INTRA-URBAN CONSUMER SPATIAL IMAGERY FIELDS

AN ANALYSIS OF INTRA-URBAN CONSUMER SPATIAL IMAGERY FIELDS

by

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SCOPE AND CONTENTS:

The general objective of the thesis is to investigate the mental information that consumers hold of the spatial distribution of a set of retail outlets. An individual's mental information on the spatial distribution of a specific set of environmental elements, within an areal unit, is termed a spatial imagery field. The selected areal unit for the study is the city of Hamilton, Ontario. The specific objectives are: (i) to indicate whether the spatial properties of consumer spatial imagery fields are related to length of residence; (ii) to indicate whether the spatial properties of consumer spatial imagery fields are related to social status; (iii) to indicate whether there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields. Hypotheses are formulated in accordance with these objectives. The data are collected from a census tract located in Hamilton. The hypotheses are tested by using objective statistical

inferential procedures. The findings suggest that length of residence and social status are salient indicators of the spatial properties of the fields. The postulated relationship between social status and the use-frequency of the information channels, however, is not substantiated. Recommendations are made for future related research.

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CHAPTER I

INTRODUCTION

1.1 Objective of the Thesis

The general objective of this thesis is to investigate the mental information that individuals hold of the spatial distribution of a set of environmental elements. An individual's mental information on the spatial distribution of a specific set of environmental elements, within an areal unit, is termed a spatial imagery field. The selected set of environmental elements are grocery stores. However, any set of discrete elements (e.g., banks, hotels, etc.) might be similarly investigated.

The specific objectives are:

(i) to indicate whether the spatial properties of consumer spatial imagery fields are related to length of residence;

(ii) to indicate whether the spatial properties of consumer spatial imagery fields are related to social status;

(iii) to indicate whether there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields.

Hypotheses are formulated in accordance with the specific objectives of the thesis. The hypotheses concerning length of residence are:

(I) there is a positive relationship between number of reported points and length of residence in Hamilton;

(II) there is a positive relationship between mean distance and length of residence in Hamilton;

(III) the distance-decay of reported points is greater for a "low" length of residence consumer than for a "high" length of residence consumer.

The hypotheses concerning social status are:

(IV) there is a positive relationship between number of reported points and social status;

(V) there is a positive relationship between mean distance and social status;

(VI) the distance-decay of reported points is greater for a "low" social status consumer than for a "high" social status consumer.

The hypothesis concerning the information channels is:

(VII) there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields.

The hypotheses are tested by using objective statistical inferential procedures. The results of the tests suggest that length of residence and social status are salient indicators of the spatial properties of the fields. The postulated relationship between social status and the use-frequency of the information channels, however, is not substantiated.

The remainder of Chapter I involves an outline of the nature of the research field of "environmental perception", and of how this study is placed within it. Chapter II

offers a review of the more pertinent literature which investigates man's cognitive images of the spatial distribution of environmental elements. In the same chapter the relationship of the study to this body of literature is articulated. The hypotheses and data sources of the study are presented in Chapter III. In Chapter IV the results of the tests of the hypotheses are presented and evaluated. Finally, a summary of the main conclusions of the research is offered, incorporating suggestions for future work.

1.2 Environmental Perception

An understanding of the processes through which man apprehends his environmental milieu is a major objective within the social sciences. It is believed that such an understanding will provide greater insights into the environment-behaviour relationship. Although there is no common agreement on a generic name for this interdisciplinary research field, it has frequently been alluded to as environmental perception.[1]

The field of environmental perception is concerned with the study of all processes through which man acquires and uses information relating to environmental

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[1]For a discussion of this and other related generic terms see Saarinen, T.F., Perception of Environment, Commission on College Geography, Resource Paper No.5, Association of American Geographers, Washington D.C., 1969,p.3.

elements.[2] The term "cognition" adequately covers these processes since it is "primarily concerned with knowing and knowledge, and deals with those aspects of thought that have been largely separated from the emotional aspects of knowledge."[3] Neisser explicitly defines cognition as "all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered and used. It is concerned with these processes even where they operate in the absence of relevant stimulation. Such terms as sensation, perception, imagery, retention, recall, problem-solving and thinking, among many others, refer to hypothetical stages or aspects of cognition."[4] The field of environmental perception is therefore not limited to merely describing the input of information through sense percepts.[5] In fact, the research within the

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[2]Some work within the field is also explicitly concerned with man's behavioural predispositions toward the information that he holds of environmental elements, i.e., his preferences and attitudes. For instance, see Lee, D.H.K., "The Role of Attitude in Response to Environmental Stress," Journal of Social Issues, 22 (1966), No.4, pp.83-91. The literature on geographic space preferences is reviewed on pp.22-23.

[3]George, F.H., Cognition, Methuen, London, 1962, p.24.

[4]Neisser, U., Cognitive Psychology, Appleton-Century-Crofts, New York, 1967, p.4.

[5]There is, in fact, an increasing tendency to replace "environmental perception" with the more accurate term "environmental cognition". For example, see Stea, D. and Downs, R.M., "From the Outside Looking at the Inside Looking Out," Environment and Behavior, 2 (1970), p.8.

field which investigates the process of sense perception per se is primarily confined to that of social anthropologists and social psychologists.[6] Emphasis is more generally placed upon the investigation of the information store that an individual holds pertaining to environmental phenomena. This stored information is conventionally defined as a cognitive representation known as the image or cognitive image.[7] Downs, for example, explicitly defines a cognitive image as "stored information"[8] and states that it is the "product of the process of collecting, coding, and evaluating information about the spatial environment."[9] This definition appears to be closely related to Boulding's philosophic exposition of the image as "subjective knowledge"[10]

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[6]For example, see Sommer R., Personal Space, the Behavioral Basis of Design, Prentice-Hall, Englewood Cliffs, New Jersey, 1969.

[7]The adjective "cognitive" is used to distinguish the concept of the image, as defined by researchers in environmental perception, from the psychological concept of the image which has a more restricted connotation (see pp.6-7). The term "cognitive image", in fact, is frequently used within environmental perception research. For example, see Horton, F.E. and Reynolds, D.R., "Effects of Urban Spatial Structure on Individual Behavior," Economic Geography, 47 (1971), p.37.

[8]Downs, R.M., "Geographic Space Perception: Past Approaches and Future Prospects," in Board, C., et.al., Progress in Geography, Volume 2, Arnold, London, 1970, p.71.

[9]Downs, R.M., "The Cognitive Structure of an Urban Shopping Centre," Environment and Behavior, 2 (1970), p.15.
Nb., Downs' inclusion of an evaluative component in the definition of a cognitive image is inconsistent with that of other researchers. For example, see Horton, F.E. and Reynolds, D.R. (1971), op.cit.

[10]Boulding, K.E., The Image, The University of Michigan Press, Ann Arbor, Michigan, 1956.

which "is built up as a result of all past experiences of the possessor of the image."[11]

The concept of the cognitive image in environmental perception should not be confused with the psychologist's concept of the image which is traditionally defined as "sensory-like experiencing which occurs in the absence of appropriate sensory stimulation."[12] Where the sensory mode is visual, for example, one is said to have an image whenever one's visual experience does not correspond with what is present to the senses. In recent years, however, the concept of imagery has been more cautiously defined by psychologists in an attempt to distinguish the process from sense perception. Segal, for example, states that "When we have been able to ascertain that a given impression shows adequate correlation with external events to satisfy our current needs, it is conventional to call it a perception. When there is a disturbing lack of correspondence, the impression may be called an illusion, an image, a hallucination, or a dream."[13]

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[11] Ibid., p.6.

[12] Hunter, I.M.L., Memory, Penguin, Harmondsworth, Middlesex, 1957, p.184.

[13] Segal, S.J., "Processing of the Stimulus in Imagery and Perception," in Segal, S.J. (ed.), Imagery: Current Cognitive Approaches, Academic Press, New York and London, 1971, p.97.

Neisser appears to subscribe to the same viewpoint when he states that "visual imagery is a partly defined term for something seen somewhat in the way real objects are seen, when little or nothing in the immediate or very recent input appears to justify it." See Neisser, U. (1967), op.cit., p.146.

Whichever definition of imagery is accepted by psychologists, it is clear that the concept of the cognitive image as used by researchers in environmental perception carries a more generic connotation. Specifically, a cognitive image alludes to any set of stored information relating to environmental phenomena, which may be consciously recalled by an individual through any retrieval process. For example, the recall process[14] may involve, wholly or in part, the retrieval of non-sensory verbally coded information. The recalled information, therefore, is not limited to that which is retrieved exclusively through sensory experiences.

Cognitive processes in general, therefore, fulfill the common role of furnishing man with information about the environment within which he resides. Environment may be explicitly defined as the aggregate of all of the external conditions, exogenous to an organism, which are potential sources of stimulation for the organism.[15] It may be divided into four components:[16]

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[14]The recall process should not be confused with the procedures through which the recalled information is elicited and recorded, i.e., the response formats. For a brief discussion of the nature of these procedures see pp. 30-31, and for a description of the response format used in this study see pp.46-50.

[15]For a comprehensive discussion of the environment as a source of potential stimulation see Gibson, J.J., The Senses Considered as Perceptual Systems, Houghton Mifflin, Boston, 1966, pp.7-30.

[16]The division of environment into four components is a modification of Gibson's original taxonomy of: (i) the terrestrial environment; (ii) the animate environment; and (iii) the cultural environment. See ibid., pp.8-28.

(a) the natural environment consisting of land, water, and air unmodified by man;

(b) the man-made physical environment, eg., buildings and roads;

(c) the animate environment consisting of other organisms;

(d) the cultural environment consisting of man-made artificial sources of stimulation (eg., painting, speaking, and writing) which convey information at second-hand.

Each of these environmental components, then, provides potential sources of information for man. The effective utilization of this information, however, is dependent upon the processes of cognition.

Most of the research in environmental perception is directed towards the explicit solution of substantive problems in an empirical, rather than a theoretical context. For example, planners have attempted to apply findings toward the improvement of the functional qualities of the structural environment,[17] while the social psychologists have undertaken experiments expressly designed to facilitate a greater comprehension of social interaction processes.[18] The development of an organized methodology as envisaged

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[17]For example, see Lynch, K., The Image of the City, The M.I.T. Press, Cambridge, Massachusetts, 1960.

[18]For example, see Ittelson, W.H., Proshansky, H.M. and Rivlin, L.G., "Bedroom Size and Social Interaction of the Psychiatric Ward," Environment and Behavior, 2 (1970), pp. 255-70.

by Boulding in his proposition of an interdisciplinary science of "eiconics",[19] is far from being realised at present. This is a clear reflection of the relatively recent development of research on environmental perception, as well as the empirical nature of the studies thus far undertaken.

Although progress toward the development of a general methodology in environmental perception must undoubtedly await the results of more empirical studies, it is proposed that the development of more limited structures is possible, particularly within the discipline of geography. The investigation of the environment-behaviour relationship at various levels of spatial aggregation has, in fact, been a traditional geographic concern. In the past, geographers have endeavoured to comprehend this relationship by attempting to explain spatial behaviour directly in terms of the spatial layout of the environment within which the behaviour takes place. This strategy necessitates the use of simplistic assumptions concerning the human decision-making process. Deterministic classical central place theory,[20] for example, uses the rational economic man concept as a simple descriptive device to summarize consumer behaviour.

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[19]Boulding, K.E., The Image, The University of Michigan Press, Ann Arbor, Michigan, 1956, pp.143-63.

[20]See Christaller, W., Central Places in Southern Germany, Prentice-Hall, Englewood Cliffs, New Jersey, 1966; and Losch, A., The Economics of Location, Yale University Press, New Haven, 1954.

Overt spatial behaviour is entirely related to the spatial distribution of an hierarchy of market centres. The "stochastic approach"[21] to location theory, on the other hand, involves the formulation of probability models to describe the aggregate effects of individual behaviour patterns. The "deterministic" and "stochastic" approaches to the study of human spatial behaviour, however, do not explicitly conceptualize the nature of the decision-making process of individuals and those psychological attributes involved in the act of decision.

There has been an increasing awareness in geography that individuals do not respond directly to environmental stimuli but subordinate the objective world to their own uniquely apprehended milieux. One of the earlier statements is made in 1947 when J.K. Wright proposes a discipline of "geosophy"[22] which would be concerned with man's sense of terrestrial space and would cover the "geographic ideas, both true or false, of all manner of people."[23]

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[21]This approach is reviewed in Harvey, D., "Conceptual and Measurement Problems in the Cognitive-Behavioral Approach to Location Theory," in Cox, K.R. and Golledge, R.G. (eds.), Behavioral Problems in Geography: A Symposium, Northwestern University Studies in Geography No.17, Department of Geography, Evanston, Illinois, 1969, pp.35-68.

[22]Wright, J.K., "Terrae Incognitae: The Place of Imagination in Geography," Annals of the Association of American Geographers, 37 (1947), pp.1-15.

[23]Ibid., p.12.

In 1952, Kirk distinguishes the "Phenomenal Environment" from the "Behavioural Environment."[24] The former is defined as the world of physical facts (cf., the objective spatial environment), while the latter is a psycho-physical field in which phenomenal facts are arranged into structures (cf., cognitive images) and acquire values in a cultural context (cf., attitudes and preferences). Kirk's concept of the "Behavioural Environment" is paralleled by H. and M. Sprouts' concept of an individual's "psycho-milieu", which is defined as "images or ideas, derived from some sort of interaction between what he selectively receives from his milieu (via his sensory apparatus) and his scheme of values, conscious memories, and sub-consciously stored experiences."[25] Lowenthal (1961) recognizes that "all types of experience, from those most closely linked with our everyday world to those which seem furthest removed, come together to make up our individual picture of reality"[26] and that "the surface of the earth is shaped for each person

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[24]Kirk. W., "Historical Geography and the Concept of the Behavioural Environment," Indian Geographical Journal, Silver Jubilee Issue, 1952, pp.152-56.

[25]Sprout, H. and Sprout, M., The Ecological Perspective on Human Affairs with Special Reference to International Politics, Princeton University Press, Princeton, New Jersey, 1965, p.27.

[26]Lowenthal, D., "Geography, Experience and Imagination: Towards a Geographical Epistemology," Annals of the Association of American Geographers, 51 (1961), p.260.

by refraction through cultural and personal lenses of custom and fancy."[27]

The exposition of these ideas has resulted in the emergence of the cognitive-behavioural approach in geography. The approach recognizes the need to specify those psychological attributes which mediate the relationship between the objective spatial environment and overt spatial behaviour. Such psychological attributes include cognitive processes, preferences, attitudes, etc.[28] These attributes mediate the flow of information from the environment such that one individual apprehends the environment differently from another despite the similarity of environmental stimuli. The approach thus emphasizes the role of the actor within the spatial system rather than the spatial system per se. Man is permitted to become an intervening variable within the conceptualization of the environment-behaviour relationship rather than a constant. The limiting assumptions concerning the nature of man are thus replaced with ones which provide a more accurate expression of his various capabilities and shortcomings.

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[27] Ibid., p.260.

[28] An example of an attempt to conceptualize these attributes is Huff, D.L., "A Topographical Model of Consumer Space Preferences," Papers and Proceedings of the Regional Science Association, 6 (1960), pp.159-73.

1.3 The Place of the Study within the Field of Environmental Perception

The cognitive-behavioural approach represents the geographic contribution to the interdisciplinary field of environmental perception. Specifically, the approach emphasizes the spatial parameters of those psychological attributes previously described (see pp.3-6) and of the related overt behaviour patterns. Saarinen broadly outlines the traditional geographic concepts and techniques which are available to contribute toward the development of pertinent methodology:

> "They (geographers) have always worked in the real-world trying to see broad relationships among combinations of variables rarely considered together by others. For the geographer there should be no painful transition from controlled laboratory conditions to the buzzing confusion of life as it occurs..... Whenever environmental behavior can be described in terms of spatial locations or patterns of movement, the geographer's skills in map interpretation and the spatial statistical techniques should be invaluable."29

This thesis involves a spatial analysis of the stored information held by individuals, defined according to their length of residence and social status. The information pertains to the spatial distribution of a specific set of environmental elements. Investigation is, in effect,

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[29] Saarinen, T.F. (1969), op.cit., p.27.

confined to the cognitive image of a restricted set of man-made elements (i.e., grocery stores) located within a defined areal unit. Such restriction is conducive to the use of a controlled analysis.[30] This approach differs from much previous research on environmental perception which investigates man's cognitive image of the total set of environmental elements within a specified areal unit (i.e., the total image).[31]

The investigation of spatial imagery fields may be carried out at almost any scale of analysis, from the room of a building[32] to the world level.[33] The selected level of analysis for the present study is the city (specifically, Hamilton, Ontario). The decision to study the spatial imagery fields at an intra-urban level is motivated by three considerations. First, this intermediate scale ensures that data relating to the location of any set of man-made structural elements (in this case grocery store locations) may be rapidly and reliably collected. Second, statements

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[30] See pp. 31-32 for further discussion.

[31] An example is Lynch, K. (1960), op.cit.

[32] For example, see Kira, A., The Bathroom: Criteria for Design, Research Report No.7, Center for Housing and Environmental Studies, Cornell University, Ithaca, New York, 1966.

[33] For example, see Tuan, Yi-Fu, "Discrepancies between Environmental Attitude and Behaviour: Examples from Europe and China," Canadian Geographer, 12 (1968), pp.176-91.

made by a sample of respondents about the location of structural elements may be verified with reference to these data. Third, the city represents an "operational environment"[34] for large numbers of individuals in Western society.

In conclusion, it is proposed that an understanding of the nature of consumer spatial imagery fields within an urban system must necessarily precede any meaningful examination of how these fields operate as an intervening link in the environment-behaviour relationship. The ultimate aim of this thesis is to provide a contribution toward such an understanding by investigating how specified properties of the fields vary among consumers, defined according to their length of residence and social status.

1.4 Summary

The stated purpose of the thesis is to investigate the spatial imagery fields of consumers. Specifically, the objectives are:

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[34]The term "operational environment" alludes to those portions of the environment in which man operates and which consciously or sub-consciously influence his behaviour. It represents one of a set of nested environments recognized by Sonnenfield, J., Geography, Perception, and the Behavioral Environment, Paper presented at the Dallas AAAS in Symposium on "The Use of Space by Animals and Man," Dallas, Texas, December, 1968.

(i) to indicate whether the spatial properties of consumer spatial imagery fields are related to length of residence;

(ii) to indicate whether the spatial properties of consumer spatial imagery fields are related to social status;

(iii) to indicate whether there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields.

Hypotheses are formulated in accordance with these objectives. The nature of the interdisciplinary research area of environmental perception is described. With reference to the role of the cognitive-behavioural approach in geography, the place of the study within the field of environmental perception is articulated.

CHAPTER II

REVIEW OF LITERATURE

With reference to the cognitive-behavioural approach, geography and related disciplines appear to be making two general contributions toward the development of environmental perception. First, the techniques of locational analysis and of two-dimensional description,[1] with which geographers are particularly familiar, are employed to identify and investigate the spatial structures of the cognitive images and preferences of individuals. Second, the investigation of how these psychological structures are related to decision-making and overt spatial behaviour is undertaken. In this study, these approaches are termed locational and ecological respectively. A review of the pertinent literature is presented within this twofold taxonomy.

2.1 The Locational Approach

Lynch (1960)[2] makes the earliest attempt to identify the spatial structures of cognitive images held by individuals. Specifically, he attempts to determine the common cognitive

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[1] A comprehensive review of such techniques is offered in Haggett, P., Locational Analysis in Human Geography, Arnold, London, 1965.

[2] Lynch, K. (1960), op.cit.

images of city elements held by groups of sampled respondents in Boston, Jersey City, and Los Angeles. Such "public images" are identified through interviews in which the respondents are each required to sketch a map of the central area of the city; to orally identify those elements of the central area which they feel to be the most distinctive; and to orally describe a number of trips through the city. For each city, the maps are compared and the more frequently drawn (i.e., more imageable) elements thus recognized. Interestingly, the maps drawn by the respondents closely correspond with those drawn by trained observers, suggesting a consistency in the relative imageability of elements. Although Lynch is principally interested in the way that respondents structure the city into a coherent whole, he recognizes several distinct groups of elements. He organises these within a fivefold taxonomy (viz., paths, edges, districts, nodes, and landmarks) according to their functional and structural characteristics.

Later research is largely confined to the development of Lynch's notions. DeJonge (1962),[3] for example, investigates the impact of various form elements upon the formation of cognitive images in selected Dutch cities,

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[3]DeJonge, D., "Images of Urban Areas: Their Structure of Psychological Foundations," Journal of the American Institute of Planners, 28 (1962), pp.266-76.

while Gulick (1963)[4] conducts a similar study in Tripoli, Lebanon, which considers the role of the socio-cultural associations of elements in the development of composite urban images. Appleyard (1969)[5] attempts to quantitatively develop Lynch's findings by determining the relative effectiveness of the form attributes of buildings (together with visibility, use, and significance attributes) in capturing the attention of individuals. The survey, undertaken in Ciudad Guayana (a new Venezuelan town), involves the scaling of nearly two hundred buildings on the basis of these attributes. The scaled attributes are correlated with recall frequencies from three questions (viz., free map, free verbal, and free trip recall), answered by a sample of over three hundred respondents. Of the seven form attributes selected, external movement, contour, size, shape, and surface have the highest correlations with the frequencies in the three different response situations. The multiple correlation coefficients of the form, visibility, and significance attributes suggest that each of these groups is of comparable importance in determining whether buildings are sense perceived and remembered. Despite some problems encountered in the scaling of attributes, the study does attempt to rigorously identify the salient

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[4]Gulick, J., "Images of an Arab City," Journal of the American Institute of Planners, 29 (1963), pp.179-98.

