhat consistent relationship with distance to the city center. Some density features are associated with particular land uses. In the concentric structure, where several land use changes may occur along the length of a route, density differences may be the result of (1) distance to the city center and/or (2) the type of land use activity. A similar situation exists for the mixed city where density changes may be due to either the reasons stated for the concentric city-type as well as nearness to a secondary commercial or otherwise influential node (e.g., urban university area). Given the multiplicity of density associations in the concentric and mixed
structures, the outcome for "distance zone accuracy" is understandable.

(c) For "overperception of distance," the ordering of the accuracy means is Cities III, I, II; thus overperception is lowest for the mixed structure and greatest for the concentric structure. As explained above, the respondents were more familiar with City III than with the other two cities. Respondents in all categories of residence were more accurate in their distance estimates for City III, the mixed city, than they were for either the sectoral (I) or concentric city (II). Although the difference is small, overperception is less for the sector city than for the concentric city. This result leads one to believe that respondents are better able to judge the interrelation between land use and perceived "actual" distance in the sector structure (I) than in the concentric structure (II), just as they did the interrelation between land use and relative distance. While diverse density patterns may have affected the "distance zone accuracy" for City III, they are not as effective in influencing the "overperception of distance." Instead, familiarity has greater impact for this variable on City III. It is interesting to speculate what ordering of accuracy means may have occurred had all three cities been equally unfamiliar to the respondents. In this case, the writer believes the results would have been the same as those observed for "distance zone accuracy."

(d and e) The final two variables are concerned with the field trip experiment. The expected order of means for the "anticipation" and "memory" accuracies is II, III, I; the observed order for both
measures is I, II, III. The respondents are most accurate for the sector city and least accurate for the mixed city. Several possible causes exist for the deviations of the ordering of the means from the hypothesized direction. Firstly, as stated above there is the factor of city size. City III is larger than the others and therefore, has a greater number of features to be noticed. The richness of the environment can result in greater selectivity of features to be included in the mental images, especially since individuals tend to skeletonize the urban environment in mental representations. The greater the number of features present in an environment, the greater the likelihood of a memory lapse. Therefore, the richness of the environment affects both the "anticipation" and "memory" accuracies. Secondly, traffic arteries have a greater role in the organization of the sector structure. Unless the trip is planned to traverse many of the interstitial areas of a city, a field trip tends to be arterial in nature. This is certainly true of the trips in the present study. Thirdly, since most of the trip route in each structure was located beyond the city core, Steinitz's statement that urban knowledge patterns appear to be sectoral beyond the core apply. He attributes this occurrence to the individuals' "automobile" experience of the city. Steinitz's "automobile" experience can be interpreted to express the individuals' typical style of movement in the city—that of traveling along routes from one point to another in the city.

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18 Steinitz, "Meaning and the Congruence," p. 244.
The results of the analysis do not confirm the proposed hypothesis that the concentric structure facilitates image formation. In fact, if the effect of familiarity can be isolated, the results support the idea that the sector structure is easier to image than the other structures.

Hypothesis C3

Hypothesis C3 states **city structure** has a greater discriminatory power than any of the individual characteristics examined. For the slide perceptions, the results of the analysis can again be interpreted by the methods listed in Chapter III. A larger proportion of the accuracy measures exhibit significant F-values when discriminated by each city-type than when discriminated by any given individual characteristic\(^{19}\) (see Table 22). The number of significant F-values observed are (1) **city structure**, 3; (2) **length of residence**, 1; (3) **urban experience**, 1; (4) **downtown shopping propensity**, 0; and (5) **navigational experience**, 0. A second method compares the proportion of accuracy measures with significant F-values when the data are cross-classified by city structure and each of the personal characteristics.\(^{20}\) **City structure** again displays greater discriminatory power than any of the personal characteristics examined. The number of significant F-values observed for each basis of classification is (1) **city structure**, 3, this remains constant across all the classifications; (2) **length of residence**, 0; (3) **urban experience**, 1;

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\(^{19}\)This is equivalent to a one-way analysis of variance.

\(^{20}\)This is equivalent to a two-way analysis of variance.
(4) downtown shopping propensity, 0; and (5) navigational experience, 0 (for breakdown by accuracy measures, see Table 20). Finally, the F-values for city structure are always greater than those for the personal characteristics when the measures are cross-classified by city structure and personal characteristics. In this comparison, there are twelve F-values for city structure and twelve for the personal characteristics. All three interpretations confirm the hypothesis for the slide experiment measures.

The nature of the field trip data only permit one method of interpretation—that of comparing the proportion of accuracy measures which exhibit significant F-values when grouped in turn by city structure and each person characteristic. The number of significant F-values observed are (1) city structure, 2; (2) length of residence, 0; (3) urban experience, 1; (4) downtown shopping propensity, 2; and (5) navigational experience, 0. The F-values for city structure are significant at the .01 level, while those for downtown shopping propensity are significant at the .05 level. Thus, although the number of significant F-values observed for city structure and downtown shopping propensity are equal, it appears that the discriminatory power of city structure is still greater than that of the personal characteristic downtown shopping propensity.

Hypothesis D1

According to this hypothesis, length of residence in a large urban place will be more meaningful than any of the other personal

\[21\text{In this comparison, all F-values, whether significant of not, are used.}\]
characteristics in discriminating between the mean accuracy measures for both the slide and field trip experiments. The results of the analysis weakly support the hypothesis for the slide perceptions where the analysis produces one significant F-value for both length of residence and urban experience for overperception of distance. There are no significant F-values for the remaining personal characteristics. The level of significance, however, is lower for residency (.05) than for urban experience (.01). When the data are cross-classified by city-type and each of the personal characteristics, only the F-value for urban experience remains significant.

For the field trip perceptions, the results of the analysis reject the hypothesis. No significant F-values occur for the length of residence. Of the personal characteristics, downtown shopping propensity appears to be the most meaningful with two significant F-values. Urban experience has one significant F-value for "anticipation accuracy." Navigational experience has no significant F-values. The implications of the field trip results are interesting. The fact that downtown shopping propensity is the most meaningful personal characteristic again supports statements made above concerning the importance of using personal characteristics which depict activity or actual use of the city in studying urban images. Secondly, the significant F-value observed for urban experience for the variable "anticipation accuracy" seems to suggest that individuals do rely on their past experience with particular types of environments when anticipating future environmental conditions. More research is necessary to explore the effects of this last assertion.
be mentioned before dismissing the value of urban experience in the perception of the city. Two of the cities in the study belong to the small city category; thus, it is understandable that the respondents with small city backgrounds were most accurate for four of the perception measures. Only five respondents who participated in the field trip experiment had a rural background (eleven of the slide experiment respondents had a rural background). This fact may have affected the results for "distance zone accuracy" more than the environmental experience. Definite conclusions on the effect of past urban experience (environmental background) on urban perception must await further research designed specifically to test this relationship.

Hypothesis D3

Hypothesis D3 states that individuals who reported experiencing confusion while driving in an urban area are less able to form or retain accurate images than are those who do not experience confusion. Thus, it is expected that individuals who reported no confusion will exhibit greater mean accuracy for the measures examined. The two accuracy measures used in the field trip design provide evidence for both image formation and retention. In both cases, individuals who reported experiencing confusion have a greater mean accuracy score than those who experienced no confusion (see Table 26). The slide measures also provide information on the formation and retention of images, although the retention factor was not specifically incorporated into the design. It is more the result of the respondents' familiarity with City III. Individuals who reported experiencing confusion have a lower mean for "overperception of distance;" thus, they are more
TABLE 26
SUMMARY OF MEAN ACCURACY FOR SLIDE AND FIELD TRIP PERCEPTION MEASURES WHEN GROUPED BY NAVIGATIONAL EXPERIENCE

<table>
<thead>
<tr>
<th>Accuracy Measures</th>
<th>Do Not Experience</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Confusion</td>
<td>Confusion</td>
</tr>
<tr>
<td>land use accuracy</td>
<td>86.6</td>
<td>86.5</td>
</tr>
<tr>
<td>distance zone accuracy</td>
<td>72.3</td>
<td>71.7</td>
</tr>
<tr>
<td>overperception of distance</td>
<td>2.568</td>
<td>2.345</td>
</tr>
<tr>
<td>anticipation accuracy</td>
<td>32.93</td>
<td>42.08</td>
</tr>
<tr>
<td>memory accuracy</td>
<td>57.44</td>
<td>66.37</td>
</tr>
</tbody>
</table>

*aThe smaller figure for this measure is more accurate than the larger figure.*
accurate for this measure.23 The results for the two remaining measures, "land use accuracy" and "distance zone accuracy" indicate that those respondents who do not report experiencing confusion are slightly more accurate than the others. These results tend to confirm the hypothesis.

It is possible to speculate why the reversal of mean accuracy occurred for three of the five measures. Perhaps individuals who experience confusion while driving in an urban area pay more attention to details which permit them to find their way in an otherwise hostile environment. These individuals will tend to anticipate more features on a given route, especially one with which they are somewhat familiar as was the case in the field trip display; in addition, they will tend to remember more features. These individuals may also be more careful in noting exact distances between places. On the other hand, individuals who experience little or no confusion may have little concern for details when traveling over a route. These people may feel that they have a good general idea of approximately where a particular place is or should be located with respect to the central core of the city and what types of land use activity and traffic to expect along the route and/or in the vicinity of a particular place. Thus, they are more accurate in identifying the general measures. Of course, the results for these two measures indicate only a very slight difference

23 Recall that the mean in this case refers to the amount of overperception in miles; therefore, the lower the mean, the less overperception occurs.
**Hypothesis D2**

Hypothesis D2 states that individuals with the greatest urban experience will have the most accurate slide and field trip perceptions. The hypothesis follows from Appleyard's statement concerning the relationship between the accuracy of urban images and the past urban experience of individuals. The three types of environmental experience considered in the study included living the majority of one's first eighteen years in a (1) rural environment, (2) a small city, and (3) an urban/suburban place (metropolitan area). The expected order for the means of the accuracy measures by experience category is 3, 2, 1; that is, those who spent most of their early life in an urban/suburban place are expected to have the most accurate slide and field trip perceptions.