[5]Appleyard, D.L., "Why Buildings are Known," Environment and Behavior, 1 (1969), pp.131-56.

imageability components of urban elements.

There are a number of studies which attempt to define the cognitive images that individuals hold of specific areas of the city. For example, Lee (1964)[6] asks individuals to outline their local neighbourhood on a map. He uses the term "schemata" to conceptualize the cognitive images of physical-social space which are held by individuals. Lee concludes that an individual has a schema of his neighbourhood comprised of an area of ground rather than an aggregate of people. On a more restricted scale, Downs[7] attempts a detailed analysis concerning the structure of the cognitive image of a planned downtown shopping centre in Bristol, England. Employing correlation and factor analytic procedures on a set of thirty-six semantic differential scales (within which the subjects' views on the centre are expressed), an eight dimensional structure is recognized. Downs concludes that the image of a downtown shopping centre is comprised of eight cognitive categories of which service-quality, price, and design are respectively identified as the more important.

Some studies attempt to determine whether there is a regular variation of the cognitive images among specified

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[6]Lee, T.R., "Psychology and Living Space," Transactions of the Bartlett Society, 2 (1963-64), pp.9-36.

[7]Downs, R.M. (1970A), op.cit.

groups of individuals. At the city level, Saarinen (1964,[8] 1969[9]) conducts an investigation within the Chicago Loop in which defined groups of respondents draw maps (i.e., Loop workers, students from a local teachers college, and graduate students from the University of Chicago). Inter-group differences in the maps drawn are attributed to the variations of travel patterns among the groups, which result in variations of the relative familiarity of elements within the Loop. Klein (1967)[10] undertakes an extensive survey in Karlsruhe, Germany, to discover whether significant variations in the cognitive image of the spatial extent of the town-centre occur among groups of individuals, defined according to their social status and place of residence. While a coherent central area is recognized by all groups, the defined areal extent of the town-centre varies among them. For example, a positive relationship is determined between the reported extent of the town-centre and the length of residence of the individual within the city. It is also noted that subjects residing in or near the centre tend to have a more restricted cognitive image of its

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[8]Saarinen, T.F. The Image of the Chicago Loop, Unpublished Paper, 1964.

[9]Saarinen, T.F. (1969), op.cit.

[10]Klein, H.J., "The Delimitation of the Town-Centre in the Image of its Citizens," in Brill, E.S. (ed.), Urban Core and Inner City, Leiden, Netherlands, 1967, pp.286-306.

areal extent than those residing further away. Lee (1968)[11] investigates the elements (eg., level of social interaction, socio-economic status, and the spatial structure of the environment) which are postulated to influence the size and composition of the neighbourhood schema that an individual holds. One of his conclusions suggests that the physical dimensions of the schemata are positively related to social status and level of social interaction. On a national level, Gould (1966),[12] and Gould and White (1967),[13] investigate the "mental maps" of samples of students in the U.S.A. and U.K. respectively. The respondents are required to rank American states and British counties according to their preferences of relative residential desirability.[14] Within each study, students are sampled in different areas of the country and comparison of the maps, constructed through principal components analysis of the data, reveals

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[11]Lee, T.R., "Urban Neighbourhood as a Socio-Spatial Schema," Human Relations, 21 (1968), pp.241-67.

[12]Gould, P.R., On Mental Maps, Michigan Inter-University Community of Mathematical Geographers, Discussion Paper No. 9, Department of Geography, University of Michigan, Ann Arbor, Michigan, 1966.

[13]Gould, P.R. and White, R.R., "The Maps of British School Leavers," Regional Studies, 2 (1968), pp.161-82.

[14]Specifically, a statement of preferences involves a comparative evaluation of stored information (i.e., the cognitive image) relating to a set of stimuli (i.e., the American states or British counties).

many similarities (i.e., a general or national surface) despite distortions (i.e., local domes) which are indicative of local loyalties. Thus, groups of individuals, defined according to place of residence, exhibit basically similar spatial preferences. These preferences appear to be shaped by flows of information (particularly via the mass media) about the relative desirability of politically defined areas.

Other research has followed a somewhat different approach by specifically focussing attention upon urban cognitive distance (i.e., cognitive images of the distances between spatially separated elements). For example, Thompson (1963)[15] in his study within four San Francisco Bay Communities, discovers that distance and time of travel to two specific landmarks (viz., a department store and a discount house) are invariably overestimated by his sample groups of respondents. The degree of overestimation for the discount houses, however, in all cases exceeds that for the department stores. Thompson argues that the difference is attributable to the fact that discount houses offer considerably fewer consumer conveniences and services, suggesting that the functional characteristics of landmarks (or of any other elements) are important factors in fixing their location in the minds of individuals. These conclusions

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[15]Thompson, D.L., "New Concept: Subjective Distance," Journal of Retailing, 39 (1963), pp.1-6.

receive some support from Lee's (1970)[16] investigation of reported distance estimates in Dundee, Scotland. Specifically, Lee hypothesizes that a resident's schema of a city is characterized by a focal orientation, built up through the satisfactions of the city centre and resulting in a relative foreshortening of cognitive distance in a downtown direction. He empirically confirms this by measuring reported distances for 22 varied destinations in Dundee, from a single inception point. These findings are consistent with earlier work undertaken by Brennan (1948)[17] which reveals that housewives prefer to use more distant shops in a downtown direction to nearer shops in an outward direction. Stea (1968)[18] investigates distance and areal distortions on a global scale by asking Clark University students to estimate (i) the shortest distance from Worcester, Massachusetts, to each of ten foreign countries; and (ii) the size of each of these countries. Although the distance estimates are found to be unrelated to the judged economic and political importance of each country, the accuracy of the size estimates does appear, in fact, to

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[16]Lee, T.R., "Perceived Distance as a Function of Direction in the City," Environment and Behavior, 2 (1970), pp.40-51.

[17]Brennan, T., Midland City, Dobson, London, 1948.

[18]Stea, D., On the Measurement of Mental Maps, Unpublished Paper, Department of Geography, Clark University, Worcester, Massachusetts, 1968.

be related to these factors. This, not surprisingly, suggests that the most accurately reported countries are those which are more frequently exposed to the public through the mass media.

2.2 The Ecological Approach

The limited ecological research concentrates almost exclusively upon determining cognitive images of the temporality and spatial extent of natural hazards (e.g., floods and storms) within specified areal units. The consequent behavioural adjustments are also investigated. Burton, Kates, and White (1968)[19] review such studies which seek to descriptively identify group responses to the uncertainty of natural hazards and investigate the extent to which human adjustment takes place. The findings of this research indicate that the individual's image of hazard occurrence is both subjective and generalized, and that major adjustments take place only in response to major crises. Researchers recognize a sub-optimal level of adjustment to natural hazards "..... that is, fewer and weaker steps are taken than are required to minimize the effects of the natural hazards while permitting maximum

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[19]Burton, I., Kates, R.W. and White, G.F., The Human Ecology of Extreme Geophysical Events, Natural Hazard Working Paper No. 1, Department of Geography, University of Toronto, Toronto, Ontario, 1968.

use of resources associated with that hazard."[20] Whether this behaviour can be reconciled with Simon's concept of the satisficer,[21] content with sub-optimal solutions, or the traditionalist's concept of the born optimizer saddled with ignorance and ill fortune, remains a polemical issue.

Comparison of research findings indicates that the accuracy of hazard imagery appears to be associated with several factors. A relatively frequent occurrence of the hazard (e.g., storm hazards on the shores of Megalopolis[22] or drought hazards in the Great Plains [23]) appears to result in a more accurate imagery of risk and a greater level of human adjustment than where the occurrence of the hazard is relatively rare (e.g., flooding hazards on riverine floodplains).[24] An increase of the awareness of risk and the degree of response similarly occurs where the hazard is directly related to resource use as, for example, in the

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[20] Kates, R.W., "The Perception of Storm Hazard on the Shores of Megalopolis," in Lowenthal, D. (ed.), Environmental Perception and Behavior, Research Paper No.109, Department of Geography, The University of Chicago, Chicago, Illinois, 1967, p.61.

[21] Simon, H.A. Models of Man: Social and Rational, Wiley, New York, 1957.

[22] Kates, R.W. (1967), op.cit.

[23] Saarinen, T.F. (1966), op.cit.

[24] Kates, R.W., Hazard and Choice Perception in Flood-plain Management, Research Paper No. 78, Department of Geography, The University of Chicago, Chicago, Illinois, 1964.

drought prone areas of the Great Plains, and also where the degree of personal experience of the hazard is considerable. These variations, however, are relative and the overall tendency of inaccurate cognitive imagery of hazard occurrence, and insufficient behavioural response, remains.

The ecological research discussed above is limited to the study of cognitive images of extreme and ephemeral environmental occurrences and the consequent human adjustments. Horton and Reynolds,[25] however, are currently carrying out a research programme which is concerned with investigating the overt behavioural implications of the cognitive images which individuals hold of stable sets of environmental elements. Specifically, this involves the delineation of a conceptual framework for examining the process of "urban action space" formation. Horton and Reynolds explicitly define urban action space as "the collection of all urban locations about which the individual has information and the subjective utility he associates with the locations."[26] A subset of urban action space is "activity space" which is defined as "the subset of all

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[25] See Horton, F.E. and Reynolds, D.R., "An Investigation of Individual Action Space: A Progress Report," Proceedings of the Association of American Geographers, 1 (1969), pp.70-75; and Horton, F.E. and Reynolds, D.R. (1971), op.cit.

[26] Ibid., p.37.

urban locations with which the individual has direct contact as a result of day to day activities."[27] Within their framework, Horton and Reynolds envisage urban action space formation and, therefore, activity space formation as the outcome of a two stage process. The first concerns the relationship between objective spatial structure, residential location, length of residence, socio-economic attributes; and travel preferences and the cognitive image of the urban environment. The second involves relating of travel preferences and the cognitive image to the process of urban action space formation. The findings to date suggest that the aggregate action spaces of two samples closely reflect the nature of urban objective spatial structure (particularly major artery locations and principal interaction nodes, e.g., the central business district) and the residential location of the individual within the structure. However, variations within the aggregate action spaces suggest that smaller sub-groups of individuals have internally similar action spaces which are not attributable to objective spatial structure and residential location. Horton and Reynolds claim that these variations are attributable to the other elements (i.e., length of residence and social status) outlined within their framework.

Adams (1969)[28] postulates that urban residents hold cognitive images of the city which are sectoral or

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[27] Ibid.

[28] Adams, J.S., "Directional Bias in Intra-Urban Migration," Economic Geography, 45 (1969), pp.302-23.

wedge-shaped in form. Specifically, the sectoral image of an urban resident includes: (i) the portion of the city where the resident lives; (ii) the most direct route between the place of residence and the central business district; and (iii) the most direct route between the place of residence and the urban fringe. Adams deduces a corresponding directional bias in intra-urban migration patterns from such sectoral images. A directional bias is indeed disclosed in Adams' analysis of migration patterns within Minneapolis. In an independent report, Johnston (1971)[29] discloses a directional bias in people's evaluation of residential areas within Christchurch, New Zealand. This finding offers some substantive support for Adams' contention that urban residents do, in fact, hold intra-urban sectoral images.

2.3 Summary and Place of the Study within the Literature

The review of literature which investigates man's cognitive images of the spatial distribution of environmental elements is divided into locational and ecological contributions. The locational contributions include

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[29]Johnston, R.J., "Mental Maps of the City: Suburban Preference Patterns," Environment and Planning, 3 (1971), pp.63-71.

research which (i) explicitly identifies the cognitive images that individuals hold of the spatial distribution of environmental elements within specific areal units; (ii) investigates variations in the spatial structures of the cognitive images among specified groups of individuals; and (iii) focuses attention upon urban cognitive distance. The ecological research is concerned with (i) the investigation of man's cognitive images of the temporality and intensity of natural hazards within specific areal units, and the consequent human adjustments; and (ii) the investigation of the overt behavioural implications of the cognitive images that individuals hold of stable sets of environmental elements.

The limited ecological literature other than that related to hazard imagery appears closely related to problems encountered in the identification and measurement of cognitive images. A considerable number of response formats are used in empirical research to interpolate the information store which exists in the minds of individuals and, therefore, cannot be directly encountered.[30] Lynch[31] and Appleyard,[32] for example, use free map and free verbal recall procedures

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[30]For a comprehensive review of the response formats which are available see Craik, K.H., "The Comprehension of the Everyday Physical Environment," Journal of the American Institute of Planners, 34 (1968), pp.29-37.

[31]Lynch, K. (1960), op.cit.

[32]Appleyard, D.L. (1969), op.cit.

to elicit such information, while Downs[33] uses the semantic differential rating scale. The "locational approach" studies attempt to employ such response formats to elicit man's cognitive image of the spatial structure of the total environment (i.e., the total image) at various areal levels. However, the spatial complexity of the total image has tended to preclude rigorous methodology pertaining to data collection and analysis.[34]

The problem[35] limits the scope of investigation to the spatial distribution of a specific set of discrete environmental elements at an intra-urban level. Although the specification of a set of elements necessitates extraction from man's total image, the approach does have two advantages. First, a restricted set is easier to handle and may facilitate a more rigorous analysis. Second, the methods employed within this study may be applied to investigate spatial imagery fields of other specified sets of elements and stimulate the generation of substantive hypotheses on the characteristics of the total

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[33]Downs, R.M. (1970A), op.cit.

[34]These problems are reviewed in Downs, R.M. (1970B), op.cit., pp.91-101.

[35]See Chapter I, Section 1.1, pp.1-3, for the statement of the problem.

image.

Horton and Reynolds[36] postulate that length of residence and social status are each inputs to the formation of cognitive images of urban spatial structure. Other theoretical formulations propose a fundamental relationship between cognitive structures of the environment and social status.[37] However, these propositions have not been substantively tested. The objective of this thesis is to empirically determine whether cognitive images of a specific set of environmental elements are related to length of residence and social status. Since the problem is explicitly concerned with the spatial structures of cognitive images it may, in the context of the review of literature, be appropriately placed within the "locational approach".

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[36]Horton, F.E. and Reynolds, D.R. (1969), op.cit., p.73; and Horton, F.E. and Reynolds, D.R. (1971), op.cit. p.41.

[37]See Downs, R.M. (1970B), op.cit., pp.88-89; and Huff, D.L. (1960), op.cit.

CHAPTER III

THE HYPOTHESES AND DATA SOURCES

The hypotheses of the study are derived and presented in this chapter. The data sources, which are used to test the hypotheses, are then outlined. To provide a background for each of these discussions, however, a statement is first presented on how a spatial imagery field is defined and measured.

3.1 The Definition and Measurement of a Spatial Imagery Field

A spatial imagery field is defined as the mental information that an individual holds of the spatial distribution of a specific set of environmental elements. In this study, the selected set of environmental elements are grocery stores within the city of Hamilton. This group of elements is selected because they represent significant points in consumer activity spaces, groceries being habitually consumed at frequent intervals by all households. Furthermore, since grocery stores are discrete elements in space, which may be represented as points on a two-dimensional surface, they should be unambiguously identified.

Three spatial properties of a spatial imagery field are measured: (i) number of reported points;

(ii) mean distance; and (iii) distance-decay. Number of reported points and mean distance are each measures of the "size" of a spatial imagery field. Number of reported points is the total number of grocery store locations, or points, reported by a consumer in Hamilton. Mean distance is the mean distance between the place of residence[1] and the reported store locations.[2] Distance-decay describes the decrease in the density of reported points as distance from the place of residence of a consumer increases.

3.2 The Hypotheses

Horton and Reynolds[3] postulate that cognitive images of urban spatial structures are related to length of residence and social status (see pp.27-28 and p.32). In this thesis, hypotheses are formulated to test these propositions. Specifically, the hypotheses are organized within three parts in accordance with the specific objectives of the thesis. The objectives are:

(i) to indicate whether the spatial properties of consumer spatial imagery fields are related to length of residence;

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[1] A residence control (see pp.50-53) is used to define the place of residence of the entire sample.

[2] The mean distance measure is correlated with the number of reported points measure (see Appendix I). For a discussion of how the problem is handled analytically see pp.76-77. (Nb., the measurement of distance is described on pp.50-53.)

[3] Horton, F.E. and Reynolds, D.R. (1969), op.cit., p.73; Horton, F.E. and Reynolds, D.R. (1971), op.cit., p.41.

(ii) to indicate whether the spatial properties of consumer spatial imagery fields are related to social status;

(iii) to indicate whether there is a relationship between social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields.

Within each part, a presentation of the hypotheses is followed by a statement of their derivation.

3.2.1 Hypotheses concerning Length of Residence

The objective is to investigate the relationship between the spatial properties of consumer spatial imagery fields and length of residence.

Horton and Reynolds postulate that a cognitive image of urban spatial structure is primarily developed through a complex learning process.[4] This proposition is consistent with cognitive learning theories which conceptualize cognitive structure as the outcome of a dynamic learning process.[5] Overt behaviour is viewed as a function of such a learned cognitive structure. Horton and Reynolds explicitly conceptualize the learning process

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[4]Horton, F.E., and Reynolds, D.R. (1971), op.cit., pp.38-40.

[5]For example, see Tolman, E.C., Purposive Behavior in Animals and Man, Appleton-Century, New York, 1932; and Lewin, K., Field Theory and Social Science, Harper, New York, 1951.

within three stages. During the "distance bias stage", the cognitive images of relative newcomers to the urban system are spatially constrained: "Nodes near the residence are 'learned' first, then those at increasing distances."[6] During the "community socialization stage", the distance bias decreases as the individual learns of other potentially satisfactory elements within the city, particularly through indirect contacts. Many of these elements may be located at considerable distances from the domicile and workplace. At the "spatial equilibrium stage", the cognitive image is relatively stable. Equilibrium, in this context, alludes to a stable pattern of urban spatial behaviour produced by the individual's satisfaction with his current set of cognitive information. It is unlikely, however, that a true equilibrium solution will occur. The spatial layout of the objective urban environment is subject to continuous change. Although "perceptual lags" may occur, the individual will eventually recognize such environmental change and consequently modify his spatial behaviour patterns. Environmental learning, therefore, does continue during this final stage.

In the light of these propositions it is postulated that consumers who have lived in Hamilton for a considerable

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[6]Horton, F.E. and Reynolds, D.L. (1971), op.cit., p.39.

time-period will, over the years, have built up larger spatial imagery fields than relative newcomers. The imagery fields are developed through a continuous environmental learning process.

On this basis, it is desirable to formulate Hypothesis (I):

> there is a positive relationship between number of reported points and length of residence in Hamilton;

and Hypothesis (II):

> there is a positive relationship between mean distance and length of residence in Hamilton.

It is further postulated that a spatial imagery field at the "distance bias stage" is confined to a few familiar areas, particularly the immediate area about the place of residence. During the "community socialization stage" and the "spatial equilibrium stage", the consumer becomes familiar with more distant districts of the city through the environmental learning process. The points within a spatial imagery field will, therefore, become more widely dispersed in terms of distance from the place of residence. As a consequence, it is desirable to formulate Hypothesis (III):

> the distance-decay of reported points[7] is greater for a "low" length of residence consumer than for a "high" length of residence consumer.

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[7] In this context, "distance-decay" describes the decrease in the density of reported points as distance from the place of residence of a consumer increases; see p.34.

3.2.2 Hypotheses concerning Social Status

The objective is to determine whether the spatial properties of consumer spatial imagery fields are related to the social status of consumers.

The rationale for the derivation of the hypotheses are similar. Losch (1938),[8] Marble (1959),[9] and Rushton (1966)[10] provide evidence supporting the notion that consumers of a relatively high social status travel greater distances to stores, and purchase convenience goods more frequently. The spatial behaviour of lower status consumers, however, is largely tied to the place of residence. Consequently, higher status consumers are more likely to be exposed to a greater number of store locations than lower status consumers. Furthermore, the probability of a higher status consumer directly encountering a given store location within the urban system is less likely to be constrained by the distance of the store from the place of residence.

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[8]Losch, A., "The Nature of Economic Regions," Southern Economic Journal, 5 (1938), pp.71-78.

[9]Marble, D.F., "Transport Inputs at Urban Residential Sites," Papers and Proceedings of the Regional Science Association, 5 (1959), pp.253-56.

[10]Rushton, G., "Spatial Patterns of Grocery Purchases by the Iowa Rural Population," Studies in Business and Economics, New Series No.9, The University of Iowa, Iowa City, Iowa, 1966.

In accordance with these propositions, three hypotheses are formulated:

Hypothesis (IV):

> there is a positive relationship between number of reported points and social status;

Hypothesis (V):

> there is a positive relationship between mean distance and social status;

Hypothesis (VI):

> the distance-decay of reported points is greater for a "low" social status consumer than for a "high" social status consumer.

3.2.2.1 The Measurement of Social Status

To test the hypotheses concerning social status, social status is measured by employing two surrogates: (a) Hollingshead's Three Factor Index of Social Position;[11] and (b) a set of scaled socio-economic attributes. Hollingshead's Three Factor Index of Social Position is "developed to meet the need for an objective, easily applicable procedure to estimate positions individuals occupy in the status structure of the community."[12] It is

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[11]See Hollingshead, A.B. and Redlich, F.C., Social Class and Mental Illness, Wiley, New York, 1958, pp.387-97. The derivation and composition of the index is also summarized in Bonjean, C.M., Hill, R.J. and McLemore, S.D., Sociological Measurement, Chandler, New York, 1967, pp.381-85.

[12]Hollingshead, A.B. and Redlich, F.C. (1958), op.cit., p.387.

comprised of three weighted and scaled variables:

FACTOR	WEIGHT	RANGE OF SCORES Highest	Lowest
Residence type	6	1	6
Occupation	9	1	7
Education	5	1	7

The weights are empirically estimated (using data collected from a sample residential area) from a multiple regression equation which treats the factors as independent variables, with an estimated social class scale as the dependent variable. The criteria used in the assignment of individuals into the social classes are: (a) where a family lives; (b) the way it makes its living; and (c) its tastes, its cultural orientation, and the way it spends its leisure time.[13] Multiplying each score by its appropriate weight "yields a distribution of scores ranging from a theoretical low of 20 to a theoretical high of 134 and representing a continuum from the highest class to the very lowest."[14]

The set of socio-economic attributes are scaled measures of social status[15] and include five unweighted variables:

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[13]The criteria are more fully described in ibid., p.390.

[14]Ibid., p.394. For the scalings, see Figure 9. (The data on the three constituent variables are presented in Figures 3-5.)

[15]For the scalings, see Figures 3-7.

(i) Income level of the head of the household;
(ii) Automobile ownership;
(iii) Occupation level;
(iv) Residence type;
(v) Education level.

Unlike the Index of Social Position, these attributes represent direct measures of the various elements of social status. Each attribute is a discrete variable whose relative weight is unknown. The attributes cannot, therefore, be combined within an index although they may each be treated as independent variables within a multiple regression equation.[16] In summary, Hollingshead's Three Factor Index of Social Position provides a composite measure of estimated social status, while the socio-economic attributes are discrete measures of selected elements of social status.

3.2.3 Hypothesis concerning the Information Channels

The sources of information on grocery store locations are divided into three mutually exclusive types of information channel: spatial experience, personal communication, and the mass media. The points known to the consumer through spatial experience are those which are originally encountered as a result of day to day activities (i.e., direct contacts). The points known to the consumer

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[16]See Appendix I for the zero-order correlation matrix of all of the consumer variables.

through personal communication and the mass media are those which are originally encountered through second-hand channels (i.e., indirect contacts).

Greer (1962)[17] recognizes a relationship between social class and level of social participation. Specifically, Greer concludes that the social participation (especially formal participation) of lower status individuals is largely tied to "kinfolk and the small-scale world of the neighbourhood."[18] It is plausible that this variation in the level of participation among the social classes will result in a variation of the use-frequency of the channels through which they most consistently receive information pertaining to environmental phenomena. However, since the direction of this relationship cannot be precisely stated it is desirable to formulate an exploratory hypothesis. Therefore, Hypothesis (VII) is:

> there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields.

3.3. The Data Sources

The data are collected from a portion of census tract 27, located in the "East End" of Hamilton (see

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[17] Greer, S., The Emerging City, The Free Press, New York, 1962.

[18] Ibid., p.127.

Figure 1). The area of study and the field survey are discussed, and the measurement of distance is then explained.

3.3.1. The Area of Study

In research which attempts to compare the spatial imagery fields of individuals, a compact study area of relatively limited areal extent is desirable. A compact study area permits the residential locations of individuals to be held constant relative to elements within the spatial system. In this study, it is advantageous to locate the study area at a reasonable distance from the Hamilton city limits. Any possible boundary effects upon the nature of the spatial imagery fields are thus reduced. Finally, it is desirable that extremes relating to social class characteristics within the study area be avoided. The selected study area (see Figure 1 and Appendix 2)[19] satisfies these criteria. The area includes approximately one half of the households located within census tract 27 (i.e., 775 households). Within the boundaries of the study area, a 100 per cent coverage of the households is carried out.

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[19] Appendix 2 discloses that the average male and female incomes of census tract 27, in which the study area is located, are within one standard deviation of the respective mean values for the city of Hamilton. These data suggest that extreme social class characteristics within the study area are avoided.

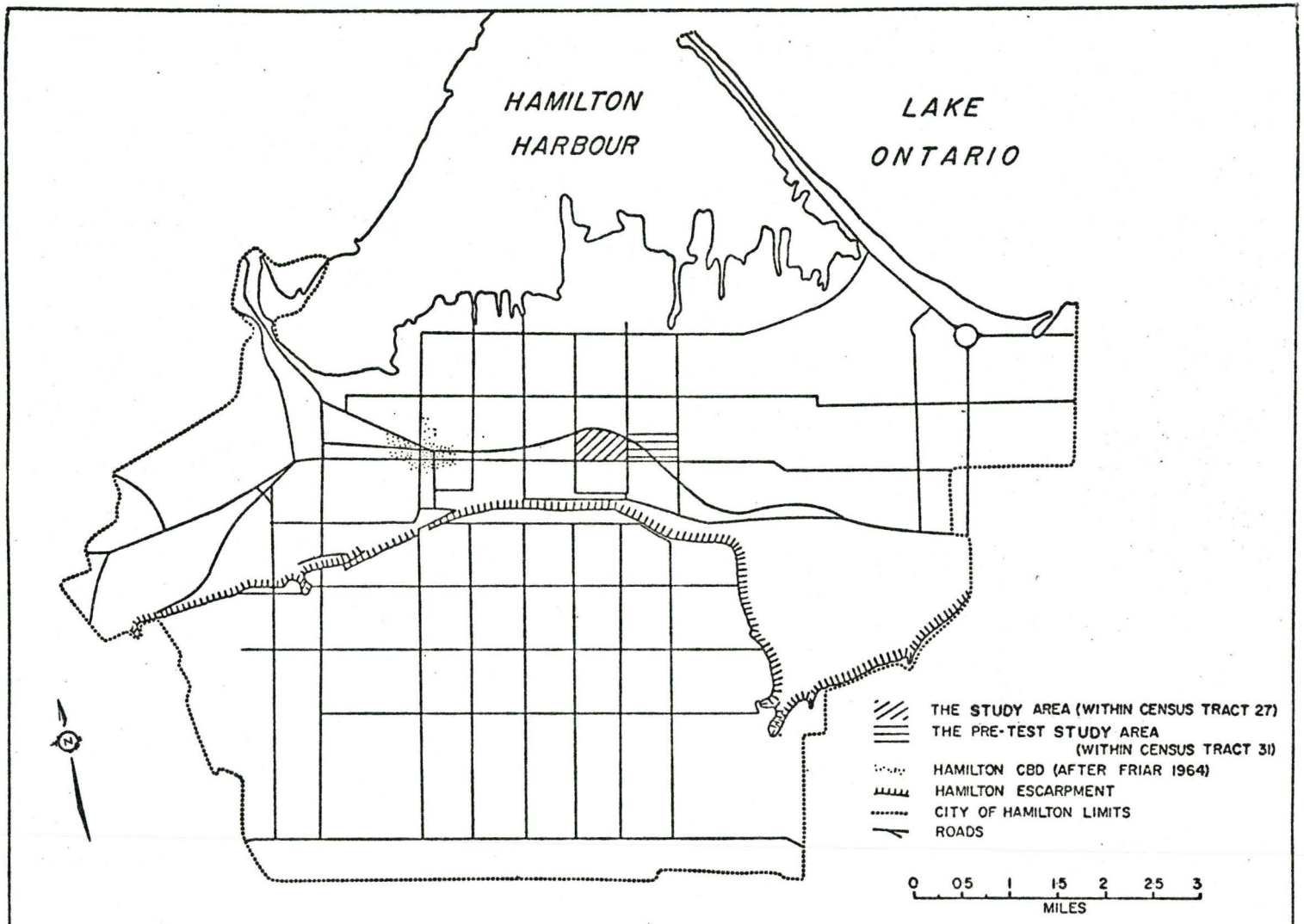

FIGURE 1: THE CITY OF HAMILTON AND THE LOCATION OF THE STUDY AREA

3.3.2. The Field Survey

A two part field survey is used:

(a) the compilation of an inventory of house types;

(b) a questionnaire/interview survey of the households.

Part (a) is concerned with the collection of data for the computation of the residence type scale. The residence type scale is included within the Hollingshead Three Factor Index of Social Position and the set of socio-economic attributes. Part (b) requires households within the study area to complete a mailed questionnaire and a structured interview. These procedures enable the collection of the remainder of the social class data and the data required to compute consumer spatial imagery fields.

3.3.2.1. The Inventory of Residence Types

To calculate the residence type scale, as a preliminary for the computation of Hollingshead's Three Factor Index of Social Position and the set of socio-economic attributes, a modified Warner house type scale is employed.[20] Warner's original seven point scale is

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[20] See Warner, W.L., Social Class in America, Harper, New York, 1966. Nb., it is necessary to use the modified house type scale since the Hollingshead residence type scale cannot be generally applied. For further comment see Bonjean, C.M., Hill, R.J. and McLemore, S.D. (1967) op.cit., p.392.

modified into a six point scale by combining classes 5 and 6 (i.e., the "fair" and "poor" house type categories). This adjustment is necessary since Hollingshead's Three Factor Index of Social Position requires a house type scale comprised of six classes (see Table 1 for the modified scale). The basic criteria for the taxonomy are house type and condition. In the interpretation of the scale, it should be noted that the residences intended for one family but converted into multiple-family dwellings are given a rating of one point lower than that allocated to total structures. Apartments in a regular apartment building are not limited to a single rating. In ranking such apartments, more emphasis is placed upon exterior condition than total size. This strategy is based on Warner's contention that the size of an apartment building is not necessarily a valid indicator of its desirability as a place to live.[21]

3.3.2.2. The Questionnaire/Interview Survey

The prepared questionnaire was originally divided into two sections (see Appendix 3). Section A includes questions relating to social class structure. They provide the necessary data to compute Hollingshead's Three Factor Index of Social Position and the set of socio-economic

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[21]These interpretations of the house type scale are consistent with those assumed by Warner. See ibid., p.150.

TABLE 1

HOUSE TYPE SCALE AND DEFINITION

Rating	Description
1	EXCELLENT HOUSES. This includes only houses which are very large single family dwellings in good repair and surrounded by large lawns and yards which are landscaped and well cared for. These houses have an element of ostentation with respect to size, architectural style, and general condition of lawns and yards.
2	VERY GOOD HOUSES. Roughly, this includes all houses which do not quite measure up to the first category. The primary difference is one of size. They are slightly smaller but still larger than utility demands for the average family.
3	GOOD HOUSES. In many cases they are only slightly larger than utility demands. They are more conventional and less ostentatious than the two higher categories.
4	AVERAGE HOUSES. One and a half to two storey wood frame and brick single family dwellings. Conventional style, with lawns well cared for but not landscaped.
5	FAIR HOUSES. In general, this includes houses whose condition is not quite as good as those houses given a 4 rating. It also includes smaller houses in excellent condition. POOR HOUSES. In this and the category below, size is less important than condition in determining evaluation. Houses in this category are badly run down but have not deteriorated sufficiently that they cannot be repaired. They suffer from lack of care but do not have the profusion of debris which surrounds houses in the lowest category.
6	VERY POOR HOUSES. All houses which have deteriorated so far that they cannot be repaired. They are considered unhealthy and unsafe to live in. All buildings not originally intended for dwellings, shacks, and overcrowded buildings. The halls and yards are littered with junk and many have an extremely bad odor.

Source: Warner, W.L. (1960), op.cit., (modified scale).

attributes. Section B involves a free verbal response format which requires each respondent to state:

(a) the names and locations of known grocery stores within the city of Hamilton;

(b) the knowledge sources of the stated stores.

These data enable the measures of the properties of the spatial imagery fields to be computed.

It was originally decided that each questionnaire be mailed, and completed by each selected respondent. Specifically, each respondent would be the adult member of the household who most frequently purchased groceries. Each questionnaire was attached to an explanatory letter (see Appendix 3), which provided broad details of the nature and purpose of the survey. To establish the effectiveness of this procedure, a small pre-test was carried out in an area immediately adjacent to the selected tract, i.e., within tract 31 (see Figure 1). Thirty-five households received mailed questionnaires. Sixteen were personally collected during two separate visits within five days of the original delivery. This represented a response rate of 46 per cent. Of the nineteen respondents who did not complete the questionnaire, sixteen were successfully contacted during the two visits. They were each asked whether their refusal to complete the questionnaire was due to difficulties in understanding either of the sections included within it. An affirmative answer required the

specification of the section(s). Of the seven respondents who answered in the affirmative, six stated they had difficulties in comprehending the free verbal response format (Section B).

On the basis of the experience gained from the pre-test, it was decided to restructure the questionnaire into written (Section A) and oral (Section B) components (See Appendix 4). The revised mailed questionnaire was, therefore, limited to include Section A of the pre-test questionnaire. A team of four interviewers was employed to collect the mailed questionnaire, and to orally question each respondent to complete the free verbal response format (Section B). To reduce the risk of error arising from difficulties on the part of the respondent in recalling store locations, details are recorded separately in the response format (see Appendix 4, Section B) for:

(a) stores actually visited regularly and/or recently;[22]

(b) stores which the respondent had a knowledge of in stated districts of Hamilton, taken in turn;[22]

(c) the source of knowledge for each recorded store location.

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[22]Only correctly reported store locations are recorded. A correctly reported store location is defined where (i) the street on which the store is located is correctly named; and (ii) the store name is correctly identified OR the nearest cross-street is correctly named (see Appendix 4, Section B).

The recording of store location details for specific districts of Hamilton in (b) represents an attempt to stimulate the memory of each respondent and reduce recall error. Since some longer residence respondents expressed difficulties in recalling their information sources during the pre-test, (c) was completed only by those respondents who had lived in Hamilton for a period of four years or less. A minimum of three calls were made to each dwelling unit included in the sample within one week of the original delivery.

Of the 775 subjects selected, 406 completed both stages of the questionnaire/interview survey. This represents a response rate of 52 per cent[23] (i.e., an increase of 6 per cent on the results of the pre-test). Of the 406 respondents, 110 had resided in Hamilton for less than four years and were, therefore, required to complete part (c) of the field interview.

3.3.3. The Measurement of Distance

The spatial compactness of the study area permits the allocation of the residences of the respondents to a control location to facilitate the analysis. Specifically, it was decided to assign residences to a common point

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[23] Or 26 per cent of the total number of households within the census tract.

(i.e., a residence control), which represents the mean centre of gravity of the study area. Such spatial generalization is necessary since the scale of the base map of Hamilton (see Figure 2), on which all of the grocery store locations within Hamilton are recorded,[24] is too small to distinguish between the individual residence locations within the sample.

A total of 117 reported store locations are recorded in the survey (see Figure 2). To facilitate an accurate calculation of the airline distances between the residence control and the reported store locations for each respondent, a Benson-Lehner Decimal Convertor is employed.[25] This device enables point locations on the map to be converted into a common system of location coordinates expressed in digital values. Employing the scale of the base map and the Pythagoras Theorem, the linear distances between the residence control

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[24]The sources of the grocery store location data are: Vernon's City of Hamilton Classified Business Directory, Griffin and Richmond Co. Ltd., Hamilton, Ontario, 1969; Hamilton and District Telephone Directory, Bell Canada, 1969; and direct field observations.

[25]For a description of the applications of the Convertor see Ingram D.R. and Fulton, R.D., "Hamilton Coordinate Mapping System," Departmental Note No.3, Department of Geography, McMaster University, Hamilton, Ontario, 1966.

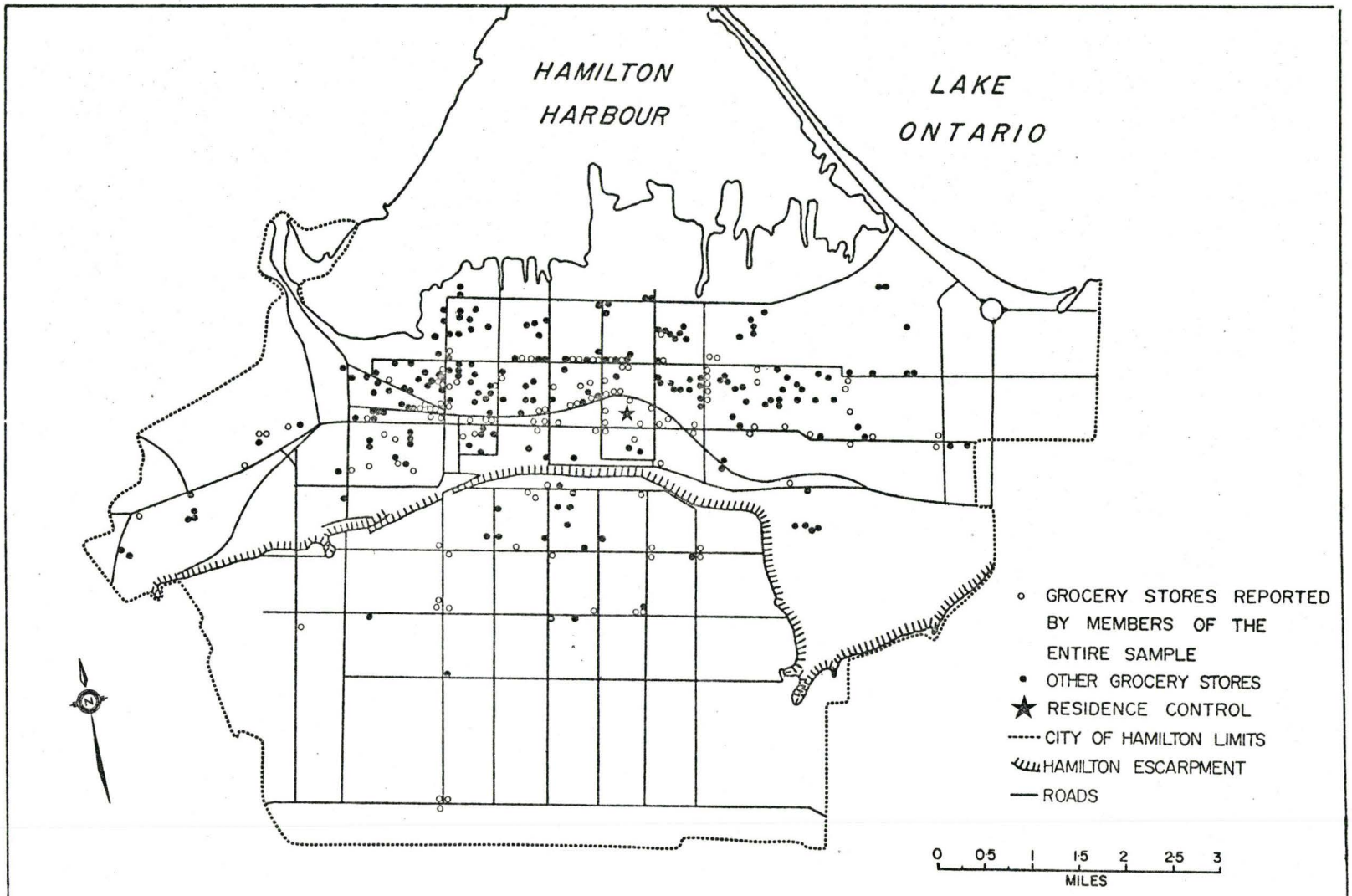


FIGURE 2: THE DISTRIBUTION OF THE GROCERY STORES OF HAMILTON IN RELATION TO THE RESIDENCE CONTROL.

and each store location are computed and adjusted into mileage units.

3.4 Summary

To provide a background for the discussions of the hypotheses and data sources, a statement is first presented on how a spatial imagery field is defined and measured.

Three hypotheses are derived concerning length of residence:

(I) there is a positive relationship between number of reported points and length of residence in Hamilton;

(II) there is a positive relationship between mean distance and length of residence in Hamilton;

(III) the distance-decay of reported points is greater for a "low" length of residence consumer than for a "high" length of residence consumer.

Three hypotheses are derived concerning social status:

(IV) there is a positive relationship between number of reported points and social status;

(V) there is a positive relationship between mean distance and social status;

(VI) the distance-decay of reported points is greater for a "low" social status consumer than for a "high" social status consumer.

One hypothesis is derived concerning the information channels:

(VII) there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields.

Finally, the sources of the data, which are used to test the hypotheses, are outlined.

CHAPTER IV

THE ANALYSIS

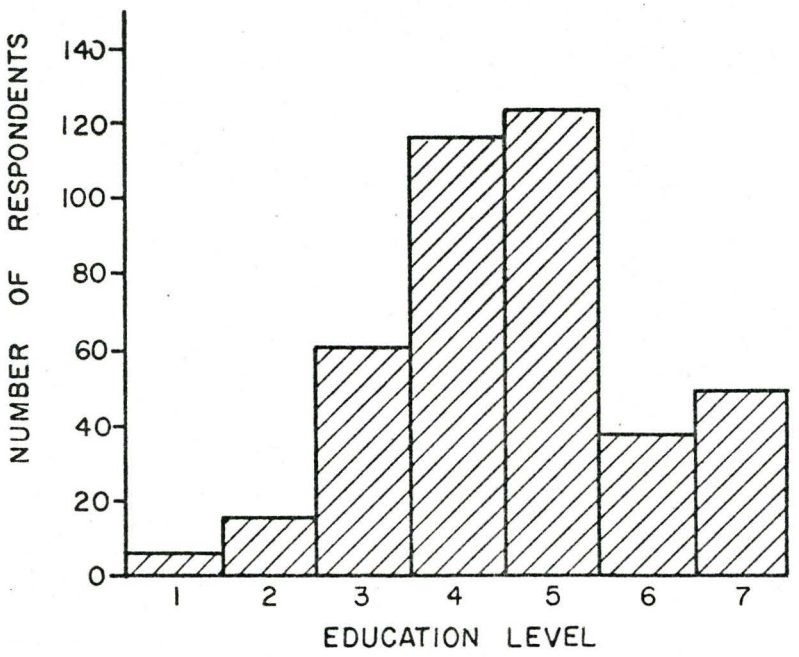
The focus of this chapter concerns the empirical testing of the hypotheses. The data upon which the analysis is performed are presented. The substantive tests of the hypotheses are then described. For each hypothesis, an interpretive presentation of the results of the test is offered.