Individuals with a small city background have the most accurate field trip perceptions while those with an urban/suburban background have the least accurate. The same results occur for the "overperception of distance." For "land use accuracy," individuals with small city backgrounds are most accurate, while those with rural backgrounds are least accurate. For "distance zone accuracy," a switch occurs. The individuals with a rural background are most accurate while those with a small city background are least accurate.

The hypothesis is not confirmed since the expected ordering of means never occurs. There are, however, two reservations that should

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22 Appleyard, "Notes," p. 98.
between the two groups of individuals as compared to the differences for the other measures. Nevertheless, it is possible to speculate why the differences occurred, but a more definitive explanation requires more specific testing of these notions.

**Hypothesis D4**

According to this hypothesis, individuals who patronize shops in the city center have more accurate distance perceptions with respect to the city center than those who patronize shopping centers. The results appear in Tables 27 and 28. The difference between the means of the two groups for distance zone accuracy is quite small, but in the expected direction. The same is true for the difference between the means for "overperception of distance." When the data are cross-classified by city structure and downtown shopping propensity, the results support the hypothesis five of the six possible times. The non-conforming case occurs for the concentric city (II).

Although the difference between the two groups is slight in some of the comparisons, the results are in the predicted direction. In a study of perceived urban distance as a function of direction, Lee commented that individuals who interact with the city center tend to have more accurate perception of distance with respect to the city center than those who don't. The results of the present study provide additional support for Lee's comments.

**Summary**

The results for the tests of the hypotheses which concern the

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24Lee, "Perceived Distance as a Function of Direction," pp. 45-49.
### TABLE 27
**SUMMARY OF MEAN ACCURACY FOR DISTANCE MEASURES WHEN GROUPED BY DOWNTOWN SHOPPING PROPENSITY**

<table>
<thead>
<tr>
<th>Distance Measures</th>
<th>Shop Downtown</th>
<th>Do not Shop Downtown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance Zone Accuracy</td>
<td>72.8</td>
<td>72.0</td>
</tr>
<tr>
<td>Overperception of Distance</td>
<td>2.321</td>
<td>2.515</td>
</tr>
</tbody>
</table>

### TABLE 28
**SUMMARY OF MEAN ACCURACY FOR DISTANCE MEASURES WHEN GROUPED BY CITY STRUCTURE AND DOWNTOWN SHOPPING PROPENSITY**

<table>
<thead>
<tr>
<th>Distance Measures</th>
<th>City</th>
<th>Shop Downtown</th>
<th>Do Not Shop Downtown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance Zone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>City I</td>
<td>83.3</td>
<td>78.1</td>
</tr>
<tr>
<td></td>
<td>City II</td>
<td>66.1</td>
<td>70.1</td>
</tr>
<tr>
<td></td>
<td>City III</td>
<td>69.0</td>
<td>67.7</td>
</tr>
<tr>
<td>Overperception</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of Distance</td>
<td>City I</td>
<td>3.123</td>
<td>3.434</td>
</tr>
<tr>
<td></td>
<td>City II</td>
<td>3.336</td>
<td>3.564</td>
</tr>
<tr>
<td></td>
<td>City III</td>
<td>.365</td>
<td>.548</td>
</tr>
</tbody>
</table>
mean accuracy of the respondents' slide and field trip experiments of the city are summarized in Table 29. Two of the hypotheses involving the relationship between city structure and the accuracy of the respondents' perceptions are confirmed: (1) city structure does differ significantly with respect to the accuracy measures tested; and (2) city structure has a greater discriminatory power than any of the personal characteristics examined. The remaining city structure hypothesis is rejected; the zonal structure does not facilitate image formation. In general, these results support others' statements concerning the important role that the actual urban environment, which is represented by city structure in this study, has in the accurate perception of the urban area.25

Of the four hypotheses involving the relationship between a personal characteristic and the accuracy of perception, only one is accepted. Individuals who shop in the city center tend to have a lower overperception of distance than those who do not shop in the city center. This result again supports the suggestion presented in Chapter III that personal characteristics which reflect the individuals actual use of the city have a more meaningful influence in the development of urban images. The following chapter contains a discussion of the overall results of the study and possibilities for future investigation.

### TABLE 29

**SUMMARY OF THE RESULTS FOR THE HYPOTHESES CONCERNING THE ACCURACY OF SLIDE AND FIELD TRIP EXPERIMENTS OF THE CITY**

<table>
<thead>
<tr>
<th>HYPOTHESIS</th>
<th>CRITERION</th>
<th>RESULTS</th>
<th>CONCLUSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1. City structure significantly explains the variations in mean accuracy for both the slide and field trip experiments of the city.</td>
<td># of significant $F$ values of 5 possible</td>
<td>5 significant $F$ values observed.</td>
<td>Accept the hypothesis.</td>
</tr>
<tr>
<td>C2. The concentric structure facilitates mental image formation. This structure should have greater mean accuracy values for the perceptual measures.</td>
<td># of times the expected order of mean accuracy scores occurs.</td>
<td>1 time of 5 possible times.</td>
<td>Reject the hypothesis.</td>
</tr>
<tr>
<td>C3. City structure has a greater discriminatory power than any of the personal characteristics examined.</td>
<td>For slide perception: (1) # of significant $F$ values when grouped by city structure; (2) # of significant $F$ values when cross-classified by city structure and personal characteristic; (3) # of times $F$ value for city structure is greater than that for personal characteristic when cross-classified. For field trip: # of significant $F$-values as in (1) above and also the comparative strength of $F$ value.</td>
<td>Slides: (1) 3, others vary from 0-3; (2) 3, others vary from 0-3; (3) 12 times of 12 possible. For field trip 2, but others vary from 0-2; $F$'s for city structure are significant at .01, others at .05.</td>
<td>Accept the hypothesis.</td>
</tr>
<tr>
<td>D1. Of the personal characteristics considered, the length of residence in a large urban place will be most meaningful in discriminating between the mean accuracy measures for both the slide and field trip experiments.</td>
<td># of significant $F$ values of 3 possible for slides and 2 for field trip.</td>
<td>Slides: 1, others vary from 0-1 in 1 way analysis; in 2-way, significant $F$ for residence lost, 1 remains for other characteristic. For field trip: 0.</td>
<td>Reject the hypothesis.</td>
</tr>
<tr>
<td>D2. Individuals with the greatest urban experience will have the most accurate perceptions.</td>
<td># of times expected order of accuracy means occurs for 5 measures when data grouped by urban experience; expected order: (1) urban/suburban, (2) small city, (3) rural.</td>
<td>0 times.</td>
<td>Reject the hypothesis.</td>
</tr>
</tbody>
</table>
D3. Individuals who reported experiencing confusion while driving in an urban area are less able to form or retain accurate images of the city.

<table>
<thead>
<tr>
<th># of times expected order of accuracy means occurs for 5 measures when data are grouped by navigational experience; expected order: (1) no confusion; (2) confusion.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 times of 5 possible; difference but even then between two groups for the 5 measures is slight.</td>
</tr>
</tbody>
</table>

D4. Individuals who patronize shops in the city center have more accurate distance perceptions with respect to the city center.

<table>
<thead>
<tr>
<th># of times expected order of accuracy means occurs for 2 distance measures when grouped by downtown shopping propensity; expected order: (1) shop downtown; (2) don't shop downtown.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 of 2 times.</td>
</tr>
</tbody>
</table>

TABLE 29 (cont.)
CHAPTER V
CONCLUSIONS

The purpose of the study was to examine the role that the cognitive representations of the spatial structure of the city had on movements to the city center, and to see if variations in the physical structure of cities significantly influenced image building and consequent movement to the city center. Researchers such as Carr and Schissler, Lynch, and Jones\(^1\) reported that the actual environment influences the perception of that environment. Given that the spatial arrangement of features within cities differs, these researchers speculated about the effects of the varied urban structures on image development. Although the question has been raised, most of the empirical work on urban images focused on the specific features included in urban images. No attempt was made to relate organizational characteristics of elements in the urban images to the generalized models of the arrangement of city elements suggested in the geographic and planning literature. The present study attempted to relate the elements found in both urban images and the generalized models of city structure by means of a two-fold approach (1) examining the difference, if any, in the importance attached by a sample of respondents to the same environmental cues as potential way-finding clues in various

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urban structures and (2) investigating the differences in the perception of distance in various urban structures as an indication of the ease of image facilitation.

Two sets of hypotheses were proposed to test the effect of city structure on the cue importance ratings and accuracy measures obtained from the slide and field trip experiment. Two additional sets of hypotheses were proposed to test the effect of the selected personal characteristics on the cue importance ratings and the accuracy measures from the slide and field trip experiments. Analysis of variance was used to test the relationship between the factor of city structure and image variables and also to test the relationship between personal characteristic factors and the image variables. The interpretation of the results for some of these hypotheses involved comparing the number of significant F-values observed for the different factors and the ordering the observed means for the cue importance and accuracy measures (from the slide and field trip experiments) when grouped by different factors.