4.1 The Composition of the Entire Sample

The field survey data are initially presented in summary form to show: (a) the social status composition of the entire sample; and (b) the sizes of the spatial imagery fields of the entire sample (see Figures 3-10).

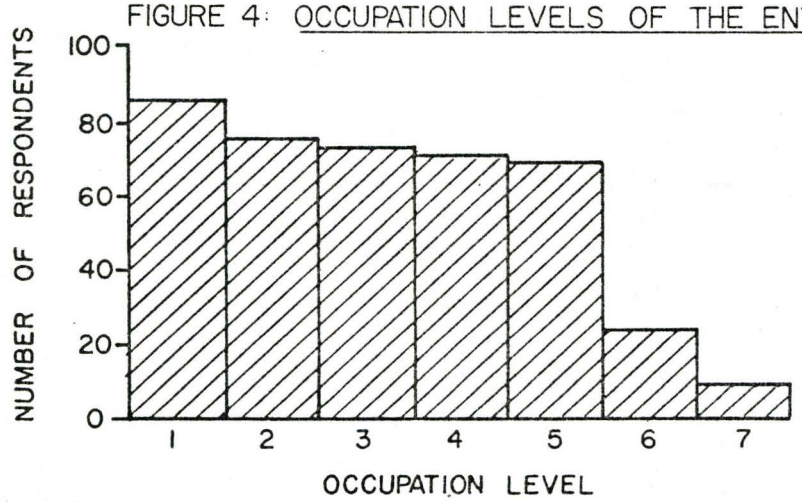
The frequency distribution for occupation reflects the heterogeneous employment structure of the sample (see Figure 4). The lower and middle classes of the distribution specifically include proprietors of small-scale businesses, manual workers of various levels of skill, and an assortment of clerical and secretarial employees. The survey data indicate that the upper classes of the distribution are primarily composed of representatives of the teaching and medical professions, and managers of medium to large businesses. Conversely, there is a small variance in the frequency distribution

FIGURE 3: EDUCATION LEVELS OF THE ENTIRE SAMPLE

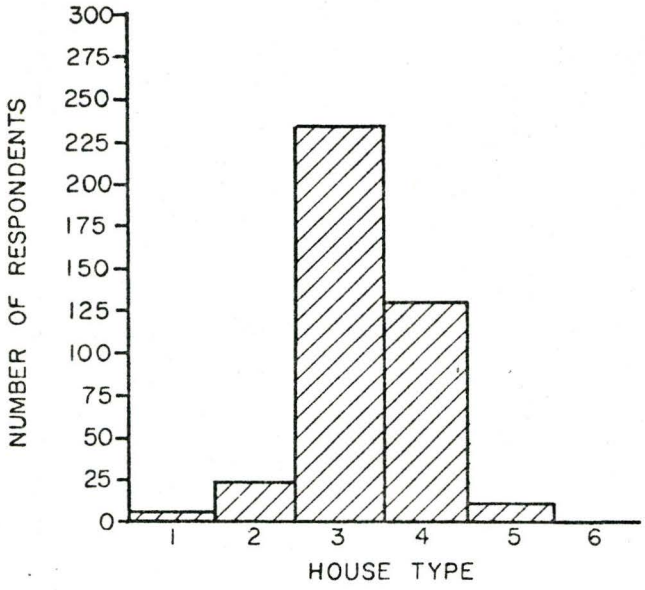


1. PRE-GRADE
2. GRADE 1-4
3. GRADE 5-8
4. HIGH SCHOOL INCOMPLETE
5. HIGH SCHOOL COMPLETE
6. COLLEGE (NON DEGREE OR DEGREE INCOMPLETE)
7. COLLEGE DEGREE

FIGURE 4: OCCUPATION LEVELS OF THE ENTIRE SAMPLE

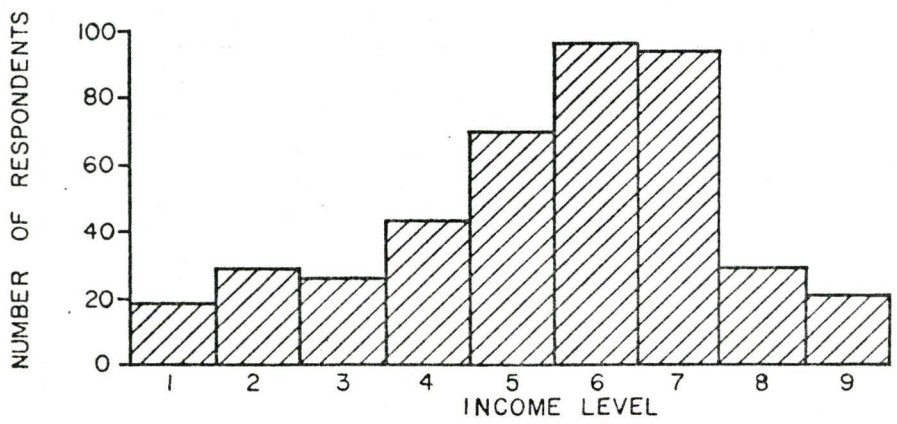


1. UNSKILLED
2. SEMI-SKILLED
3. SKILLED
4. CLERKS (ETC)
5. SMALLER BUSINESSMEN
6. MINOR PROFESSIONALS, MANAGERS, PROPRIETORS.
7. MAJOR PROFESSIONALS



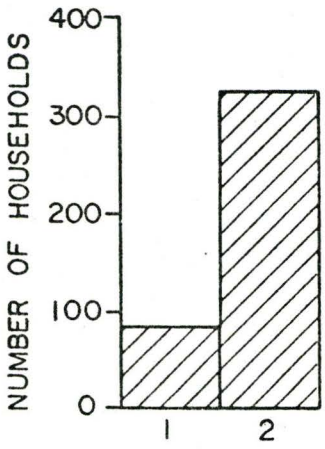
1. VERY POOR HOUSES
2. POOR HOUSES
3. AVERAGE HOUSES
4. GOOD HOUSES
5. VERY GOOD HOUSES
6. EXCELLENT HOUSES

FIGURE 5: HOUSE TYPES OCCUPIED BY THE ENTIRE SAMPLE



1. $1000-2000
2. 2000-2999
3. 3000-3999
4. 4000-4999
5. 5000-5999
6. 6000-6999
7. 7000-9999
8. 10000-12499
9. 12500+

FIGURE 6: INCOME LEVELS OF THE ENTIRE SAMPLE (HEAD OF THE HOUSEHOLD)



1. NO CAR
2 OWNERSHIP OF ONE OR MORE CARS

FIGURE 7: CAR OWNERSHIP OF THE ENTIRE SAMPLE

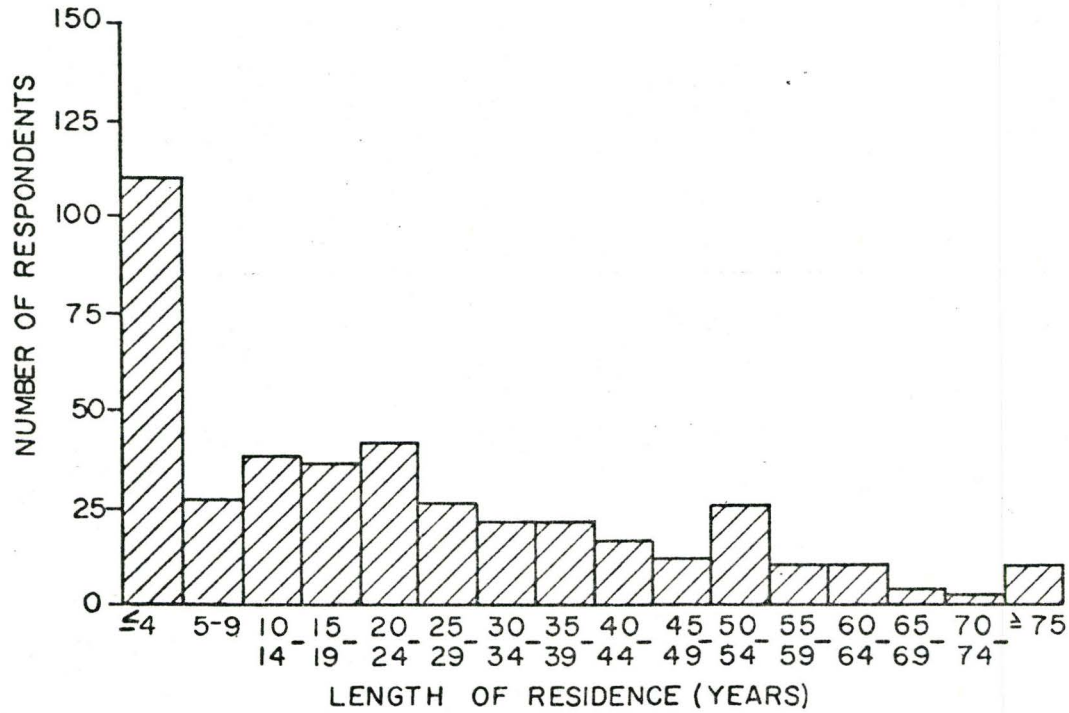


FIGURE 8: LENGTH OF RESIDENCE OF THE ENTIRE SAMPLE

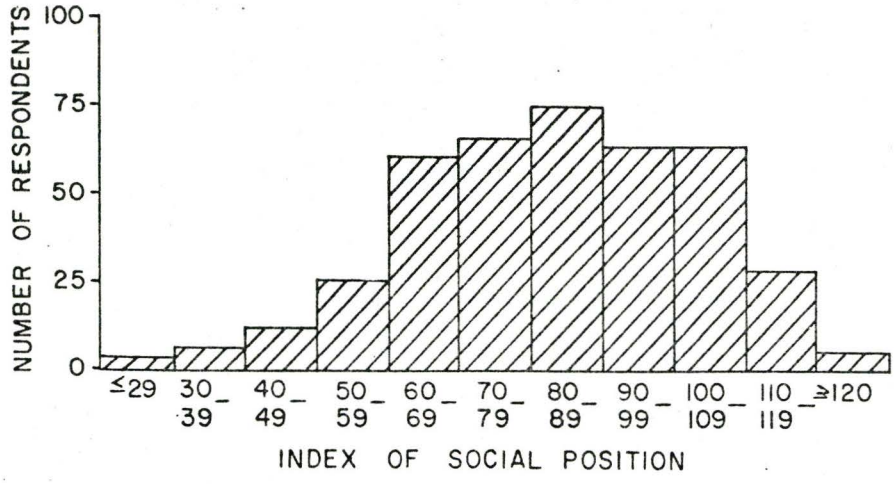
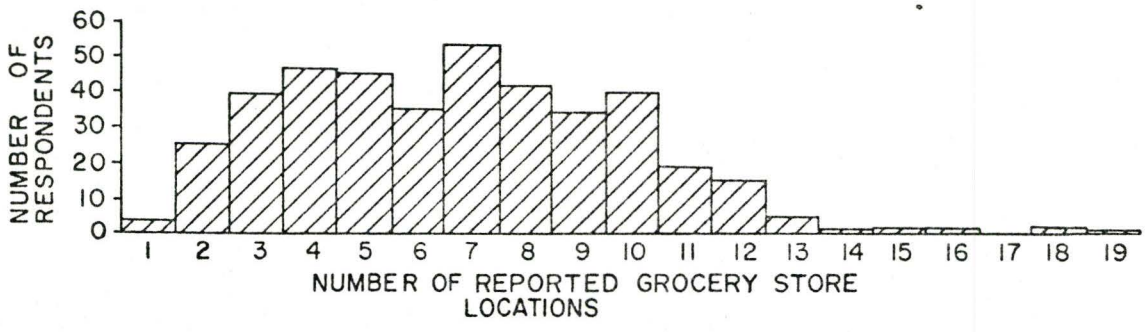


FIGURE 9: VALUES OF HOLLINGSHEAD'S INDEX OF SOCIAL POSITION FOR THE ENTIRE SAMPLE

10·1 NUMBER OF REPORTED GROCERY STORE LOCATIONS



10·2 MEAN DISTANCE OF THE GROCERY STORE LOCATIONS FROM THE RESIDENCE CONTROL

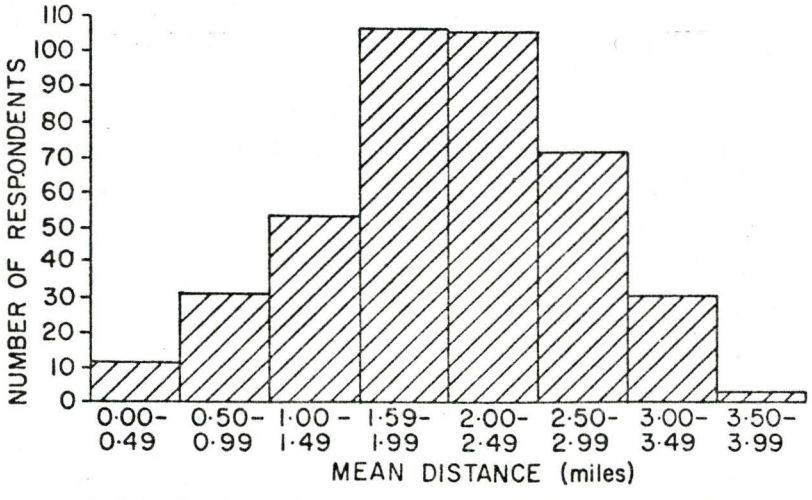


FIGURE 10: SIZES OF THE SPATIAL IMAGERY FIELDS FOR THE ENTIRE SAMPLE

of house type (see Figure 5). This is indicative of the overall homogeneity of the "working" to "lower-middle" social class structure of the study area. Specifically, the housing consists of two storey, wood frame, single (more commonly) or double family dwellings; and small brick apartments.

Although the frequency distribution of mean distance is approximately normal (see Figure 10.2), the distribution of the number of reported grocery store locations (i.e., number of reported points) suggests a slight positive skewness (see Figure 10.1). The length of residence distribution is also positively skewed (see Figure 8). This may be attributable to the transient households from outside Hamilton who are attracted to the numerous small apartments within the study area.

4.2 The Data Transformations

Since the analysis involves the use of regression procedures, normality of the data distributions of the variables is desirable.[1] The variables are tested for

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[1]The assumption of normality is critically discussed in Poole, M.A. and O'Farrell, P.N., "The Assumptions of the Linear Regression Model," Transactions of the Institute of British Geographers, 44 (1970), pp.148-49; and Olsson, G., "Distance and Human Interaction: A Migration Study," Geografiska Annaler 47 (1965), p.8. Since car ownership is a binary variable, the problem of normality does not arise.

Nb. In the regression analyses, the Index of Social Position scores are inverted. Thus, the scores of all of the social status variables are expressed according to an ascending magnitude of status; i.e., low scores represent low status, and high scores represent high status.

normality by computing their skewness and kurtosis.[2] These moments are, respectively, measures of the symmetry and shape of each of the data distributions. For each variable, a t-test[3] is employed to compute the statistical significance of the departure of the data distribution from normality (see Appendix 5.1).

If the deviations of the skewness and/or kurtosis values from normality (i.e., zero) are significant at the 0.05 level, the data are transformed.[4] Appendix 5.2 summarizes the skewness and kurtosis values of the transformed and untransformed variables. Where the deviation of a skewness and/or kurtosis value from normality is reduced such that it

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[2]This procedure is used in Berry, B.J.L., Commercial Structure and Commercial Blight, Research Paper No.85, Department of Geography, The University of Chicago, Chicago, Illinois, 1963, pp.230-32.

[3]For a discussion of this test see Snedecor, G.W., Statistical Methods, The Iowa State University Press, Ames, Iowa, 1956, pp.199-202. Also for an empirical example of its use see Berry, B.J.L. (1963), op.cit., pp. 230-32.

[4]This selection of transformations is similar to the strategy adopted by Berry, i.e., common logarithms are used to transform positively skewed data, while reciprocals are used to transform negatively skewed data. See ibid.

Nb., Square roots are also used to transform positively skewed data. However, since these do not reduce the deviations of the skewness and kurtosis values from zero they are not retained for any of the variables. The square root transformations are not summarized in Appendix 5.2.

is not significant at the 0.05 level, the relevant transformation is retained. Although departures of the data distributions from normality are not completely eliminated, they are substantially reduced wherever possible.[5] The values of the retained transformed variables and the untransformed variables, after this selection procedure, are summarized in Appendix 5.3. The normality of the transformed variables is confirmed by plotting the data on arithmetic probability paper.

4.3 Tests of Hypotheses

The tests of the hypotheses are presented within four parts. The parts are defined according to the properties of a spatial imagery field which are analyzed. Specifically, the parts are: the analysis of number of reported points; the analysis of mean distance; the analysis of distance-decay; and the analysis of the information channels.

4.3.1 Analysis of Number of Reported Points

Number of reported points is the total number of gocery store locations, or points, reported by a consumer in Hamilton. This analysis involves the tests of

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[5]Similar criteria for retaining transformed data are used in ibid.

Hypotheses (I) and (IV):

Hypothesis (I) : there is a positive relationship between number of reported points and length of residence in Hamilton;

Hypothesis (IV) : there is a positive relationship between number of reported points and social status.

The hypotheses are tested within the framework of stepwise multiple regression analysis.[6] Use of stepwise multiple regression procedures permits the control of social status for the test of Hypothesis (I), and the control of length of residence for the test of Hypothesis (IV).[7] Two multiple regression models are tested, each employing number of reported points (X_0) as the dependent variable. Model (i) determines how variations in number of reported points (X_0) are "explained" by variations in length of residence (X_2)

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[6]The technique is presented in Efroymsen, M.A., "Multiple Regression Analysis," in Ralston, A., and Wilf, H.S. (eds.), Mathematical Methods for Digital Computers, Wiley, New York, 1960, pp.191-203. The program used (BMD02R) is described in Dixon, W.J. (ed.), B.M.D. Biomedical Computer Programs, Health Sciences Computing Facility, Department of Preventive Medicine, University of California, Los Angeles, 1964, pp.233-57.

[7]Length of residence (X_2) is correlated with Index of Social Position (X_3), occupation level (X_6), and income level (X_7) at the 0.01 significance level (see Appendix I).

and Index of Social Position (X_3).[8] Model (ii) is formulated to determine how variations in number of reported points (X_0) are "explained" by variations in the set of socio-economic attributes ($X_4, \ldots, X_8$). F-tests are used to test the statistical significance of the regression and correlation coefficients. The models are treated in turn.

Model (i)

The model is used to test both hypotheses and is of the general form:

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[8] A two-way analysis of variance was initially used to determine whether there are significant effects of length of residence and social status (Index of Social Position) upon number of reported points. A formal statement of the model and the hypotheses is presented in Appendix 6.1. The length of residence and social status samples, and their respective means, are defined in Appendix 6.2. The tests for normality suggest that each of the samples is normally distributed (see Appendix 6.3). The results of Bartlett's test indicate that the variances of the samples defined according to length of residence are equal, and that the variances of the samples defined according to social status are also equal (see Appendix 6.4). The results of the analysis of variance (i.e., sums of squares) are presented in Appendix 6.5. The variance-ratio tests (see Appendix 6.6) indicate that the calculated F values for length of residence and social status significantly exceed the critical value of F. These results suggest that there are significant effects of length of residence and social status upon number of reported points. For a detailed discussion of the model used (i.e., the two-way classification model with an unequal number of replications per cell) see Chakravarti, I.M., Laka, R.G. and Roy, J., Handbook of Statistical Methods: Volume I, Wiley, New York, 1967, pp.350-55.

$$X_0 = a + b_{02.3}X_2 + b_{03.2}X_3$$

where X_0 denotes number of reported points, and X_2 and X_3 denote independent variables specified respectively as length of residence and Index of Social Position.

Two intermediate simple regression equations are computed. The equations are:

(i) $X_0 = a + b_2X_2$

(ii) $X_0 = a + b_3X_3$

Length of residence (X_2) is "forced" into equation (i). The partial coefficient of determination $r^2_{03.2}$ is then computed to determine the proportional reduction of the variance of X_0, "unexplained" by X_2, which is attributable to the variation of Index of Social Position (X_3). Index of Social Position (X_3) is "forced" into equation (ii). The partial coefficient of determination $r^2_{02.3}$ is then computed to indicate the proportional reduction of the variance of X_0, "unexplained" by X_3, which is attributable to the variation of length of residence (X_2). The results of the test of model (i) are summarized in Table 2.[9]

The results offer support for Hypothesis (I). There is a proportional reduction of 49 per cent in the variation of X_0, "unexplained" by X_3, which is attributable to the

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[9] In Table 2, equation (iii) is the general solution of model (i).

TABLE 2

SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (i)

(i) $X_0 = 0.465 + 0.296X_2$	r=0.685	r^2=0.469	$r_{03.2}$=0.586	$r^2_{03.2}$=0.343
(ii) $X_0 = 0.370 + 0.006X_3$	r=0.559	r^2=0.312	$r_{02.3}$=0.702	$r^2_{02.3}$=0.492
(iii) $X_0 = 0.173 + 0.257X_2 + 0.005X_3$	R=0.807	R^2=0.651		

variation of length of residence (X_2). Therefore, for a group of consumers defined according to their social status, there is a relationship between the number of reported store locations and length of residence in Hamilton. The entry of length of residence (X_2) into the regression equation already including Index of Social Position (X_3) registers a significant increase in the level of "explained" variation of X_0.[10] The sign of the partial regression coefficient $b_{02.3}$ is positive as postulated and the coefficient is significant at the 0.01 level.

The results verify that the number of reported store locations is positively related to length of residence in Hamilton. The findings are consistent with the a priori proposition that environmental learning occurs among consumers (see pp.35-37). It is argued that, through this process, a consumer's knowledge of store locations is dependent upon his length of residence within the city.