The results of the hypothesis testing revealed city structure significantly explained the variations in the mean importance assigned to the environmental features as potential way-finding clues by a sample of respondents. City structure also significantly explained the variations in the mean accuracy of responses associated with the slide and field trip experiments. In other words, city structures do differ significantly with respect to both the respondents' rating of way-finding potential of urban features, and the understanding of distance relations between urban features and the city center.
However, the results of the analysis rejected an hypothesis that the zonal structure best facilitated image formation. Based on greater mean values for three of the five accuracy measures from the slide and field trip experiments, the sectoral structure better fostered the understanding of the spatial relationships between urban features and the city center. Finally, city structure had a greater discriminatory power than any of the personal characteristics examined for both the cue importance measures and the measures of perceptual accuracy. City structure differentiated significantly between cue importance means for a greater number of cue types than did any of the personal characteristics. For the four environmental displays taken together, eighteen (of thirty-one) significant F-values were observed for city structure; whereas fewer significant F-values were observed for the personal characteristics. This number varied from a low of three to a high of six significant F-values.

The hypotheses concerning the relationship between individual personal characteristics and the image variables were not as successful as those for city structure. The personal characteristics which conveyed the idea of active participation in the city—downtown shopping propensity and navigational experience—were more meaningful in discriminating between both the mean cue importance and mean accuracy of perception than the length of residence in a large urban place. Recall that it was hypothesized that the individuals who patronized the city center would have more accurate distance perceptions with respect to the city center. This hypothesis was confirmed for both the perception of absolute and relative distance with respect
to the city center. Finally, the hypotheses which concerned the relationship between navigational experience and the urban image variables were rejected.

In general, the results of the hypotheses testing confirmed the importance of the actual urban environment in determining the image of the city. The results also suggested that real differences exist in the mean importance assigned to the same urban features as potential way-finding clues in different structures. Furthermore, they suggested that differences in the perception of distance are also related to city structure. Although these hypotheses were confirmed, the writer uses the word "suggested" as a precautionary measure against the possibility that the results will be generalized across many cities whose structures may differ somewhat from the cities used in the study. To be sure, it is hoped that similar results would be observed for many cities whose structures can be identified as a variation of one of the three generalized models used in the present study. However, until more extensive tests of the hypotheses are undertaken, it is best to view the results as being somewhat specific to the three cities tested.

Summary of Study Conceptualization and Limitations of the Experimental Design and Procedure

The initial stages of the experiment were devoted to operationalizing the four components of urban cognition: (A) urban environment, (B) characteristics of the individual, (C) spatial mobility (behavior), and (D) images of the city. Later stages sought to examine (1) the effect of the urban environment on urban images and (2) the effect of a range of personal characteristics on urban
images. A summary of each operationalization of each component part of urban cognition will be followed by a discussion of the limitations which apply to this operationalization.

The Urban Environment

The "urban environment" was defined as the degree to which the arrangement of urban land uses conformed to one of three classic patterns of city structure: (1) sectoral model, (2) zonal model, and (3) mixed land use model. Three Ohio cities, each representing one of the three generalized models, were selected for testing the effect of various spatial arrangements of land uses on urban image development. The cities which were selected included (1) Newark--sectoral model (also referred to as City I); (2) Marion--zonal model (City II); and (3) Columbus--mixed model (City III).

There were three problems encountered with the operationalization of the urban environment. The first problem with the cities used in the study was that their land use patterns were in some instances imperfect representations of the three generalized models of city structure. Of course, given the distortions caused by features such as rivers and railroads in the land use pattern of any city, it is probably unrealistic to feel that perfect representations of the three classic models of city structure can be found. However, it is possible that a city with a more concentric land use pattern than Marion could be found and used in testing the hypothesis. There is also one other solution to correcting the problem of imperfect representations. This is to work with hypothetical cities; that is, to use map and model displays of cities whose land use patterns and
supporting features were designed to perfectly portray one of the classic generalized models of city structure. Defining the cue content of such classic models would go considerably beyond their original intent or expectation. Of course, the use of hypothetical cities precludes extending the investigation to the real world, but the knowledge gained may justify its artificiality.

The second problem with the cities used in the study concerned their varying size. The experimental results might have been clearer or more meaningful if the three cities had been equal or more uniform in size. The size of the city influences the number of features which occur within the city. This appears to affect the importance of particular environmental features. Distance and density relationships are also distorted in a large city. This appears to affect the accuracy of distance perception. In a study limited to one city, Howard, Chase and Rothman \(^2\) attempted to relate the frequency of seven categories of environmental features to line-of-sight distance estimates provided by a sample of college students in Hamilton, New York (1970 population size: 3,636). They found that the actual frequency of features increased the multiple regression coefficient and thus, accounted for more of the variance for more of the variance for the subjective distance estimates. The actual frequency of features also accounted for more of the variance than did the subjective (cognized) frequency of

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the environmental features. The results of the Howard, et al. study raise several questions concerning the size of cities, the frequency of features, and the relationship of these factors to the cognitive representations of the city.

The third problem with the cities used concerned the differences in the degrees of familiarity with the sample cities. All the respondents were more familiar with Columbus (City III) than with the other two cities. The greater degree of familiarity may have also affected the results of the study. For this reason, it might have been better to use three cities which were equally unfamiliar to the respondents. A foreseeable problem in this case may have been finding a city with a mixed city structure that would have been conveniently located.

The Characteristics of the Sample

The "individual characteristics" considered in the study were those that are thought to be most meaningful in influencing what a person sees or interprets in the environment and what eventually becomes part of the person's urban image. The four characteristics considered included (1) length of residence in a large urban place (Columbus), (2) urban experience, (3) downtown shopping propensity, and (4) navigational experience. Other characteristics such as life cycle stage, income, socio-economic class, and so on were similar for all individuals in the sample. Individual members of a common group (social class, etc.) tend to have similar urban images; therefore, the effect

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3Lynch, Image of the City, p. 7.
of the group characteristics was not examined. The same sample was used in all three city structures to avoid the possibility that characteristics peculiar to the individual such as map-reading abilities would offset the effect of the city structure differences.

Two types of limitations appeared in this part of the study. The first type concerned the relative insignificance of the four personal characteristics used in the hypothesis testing. A perusal of some of the existing literature suggested that these characteristics appeared to be most meaningful in influencing a person's urban image. The results of the hypothesis testing revealed that personal characteristics which define length of residence or type of environmental exposure. From the study results, it appears that more thought must be directed into the isolation and definition of meaningful personal characteristics.

The second type of limitation concerned the sample of respondents used in the study. The respondents were all college students. Therefore, the results of the study must be viewed with this in mind. It is entirely possible that a less uniform sample with respect to characteristics such as age, education, and so on may have produced different cue importance ratings for specific features. In an exploratory study, however, the limitations imposed by using a controlled group of respondents are offset by the elimination of additional variables which would inject "noise" into the initial efforts of isolating particular relationships.

The Urban Image

The "urban image" was defined as the individual's internal representation of the city. It was said to consist of two parts
(1) content/meaning and (2) location/spatial relations. The first part pertained to the existence of urban features or cues in the image and the meaning ascribed to them. Meaning was defined as the importance assigned to a feature with respect to its potential as a way-finding clue. The second part of the image pertained to the locational component of urban features and the spatial relations between such features. Although the term "spatial relations" can be interpreted to include the directional orientation and connection between features, its interpretation is limited to mean distance separation between urban features in this study (as is common to many other studies of urban cognition).

The present study attempted to relate the features found in both the urban images and the generalized models of city structure by means of a two-fold approach. This approach included examining the importance assigned to the features and the accuracy of the perceived spatial relations between selected environmental features and the city center. For all practical purposes, the study concerns both the content and spatial relations of the urban image. The first part consisted of defining the "meaning" of the selected urban features in terms of the ratings of their usefulness in way-finding tasks. The second part concerned the "spatial relations" between urban features, or rather the individual's understanding of the distance separating urban features and the city center within a particular urban structure. The method of inquiry used in the study followed this dichotomization of the urban image. Thus, respondents were first asked to provide ratings for urban features with respect to their potential as
way-finding clues. These elements occurred either along a route to the city center or in an urban scene some distance from the city center. The respondents were next asked to identify the spatial relations between specific features and the city center. This involved specifying the distance between particular features and the city center and ordering these elements along a route to the city center. The respondents repeated the procedure in each of the three cities, thus enabling the writer to compare the differences in responses for the three generalized models of city structure.

The problem encountered with respect to the urban image did not concern the definition of a dichotomous image, but the gathering of information relative to the two aspects of the urban image. Collecting information on the importance of environmental features with respect to their way-finding potential was not difficult. This required the respondents to select a route to the city center or merely to imagine a trip to the city center, visually observe the environmental features that appeared, and finally to evaluate the features with respect to their value in way-finding. The difficulty with this procedure, however, was that since the respondents were free to select any route to the city, they did not always rate the same features in each city structure. It may have been advantageous to have all the respondents take the same route into the city center in each city. This would have forced all the respondents to rate the same urban

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4 Distances were specified for the slide display and the ordering of cues was given for the field trip experiment.
features with respect to their potential as way-finding clues. Obviously, this procedure eliminates the problem of missing data. The procedure, however, would work best in the case of a hypothetical city where the routes could be designed to perfectly reflect the city's structure. In addition, the procedure would result in a smaller number of urban features which could be compared across city structures since a route in a sectoral city would lack the variety of features found on a route in a concentric city.

Other difficulties occurred in collecting the information regarding the spatial relations of the urban image. Firstly, the slide experiment by necessity asked the respondents a different, but similar question. This question asked "How important was the feature in your decision of the slide's location in the city?" In this instance, the respondent was actually engaged in way-finding rather than in describing the route to a stranger seeking that route to the city center. Secondly, data for the field trip measures were available for a relatively small sample of respondents. Factors which contributed to this: (1) the difficulties of getting respondents to make the trip to Marion or Newark and (2) difficulties involved in arranging field trips for similar periods of the day. It also became necessary to limit the field trip to a pre-selected route and to have all respondents act as passengers rather than drivers. The effect of the passenger role may have affected the hypotheses concerning the importance of "traffic" and the anticipation and memory accuracy measures.

Spatial Mobility (Behavior)

"Spatial mobility" was defined as the individual's movement
toward a definite locational goal, the city center. He expressed this behavior in several ways which were related to the different environmental displays—(1) selecting a path to the city center on a map and scale model of the city, (2) traveling over a pre-selected actual route in a city (field trip), and (3) imagining the act of driving in a city while searching for locational clues with respect to the location of the city center (slides). Characteristics of the individual's urban image were inferred from responses made while performing their tasks.

Environmental Displays

Due to the multiplicity of features in any city, it was decided to use four environmental displays in presenting each city structure to the respondents. The four displays used included (1) a map, (2) a scale model, (3) slides, and (4) a field trip experience (real city experience). The four displays represented four different levels of abstraction.

The comparability between the four environmental displays would have been enhanced if the difference between the displays was restricted to the level of abstraction. In this study, additional "noise" was introduced by the differences in the number and types of feature types on the four environmental displays. Part of the problem rests with the number of features one can realistically expect to include on the map. It may be best to ignore land use patterns and present only symbols depicting school buildings, insurance buildings, etc. on a map. The generalized models of the spatial arrangement of urban features found in the geographic and planning literature, however,
are based on land use activity patterns and not the spatial arrangement of specific urban features. The development of generalized models of the spatial arrangement of specific urban features may be an important step in investigating urban images since it appears that individuals consider specific urban features more important than generalized land use activity features.

The differences in the displays also hampered isolating the effect of the different displays on the cue importance and accuracy measures. Only two cue types "land use" and "traffic" were common to all displays. The cue type "traffic" became less important as the displays decreased in the level of abstraction. The importance of the cue type "land use" fluctuated with the availability of more specific features as potential way-finding clues. The greater the number of specific features available to the respondents, the lower the mean importance assigned to "land use." No similar assessment can be made of the effect the field trip and slides on the accuracy of the urban image.

Recently, there has been considerable attention paid to the use of several methods of obtaining information concerning the content/meaning and the location/spatial relation aspects of urban images. Caldwellader, Briggs, and Howard et al. have discussed alternative methods of obtaining cognized distance estimates. The

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work concerning alternative methods of obtaining information relative to the meaning and content of urban images has not reached the same level as that involving cognitive distance estimates. Appleyard attempted to correlate the frequency with which features were mentioned in verbal recall of the city image with the features included in the cognitive maps which were reproduced on paper, and a number of others have commented upon the differences in using real and representative environments. In most cases, the studies have not been concerned with the perception of the macro-urban environment per se (e.g., the city), but with affective responses to buildings, rooms, lighting, etc. There are definite advantages in using representative environments studying urban images. The chief advantage appears to be a reduction in the "noise" features which complicate the isolation of relevant information. However, if the relationship between information concerning urban images of scale models of the city shows little correspondence to those of the actual environment then the question of relevance of simulated environmental research demands attention. In the writer's opinion, the state at which this question may be meaningfully answered has not yet arrived.


Future Research

The study has had reasonable success considering its exploratory nature and the limitations encountered in its design and execution. The study supports the relationship between the actual urban environment and the selection of environmental cues that has been mentioned by others. It suggests that city structure does influence the importance assigned to urban features as potential way-finding clues and the accuracy of distance perception. Among the most interesting aspects of the study, however, are the many potential research questions that it raised. One such question concerns the personal characteristics which are thought to have some influence in the perceptual selection and organization of environmental information. The results suggest that more meaningful ways are needed to represent an individual's interaction with the urban environment. Still other possibilities for understanding the relationship between the individual characteristics and cognitive representations or perceptual selection may warrant investigating further Kelly's thoughts on personal constructs.8

Another avenue for research includes that of developing a generalized model of the arrangement of specific urban features and then studying the correspondence between its features and those found in the common urban images of individuals. This research might be extended to investigate the hierarchical order of urban nodes and

features within a city and also the possibility of a corresponding hierarchical ordering of such nodes and features in the city of the mind. This avenue of research might also be extended to investigate the frequency with which particular features appear in the city and how this frequency affects both the content and spatial relations aspect of urban images.

The work of Howard, Chase and Rothman suggested the actual frequency of environmental features had a different relationship with cognized distance estimates. Although not specifically used in this thesis, the writer is fortunate to have collected information from the respondents which could further test these suggested relationships.

Further research concerning the correspondence between environmental features and spatial relations found in urban images and those found in various city structures should be valuable to city planners and designers. The present study suggested that sectoral arrangement of urban land use features results in a better understanding of the distance separation between urban features and the city center. It is, however, difficult to generalize this finding beyond the three cities tested in the study. Wider testing of the ideas in this study could aid designers and geographers engaged in the central city revitalization programs in providing urban environments which promote

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comprehension of spatial relations. Such urban environments could possibly provide both the "legibility" and "emotional security" urban designers feel urban residents need.
APPENDIX A

CITY MAPS WITH ZONES AND SECTORS MARKED
FIGURE 16
CITY I (NEWARK) WITH SECTORS MARKED
FIGURE 17
CITY II (MARION) WITH ZONES MARKED
FIGURE 18
CITY II (MARION) WITH SECTORS MARKED

[Diagram showing city layout with various areas marked, including Low Density Residential, High Density Residential, Open Space and Parks, Commercial and Offices, and Institutions.]
FIGURE 19

CITY III (COLUMBUS) WITH ZONES MARKED

Low Density Residential

High Density Residential

Commercial and Offices

Industrial

Open Space and Parks

Institutions

Central point

Traffic lights

Scale: 0 - 5000 feet

CITY 3 N
FIGURE 20
CITY III (COLUMBUS) WITH SECTORS MARKED

- Low Density Residential
- High Density Residential
- Commercial and Offices
- Industrial
- Open Space and Parks
- Institutions
- Central point
- Traffic lights

Legend:

- 0 3000 6000 feet
APPENDIX B

ILLUSTRATIONS OF SCALE MODELS FOR THREE CITIES

170
FIGURE 21. Overhead view of Model for City II (Marion).

FIGURE 22. Oblique view of Model for City II (Marion).
FIGURE 23. Overhead view of Model for City II (Marion) With Transparent Plastic Frame

FIGURE 24. Key: Land Use.\textsuperscript{a}

\textsuperscript{a}The land use key is the same for all three cities.
FIGURE 25. Key: Symbols.\textsuperscript{a}

\textsuperscript{a}This key is the same for all three cities.

FIGURE 26. Key: Generalized and Unique Features.\textsuperscript{a}

\textsuperscript{a}The generalized features appear on all three city models. The unique features are specific to each city.
FIGURE 27. Overhead view of Model for City I (Newark).

FIGURE 28. Overhead view of Model for City III (Columbus).
APPENDIX C

LIST OF SLIDES AND SAMPLE ILLUSTRATIONS OF SLIDES
List of Slides

City I - Newark

1. Central Square
2. Restaurant Row - Central Business District
3. Single Family Residences Between Inner City and Suburban
4. Trailer Park
5. Ohio State Branch Campus Building
6. Factory in Industrial Park
7. Factory in Inner City
8. Suburban Single Family Housing
9. Southgate Shopping Center
10. McDonald's
11. Suburban Upper Class Housing
12. Central Business District View

City II - Marion

1. Single Family City Neighborhood
2. Regional Shopping Center
3. City Elementary School
4. City Hall (Suburban Site)
5. Central Business District
6. Industry in Inner City
7. High Rise City Apartments
8. Single Family Residences Between Inner City and Suburban
9. Industrial Park
10. City Apartments
11. Neighborhood Grocery Store
12. Suburban Park

City III - Columbus

1. Inner City Residences
2. Inner City School
3. City Skyline
4. Arterial Commercial Strip
5. Suburban Shopping Strip
6. Inner City Houses
7. Central Business District
8. Suburban Residences
9. Single Family Residential
10. Neighborhood Grocery Store
11. Suburban Factory
12. Suburban High School
13. Campus Shopping Strip
14. Large Single Family Houses
15. City Apartments
FIGURE 29. Newark - Central Square

FIGURE 30. Newark - Factory in Inner City
FIGURE 31. Newark - Single Family Residences Between Inner City and Suburban

FIGURE 32. Marion - High Rise City Apartments
FIGURE 33. Marion - City Apartments

FIGURE 34. Marion - Industry in Inner City
FIGURE 35. Columbus - Central Business District

FIGURE 36. Columbus - Inner City Houses
APPENDIX D

DISPLAY EFFECT
FIGURE 37. Columbus - Neighborhood Grocery Store
Four environmental displays are used in the study: (1) maps, (2) models, (3) slides, and (4) field trips. The features or feature types on each display differ in both number and kind. There are, however, two feature types which appear on and are similarly defined for all four displays. These features types are (1) "traffic" and (2) "land use." The differences in the number and kinds of feature types on each display make it difficult to test the effect of display on the importance ratings. Some insight into the display effect, however, can be gained by comparing the grand means for cue importance when the data are grouped by the factor, city structure, for the cue types which are common to the four displays.