Table 2 offers support for Hypothesis (IV). There is a proportional reduction of 34 per cent in the variation

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[10]The increase in the level of "explained" variation of X_0 is 34 per cent, which is significant at the 0.01 level. (See equations (ii) and (iii) in Table 2.)

of X_0, "unexplained" by X_2, which is attributable to the variation of Index of Social Position (X_3). Therefore, for a group of consumers defined according to their length of residence in Hamilton, there is a relationship between the number of reported store locations and social status. The entry of Index of Social Position (X_3) into the regression equation already including length of residence (X_2) registers a significant increase in the level of "explained" variation of X_0.[11] The sign of the partial regression coefficient $b_{03.2}$ is positive as postulated and the coefficient is significant at the 0.01 level.

These results verify that the number of reported store locations is positively related to social status. It is argued a priori that this relationship is indicative of the greater levels of spatial interaction among higher status consumers who are therefore exposed to more store locations (see pp.38-39).

Model (ii)

The model is used to test Hypothesis (IV) and is of the general form:

$$X_0 = a + b_{02.45678}X_2 + b_{04.25678}X_4 + b_{05.24678}X_5 + b_{06.24578}X_6 + b_{07.24568}X_7 + b_{08.24567}X_8$$

where:

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[11]The increase in the level of "explained" variation of X_0 is 18 per cent, which is significant at the 0.01 level. (See equations (i) and (iii) in Table 2.)

X_0 = Number of reported points;

X_2 = Length of residence;

X_4 = Residence type;

X_5 = Car ownership;

X_6 = Occupation level;

X_7 = Income level;

X_8 = Education level.

The model is formulated to determine how variations in X_0 are "explained" by variations in the set of socio-economic attributes (X_4, ..., X_8).

To control length of residence, X_2 is first "forced" into the regression equation. The regression equation is then built up by adding one independent variable at a time, thus generating a set of intermediate regression equations.[12] In each step, the variable that accounts for most of the "unexplained" variation of X_0 is entered into the regression equation. This means that upon the completion of step 1 (i.e., the two variable regression of X_0 on length of residence (X_2)),the partial correlation coefficients of

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[12]For a discussion of the conventional stepwise multiple regression procedure see Draper, N.R. and Smith, H., Applied Regression Analysis, Wiley, New York, 1966, pp.171-95; and Olsson, G., "Distance and Human Interaction: A Migration Study," Geografiska Annaler, 47 (1965), pp.3-47.

each of the remaining variables are computed.[13] The independent variable with the highest partial correlation coefficient is selected for step 2 and is entered into the regression equation. A new regression equation including two independent variables is then determined. The selection of the next independent variable to be entered into the equation depends upon the revised partial coefficients of the remaining independent variables, the highest again being selected. The stepwise procedure is repeated until all of the specified variables are included within the regression equation.

The results of the test of the model are summarized in Table 3. The results indicate a significant increase in the coefficient of determination due to the entry of the socio-economic attributes into the regression equation.[14] The partial coefficients of determination at step 1 are indicative of the relative "explanatory" power of the attributes after length of residence (X_2) is "forced" into the regression equation. Specifically, occupation level (X_6) accounts for most of the remaining variation of X_0

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[13]The computations of the partial correlation coefficients are such that the variable(s) already in the equation are held constant.

[14]The increase in the level of "explained" variation of X_0 is 14 per cent, which is significant at the 0.01 level.

TABLE 3

SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (ii)

STEP	INCLUDED VARIABLES								VARIABLES NOT INCLUDED		
	VARIABLE	R	STANDARD ERROR OR ESTIMATE	R^2	INCREASE	X_0 INTERCEPT	REGRESSION COEFFICIENT	STANDARD ERROR	VARIABLES	PARTIAL CORRELATION COEFFICIENT	PARTIAL COEFFICIENT OF DETERMINATION
1	X_2	0.6847*	0.1601	0.4689	0.4689*	0.4651	b_2 =0.2458*	0.0157	X_4	0.3947	0.1558
									X_5	0.1873	0.0351
									X_6	0.5503	0.3028
									X_7	0.2009	0.0404
									X_8	0.3874	0.1501
2	X_6	0.7935*	0.1338	0.6296	0.1207*	0.3281	$b_{02.6}$ =0.2643*	0.0133			
							$b_{06.2}$ =0.0545*	0.0041			
									X_4	0.1485	0.0221
									X_5	0.0367	0.0013
									X_7	0.0608	0.0037
									X_8	0.1997	0.0399
3	X_8	0.8027*	0.1313	0.6443	0.0147*	0.2176	$b_{02.68}$ =0.2686*	0.0131			
							$b_{02.68}$ =0.0466*	0.0044			
							$b_{08.26}$ =0.0240*	0.0059			
									X_4	0.1064	0.0113
									X_5	0.0116	0.0001
									X_7	0.0202	0.0004
4	X_4	0.8052*	0.1307	0.6483	0.0040≠	0.2007	$b_{02.468}$ =0.2705*	0.0131			
							$b_{04.268}$ =0.0084*	0.0039			
							$b_{06.248}$ =0.0421*	0.0049			
							$b_{08.246}$ =0.0210*	0.0060			
									X_5	0.0118	0.0001
									X_7	0.0018	0.0000
5	X_5	0.8054*	0.1308	0.6484	0.0001	0.2108	$b_{02.4568}$ =0.2701*	0.0131			
							$b_{04.2568}$ =0.0090*	0.0041			
							$b_{05.2468}$ =0.0078	0.0178			
							$b_{06.2458}$ =0.0049*	0.0049			
							$b_{08.2456}$ =0.0211*	0.0060			
									X_7	0.0032	0.0000
6	X_7	0.8054*	0.1310	0.6484	0.0000≠	0.2093	$b_{02.45678}$=0.2700*	0.0134			
							$b_{04.25678}$=0.0089*	0.0042			
							$b_{05.24678}$=0.0078	0.0179			
							$b_{06.24578}$=0.0422*	0.0050			
							$b_{07.24568}$=0.0007≠	0.0113			
							$b_{08.24567}$=0.0211*	0.0061			

* = Significant at the 0.01 level
\+ = Significant at the 0.05 level
≠ = Not significant

(i.e., 30 per cent). Residence type (X_4) and education level (X_8) provide the next greatest "explanatory" power for the remaining variation of X_0, respectively accounting for 16 per cent and 15 per cent of the variance "unexplained" by X_2. These results indicate that, for a group of consumers defined according to their length of residence in Hamilton, there is a relationship between the number of reported store locations and three socio-economic attributes: occupation level, residence type and education level. The levels of "explanation" provided by income level (X_7) and car ownership (X_5) are relatively small.

The order of entry of the variables into the regression equation is based upon the magnitude of their proportional reduction of the variation of X_0 "unexplained" by the variables already included within the equation. The first two socio-economic variables entered into the equation are respectively occupation level (X_6) and education level (X_8). Each registers a significant increase in the coefficient of determination at the 0.01 level. Residence type (X_4), car ownership (X_5),[15] and

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[15]Inferential tests (F-tests) are not performed upon car ownership (X_5), which is a binary variable (i.e., a consumer owning a minimum of one car takes the value 1, while a consumer who does not own a car takes on a value of 0). The role of a binary variable in multiple regression analysis is reviewed in Lapin, L.L., Statistics for Modern Business Decisions, Harcourt Brace Jovanovich, New York, 1973, pp.516-21.

income level (X_7) are then entered into the equation although they do not register any significant increases in R^2. These non-significant increases in R^2 appear, in part, to be attributable to the intercorrelations between the socio-economic attributes (see Appendix 1).

The final estimating equation is:

$$X_0 = 0.209 + 0.270X_2 + 0.0422X_6 + 0.021X_8 + 0.009X_4 + 0.008X_5 + 0.001X_7$$

When the variables with partial regression coefficients non-significant at the 0.05 level are deleted, the equation reduces to:

$$X_0 = 0.209 + 0.270X_2 + 0.0422X_6 + 0.021X_8 + 0.009X_4$$

Hypothesis (IV) is therefore verified where occupation level (X_6), education level (X_8), and residence type (X_4) are used to measure social status. Although $b_{05.24678}$ and $b_{07.24568}$ are not significant,[16] the signs of the regression coefficients are positive. This suggests that the directionality of Hypothesis (IV) is meaningfully stated where social status is measured by the entire set of socio-economic attributes.

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[16] $b_{05.24678}$ is the partial regression coefficient for a binary variable (car ownership (X5)), which is not tested for significance.

4.3.1.1 Summary

(a) Hypothesis (I)

The results of the test of stepwise regression model (i) provide substantive verification of the hypothesis. The model permits the control of social status, which is treated as a "forced variable". The partial coefficient of determination $r^2_{02.3}$ exceeds 0.49, while length of residence contributes significantly to the "explanatory" power of the model. The significant partial regression coefficient $b_{02.3}$ is positive as postulated. Therefore, for a group of consumers defined according to their social status, there is a positive relationship between the number of reported store locations and length of residence. The proposition that environmental learning occurs among consumers is consistent with these results.

(b) Hypothesis (IV)

The results of the tests of stepwise regression models (i) and (ii) verify the hypothesis. The models permit the control of length of residence, which is treated as a "forced variable".

The test of model (i) indicates a positive relationship between number of reported points and Index of Social Position. The partial coefficient of determination $r^2_{03.2}$ exceeds 0.34, while the Index contributes significantly to the power of the model. The partial regression coefficient

$b_{03.2}$ is significant and positive as postulated. Therefore, for a group of consumers defined according to their length of residence in Hamilton, there is a positive relationship between the number of reported store locations and social status. It is posited that this relationship is indicative of the greater levels of spatial interaction enjoyed by higher status consumers.

The test of model (ii) indicates a positive relationship between the number of reported store locations and the set of socio-economic attributes. Occupation level and education level each register significant increases in the "explanatory" power of the model. Further, the partial regression coefficients of each of these variables, and of residence type, are significant. Hypothesis (IV) is thus clearly verified where occupation level, education level, and residence type are used to measure social status. However, car ownership and income level contribute negligible "explanatory" power to the model after the other variables are taken into account. It is proposed that this is indicative, in part, of the intercorrelations between the socio-economic attributes.

4.3.2 Analysis of Mean Distance

Mean distance is the mean distance between the residence control and the reported store locations. The

analysis of mean distance involves the tests of two hypotheses:

Hypothesis (II) : there is a positive relationship between mean distance and length of residence in Hamilton;

Hypothesis (V) : there is a positive relationship between mean distance and social status.

The hypotheses are tested using stepwise multiple regression procedures. Use of the stepwise solution of the regression model permits the control of social status for the test of Hypothesis (II), and the control of length of residence for the test of Hypothesis (V). Two multiple regression models are tested, each employing mean distance as the dependent variable. Model (iii) is formulated to determine how variations in mean distance (X_1) are "explained" by variations in length of residence (X_2) and Index of Social Position (X_3). Model (iv) is formulated to determine how variations in mean distance (X_1) are "explained" by variations in length of residence (X_2) and the set of socio-economic attributes (X_4, ..., X_8). F-tests are used to test the statistical significance of the regression and correlation coefficients.

The values of mean distance (X_1) are correlated with the respective values of number of reported points (X_0).[17] To test the postulated relationships by employing

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[17] See Appendix I.

X_1 as an independent distance measure of the size of a spatial imagery field, it is necessary to control the effects of X_0. In each model this problem is handled by treating X_0 as a "high-level forced variable" (i.e., it is the first independent variable entered into the regression equation). The effects of X_0 are then held constant while the postulated relationships are tested using partial correlation and regression analyses. The models are treated in turn.

Model (iii)

The model is used to test both hypotheses and is of the general form:

$$X_1 = a + b_{10.23}X_0 + b_{12.03}X_2 + b_{13.02}X_3$$

where:

X_0 = Number of reported points;

X_1 = Mean distance;

X_2 = Length of residence;

X_3 = Index of Social Position.

Two intermediate multiple regression equations are computed. The equations are:

(i) $X_1 = a + b_{10.2}X_0 + b_{12.0}X_2$

(ii) $X_1 = a + b_{10.3}X_0 + b_{13.0}X_3$

Number of reported points (X_0) and length of residence (X_2) are "forced" into equation (i). The partial coefficient of determination $r^2_{13.02}$ is then computed to determine the proportional reduction of the variance of X_1, "unexplained" by X_0 and X_2, which is attributable to the variation of

Index of Social Position (X_3). Number of reported points (X_0) and Index of Social Position (X_3) are forced into equation (ii). The partial coefficient of determination $r^2_{12.03}$ is then computed to determine the proportional reduction of the variance of X_1, "unexplained" by X_0 and X_3, which is attributable to the variation of length of residence (X_2). The results of the test of model (iii) are presented in Table 4.[18]

The results offer support for Hypothesis (II). There is a proportional reduction of 9 per cent in the variation of X_1, "unexplained" by X_0 and X_3, which is attributable to the variation of length of residence (X_2). Therefore, for a group of consumers defined according to their social status, there is a relationship between the mean distances of reported store locations from their domiciles and their length of residence in Hamilton. The entry of length of residence (X_2) into the multiple regression equation already including X_0 and X_3 registers a significant increase in the level of "explained" variation of X_1.[19] The sign of the partial regression coefficient is positive as postulated and the coefficient is significant at the 0.01 level.

These results verify that mean distance is positively related to length of residence in Hamilton. It is posited that this relationship is indicative of the effects of environmental learning among consumers (see pp.35-37).

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[18] In Table 4, equation (iii) is the general solution of model (iii).

[19] The increase in R^2 is 6 per cent, which is significant at the 0.01 level (see equations (ii) and (iii) in Table 4.)

TABLE 4

SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (iii)

(i) $X_1 = 0.419 + 0.885X_0 + 0.279X_2$	R=0.518	R^2=0.268	$r_{13.02}$=0.336	$r^2_{13.02}$=0.112
(ii) $X_1 = 0.144 + 0.917X_0 + 0.008X_3$	R=0.537	R^2=0.288	$r_{12.03}$=0.296	$r^2_{12.03}$=0.087
(iii) $X_1 = 0.120 + 0.107X_0 + 0.422X_2 + 0.010X_3$	R=0.592	R^2=0.350		

Store locations near the residence are learned first, then those at increasing distances. As the distance bias decreases through time, the probability of a consumer directly encountering a given store location is less likely to be constrained by the distance of the store from the place of residence. Therefore, the mean distance of learned store locations from the domicile of a consumer is positively related to his length of residence within the city.

Table 4 offers support for Hypothesis (V). There is a proportional reduction of 11 per cent in the variation of X_1, "unexplained" by X_0 and X_2, which is attributable to the variation of Index of Social Position (X_3). Therefore, for a group of consumers defined according to their length of residence, there is a relationship between the mean distance of reported store locations from their domiciles and social status. The entry of Index of Social Position (X_3) into the multiple regression equation already including X_0 and X_2 registers a significant increase in the level of "explained" variation of X_1.[20] The sign of the partial regression coefficient is positive as postulated and the coefficient is significant at the 0.01 level.

These results verify that mean distance is

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[20]The increase in R^2 is 8 per cent, which is significant at the 0.01 level (see equations (i) and (iii) in Table 4.)

positively related to social status. It is proposed a priori that this relationship is indicative of the greater levels of spatial interaction enjoyed by higher status consumers (see pp.38-39). The probability of a higher status consumer directly encountering a given store location within the city is, therefore, less likely to be constrained by the distance of the store from the place of residence.

Model (iv)

The model is used to test Hypothesis (V) and is of the general form:

$$X_1 = a + b_{10.245678}X_0 + b_{12.045678}X_2 + b_{14.025678}X_4 + b_{15.024678}X_5 + b_{16.024578}X_6 + b_{17.024568}X_7 + b_{18.024567}X_8$$

where:

X_0 = Number of reported points;

X_1 = Mean distance;

X_2 = Length of residence;

X_4 = Residence type;

X_5 = Car ownership;

X_6 = Occupation level;

X_7 = Income level;

X_8 = Education level.

The model is formulated to determine how variations in X_1 are "explained" by variations in the set of socio-economic attributes (X_4, ..., X_8).

To control number of reported points (X_0)[21] and length of residence (X_2), X_0 and X_2 are first "forced" into the regression equation. The regression equation is then built up by adding one independent variable (i.e., socio-economic attribute) at a time, thus generating a set of intermediate regression equations. In each step, the variable that accounts for most of the "unexplained" variation of X_1 is entered into the multiple regression equation until all of the specified variables are included.

The results of the test of the model are summarized in Table 5. The table indicates a significant increase in the coefficient of multiple determination (R^2) due to the entry of the socio-economic attributes into the regression equation.[22] The partial coefficients of determination at step 1 indicate the relative "explanatory" power of the attributes after X_0 and X_2 are "forced" into the equation. Occupation level (X_6) accounts for most of the remaining variation of X_1 (i.e., 10 per cent). This indicates that, for a group of consumers defined according to their length of residence in Hamilton, there is a relationship between mean distance and occupation level. However, the levels of "explanation" provided by the other attributes are relatively small.

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[21]The rationale for controlling number of reported points (X_0) is presented on pp.76-77.

[22]The increase in R^2 is 8 per cent, which is significant at the 0.01 level.

TABLE 5

SUMMARY OF THE RESULTS OF STEPWISE REGRESSION MODEL (iv)

STEP	INCLUDED VARIABLES								VARIABLES NOT INCLUDED		
	VARIABLE	R	STANDARD ERROR OF ESTIMATE	R^2	INCREASE	X_0 INTERCEPT	REGRESSION COEFFICIENT	STANDARD ERROR	VARIABLES	PARTIAL CORRELATION COEFFICIENT	PARTIAL COEFFICIENT OF DETERMINATION
1	X_0 X_2	0.5178*	0.5120	0.2681	0.2681*	0.4194	$b_{10.2}$ =0.8853* $b_{12.1}$ =0.2793≠	0.1591 0.0688	X_4 X_5 X_6 X_7 X_8	0.1123 0.0617 0.3206 0.0920 0.1572	0.0126 0.0038 0.1028 0.0085 0.0247
2	X_6	0.5859*	0.4856	0.3432	0.0751*	0.4278	$b_{10.26}$ =0.2104≠ $b_{12.06}$ =0.4087* $b_{16.02}$ =0.1214*	0.1808 0.0679 0.0179	X_4 X_5 X_7 X_8	-0.0191 -0.0110 0.0291 0.0734	0.0247 0.0001 0.0008 0.0054
3	X_8	0.5889*	0.4849	0.3468	0.0036≠	0.2954	$b_{10.268}$ =0.1563≠ $b_{12.068}$ =0.4289* $b_{16.028}$ =0.1136* $b_{18.026}$ =0.0327≠	0.1842 0.0692 0.0186 0.0222	X_4 X_5 X_7	-0.0357 0.0202 0.0148	0.0013 0.0004 0.0002
4	X_4	0.5896*	0.4852	0.3476	0.0008≠	0.3133	$b_{10.2468}$ =0.1703≠ $b_{12.0468}$ =0.4229* $b_{14.0268}$ =0.0105≠ $b_{16.0248}$ =0.1186≠ $b_{18.0246}$ =0.0361+	0.1854 0.0698 0.0147 0.0199 0.0223	X_5 X_7	-0.0099 0.0213	0.0001 0.0005
5	X_7	0.5899*	0.4857	0.3479	0.0003≠	0.2764	$b_{10.24678}$=0.1702≠ $b_{12.04678}$=0.4185* $b_{14.02678}$=-0.0116≠ $b_{16.02478}$=0.1179* $b_{17.02468}$=0.0177≠ $b_{18.02467}$=0.0230+	0.1856 0.0706 0.0147 0.0199 0.0417 0.0230	X_5	-0.0113	0.0001
6	X_5	0.5900*	0.4862	0.3481	0.0002	0.2947	$b_{10.245678}$=0.1693≠ $b_{12.045678}$=0.4180* $b_{14.024578}$=-0.0106≠ $b_{15.024678}$=-0.0150 $b_{16.024578}$=0.1182* $b_{17.024568}$=0.0184≠ $b_{18.024567}$=0.0348+	0.1858 0.0707 0.0156 0.0663 0.0200 0.0418 0.0231			

* = Significant at the 0.01 level
\+ = Significant at the 0.05 level
≠ = Not significant

The order of entry of the variables into the multiple regression equation is based upon the magnitude of their proportional reduction of the variation of X_1 "unexplained" by the variables already included within the equation. Occupation level (X_6) is the first socio-economic attribute to enter the equation, and is the only one to register a significant increase in the coefficient of multiple determination. The remaining variables are entered into the equation although they do not register significant increases in R^2.

The final estimating equation is:

$$X_1 = 0.295 + 0.169X_0 + 0.418X_2 + 0.118X_6 + 0.035X_8 - 0.011X_4 + 0.018X_7 - 0.015X_5$$

When the variables with non-significant partial regression coefficients at the 0.05 level are deleted, the equation reduces to:

$$X_1 = 0.295 + 0.418X_2 + 0.118X_6 + 0.035X_8$$

The signs of the significant partial regression coefficients are positive. Hypothesis (V) is therefore verified where social status is measured by occupation level (X_6) and education level (X_8). The remaining socio-economic attributes (residence type (X_4), car ownership (X_5), and income level (X_7)) are not significantly related to X_1 after the other attributes are entered into the equation. This appears to be indicative, in part, of the intercorrelations between

the socio-economic attributes (see Appendix I). Furthermore, the partial regression coefficients of car ownership (X_5) and residence type (X_4) are negative although non-significant.[23] Therefore, Hypothesis (V) is not verified when social status is measured by residence type (X_4), income level (X_7), and car ownership (X_5).

4.3.2.1 Summary

(a) Hypothesis (II)

The results of the test of stepwise regression model (iii) offer substantive verification for the hypothesis. The model permits the control of number of reported points and social status, which are treated as "forced variables". Length of residence contributes significantly to the "explanatory" power of the model, while the significant partial regression coefficient $b_{12.03}$ is positive as postulated. Therefore, for a group of consumers defined according to social status, there is a positive relationship between the mean distances of reported store locations from their domiciles and length of residence in Hamilton. These results are consistent with the proposition that consumer information is accumulated through an environmental learning process.

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[23] Since car ownership (X_5) is a binary variable, it is not tested for significance.

(b) Hypothesis (V)

The results of the tests of stepwise regression models (iii) and (iv) verify the hypothesis. The models permit the control of number of reported points and length of residence, which are treated as "forced variables".

The test of model (iii) indicates a positive relationship between mean distance and Index of Social Position. The Index contributes significantly to the "explanatory" power of the model, while the significant partial regression coefficient $b_{13.02}$ is positive as postulated. Therefore, for a group of consumers defined according to length of residence in Hamilton, there is a positive relationship between the mean distances of reported store locations from the places of residence and social status. It is posited that this relationship is indicative of greater levels of spatial interaction enjoyed by higher status consumers.

The test of model (iv) indicates a significant positive relationship between mean distance and two of the socio-economic attributes (i.e., occupation level and education level). However, only occupation level contributes significantly to the "explanatory" power of the model. The "explanation" provided by residence type, income level, and car ownership is negligible. It is suggested that this is attributable, in part, to the intercorrelations between the variables.

4.3.3 Analysis of Distance-Decay

Distance-decay describes the decrease in density of reported points as distance from the place of residence of a consumer increases. The analysis of distance-decay involves the tests of Hypotheses (III) and (VI). The hypotheses are each tested by using a procedure which involves the z-test for differences between two proportions.[24] The hypotheses are treated in turn.

(a) Hypothesis (III)

The hypothesis is "the distance-decay of the reported points is greater for a 'low' length of residence consumer than for a 'high' length of residence consumer." The procedure used to test the hypothesis involves the stratification of the entire sample. Specifically, the entire sample is stratified into two sub-samples to permit the control of social status,[25] i.e., the High and Low Social Status Samples.[26] Each of these sub-samples is

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[24]The test is described in Freund, J.E., Modern Elementary Statistics, Prentice-Hall, Englewood Cliffs, New Jersey, 1952, pp.285-87.

[25]Length of residence is correlated with Index of Social Position at the 0.01 significance level (see Appendix I).

[26]The sub-samples are defined according to the median value of the Index of Social Position for the entire sample, i.e., 84 points. (Subjects with 84 points are arbitrarily included in the Low Social Status Sample.) The High Social Status Sample includes 212 subjects while the Low Social Status Sample includes 194 subjects.

divided into two groups according to the length of residence of the subjects included within them.[27]

Having thus stratified the entire sample, all grocery stores in Hamilton are allocated to five distance zones with respect to their distances from the residence control.[28] The five distance zones are such that they each contain an equal number of stores (i.e., 66 stores per zone). This definition of distance zones which contain an equal number of stores is, in effect, a control which eliminates the possible influence that the physical distribution of store locations in Hamilton may have upon

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[27]Within each sub-sample, the groups are defined according to the median value of length of residence for the entire sample, i.e., 18 years. (Subjects with 18 years residence are arbitrarily included within the respective "low" length of residence group.) The groups are:

	Group	No. of Subjects
High Social Status Sample	Low Length of Residence	92
	High Length of Residence	120
Low Social Status Sample	Low Length of Residence	109
	High Length of Residence	85

[28]The distances of the stores from the residence control (in miles) are:

Zone 1 = 0.000 - 1.306
Zone 2 = 1.307 - 1.932
Zone 3 = 1.933 - 2.706
Zone 4 = 2.707 - 3.501
Zone 5 = 3.502 - 8.000

the nature of the distance-decay effect. For each distance zone, a consumer is assigned the value 1 if he reports one or more grocery store locations within a zone, or 0 if he does not report any locations in the same zone. The total observations in each of the five distance zones, represent the aggregate positive outcomes, or "successes", for consumers included within a given group. The distribution of these observations among the five distance zones for each group (see Tables 6-7) appears to provide initial support for the hypothesis.

The hypothesis is formally tested by determining: (i) whether the "low" length of residence group reports a greater proportion of observations in the nearest distance zone to the residence control (i.e., zone 1) than the "high" length of residence group; and (ii) whether the "low" length of residence group reports a smaller proportion of observations in the furthest distance zone (i.e., zone 5) than the "high" length of residence group. Specifically, two sets of hypotheses are tested using the z-test for differences between two proportions:

Distance Zone 1

(i) Null Hypothesis (H_0):

there is no difference between the proportion of observations in distance zone 1 for the "low" length of residence group and the corresponding proportion for the "high" length of residence group.

TABLE 6

SPATIAL DISTRIBUTION OF THE REPORTED GROCERY STORE LOCATIONS:
HIGH SOCIAL STATUS SAMPLE

Group	Distance Zone* 1	2	3	4	5	Total Observations
Low Length of Residence	104(0.361)	92(0.319)	41(0.149)	21(0.067)	30(0.104)	288
High Length of Residence	88(0.223)	86(0.218)	75(0.190)	67(0.170)	76(0.193)	384

Nb., the proportion which each value represents of the total observations in its respective row is indicated in parentheses.

* Each distance zone includes 66 stores.
The distances of the stores from the residence control (in miles) are:

Zone 1 = 0.000 - 1.306
Zone 2 = 1.307 - 1.932
Zone 3 = 1.933 - 2.706
Zone 4 = 2.707 - 3.501
Zone 5 = 3.502 - 8.000

TABLE 7

SPATIAL DISTRIBUTION OF THE REPORTED GROCERY STORE LOCATIONS:
LOW SOCIAL STATUS SAMPLE

Group	Distance Zone* 1	2	3	4	5	Total Observations
Low Length of Residence	117(0.509)	65(0.283)	26(0.113)	10(0.043)	12(0.052)	230
High Length of Residence	96(0.308)	78(0.250)	75(0.240)	43(0.138)	35(0.112)	312

Nb., the proportion which each value represents of the total observations in its respective row is indicated in parentheses.

*Each distance zone includes 66 stores.
The distances of the stores from the residence control (in miles) are:

Zone 1 = 0.000 - 1.306
Zone 2 = 1.307 - 1.932
Zone 3 = 1.933 - 2.706
Zone 4 = 2.707 - 3.501
Zone 5 = 3.502 - 8.000

Alternative Hypothesis (H_1):

the proportion of observations in distance zone 1 for the "low" length of residence group is greater than the corresponding proportion for the "high" length of residence group.

Distance Zone 5

(ii) Null Hypothesis (H_0):

there is no difference between the proportion of observations in distance zone 5 for the "low" length of residence group and the corresponding proportion for the "high" length of residence group.

Alternative Hypothesis (H_1):

the proportion of observations in distance zone 5 for the "low" length of residence group is smaller than the corresponding proportion for the "high" length of residence group.

The directionality of the alternative hypotheses is therefore designated such that a rejection of the null hypotheses implies that the distance-decay effect is greater for the "low" length of residence group than for the "high" length of residence group. For each of the sub-samples, the results of the z-test indicate that the differences between the two proportions in each of distance zones 1 and 5 are significant at the 0.05 level.[29] The main hypothesis is, therefore, supported.

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[29]Specifically, the computed z-scores are:

High Social Status Sample
Zone 1: z = 4.45 (critical value = 1.64)
Zone 5: z = -2.86 (critical value = -1.64)
Low Social Status Sample
Zone 1: z = 2.70 (critical value = 1.64)
Zone 5: z = -3.30 (critical value = -1.64)

The hypothesis is based on the premise that the spatial imagery fields of newcomers are confined to relatively few areas, particularly the immediate district about the place of residence (see pp.35-37). Given this initial condition, the effect of the consumer learning process through time should result in a more dispersed distribution of known store locations in the city with regard to distance from the residence. The positive results of the test of the hypothesis are consistent with this proposition.

The data presented within Tables 6-7 suggest that the distance-decay effect, at this level of spatial aggregation, is not continuous. For each group, the number of observations in the furthest distance zone from the residence control (i.e., zone 5) actually increases.[30] Figures 11-14, which disclose the number of times each of the store locations is reported by the consumer groups, clearly reveal this effect.

(b) Hypothesis (VI)

The hypothesis is: "the distance-decay of the reported points is greater for a 'low' social status consumer than for a 'high' social status consumer. The

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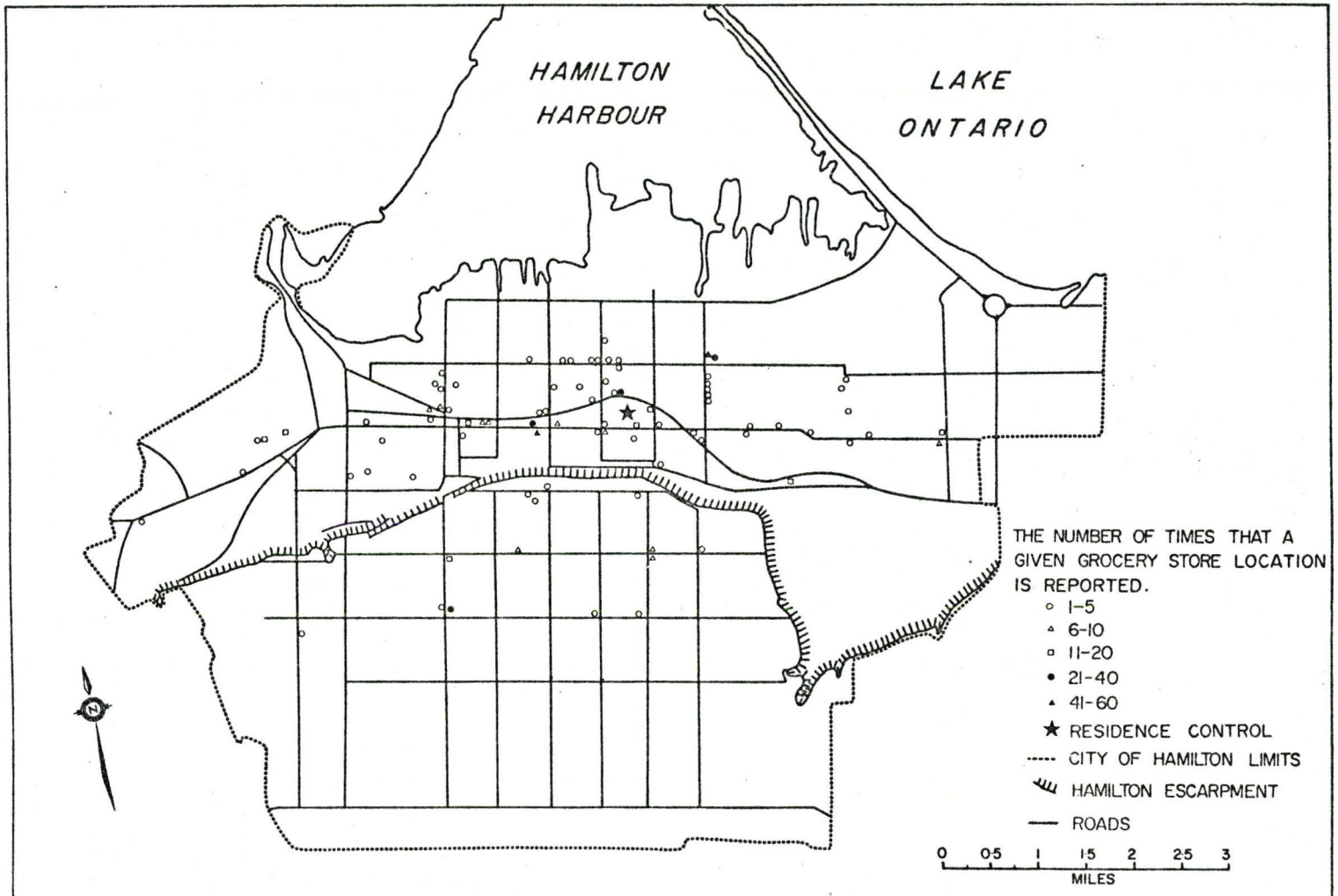
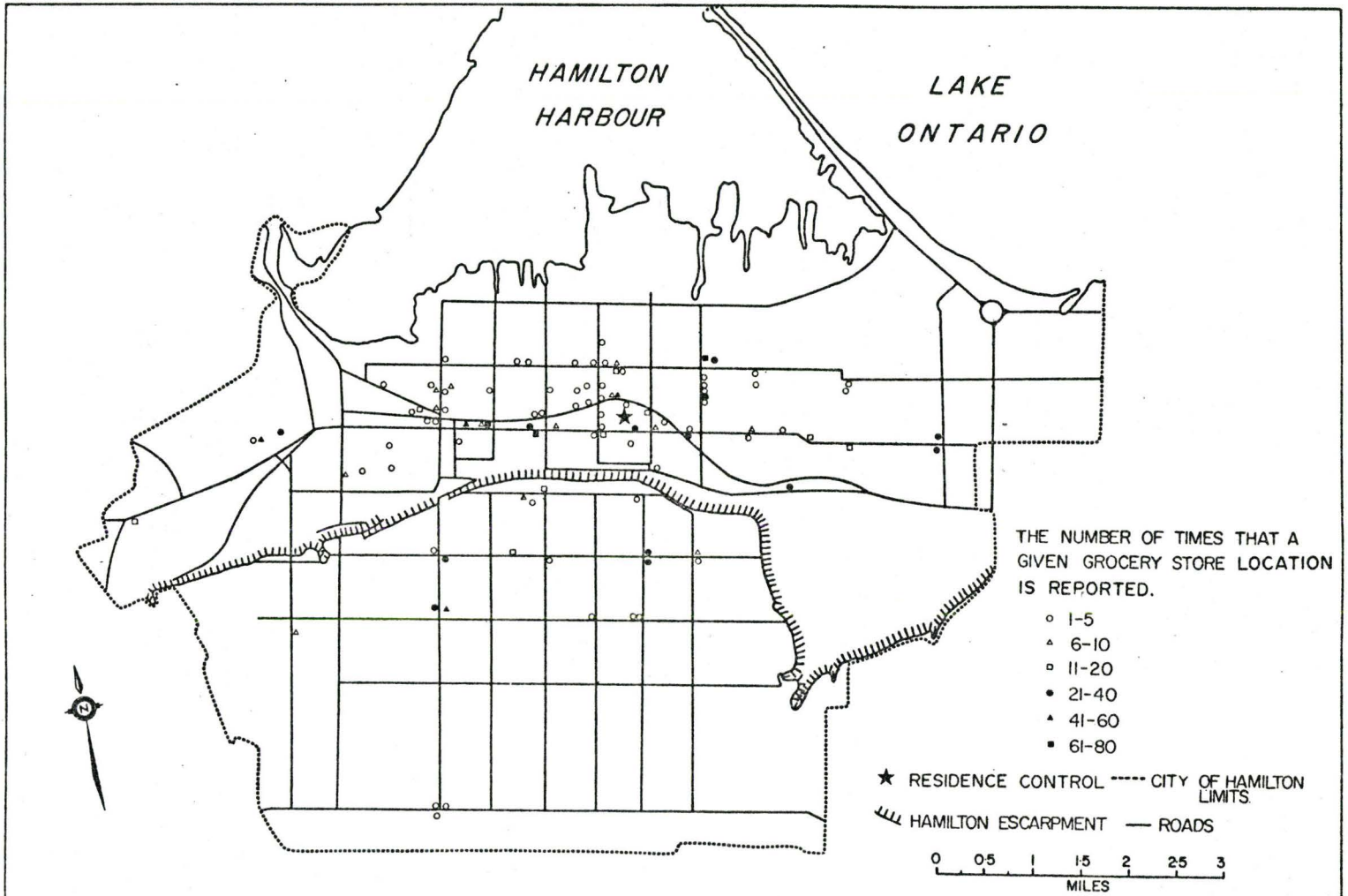
[30] A possible explanation of this tendency is offered on pp.114-115.



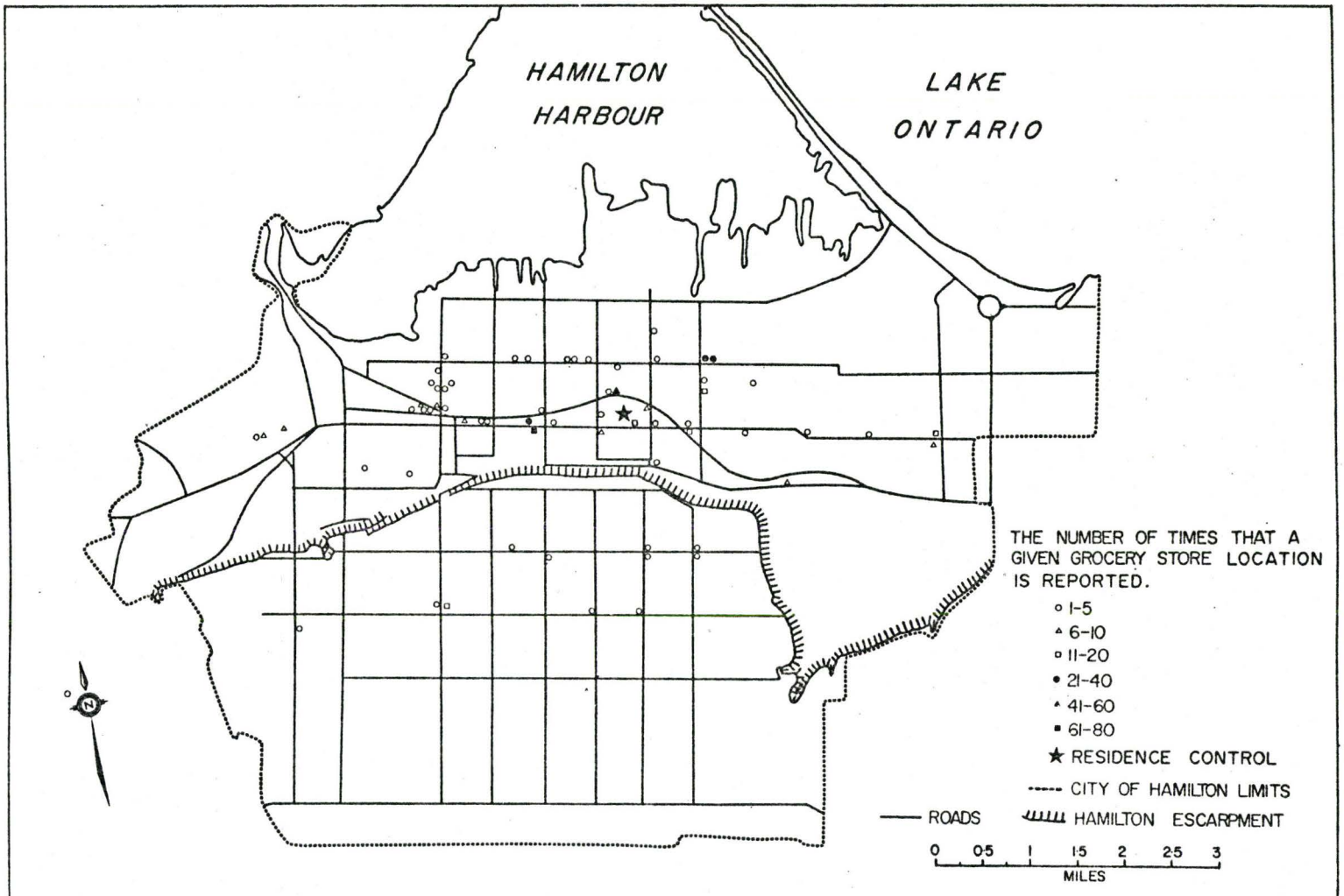
NOTE: those store locations which are not reported by any member of this group of consumers are omitted.

FIGURE 11: THE TOTAL REPORTS OF EACH GROCERY STORE LOCATION BY THE 'LOW LENGTH OF RESIDENCE/HIGH SOCIAL STATUS' GROUP OF CONSUMERS.