Before being able to compare the mean cue importance for the cue types "traffic" and "land use," it is necessary to re-group the appropriate features on the map display. This requires summing the grand means for the two "traffic" features and six "land uses" appearing on the map display and getting an average grand mean for each. Essentially, this procedure combines single traffic and land use features into feature types comparable to those on the other displays.\(^1\)

Anticipating the possible display effect, the writer feels the cue type "traffic" will be rated most important on the field trip display. It is believed that traffic features demand more attention from individuals when they are actually engaged in driving in the city than when they are reading city maps. This belief prompts the writer

\(^1\)For definition of these cue types on the other displays, see Tables 3, 4, and 5 in Chapter II.
to anticipate a consistent increase in the mean cue importance observed for "traffic" as the level of abstraction for the displays decreases. Conversely, the writer feels that "land use" will be rated least important on the field trip. In a real city environment, a great number of features compete for selection as way-finding clues. In general, it is believed that individuals choose specific rather than generalized features (large building versus land use) as way-finding clues when describing a location or route. Thus, two hypotheses concerning the display effect are proposed:

Hypothesis 1: The cue type "traffic" will be rated most important for the field trip display.

Hypothesis 2: The cue type "land use" will be rated least important for the field trip display.

Before examining the grand means, it should be recalled that for each display, the respondents rated the features with respect to how important the feature would be if the respondents were relating their route of travel to a stranger who wished to take the same route into 'town.' Thus, the respondents were rating the features in terms of their potential as way-finding clues. For the slide display, the respondents were asked to rate the features with respect to the feature's importance in the respondents' locational identification of the scene. This importance rating may also be interpreted as the feature's potential as a way-finding clue. In this case, however, the respondents were actually seeking the location of a scene. The features

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2Respondents rated single features on each display. These features were grouped into types to facilitate analysis of the model, slide, and field trip results.
they used as clues in the identification of the scene's location are probably the features they would use in describing the scene to a stranger desiring to find that particular location (scene).

The grand means for the cue types "traffic" and "land use" appear in Table 30. "Traffic" is rated least important on the field trip. In fact, "traffic" decreases in importance as the displays become less abstract. It appears that traffic features are more important in an abstract setting than in settings which better represent the city as

**TABLE 30**

GRAND MEANS OF CUE IMPORTANCE FOR CUE TYPES TRAFFIC AND LAND USE^a^  

<table>
<thead>
<tr>
<th>Environmental Display</th>
<th>Traffic</th>
<th>Land Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maps</td>
<td>68.948^b^</td>
<td>62.753^c^</td>
</tr>
<tr>
<td>Scale Models</td>
<td>58.338</td>
<td>53.673</td>
</tr>
<tr>
<td>Slides</td>
<td>49.856</td>
<td>65.506</td>
</tr>
<tr>
<td>Field Trip</td>
<td>48.870</td>
<td>41.826</td>
</tr>
</tbody>
</table>

^a^The grand means are those observed when the data is grouped by the factor, city structure.

^b^Represents the average grand mean for the two traffic features, traffic lights and railroad crossings.

^c^Represents the average grand mean for the six land uses on the maps.

the respondents see and experience it in their daily existence. This result may be related to the fact that traffic features are both (1) prominently displayed on the maps and also (2) one of only three different feature types available for rating. It is also possible that
The respondents rated "traffic" less important in the field trip situation than they might have had they been given the responsibility of negotiating the trip themselves.

The cue type "land use" is rated least important for the field trip. It is also rated less important on the models than on the maps and slides. Both the models and the field trip had a greater number of specific features than did the maps and slides. Thus, it seems that respondents rated "land use" less important as a potential way-finding clue when they were confronted with a greater number of more specific features from which to choose important way-finding clues.

In summary, the difference in the number and kind of features types found on the different displays makes it difficult to isolate the effect or the different displays on cue importance. It does, however, appear that the general cue types such as "traffic" and "land use" become less important as potential way-finding clues when the number of specific features available for selection as clues increases.
APPENDIX E

ORDER EFFECT
TABLE 31
MEAN ACCURACY FOR SLIDE PERCEPTION MEASURES WHEN CLASSIFIED BY THE ORDER OF PERFORMANCE (GROUP)

<table>
<thead>
<tr>
<th>Order of Display</th>
<th>Group</th>
<th>Land Use Accuracy</th>
<th>Distance Zone Accuracy</th>
<th>Overperception of Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Trip, Maps,</td>
<td>IV</td>
<td>88.2 (1)</td>
<td>73.8 (1)</td>
<td>2.385 (1)</td>
</tr>
<tr>
<td>Models, Slides</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maps, Models,</td>
<td>I</td>
<td>87.8 (2)</td>
<td>71.9 (3)</td>
<td>2.555 (4)</td>
</tr>
<tr>
<td>Slides, Field Trip</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Models, Slides,</td>
<td>II</td>
<td>86.7 (3)</td>
<td>72.8 (2)</td>
<td>2.511 (2)</td>
</tr>
<tr>
<td>Field Trip, Maps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maps, Models,</td>
<td>III</td>
<td>83.3 (4)</td>
<td>69.6 (4)</td>
<td>2.527 (3)</td>
</tr>
<tr>
<td>Slides, Field Trip</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Recall that the most accurate mean for this measure has the lowest numerical value.

Rank of mean accuracy.

Group III worked with the slide display first. The individuals in this group are least accurate for the "land use" and "distance zone" measures. They rank third in the "overperception of distance". The ranks of the other groups vary. There appears to be a consistent trend for "land use accuracy"—in inverse relationship between the order of slide performance and accuracy of land use identification. This consistency does not hold for "distance zone accuracy" and "overperception of distance".
The writer felt that the respondents may gain experience identifying land uses and distances in the course of working with the four environmental displays. The procedure may become clearer as the respondent progresses from one display to another. In an attempt to permit some evaluation of the "learning and practice" effect, the writer divided the sample into four groups at the start of the study. Each group was then assigned to a particular order of display presentation such that each group worked with a different display first.

The accuracy measures from the slide perceptions are used in testing the order effects. Anticipating the possible effect, the writer feels that mean accuracy for the slide perceptions will be directly related to the order of environmental display performance.

Thus, the following hypothesis is proposed:

Hypothesis: The group that performed the slide display test last will have the most accurate slide perception means.

The observed ordering of the means for the slide accuracy measures when classified by group (order of performance) support the hypothesis.

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1 The results of a discriminant analysis revealed that the four groups did not differ significantly with respect to ten personal characteristics. These characteristics included the four used in the analyses of variance discussed in Chapter III and IV as well as six others such as age, sex, etc.

2 The field trip accuracy measures were not used to test the hypothesis for two reasons. Although the trip was described to respondents not taking it, only 33 respondents did participate in the field trip. Secondly, the respondents who did participate took a field trip in only one city; therefore, the field trip measures were city specific as well as group specific.

3 The results of the analysis of variance for the accuracy measures when classified by group revealed only one significant F-value--for land use. When the data were cross-classified by city structure and group in order to correct for the repeated measures problem, the results revealed no significant F-values for the group factor.
COVER SHEET
GENERAL INFORMATION

NAME______________________________________

STREET ADDRESS_______________________________
NUMBER STREET

CITY ZIP CODE

PROJECT CODE IDENTIFICATION NUMBER_______

NOTE: THIS SHEET WILL BE TORN OFF THE QUESTIONNAIRE; THEREFORE, IT IS IMPORTANT THAT YOU PUT YOUR NUMBER ON EACH PAGE. ALL INFORMATION CONTAINED IN THE QUESTIONNAIRE WILL BE KEPT CONFIDENTIAL. THE ANALYSIS OF INFORMATION WILL NOT BE ASSOCIATED WITH THE PARTICIPANT AT ANY TIME BY NAME.
PERSONAL CHARACTERISTICS:

1. Age:________

2. Sex:________male _______female

3. Marital Status:
   ____single   ____divorced   ____separated
   ____married   ____widowed

4. Education: List the highest level attained___________.
   If presently in college answer question 5.

5. Class ranking:
   ____Freshman   ____Senior
   ____Sophomore   ____Graduate Student
   ____Junior     ____Other (please specify)

6. If currently enrolled in college, specify which college (e.g. Education, Arts and Sciences):

   ___________________________

7. If currently enrolled in college, give major field of study:

   ___________________________

8. Occupation:
   ____student
   ____other (please specify)

9. If you have a job in Columbus (part-time and other-wise),
   answer the following questions:
   a. type of job: ___________________________
   b. place of work (Name): ___________________________
   c. Street address of work site: ___________________________

RESIDENTIAL INFORMATION:

10. Where is your permanent residence? (i.e. where do your parents live?)

   ___________________________
11. How long have you lived at the address in Number 10?

__________ years __________ months

12. How long have you lived in Columbus?

__________ years __________ months

13. How long have you lived in Marion, Ohio?

__________ years __________ months

14. How long have you lived in Newark, Ohio?

__________ years __________ months

15. If you commute to campus from a place outside Columbus proper, list:

a. name of town ______________________________

b. how long have you lived there __________ years __________ months

16. Where have you lived most of your life up to age 18? (include city or town and state)

17. In which of the following categories would you place your answer to question 16?

_____ rural
_____ city (over 2500 population)
_____ urban (over 500,000)
_____ suburban

18. Do you consider the place in which you now reside to be:

_____ rural
_____ city (over 2500)
_____ urban (over 500,000)
_____ suburban

19. Do you consider Columbus to be:

_____ rural
_____ city (over 2500)
_____ urban (over 500,000)
_____ suburban
20. If the place you refer to in question 18 is the same as that in question 19 (Columbus), check answer "yes" for this question.
   ______ yes
   ______ no

MOBILITY INFORMATION

21. Do you drive? (Know how to drive)
   ______ yes
   ______ no

22. Do you have a current driver's license?
   ______ yes
   ______ no

23. at what age did you begin driving? 