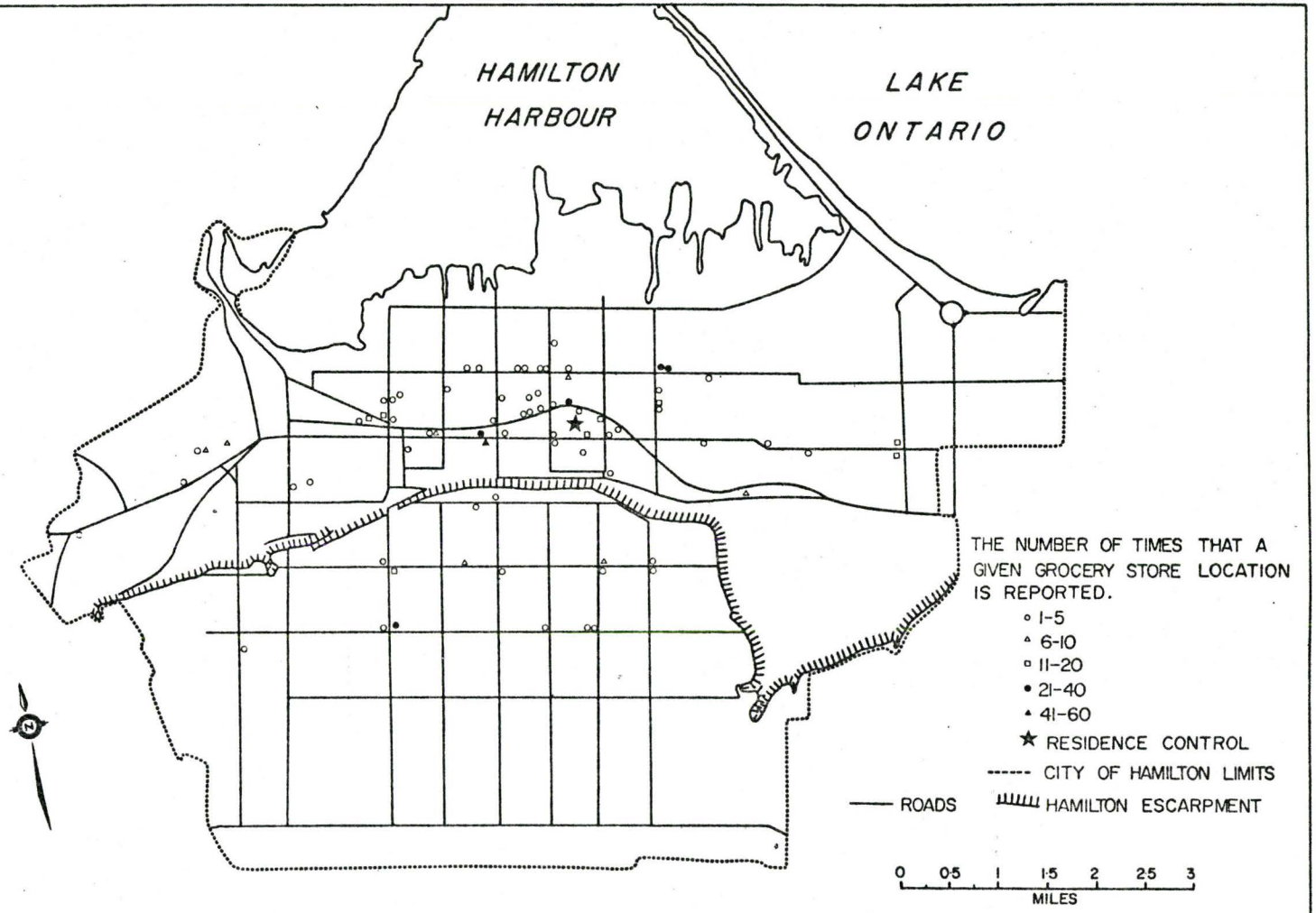
NOTE: those store locations which are not reported by any member of this group of consumers are omitted.

FIGURE 12: THE TOTAL REPORTS OF EACH GROCERY STORE LOCATION BY THE 'HIGH LENGTH OF RESIDENCE / HIGH SOCIAL STATUS' GROUP OF CONSUMERS.



NOTE: those store locations which are not reported by any member of this group of consumers are omitted.

FIGURE 13: THE TOTAL REPORTS OF EACH GROCERY STORE LOCATION BY THE 'LOW LENGTH OF RESIDENCE/LOW SOCIAL STATUS' GROUP OF CONSUMERS.



NOTE those store locations which are not reported by any member of this group of consumers are omitted.

FIGURE 14: THE TOTAL REPORTS OF EACH GROCERY STORE LOCATION BY THE 'HIGH LENGTH OF RESIDENCE / LOW SOCIAL STATUS' GROUP OF CONSUMERS.

hypothesis is tested by employing a similar procedure to that used to test Hypothesis (III).[31] The entire sample is stratified into two sub-samples to permit the control of length of residence, i.e., the High Length of Residence Sample and the Low Length of Residence Sample.[32] Each of these sub-samples is divided into two groups according to the social status of the subjects included within them (see Tables 8-9).[33] The distribution of observations among the five distance zones appears to provide initial support for the hypothesis.

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[31] See pp.87-92.

[32] The sub-samples are defined according to the median value of length of residence for the entire sample, i.e., 18 years. (Subjects with 18 years are arbitrarily included in the Low Length of Residence Sample.) The High Length of Residence Sample includes 205 subjects, while the Low Length of Residence Sample includes 201 subjects.

[33] Within each sub-sample, the groups are defined according to the median value of social status for the entire sample, i.e., 84 points. (Subjects with 84 points are arbitrarily included within the "low" social status group.) The groups are:

	Group	No. of Subjects
High Length of Residence Sample	Low Social Status	85
	High Social Status	120
Low Length of Residence Sample	Low Social Status	109
	High Social Status	92

TABLE 8

SPATIAL DISTRIBUTION OF THE REPORTED GROCERY STORE LOCATIONS:
HIGH LENGTH OF RESIDENCE SAMPLE

Group	Distance Zone* 1	2	3	4	5	Total Observations
Low Social Status	96(0.307)	78(0.250)	75(0.240)	43(0.138)	35(0.112)	312
High Social Status	88(0.223)	86(0.218)	75(0.190)	67(0.170)	76(0.193)	394

Nb., the proportion which each value represents of the total observations in its respective row is indicated in parentheses.

* Each distance zone includes 66 stores.
The distances of the stores from the residence control (in miles) are:

Zone 1 = 0.000 - 1.306
Zone 2 = 1.307 - 1.932
Zone 3 = 1.933 - 2.706
Zone 4 = 2.707 - 3.501
Zone 5 = 3.502 - 8.000

TABLE 9

SPATIAL DISTRIBUTION OF THE REPORTED GROCERY STORE LOCATIONS:
LOW LENGTH OF RESIDENCE SAMPLE

Group	Distance Zone* 1	2	3	4	5	Total Observations
Low Social Status	117(0.509)	85(0.283)	26(0.113)	10(0.043)	12(0.052)	230
High Social Status	104(0.361)	92(0.319)	41(0.149)	21(0.067)	30(0.193)	288

Nb., the proportion which each value represents of the total observations in its respective row is indicated in parentheses.

* Each distance zone includes 66 stores.
The distances of the stores from the residence control (in miles) are:

Zone 1 = 0.000 - 1.306
Zone 2 = 1.307 - 1.932
Zone 3 = 1.933 - 2.706
Zone 4 = 2.707 - 3.501
Zone 5 = 3.502 - 8.000

The hypothesis is formally tested by determining: (i) whether the "low" social status group reports a greater proportion of observations in the nearest distance zone to the residence control (i.e., zone 1) than the "high" social status group; and (ii) whether the "low" social status group reports a smaller proportion of observations in the furthest distance zone (i.e., zone 5) than the "high" social status group. Specifically, two sets of hypotheses are tested by using the z-test for differences between two proportions:

Distance Zone 1

(i) Null Hypothesis (H_0): there is no difference between the proportion of observations in distance zone 1 for the "low" social status group and the corresponding proportion for the "high" social status group.

Alternative Hypothesis (H_1): the proportion of observations in distance zone 1 for the "low" social status group is greater than the corresponding proportion for the "high" social status group.

Distance Zone 5

(ii) Null Hypothesis (H_0): there is no difference between the proportion of observations in distance zone 5 for the "low" social status group and the corresponding proportion for the "high" social status group.

Alternative Hypothesis (H_1):
the proportion of observations in distance zone 5 for the "low" social status group is smaller than the corresponding proportion for the "high" social status group.

The directionality of the alternative hypothesis is therefore designated such that a rejection of both null hypotheses implies that the distance-decay effect is greater for the "low" social status group than for the "high" social status group. For each of the sub-samples, the results of the z-test indicate that the differences between the two proportions in each of distance zones 1 and 5 are significant at the 0.05 level.[34] The main hypothesis is, therefore, supported.[35]

The disclosed results are attributed to the variation in the spatial level of interaction among consumers defined

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[34]Specifically, the computed z-scores are:

<u>High Length of Residence Sample</u>

Zone 1: z = 2.70 (critical value = 1.64)
Zone 5: z = -3.30 (critical value = -1.64)

<u>Low Length of Residence Sample</u>

Zone 1: z = 3.48 (critical value = 1.64)
Zone 5: z = -2.33 (critical value = -1.64).

[35]It should be noted that, for each group, there is an apparent "reversal" of the distance-decay effect in the furthest distance zone (i.e., zone 5). This is discussed with regard to Hypothesis (III) on pp.114-115.

according to their social status (see pp.38-39). In the context of the problem, therefore, higher status consumers will travel greater distances to stores, and purchase convenience goods more frequently. Consumers of the very lowest social status, on the other hand, with relatively limited purchasing power available to them, should normally purchase convenience goods at stores near to their domicile. For these consumers, therefore, distance is a greater constraint upon the probability of directly encountering a given store location. Hence the disclosed difference in the distance-decay effect.

4.3.3.1 Summary

(a) Hypothesis (III)

The hypothesis is tested by using a procedure involving the application of the z-test for differences between two proportions. The entire sample data are stratified to permit the control of social status. The data, in general, disclose a decrease in the density of reported store locations as distance from the places of residence of each group of consumers increases.[36] The substantive results of the test support the hypothesis.

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[36]However, a reversal of this distance-decay effect is noted at distances exceeding four miles from the study area.

They indicate that the distance-decay of reported store locations is greater for "low" length of residence consumers than for "high" length of residence consumers. The relationship is consistent with the proposition that consumer information is accumulated through an environmental learning process.

(b) Hypothesis (VI)

The hypothesis is tested by employing a similar procedure to that used to test Hypothesis (III). The entire sample data are stratified to permit the control of length of residence. The data, in general, disclose a distance-decay tendency for each group of consumers. The results of the test support the hypothesis. They indicate that the distance-decay of reported store locations is greater for "low" social status consumers than for "high" social status consumers. It is proposed a priori that this relationship is indicative of the greater levels of spatial interaction among higher status consumers.

4.3.4. Analysis of the Information Channels

One hypothesis is tested: "there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields." The sample of respondents is limited to those who have lived in Hamilton for four years or less (see p.50). The information sources

of each store location reported by these consumers are organized within a fivefold taxonomy of channels:

(a) Radio and T.V.

(b) Newspapers.

(c) Mailed store catalogues.

(d) Personal communication.

(e) Spatial experience.

The consumers are divided into two groups according to their social status.[37] For each type of information channel, a consumer is assigned the value 1 if he reports the use of the channel one or more times. The value 0 is assigned if he does not report the use of the channel. The total observations, for each type of information channel, represent the aggregate positive outcomes, or "successes", for consumers included within a given group (see Table 10.1).

The hypothesis is tested by employing the two sample chi-square test[38] to compare the frequency distributions of information channel use of the two groups. Use of the two-sample chi-square test determines whether there are significant proportional differences between two frequency distributions. Formally, the null hypothesis

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[37]The "high" and "low" social status groups each include 55 subjects.

[38]See Siegal, S., Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill, New York, 1956, pp.104-10.

TABLE 10

INFORMATION CHANNEL USE: THE CHI-SQUARE TESTS

H_0: There are no proportional differences between the distributions of information channels used by "low" social status and "high" social status groups.

H_1: There are proportional differences between the distributions of information channels used by "low" social status and "high" social status groups.

10.1

Sub-Sample	Radio & TV	News-paper	Mailed Store Catalogue	Personal Communi-cation	Spatial Experience
Low Social Status	5	5	1	12	34
High Social Status	5	15	5	29	55

significance level = 0.05 degrees of freedom = 4
critical value of χ^2 = 9.488

$$\chi^2 = 3.741$$

Since 3.741 < 9.488 accept H_0

10.2

Sub-Sample	Mass Media	Personal Communication	Spatial Experience
Low Social Status	11	12	34
High Social Status	25	29	55

significance level = 0.05 degrees of freedom = 2
critical value of χ^2 = 5.991

$$\chi^2 = 1.279$$

Since 1.279 < 5.991 accept H_0

(H_0) is: "there are no proportional differences between the distributions of information channels used by 'low' social status and 'high' social status groups." The alternative hypothesis (H_1) is: "there are proportional differences between the distributions of information channels used by 'low' social status and 'high' social status groups." The chi-square test is performed upon:

(i) the five class frequency distribution (see Table 10.1);

(ii) the three class frequency distribution in which the first three classes of (i) are aggregated to comprise a "mass media" class (see Table 10.2).

In each test, the χ^2 values do not exceed their critical values at the 0.05 significance level and the stated null hypothesis cannot be rejected. Therefore, the main hypothesis is not supported.

It is possible that this finding may be attributable to measurement error related to the collection of the data.[39] However, assuming that the data are valid, it appears that there is a similar proportional use-frequency of the information channel types by "high" and "low" status

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[39]For a discussion of the difficulties encountered in collecting data pertaining to information channel use, and of how the problem is handled, see pp.46-50.

consumers. Although it has been found that individuals of a higher social status do enjoy greater scales of interaction,[40] this tendency does not appear to influence the selection of the types of channels through which they receive information relating to spatial phenomena.

4.6.1 Summary

The results of the two-sample chi-square test do not support the hypothesis. The results suggest a similar proportional use-frequency of the information channel types by "high" and "low" social status consumers. Spatial experience (i.e., direct contacts) is clearly the most frequently employed type of information channel by all consumers in the building up of their spatial imagery fields. Of the set of indirect contacts, use of personal communication exceeds that of the mass media.

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[40] See Losch, A. (1938), op.cit., Marble, D.F. (1959), op.cit., and Rushton, G. (1966), op.cit.

CHAPTER V

SUMMARY AND DIRECTIONS FOR FUTURE RELATED RESEARCH

The purpose of the thesis is to investigate the properties of consumer spatial imagery fields. Specifically, the objectives are to indicate whether the spatial properties of the fields are related to length of residence; to indicate whether the spatial properties of the fields are related to social status; and to indicate whether there is a relationship between the social status of consumers and the use-frequency of information channels which are used to build up the fields. Although the selected set of elements comprising the spatial imagery fields are grocery stores, any set of discrete elements might be similarly investigated.

A statement of the problem, and of how it relates to the interdisciplinary research field of "environmental perception", is presented in Chapter I. Chapter II offers a review of the literature which investigates man's cognitive images of the spatial distribution of environmental phenomena. In the same chapter, the relationship of the study to this body of literature is articulated. The hypotheses and data sources of the study are presented in Chapter III. The results of the test of each hypothesis

are described and evaluated in Chapter IV. The findings pertaining to each of the hypotheses are separately presented within appropriate sections of Chapter IV. The aim of this chapter is to provide an overview of these findings and their implications. In the light of this discussion, suggestions are offered for future related research. To provide a background for these discussions, however, a summary of the research design is first presented.

5.1 The Research Design

The underlying philosophy of this study is that groups of individuals develop their cognitive images of environmental elements in accordance with certain general principles. This philosophy does not deny the palpable impact upon cognitive image formation of such personality characteristics as motivation, drive, and emotion which are unique to each individual. Instead, it assumes that despite the importance of this complexity of individualistic variables, it is possible to isolate directly measurable elements, shared by groups, which influence the nature of the spatial imagery field of the individual. Specifically, length of residence and social status are posited to be such elements. The incorporation of the variables within testable propositions is readily accomplished. The ratio

scale data pertaining to length of residence are directly collected, while data relating to the measurement of social status are presented in simple ordinal scales (viz., the set of socio-economic attributes), and a weighted composite of ordinal scales (viz., the Hollingshead Three Factor Index of Social Position). Three spatial properties of a spatial imagery field are measured: (i) number of reported points; (ii) mean distance; and (iii) distance-decay. Number of reported points and mean distance are each ratio scale measures of the "size" of a spatial imagery field. Distance-decay is measured using nominal scale data.

The hypotheses are formulated and presented in accordance with the specific objectives of the thesis. The hypotheses concerning length of residence and social status are each analyzed by parametric tests,[1] while the hypothesis concerning the information channels is analyzed by using a non-parametric test.[2] The tests of the hypotheses are organized in four parts according to the properties of a spatial imagery field which are analyzed (i.e., number of reported points, mean distance, distance-decay, and the information channels). The following overview of the results

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[1] i.e., stepwise multiple regression procedures and the z-test for differences between two proportions.

[2] i.e., the two-sample chi-square test.

of the tests and their implications, however, is presented within the context of the specific objectives of the study.

5.2 The Findings and their Implications

5.2.1 Length of Residence

The relationship between the length of residence of consumers and the spatial properties of their spatial imagery fields is investigated through the test of three hypotheses. Hypotheses (I) and (II) concern the "sizes" of the spatial imagery fields:

(I) there is a positive relationship between number of reported points and length of residence in Hamilton;

(II) there is a positive relationship between mean distance and length of residence in Hamilton.

The results of the tests of the hypotheses offer evidence of a positive relationship between the sizes of consumer spatial imagery fields and length of residence in Hamilton. The relationship is consistent with the proposition that environmental learning occurs among consumers. The urban environmental information held by newcomers to the city is spatially constrained. Store locations near the residence are learned first, then those at increasing distances. The distance bias decreases through time as the individual learns of other store

locations from the various direct and indirect sources of information. Consequently, a "high" length of residence consumer is more likely to be exposed to a greater number of store locations than a "low" length of residence consumer. Furthermore, the probability of a "high" length of residence consumer directly encountering a given store location within the urban system is less likely to be constrained by the distance of the store from the place of residence. Therefore, those individuals who have resided within the city for a sufficient length of time to have gathered large amounts of environmental information, will have the larger spatial imagery fields.

Hypothesis (III) is concerned with the distance-decay of the reported points within a spatial imagery field:

> (III) the distance-decay of reported points is greater for a "low" length of residence consumer than for a "high" length of residence consumer.

The results of the test of the hypothesis are positive. They suggest that the distance-decay of reported store locations is greater for a "low" length of residence consumer than for a "high" length of residence consumer, as postulated. It is argued that although the spatial imagery fields of comparative newcomers will be confined to relatively few areas, particularly about the place of

residence, the effect of the consumer learning process should result in an increasingly dispersed distribution of reported store locations. The results suggest that spatial imagery fields do become dispersed through time in terms of distance from the residence.

However, it is noted that the distance-decay effect is not continuous, especially in those districts of the city most distant from the study area. The explanation of this tendency may be related to the nature of the spatial distribution of grocery stores within Hamilton. Since groceries are convenience goods, the spatial distribution of grocery stores within Hamilton is relatively uniform. However, the supermarkets and discount operations, which attract a major portion of grocery purchases (and are the most frequently reported stores), are often located in planned suburban shopping centres and plazas. A number of such stores are located above the brow of Hamilton Escarpment at airline distances frequently exceeding three miles from the study area (see Figures 11-14). These stores are often located within shopping centres which offer a wide range of convenience and comparison goods. It is likely that these centres are frequently visited for multiple shopping purposes. Consequently, consumers readily develop cognitive images of stores within the centres, particularly of those

which are overtly patronized. There are no such shopping centres within, or immediate adjacent to, the study area. Thus, consumers within the area who wish to enjoy the advantages which these centres offer may frequently travel considerable distances. The nature of the spatial distribution of such shopping centres, therefore, may account for the relatively numerous reports of grocery stores which are located at considerable distances from the study area..

5.2.2 Social Status

The relationship between the social status of consumers and the spatial properties of their spatial imagery fields is investigated through the test of three hypotheses. Hypotheses (IV) and (V) concern the sizes of the spatial fields:

(IV) there is a positive relationship between number of reported points and social status;

(V) there is a positive relationship between mean distance and social status.

The results of the tests of the hypotheses indicate that the sizes of consumer spatial imagery fields are positively related to the social status of consumers. It is suggested that the relationship is indicative of the variation in the level of spatial interaction among "high"

and "low" social status consumers. Higher status consumers travel greater distances and visit a wider range of shopping centres when purchasing convenience goods. Consequently, they are more likely to be exposed to a greater number of store locations than lower status consumers. Furthermore, the probability of a higher status consumer directly encountering a given store location within the city is less likely to be constrained by distance from the place of residence. These propositions are consistent with the results of the analysis.

It is noted that occupation level and education level are found to be the better indicators among the set of socio-economic attributes. The levels of "explanation" provided by residence type, car ownership, and income level are relatively small. It is suggested that the low "explanatory" power of these variables is, in part, attributable to the considerable intercorrelation among the socio-economic attributes. Some social status characteristics may, however, be correlates of the mental ability of an individual to store and recall information relating to environmental stimuli. In the context of the research problem, occupation level and education level appear to be stronger indicators of this ability than the other attributes.

Hypothesis (VI) is concerned with the distance-decay

of the reported points within a spatial imagery field:

(VI) the distance-decay of reported points is greater for a "low" social status consumer than for a "high" social status consumer.

The results of the test of the hypothesis are positive. They indicate that the distance-decay of reported store locations is greater for "low" social status consumers than for "high" social status consumers, as postulated. This relationship is also attributed to the variation in the level of spatial interaction among consumers defined according to their social status. It is proposed that the relatively high distance-decay levels of the "low" social status consumers is indicative of their smaller scales of spatial interaction. The spatial behaviour of these consumers is largely tied to the place of residence. Consequently, they are exposed to relatively few store locations at considerable distances from the residence. Hence the enhanced distance-decay effect disclosed by the results.

5.2.3. The Information Channels

One hypothesis is tested:

(VII) there is a relationship between the social status of consumers and the use-frequency of the types of information channels which are used to build up their spatial imagery fields.

The findings do not support the hypothesis. Although higher status consumers enjoy greater levels of social participation, their use-frequency of each type of information channel does not appear to differ proportionately from that of lower status consumers. The findings indicate that spatial experience (i.e., direct contacts) is the most frequently employed type of information channel by all consumers. Of the indirect contacts employed to build up spatial imagery fields, use of personal communication exceeds that of the mass media.

An explanation of these findings may be attempted with reference to a recent study in Hamilton.[3] This research empirically reveals that very low status individuals have smaller levels of interaction than others, regardless of whether that interaction is composed of direct or indirect contacts.[4] Thus, for individuals of the lowest social status, there are proportionately similar declines in such interaction levels (compared with the levels of other individuals) as frequency of visits to friends and relatives, exposure to the mass media, and participation in organized societies. In the context of the research problem, there is a similar

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[3] The Hamilton Study of Poverty, Volume 2 of a Brief Report to the Special Senate Committee on Poverty, The Social Planning and Research Council of Hamilton and District, Hamilton, Ontario, 1970.