24. Do you own or have access to a car in Columbus?
   a. own
   b. have access to a car

25. If answer to question 24 is "b" specify conditions, for example: family car when I need to use it—about 5 times a week; friend's car, etc.

26. Do you own or have access to a car in Marion, Ohio?
   a. own
   b. have access to a car

27. If answer to question 26 is "b", specify conditions:

28. Do you own or have access to a car in Newark, Ohio?
   a. own
   b. have access to a car
29. If answer to question 28 is "b", specify conditions:

30. Do you own or have access to a car in your hometown (if you are from someplace other than Marion, Newark, or Columbus)?

   a. own
   b. have access to a car

31. If answer to question 39 is "b", specify conditions:

32. Do you drive to Campus?

   yes
   no

33. Do you ride a bicycle to campus?

   yes
   no

34. When shopping in Columbus, do you ______ to the shopping site? (Check all those that apply and put the letter of the mode you use most often in the blank above)

   a. walk
   b. drive
   c. take the bus
   d. bike
   e. go as a passenger in someone else's car

35. When shopping in Marion, do you ______ to the shopping site? (Check all those that apply and put the letter of the mode you use most often in the blank above)

   a. walk
   b. drive
   c. take the bus
   d. bike
   e. go as a passenger in someone else's car

36. When shopping in Newark, do you ______ to the shopping site? (Check all those that apply and put the letter of the mode you use most often in the blank above)

   a. walk
   b. drive
36. (continued)
c. take the bus
d. bike
e. go as a passenger in someone else's car

37. When shopping in your hometown, do ______ to the shopping site?
(Answer only if your hometown is someplace other than Columbus, Marion, or Newark. Check all those that apply and put the letter of the mode you use most often in the blank above)

   ______ a. walk
   ______ b. drive
   ______ c. take the bus
   ______ d. bike
   ______ e. go as a passenger in someone else's car

38. Where do you do most of your shopping in Columbus?

   ______ a. downtown
   ______ b. shopping center, if so name the center you visit most

39. Where do you do most of your shopping in Marion?

   ______ a. downtown
   ______ b. shopping center, if so name the center you visit most

40. Where do you do most of your shopping in Newark?

   ______ a. downtown
   ______ b. shopping center, if so name the center you visit most

41. Where do you do most of your shopping in your hometown?
(Answer only if your hometown is someplace other than Columbus, Marion or Newark.)

   ______ a. downtown
   ______ b. shopping center, if so name the center you visit most

42. Estimate the number of trips you make in a year to the downtown in the following places. (Count all trips whether they are shopping trips, recreational trips, business trips, etc.)

   ______ a. Columbus
   ______ b. Marion
   ______ c. Newark
   ______ d. Hometown
GENERAL FAMILY INFORMATION:

43. Number of people in your family

44. Number of cars in your family

45. Father's occupation? Be specific, e.g., high school teacher, assembly line worker, poultry farmer:

46. Father's education? Check the highest category applicable.
   - completion of a graduate degree
   - standard college or university graduation
   - partial college
   - high school graduation
   - partial high school
   - junior high school completion
   - less than seven years

47. Would you mind indicating the approximate income of your family? This question is optional, however, if you choose to answer it the information will give us a better insight to the travel patterns which you may have. This relationship has been made in previous studies.
   - under $3,000
   - $3,000 to 5,999
   - $6,000 to 8,999
   - $9,000 to 11,999
   - $12,000 to 14,999
   - $15,000 to 24,999
   - $25,000 and over

ATTITUDE STATEMENTS:

Check the appropriate answer.

48. I enjoy living in an urban area.

49. I enjoy driving in an urban area.

50. I find traveling in an urban area. (Traveling should be interpreted as meaning driving).
Number ______________

MAP INSTRUCTIONS:

A. Put your project code number in the right hand corner of each map. Select a map. Select a route into the central business district (city center) starting anywhere on the periphery of the map.

B. Put your project code number on each checklist. Fill-in the proper city number on the checklist. Check the route you have selected against the features on the checklist. If the feature appears on the route, please rate the features in terms of the importance you attach to remembering the feature when relating this route to a stranger desiring to use the same route into "town." If the feature does not appear on your route, do not give it a rating.

C. After finishing parts A and B for one of the cities, repeat for each of the remaining cities. In all, you will repeat the procedure three times.
After checking your selected route, please rate the features which appear on it in terms of the importance you attach to remembering the features when relating this route to a stranger desiring to use the same route into "town." If the feature does not appear on your selected route, do not give it a rating.

Indicate the rating you assign to the feature by circling the appropriate number. The numbers represent the following verbal terms:

(1) not important  (2) not very important  (3) indifferent  
(4) important  (5) very important

<table>
<thead>
<tr>
<th>RATING</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td>low density residential land use</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>high density residential land use</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>commercial and office land use</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>industrial land use</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>institutional land use</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>traffic lights</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>railroad crossings</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>streams</td>
</tr>
</tbody>
</table>

Each student received three copies of this checklist.
FIGURE 40

CITY III - WORK MAP

- Low Density Residential
- High Density Residential
- Commercial and Offices
- Industrial
- Open Space and Parks
- Institutions
- Central point
- Traffic lights
- 0 3000 6000 feet

CITY 3

[Map of City III with various land use categories marked]
Number ______________________

MODEL INSTRUCTIONS:

A. Put your project code number in the upper right hand corner of the transparent frame on the model on which you are working. Please make your numbers large and distinctive.

B. Select a route into the city center starting from anywhere on the periphery of the model. Outline the route on the transparent plastic with the water-base marker provided on the table.

C. Put your project code number on each checklist. Please be sure the checklist you are going to use matches the model you have worked on. (Checklist for City I with Model for City I.)

D. Now check the features on your route with those on the checklist. Rate the features which appear on the route you selected in terms of the importance you attach to remembering the feature when relating this route to a stranger desiring to use the same route to the city center. If the feature does not appear on your route, do not give it a rating. Rate the features in both parts A and B of the list if they appear on your route.

E. The rating scale appears at the top of each checklist. It is the same for all lists. You will circle the number when giving your rating.

   (1) not important   (2) not very important   (3) indifferent
   (4) important      (5) very important

F. When you have finished working on one model (City), repeat the above procedure for the other two models. You may work with any model first. Then move to another model that is free and begin again.
<table>
<thead>
<tr>
<th>Number</th>
<th>City Number</th>
</tr>
</thead>
</table>

Rating scale:\(^a\)

(1) not important  (2) not very important  (3) indifferent  
(4) important  (5) very important

---

CIRCLE THE APPROPRIATE NUMBER.

### Part A

| 1 2 3 4 5 | low density residential land use |
| 1 2 3 4 5 | high density residential land use |
| 1 2 3 4 5 | downtown commercial and office land use |
| 1 2 3 4 5 | arterial commercial and office land use |
| 1 2 3 4 5 | industrial land use |
| 1 2 3 4 5 | open space and parks |
| 1 2 3 4 5 | institutional land use |
| 1 2 3 4 5 | traffic lights |
| 1 2 3 4 5 | railroad crossings |
| 1 2 3 4 5 | street direction information |
| 1 2 3 4 5 | streams |
| 1 2 3 4 5 | shopping center |
| 1 2 3 4 5 | elementary school |
| 1 2 3 4 5 | high school |
| 1 2 3 4 5 | state school |
| 1 2 3 4 5 | bank |
| 1 2 3 4 5 | theater |
| 1 2 3 4 5 | freeway |
| 1 2 3 4 5 | department store |
| 1 2 3 4 5 | insurance building |
| 1 2 3 4 5 | hotel, motel |
| 1 2 3 4 5 | government office building |
| 1 2 3 4 5 | park |
| 1 2 3 4 5 | hospital |

\(^a\)Each student received three copies of Part A of the checklist. On the original work materials, Part A was all on one sheet of paper; Part B appeared on the left side of the sheet.
Number
City Number
Part A continued:

1 2 3 4 5  high rise apartment, dorm
1 2 3 4 5  library
1 2 3 4 5  car dealer
1 2 3 4 5  post office
1 2 3 4 5  utility
1 2 3 4 5  cemetery
1 2 3 4 5  medical building
1 2 3 4 5  Ohio State University Campus
1 2 3 4 5  church
Number

City Number  I

**Part B**
(Features unique to City I)

1 2 3 4 5  Continental Can Co.
1 2 3 4 5  Westinghouse Co.
1 2 3 4 5  Carrol Department Store
1 2 3 4 5  Kline Department Store

City Number  II

**Part B**
(Features unique to City II)

1 2 3 4 5  YMCA
1 2 3 4 5  Harding Home
1 2 3 4 5  Railroad Depot
1 2 3 4 5  Marion Power Plant (shovels)
1 2 3 4 5  Quaker Oats
1 2 3 4 5  Whirlpool
1 2 3 4 5  Harding Monument
1 2 3 4 5  Granary
1 2 3 4 5  Steel Factory
1 2 3 4 5  S and L Department Store
1 2 3 4 5  Uhler's Department Store
1 2 3 4 5  Trailer Park
<table>
<thead>
<tr>
<th>Number</th>
<th>Feature Unique to City III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5</td>
<td>Lazarus Department Store</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Union Department Store</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Capitol</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Union Station (Penn Central Railroad)</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Machinery Plant</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Dairy</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Heating Factory</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Timken Roller Bearing Co.</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Army Reserve Center</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Control Machinery Plant</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Continental Grain Company</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Art Gallery</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Museum of Science and Industry</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>LeVeque-Lincoln Tower</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Vets Memorial Auditorium</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>BBF</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>White Castle</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Restaurant</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
<td>Private School</td>
</tr>
</tbody>
</table>
SLIDE DIRECTIONS:

A. Look at each slide. Decide on land use type (A-G on Slide Information Sheet) and where the slide is located in the city (Choices 1-3 under each letter A-G). Put the letter followed by the number in the blank labeled "LAND USE, LOCATION" under the proper slide number. Example: Al.

B. Draw a line showing approximately how far the slide is from the city center. Place this line by the word "Distance" under the proper slide number. Use the scale, Part B, on the Slide Information Sheet as a guide in drawing your line.

C. Under each slide number, heading "C" is labeled "Feature(s)." Beside each feature give it a rating on a 1-5 scale ((1) not important, (2) not very important, (3) indifferent, (4) important, (5) very important) with respect to the feature's importance in your identification decision. Feel free to add another feature in the blank labeled "other." If you include a feature in the "other" category, please give it a rating as well.
LOCATIONS FOR PART A:

A. COMMERCIAL
   1. Central Business District (CBD)/ Inner City
   2. Shopping Strip/ between CBD and Suburban
   3. Shopping Center/Suburban

B. NEIGHBORHOOD GROCERY STORE
   1. Inner City
   2. Between Inner City and Suburban
   3. Suburban

C. RESIDENTIAL SINGLE FAMILY
   1. Inner City
   2. Between Inner City and Suburban
   3. Suburban

D. RESIDENTIAL, APARTMENTS
   1. Inner City
   2. Between Inner City and Suburban
   3. Suburban

E. INDUSTRIAL
   1. Inner City
   2. Between Inner City and Suburban
   3. Suburban

F. INSTITUTIONS
   1. Inner City
   2. Between Inner City and Suburban
   3. Suburban

G. PARK
   1. Inner City
   2. Between Inner City and Suburban
   3. Suburban

SCALE FOR PART B:

(¼ in. equals 1 mile)
CITY I

Slide Number:

1. A. Land use, location:________
   B. Distance:
   C. Feature(s):
      _____1. bank
      _____2. government building
      _____3. land use as a location feature
      _____4. traffic lights
      _____5. other, (specify)

2. A. Land use, location:________
   B. Distance:
   C. Feature(s):
      _____1. land use as a location feature
      _____2. government building
      _____3. restaurant
      _____4. spacing of buildings
      _____5. other, (specify)

3. A. Land use, location:________
   B. Distance:
   C. Feature(s):
      _____1. dirt, trash, smog
      _____2. land use as a location feature
      _____3. street widths
      _____4. spacing of buildings
      _____5. other, (specify)

4. A. Land use, location:________
   B. Distance:
   C. Feature(s):
      _____1. open land
      _____2. isolation
      _____3. hills
      _____4. land use as a location feature
      _____5. other, (specify)
Number

City I

Slido Number:

5. A. Land use, location: ________________
   B. Distance:
   C. Feature(s):
      1. land use as a location feature
      2. isolation
      3. hills
      4. industrial plant
      5. other, (specify) ________________

6. A. Land use, location:
   B. Distance:
   C. Feature(s):
      1. land use as a location feature
      2. isolation
      3. institution
      4. presence of sidewalks
      5. other, (specify) ________________

7. A. Land use, location: ________________
   B. Distance:
   C. Feature(s):
      1. primary land use as a location feature
      2. isolation
      3. smog, trash, dirt
      4. adjacent land use as a location feature
      5. other, (specify) ________________

8. A. Land use, location: ________________
   B. Distance:
   C. Feature(s):
      1. hills
      2. land use as a location feature
      3. street covering material
      4. spacing of houses
      5. other, (specify) ________________
Number

City II

Slide Number:

1. A. Land use, location: _____________________________
   B. Distance:
   C. Feature(s):
       ____ 1. presence of sidewalks
       ____ 2. land use as a location feature
       ____ 3. spacing of buildings
       ____ 4. street widths
       ____ 5. other, (specify)_______________________

2. A. Land use, location: _____________________________
   B. Distance:
   C. Feature(s):
       ____ 1. land use as a location feature
       ____ 2. size of parking lot
       ____ 3. spacing of buildings
       ____ 4. supermarket
       ____ 5. other, (specify)_______________________

3. A. Land use, location: _____________________________
   B. Distance:
   C. Feature(s):
       ____ 1. adjacent land use as location feature
       ____ 2. high school
       ____ 3. elementary school
       ____ 4. primary land use as a location feature
       ____ 5. other, (specify)_______________________

4. A. Land use, location: _____________________________
   B. Distance:
   C. Feature(s):
       ____ 1. land use as a location feature
       ____ 2. street width
       ____ 3. height of buildings
       ____ 4. spacing of buildings
       ____ 5. other, (specify)_______________________
Number
City II
Slide Number:

5. A. Land use, location: __________________________
   B. Distance:
   C. Feature(s):
      ______ 1. traffic lights
      ______ 2. land use as a location feature
      ______ 3. freeway system
      ______ 4. height of buildings
      ______ 5. other, (specify)

6. A. Land use, location: __________________________
   B. Distance:
   C. Feature(s):
      ______ 1. land use as a location feature
      ______ 2. dirt, trash, smog
      ______ 3. railroad crossings
      ______ 4. street widths
      ______ 5. other, (specify)

7. A. Land use, location: __________________________
   B. Distance:
   C. Feature(s):
      ______ 1. adjacent land use as a location feature
      ______ 2. primary land use as a location feature
      ______ 3. presence of sidewalks
      ______ 4. construction
      ______ 5. other, (specify)

8. A. Land use, location: __________________________
   B. Distance:
   C. Feature(s):
      ______ 1. spacing of buildings
      ______ 2. land use as a location feature
      ______ 3. height of buildings
      ______ 4. presence of sidewalks
      ______ 5. other, (specify)
9. A. Land use, location: ________________________
   B. Distance:
   C. Feature(s):
      1. presence of sidewalks
      2. street width
      3. isolation
      4. land use as a location feature
      5. other, (specify)

10. A. Land use, location: ________________________
    B. Distance:
    C. Feature(s):
       1. height of buildings
       2. street width
       3. spacing of buildings
       4. land use as a location feature
       5. other, (specify)

11. A. Land use, location: ________________________
    B. Distance:
    C. Feature(s):
       1. street direction information
       2. spacing of buildings
       3. primary land use as a location feature
       4. adjacent land use as a location feature
       5. other, (specify)

12. A. Land use, location: ________________________
    B. Distance:
    C. Feature(s):
       1. adjacent land use as a location feature
       2. presence of sidewalks
       3. primary land use as a location feature
       4. isolation
       5. other, (specify)
Number

City III

Slide Number:

1. A. Land use, location:

   B. Distance:

   C. Feature(s):
      
      1. dirt, trash, smog
      2. street direction information
      3. land use as a location feature
      4. traffic lights
      5. other, (specify)

2. A. Land use, location:

   B. Distance:

   C. Feature(s):
      
      1. height of buildings
      2. size of parking lot
      3. primary land use as a location feature
      4. adjacent land use as a location feature
      5. other, (specify)

3. A. Land use, location:

   B. Distance:

   C. Feature(s):
      
      1. primary land use as a location feature
      2. adjacent land use as a location feature
      3. height of buildings
      4. spacing of buildings
      5. other, (specify)

4. A. Land use, location:

   B. Distance:

   C. Feature(s):
      
      1. height of buildings
      2. spacing of buildings
      3. land use as a location feature
      4. street width
      5. other, (specify)
City III

Slide Number:

5. A. Land use, location: ________________________________

       B. Distance:

       C. Feature(s):

           1. size of parking lot
           2. primary land use as a location feature
           3. adjacent land use as a location feature
           4. spacing of buildings
           5. other, (specify) __________________________

6. A. Land use, location: ________________________________

       B. Distance:

       C. Feature(s):

           1. dirt, trash, smog
           2. spacing of buildings
           3. height of buildings
           4. land use as a location feature
           5. other, (specify) __________________________

7. A. Land use, location: ________________________________

       B. Distance:

       C. Feature(s):

           1. land use as a location feature
           2. height of buildings
           3. spacing of buildings
           4. bank (savings and loan)
           5. other, (specify) __________________________

8. A. Land use, location: ________________________________

       B. Distance:

       C. Feature(s):

           1. institution
           2. isolation
           3. hills
           4. land use as a location feature
           5. other, (specify) __________________________
9. A. Land use, location: ____________________________
   
   B. Distance:
   
   C. Feature(s):
   
   __1. land use as a location feature
   __2. height of buildings
   __3. spacing of buildings
   __4. street covering material
   __5. other, (specify)_____________________

10. A. Land use, location: ____________________________
    
    B. Distance:
    
    C. Feature(s):
    
    __1. dirt, trash, smog
    __2. spacing of buildings
    __3. sidewalk covering material
    __4. land use as a location feature
    __5. other, (specify)_____________________

11. A. Land use, location: ____________________________
    
    B. Distance:
    
    C. Feature(s):
    
    __1. land use as a location feature
    __2. presence of sidewalk
    __3. size of parking lot
    __4. street width
    __5. other, (specify)_____________________

12. A. Land use, location: ____________________________
    
    B. Distance:
    
    C. Feature(s):
    
    __1. dirt, trash, smog
    __2. size of parking lot
    __3. isolation
    __4. land use as a location feature
    __5. other, (specify)_____________________
13. A. Land use, location: __________________________
   B. Distance:
   C. Feature(s):
      ___ 1. height of buildings
      ___ 2. department store (actually Long's)
      ___ 3. land use as a location feature
      ___ 4. spacing of buildings
      ___ 5. other, (specify)________________________

14. A. Land use, location: __________________________
   B. Distance:
   C. Feature(s):
      ___ 1. land use as a location feature
      ___ 2. street material covering
      ___ 3. spacing of buildings
      ___ 4. presence of sidewalks
      ___ 5. other, (specify)________________________

15. A. Land use, location: __________________________
   B. Distance:
   C. Feature(s):
      ___ 1. land use as a location feature
      ___ 2. spacing of buildings
      ___ 3. height of buildings
      ___ 4. street covering material
      ___ 5. other, (specify)________________________
FIELD TRIP INSTRUCTIONS

CITY NAME ______________________

A. Below you are given the route which we will take into the city center and back to our original starting point. List the features you expect to see along the route. Please list them in the order you expect to see them beginning at our original starting point.

---

Since there were only a few participants in each city, the route was penciled in for the appropriate city on the forms the respondents used.
FIELD TRIP INSTRUCTIONS

CITY NAME ______________________

A. While being driven along the designated route, list and rate the features you see on a scale of 1-5 ((1) not important, (2) not very important, (3) indifferent, (4) important, and (5) very important). When rating a feature, think of the feature's importance with respect to your remembering it when giving a stranger to this city directions for following this route (re-tracing out trip). Consider specific features such as particular buildings and establishments, landmarks, and so on as well as the more abstract features such as the following:

- street width changes
- building quality changes
- isolation of buildings
- spacing of buildings
- street covering materials
- heights of buildings
- any other abstract features
- which you may notice

If necessary, you may use the back of this sheet.
FIELD TRIP INSTRUCTIONS

CITY NAME ________________________

A. Below list the features which you have noticed and would remember in realiting the trip to a stranger wishing to duplicate the trip. Please list the features in the order with which they occurred (according to your memory) beginning at our trip starting point and returning to it.

NOTE: PLEASE DO NOT RELATE TO OTHERS IN THE EXPERIMENT WHAT THE FIELD TRIP ENTAILED. THANK YOU.
APPENDIX G

EXEMPLARY CORRELATION MATRICES FOR IMPORTANCE MEASURES
### TABLE 32
CORRELATION MATRIX OF CUE IMPORTANCE FOR MAP DISPLAY
(Between Cities I and II)

<table>
<thead>
<tr>
<th>CUES</th>
<th>Low Density Residential</th>
<th>High Density Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Open Space</th>
<th>Institutional</th>
<th>Traffic Lights</th>
<th>Railroad Crossings</th>
<th>Streams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
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<tr>
<td>1</td>
<td>.627</td>
<td>(.174)</td>
<td>.148</td>
<td>.289</td>
<td>.478</td>
<td>.090</td>
<td>-.067</td>
<td>-.294</td>
<td>.036</td>
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<tr>
<td></td>
<td>(106)</td>
<td>(.51)</td>
<td>(106)</td>
<td>(94)</td>
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<td>(106)</td>
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<td>.048</td>
<td>.055</td>
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<td>(43)</td>
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<td>(19)</td>
<td>(91)</td>
<td>(87)</td>
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<td>(.219)</td>
<td>.337</td>
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<td>.048</td>
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<td>(81)</td>
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<td>(109)</td>
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<td>(75)</td>
<td>(21)</td>
<td>(102)</td>
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<td>-.088</td>
<td>-.011</td>
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</tr>
</tbody>
</table>

*a*Degrees of freedom.  
*b*Significant at .01 level.  
*c*Significant at .05 level.
### TABLE 33
CORRELATION MATRIX OF CUE IMPORTANCE FOR MAP DISPLAY
(Between Cities II and III)

<table>
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<tr>
<th>CUES</th>
<th>Low Density Residential</th>
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<th>Industrial</th>
<th>Open Space</th>
<th>Institutional</th>
<th>Traffic Lights</th>
<th>Railroad Crossings</th>
<th>Streams</th>
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<td>.352 (8)</td>
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<td>.311 (^c)</td>
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\(^a\)Degrees of freedom.
\(^b\)Significant at .01 level.
\(^c\)Significant at .05 level.


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*Degrees of freedom.

bSignificant at .05 level.

cSignificant at .01 level.
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CORRELATION MATRIX OF CUE IMPORTANCE FOR MAP DISPLAY
(City II with Itself)

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*a Degrees of freedom.

*b Significant at .05 level.
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a Degrees of freedom.
b Significant at .05 level.
c Significant at .01 level.
### TABLE 37

**CORRELATION MATRIX OF CUE IMPORTANCE FOR MODEL DISPLAY**  
(Between Cities I and III)

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<th>Bank</th>
<th>Stream</th>
<th>Park/Cemetery</th>
<th>Large Buildings</th>
<th>Shopping Center</th>
<th>Unique Features</th>
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<sup>a</sup>Degrees of freedom.  
<sup>b</sup>Significant at .05 level.  
<sup>c</sup>Significant at .01 level.
TABLE 38
CORRELATION MATRIX OF CUE IMPORTANCE FOR MODEL DISPLAY
(Between Cities II and III)

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$^a$Degrees of freedom
$^b$Significant at .05 level.
$^c$Significant at .01 level.
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a Degrees of freedom.
b Significant at .05 level.
c Significant at .01 level.
### TABLE 40

**Correlation Matrix of Cue Importance for Model Display**

*(City II with Itself)*

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*a* Degrees of freedom.

*b* Significant at .05 level.

*c* Significant at .01 level.
TABLE 41
CORRELATION MATRIX OF CUE IMPORTANCE FOR MODEL DISPLAY
(City III with Itself)

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*aDegrees of freedom.

*bSignificant at .05 level.

*cSignificant at .01 level.
TABLE 42
CORRELATION MATRIX OF CUE IMPORTANCE FOR SLIDE DISPLAY
(Between Cities I and II)

CUE TYPES

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<th>Street and Ground Conditions</th>
<th>Large Buildings</th>
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2. .690<sup>a</sup> .367<sup>a</sup> .247<sup>b</sup> -.003
3. .702<sup>*</sup> .550<sup>a</sup> .512
4. .512
5. .474<sup>a</sup>

<sup>a</sup>Significant at .01 level with 110 degrees of freedom.
<sup>b</sup>Significant at .05 level with 110 degrees of freedom.

TABLE 43
CORRELATION MATRIX OF CUE IMPORTANCE FOR SLIDE DISPLAY
(Between Cities I and III)

CUE TYPES

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2. .653<sup>a</sup> .348<sup>a</sup> .210<sup>b</sup> .127
3. .717<sup>a</sup> .490<sup>a</sup> .132
4. .633<sup>a</sup> .181
5. .253<sup>b</sup>

<sup>a</sup>Significant at .01 level with 110 degrees of freedom.
<sup>b</sup>Significant at .05 level with 110 degrees of freedom.
### TABLE 44

**CORRELATION MATRIX OF CUE IMPORTANCE FOR SLIDE DISPLAY (City I with itself)**

**CUE TYPES**

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<th>Street and Ground Conditions</th>
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<sup>a</sup>Significant at .05 level with 110 degrees of freedom.

<sup>b</sup>Significant at .01 level with 110 degrees of freedom.

### TABLE 45

**CORRELATION MATRIX OF CUE IMPORTANCE FOR SLIDE DISPLAY (City II with itself)**

**CUE TYPES**

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<td>.297&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.395&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.440&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1.000</td>
<td>.316&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.236&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.036</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1.000</td>
<td>.691&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.394&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
<td>.531&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

<sup>a</sup>Significant at .05 level with 110 degrees of freedom.

<sup>b</sup>Significant at .01 level with 110 degrees of freedom.
**TABLE 46**

**CORRELATION MATRIX OF CUE IMPORTANCE**
**FOR SLIDE DISPLAY**
*(City III with itself)*

**CUE TYPES**

<table>
<thead>
<tr>
<th></th>
<th>Traffic</th>
<th>Land Use</th>
<th>Spatial Features</th>
<th>Street and Ground Conditions</th>
<th>Large Buildings</th>
</tr>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>2</strong></td>
<td>.238(^a)</td>
<td>1.000</td>
<td>.391(^b)</td>
<td>.259(^b)</td>
<td>.272(^b)</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td></td>
<td>.267(^b)</td>
<td>1.000</td>
<td>.643(^b)</td>
<td>.273(^b)</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td></td>
<td></td>
<td>.643(^b)</td>
<td>1.000</td>
<td>.275(^b)</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

\(^a\)Significant at .05 level with 110 degrees of freedom.

\(^b\)Significant at .01 level with 110 degrees of freedom.
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