[4] Ibid., pp.5.7-5.22.

proportional decline in the use-frequency of each of the types of information channels for "low" status consumers when compared with "high" status consumers. All consumers, then, regardless of their social status, utilize similar proportions of the information channel types.

In summary, the thesis identifies consumer spatial imagery fields and investigates how the properties of these fields are related to certain consumer characteristics. Specifically, the findings suggest that length of residence and social status are indicators of the spatial properties of the imagery fields. These conclusions are consistent with Horton and Reynolds' contention that length of residence and social status are each salient inputs to the formation of cognitive images of urban spatial structures (see pp.27-28 and p.32).[5] The proposition that social status is related to the use-frequency of the types of information channels which consumers employ to build up their spatial imagery fields, however, is not substantiated.

5.3 Directions for Future Related Research

The specific future research directions which are suggested in the light of the findings of the study are presented below. This discussion is followed by a brief statement of the more general implications of the study for

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[5]Horton, F.E. and Reynolds, D.L. (1969), op.cit., p.73; and Horton, F.E. and Reynolds, D.L. (1971), op.cit., p.41.

future contributions of the geographer to the field of environmental perception.

The findings concerning length of residence suggest that this variable is a fundamental indicator of the spatial properties of a consumer spatial imagery field. A palpable question arising from these conclusions is "what are the specific processes which underlie this relationship and how do they operate?" A positive step toward providing an answer is taken by Golledge (1967 and 1969)[6] in his adaptation of a number of models from mathematical learning theories for application to geographical problems. The ultimate concern of such reformulation of derivative concepts from psychology is to predict the overt spatial and temporal manifestations of the consumer decision-making process. However, cognitive processes are explicitly conceptualized within the main body of cognitive learning theory.[7] A cognitive learning theory is, in effect, a conceptual system within which the precise characteristics of the processes which underlie the relationship between length of residence and the properties of consumer spatial imagery fields (and, ultimately, overt consumer choice) may be formalized. Although much of Golledge's adaptation has admittedly been concentrated on the more mechanistic

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[6]Golledge, R.G., "Conceptualizing the Market Decision Process," Journal of Regional Science, 7 (1967), pp.239-58; and "The Geographical Relevance of Some Learning Models," in Cox, K.R. and Golledge, R.G. (eds.), op.cit., pp.101-45.

[7]See, for example, Tolman, E.C. (1932), op.cit., and Lewin, K. (1951), op.cit.

stimulus-response learning theories which do not explicitly conceptualize cognitive processes, there is evidence that geographers are attempting to apply cognitive learning theories to spatial problems.[8] At the present early state of conceptualization, it is impossible to determine which type of learning model is preferable to another in either (a) elucidating how the cognitive image develops through time; or (b) predicting overt spatial choice patterns. Such problems cannot be satisfactorily clarified until the learning models are subjected to adequate empirical testing. The author, therefore, believes that the spatial adaptation and empirical testing of learning models is an essential future research direction toward an understanding of the precise nature of the psychological processes which underlie the development of spatial imagery fields through time.

The findings concerning social status disclose that this variable is related to the spatial properties of a consumer spatial imagery field. It was previously posited (see pp.38-39) that this relationship is based on the variation of the levels of spatial interaction of consumers according to their social status. Since higher status consumers exhibit more complex spatial behaviour patterns,

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[8]For example, see Hudson, R., Personal Construct Theory, Learning Theories and Consumer Behaviour, Seminar Paper Series A, No.21, Department of Geography, University of Bristol, Bristol, November 1970; and Downs, R.M. and Horsfall, R., Methodological Approaches to Urban Cognition, Paper presented at the Sixty-Seventh Meeting of the Association of American Geographers, Boston, Massachusetts, April, 1971.

it follows that they are more likely to be exposed to a greater portion of the environmental milieu as compared to lower status consumers. They should, therefore, have the larger spatial imagery fields. However, the spatial information held by an individual is not exclusively dependent upon his level of spatial interaction. The mental ability to store and recall information relating to environmental stimuli is also necessary. The author envisages the capacity to develop cognitive images of environmental elements to be contingent upon this essentially intellectual ability which is, in turn, related to a complexity of personality factors, e.g., motivation, drive, etc. The absence of such an ability would preclude the development of large spatial imagery fields, regardless of the level of spatial interaction of the individual. On the basis of the findings, it is suggested that such socio-economic attributes as occupation and education levels may, in fact, be indicators or correlates of an individual's mental ability to store and recall environmental information. Further investigation is required to substantiate this claim and to clarify the role of intellectual variables in mediating the relationship between the spatial properties of spatial imagery fields and social status.

The findings concerning the types of information channels emphasize the important role of the overt spatial behaviour (i.e., spatial experience) of the consumer in the building of his spatial imagery field. The findings of Adams[9] suggest that such behaviour is largely confined to a consumer's "familiarity sector". Recent research suggests that the indirect contact channel of personal communication is likewise spatially biased. Specifically, a considerable portion of the social contacts of an individual will take place within his residential neighbourhood while his more formal contacts will be made at his place of employment.[10] Further research is required to examine the extent to which the spatial biases of information channels used by a consumer results in corresponding spatial biases of the spatial imagery fields.

In this study, a free verbal response format is used to elicit the information which comprises a spatial imagery field. There is a need, however, for the refinement of this and other response formats[11] which are used to

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[9] Adams, J.S. (1969), op.cit.

[10] See Wheeler, J.O. and Stutz, F., "Spatial Dimensions of Urban Social Travel," Annals of the Association of American Geographers, 61 (1971), pp.371-86, for a summary of this research.

[11] Other examples of pertinent response formats are briefly discussed on pp. 30-31.

identify the environmental information that is retained in the minds of subjects, and which cannot be directly encountered. Throughout the study, the data obtained by the free verbal response format are analytically handled by: an image frequency measure (i.e., number of reported points); and uni-dimensional spatial measures (i.e., mean distance and distance-decay). The hypotheses do not necessitate the measurement of a second spatial dimension (i.e., direction). The selection of an appropriate geometric model, however, is an essential preliminary in research concerned with the two-dimensional spatial structures of cognitive images.[12] A further problem is concerned with the many non-spatial attributes of cognitive images of the environment.[13] Rigorous handling of these attributes does indeed pose a formidable challenge but researchers are already exploring the potential application of multi-dimensional scaling procedures to the measurement of

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[12]For a discussion of this problem, see Downs, R.M., Approaches to, and Problems in, the Measurement of Geographic Space Perception, Seminar Series A, No.9, Department of Geography, University of Bristol, Bristol, 1967.

[13]Examples of research concerned with the measurement of such attributes include Mitchell, B., "Behavioral Aspects of Water Management: A Paradigm and a Case Study," Environment and Behavior, 3 (1971), pp.135-54; and Downs, R.M., (1970A), op.cit.

cognitive images.[14] It is, therefore, evident that the resolution of these measurement problems relating to the analysis of pertinent data must precede the development of rigorous theory relating to the spatial and non-spatial characteristics of man's environmental information.

Further research must clearly be directed toward the development of measurement instruments for the identification and analysis of cognitive images before the latter can be profitably incorporated as explanatory variables within models of overt consumer behaviour. The application of the cognitive image concept toward the prediction of human behaviour is, however, the ultimate objective of most scholars of environmental perception. This approach permits man to become a significant intervening variable (i.e., a "white box") instead of a constant (i.e., a "black box") in the study of the environment-behaviour relationship. In the context of the study of consumer spatial behaviour, the limiting assumptions concerning the nature of man (e.g., the economic man concept of classical central place theory) may be replaced with ones which provide a more accurate expression of his various capabilities and shortcomings. As previously

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[14] Relevant discussion is presented in Downs, R.M. (1967), op.cit., and Downs, R.M. (1970B), op.cit.

suggested, (see pp.120-21) this task may be attempted within a learning framework which explicitly conceptualizes the cognitive images of consumers. The findings of this study, and of others which have explicitly investigated aspects of consumer cognitive images,[15] are of direct relevance to such a consumer learning framework.

Problems of cognitive image measurement, and of the application of the image concept to the explanation and prediction of overt consumer behaviour in space, are of concern to geographers and researchers from related social science disciplines. Their solution will be dependent upon a considerable level of interdisciplinary liaison, particularly between geographers and psychologists. The major task of the geographer will be that of reformulating psychological concepts in a spatial context. It is hoped that the research reported here represents a positive contribution toward this objective.

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[15] For example, see Downs, R.M. (1970A), op.cit.

APPENDIX I

ZERO-ORDER CORRELATION MATRIX FOR THE ENTIRE SAMPLE

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
X_0	1.000	0.488**	0.685**	0.559**	0.303**	0.115	0.517**	0.292**	0.285**
X_1		1.000	0.460**	0.459**	0.192**	0.082	0.436**	0.222**	0.217**
X_2			1.000	0.205**	0.023	-0.031	0.179**	0.217**	0.003
X_3				1.000	0.451	0.189	0.663	0.313**	0.500
X_4					1.000	0.412	0.521**	0.318**	0.408**
X_5						1.000	0.277	0.194	0.234
X_6							1.000	0.304**	0.424**
X_7								1.000	0.293**
X_8									1.000

Number of subjects = 406

X_0 = Logarithm of Number of Reported Points
X_1 = Mean Distance
X_2 = Logarithm of Length of Residence
X_3 = Index of Social Position
X_4 = Residence Type
X_5 = Car Ownership
X_6 = Occupation Level
X_7 = Income Level
X_8 = Education Level

* = Significant at the 0.05 level
** = Significant at the 0.01 level

Nb., Since X_3 already includes X_4, X_6, and X_8, the significance levels are not calculated for correlations between X_3 and each of these variables. Significance levels are not calculated also for correlations including X_5, which is binary variable.

APPENDIX 2

CHARACTERISTICS OF THE MALE/FEMALE INCOMES

OF: (i) CENSUS TRACT 27; (ii) CITY OF HAMILTON

(i) MEAN INCOMES OF TRACT 27

	$\bar{\mu}$
Male	$3,857
Female	$1,885

(ii) CITY OF HAMILTON INCOMES
(Tract Means and Standard Deviations)

	$\bar{\mu}$	$\bar{\sigma}$
Male	$3,999	$742.24
Female	$2,081	$302.46

Source: Calculations based on data from Dominion Bureau of Statistics, 1961 Census of Canada, Population and Housing by Census Tracts, Volume 95-523 Hamilton, Ottawa, Ontario, 1961.

APPENDIX 3

PRE-TEST LETTER OF EXPLANATION AND FIELD SURVEY QUESTIONNAIRE

McMASTER UNIVERSITY

HAMILTON, ONTARIO, CANADA

DEPARTMENT OF GEOGRAPHY

May 1st, 1969.

Dear Sir or Madam:

I am writing to ask for your help and participation in a research programme which is currently being undertaken within the Department of Geography at McMaster University. The enclosed questionnaire will take approximately 10 minutes to complete and your cooperation in arranging for the answering of the questions will be greatly valued.

Briefly, the research involves an attempt to identify variations of consumer knowledge of grocery store locations within Hamilton. The crucial question relating to this is "Number 6" and accurate answers to this would be greatly appreciated.

The questionnaire should be completed by ONE MEMBER of the household ONLY (i.e., THE ADULT HOUSEHOLD MEMBER WHO IS NORMALLY RESPONSIBLE FOR PURCHASING ALL OR MOST OF THE GROCERIES USED BY THE HOUSEHOLD). I shall be calling to collect the completed questionnaire on between 6:00 p.m. and 9:00 p.m.

Please note that none of the information which you supply will pass beyond the Department of Geography. If you wish to check on the validity of the survey, please contact the Department at 522-4971, Ext. 278.

Thanking you in advance for your kind cooperation.

Yours very truly,

GCS/rt

Geoffrey C. Smith,
Department of Geography.

FIELD SURVEY QUESTIONNAIRE

NOTE: The following questions should be completed by the ADULT HOUSEHOLD MEMBER WHO IS RESPONSIBLE FOR PURCHASING ALL OR MOST OF THE GROCERIES USED BY THE HOUSEHOLD. Please check the appropriate boxes unless instructed otherwise.

SECTION A

1. Are you the head of the household? ☐ Yes ☐ No

   If "YES" go directly to Question 3. If "NO" go to Question 2.

2. What is your relationship to the head of the household?

WIFE	SON	DAUGHTER	OTHER RELATIVE	NON RELATIVE

3. Indicate the age and sex of all persons living in the household. (N.B., Persons 18 years or over are adults.)

AGE	YOUR-SELF	ADULTS MALES	ADULTS FEMALES	AGE	CHILDREN MALES	CHILDREN FEMALES
18-30				0-4		
31-45				5-9		
46-60				10-14		
60+				15-17		

4. State your place of birth, i.e., town, province, and country.

   _____

5. How long have you lived (1) at your present address, (2) in the city of Hamilton?

(1) PRESENT LOCATION	(2) CITY OF HAMILTON

6. State the present level of education of yourself and the head of the household (if you are not the head of the household):

	NO SCHOOLING	PRE-GRADE	GRADE 1 - 4	GRADE 5-8	HIGH SCHOOL INCOMPLETE	HIGH SCHOOL COMPLETE	COLLEGE INCOMPLETE	COLLEGE DEGREE
Yourself								
Head of Household								

7. State your occupation and that of the head of the household (if you are not the head of the household):

	OCCUPATION
Yourself	
Head of Household	

8. Indicate the place of employment (i.e., street location) of yourself and of the head of the household (if you are not the head of the household):

	PLACE OF EMPLOYMENT (STREET LOCATION)
Yourself	
Head of household	

9. In which of the following categories is the gross annual income of (1) yourself; (2) the head of the household (if you are not the head of the household); and (3) the total household:

	EARNINGS UNDER 2,000	2,000-2,999	3,000-3,999	4,000-4,999	5,000-5,999	6,000-6,999	7,000-9,999	10,000-12,499	12,500+
Yourself									
Head of Household									
Total Household									

10. How many automobiles are owned by members of the household? _____

11. Does the household have the following?

	RADIO	T.V.
YES		
NO		

12. Does the household subscribe to the "Hamilton Spectator?"

Yes ☐

No ☐

SECTION B

In the table below, ALL RESPONDENTS must complete columns 1-3. In these list all of the grocery stores in Hamilton which you remember clearly, stating in column 1 the NAME OF THE STREET where each store is located. In columns 2 and 3 state, if possible, the STORE NAME and NEAREST CROSS-STREET RESPECTIVELY. Column 4 must be completed ONLY by RESPONDENTS WHO HAVE LIVED IN HAMILTON FOR LESS THAN FOUR YEARS. In it indicate how you learned about each store included in the table. Possible sources of knowledge are listed at the side of the table.

	(1) STREET NAME	(2) STORE NAME	(3) NEAREST CROSS-STREET	(4) SOURCE OF KNOWLEDGE
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				

(Continue on a separate sheet if necessary)

POSSIBLE SOURCES OF KNOWLEDGE

(In Column 4 state the appropriate number)

1. T.V. or RADIO
2. RELATIVES and FRIENDS
3. NEWSPAPER
4. MAILED STORE CATALOGUE
5. TRAVELLING AROUND HAMILTON
6. UNABLE TO REMEMBER

APPENDIX 4

FINAL SURVEY: LETTER OF EXPLANATION

FIELD SURVEY QUESTIONNAIRE

FIELD TABLE

McMASTER UNIVERSITY

HAMILTON, ONTARIO, CANADA

DEPARTMENT OF GEOGRAPHY

July 1969.

Dear Sir or Madam:

I am writing to ask for your help and participation in a research programme which is being undertaken within the Department of Geography at McMaster University. Briefly, the research involves an attempt to find out how much people know about the location of grocery stores in Hamilton.

The enclosed questionnaire should be completed by ONE MEMBER of the household ONLY (i.e., the ADULT HOUSEHOLD MEMBER WHO IS NORMALLY RESPONSIBLE FOR PURCHASING ALL OR MOST OF THE GROCERIES USED BY THE HOUSEHOLD) and will take approximately 5 minutes to answer. Its purpose is to note down such information as the size of your household and the occupation of the head of the household. Interviewers will be calling to collect the questionnaire on and will be asking a series of short questions of the household member who has completed it about his/her knowledge of Hamilton grocery store locations.

Please note that none of the information which you supply will pass beyond the Department of Geography. If you wish to check on the validity of the survey, please contact the Department of Geography at 522-4971 Ext. 278. Copies of a brief outline of the results will be forwarded to all respondents.

Thanking you in advance for your kind cooperation.

Yours very truly,

GCS/rt

Geoffrey C. Smith,
Department of Geography.

FIELD SURVEY QUESTIONNAIRE

SECTION A

NOTE: The following questions should be completed by the ADULT HOUSEHOLD MEMBER WHO IS RESPONSIBLE FOR PURCHASING ALL OR MOST OF THE GROCERIES USED BY THE HOUSEHOLD. Please check the appropriate boxes unless instructed otherwise.

1. State your age and sex:

AGE	MALE	FEMALE
18-30		
31-45		
46-60		
60+		

2. Indicate the age and sex of ALL OTHER persons living in the household (N.B., Persons 18 years or over are adults.):

	ADULTS							CHILDREN				
AGE	MALES			FEMALES			AGE	MALES			FEMALES	
18-30							0-4					
31-45							5-9					
46-60							10-14					
60+							15-17					

3. State your place of birth (i.e., town, province, and country):

TOWN	PROVINCE	COUNTRY

4. How long have you lived: (1) AT YOUR PRESENT ADDRESS, (2) IN THE CITY OF HAMILTON?

(1) PRESENT ADDRESS	(2) CITY OF HAMILTON

5. State the present level of education of YOURSELF and the HEAD OF THE HOUSEHOLD (if you are not the head of the household):

	NO SCHOOLING	PRE-GRADE	GRADE 1 - 4	GRADE 5 - 8	HIGH SCHOOL INCOMPLETE	HIGH SCHOOL COMPLETE	COLLEGE NON-DEGREE	COLLEGE DEGREE COMPLETE
Yourself								
Head of Household								

(N.B.: "COLLEGE NON-DEGREE" box should include degree courses at present incomplete.)

6. State YOUR occupation and that of the HEAD OF THE HOUSEHOLD (if you are not eh head of the household):

	OCCUPATION
Yourself	
Head of Household	

7. (A) Indicate the place of employment (i.e., street location) of YOURSELF and the HEAD OF THE HOUSEHOLD (If you are not the head of the household).

(B) State also the usual means of transport to the place(s) of employment.

	(A) PLACE OF EMPLOYMENT (Street Location)	(B) MEANS OF TRANSPORT
Yourself		
Head of Household		

8. In which of the following categories is the total gross annual income of the HEAD OF THE HOUSEHOLD and the TOTAL HOUSEHOLD?

EARNINGS	UNDER $2,000	$2,000-$2,999	$3,000-$3,999	$4,000-$4,999	$5,000-$5,999	$6,000-$6,999	$7,000-$9,999	$10,000-$12,499	$12,500-
HEAD OF HOUSEHOLD									
TOTAL HOUSEHOLD									

9. How many automobiles are owned by members of the household? _____

SECTION B

FIELD TABLE

	1. STREET NAME	2. STORE NAME	3. NEAREST CROSS STREET	4. SOURCE OF KNOWLEDGE
STORES ACTUALLY VISITED				
EAST END (including North End Renewal Area)				
DOWNTOWN				
WEST HAMILTON (West of Downtown)				
MOUNTAIN				
OTHER				

POSSIBLE SOURCES OF KNOWLEDGE

(In column 4 state appropriat number).

1. TV or RADIO
2. RELATIVES and FRIENDS
3. NEWSPAPER
4. MAILED STORE CATALOGUE
5. TRAVELING AROUND HAMILTON
6. OTHER (State)
7. UNABLE TO REMEMBER

APPENDIX 5

SUMMARY OF THE DATA TRANSFORMATIONS

5.1 SKEWNESS AND KURTOSIS VALUES OF THE VARIABLES FOR THE ENTIRE SAMPLE

	SKEWNESS	KURTOSIS
Number of Reported Points (X_0)	0.625**	1.356**
Mean Distance (X_1)	-0.152	0.688
Length of Residence (X_2)	0.702**	2.690**
Social Status (X_3)+	-0.182	0.968**
Residence Type (X_4)	0.096	0.400
Occupation Level (X_6)	0.582	0.627
Income Level (X_7)	0.303	0.557
Education Level (X_8)	0.184	2.233**

* = Significant at the 0.05 level

** = Significant at the 0.01 level

\+ Social Status is the Index of Social Position

5.2 SKEWNESS AND KURTOSIS VALUES OF TRANSFORMED VARIABLES FOR THE ENTIRE SAMPLE

	SKEWNESS	KURTOSIS	TRANSFORMATION
Number of Reported Points (X_0)	-0.346	0.764*	logarithmic
Mean Distance (X_1)	-0.152	0.688	untransformed
Length of Residence (X_2)	0.111	0.590	logarithmic
Social Status (X_3)	1.033**	2.162**	reciprocal
Residence Type (X_4)	0.096	0.400	untransformed
Occupation Level (X_6)	0.582	0.627	untransformed
Income Level (X_7)	0.303	0.557	untransformed
Education Level (X_8)	-0.844**	4.764**	logarithmic

* = Significant at the 0.05 level

** = Significant at the 0.01 level

5.3 FINAL SKEWNESS AND KURTOSIS VALUES OF THE SELECTED TRANSFORMED AND UNTRANSFORMED VARIABLES FOR THE ENTIRE SAMPLE

	SKEWNESS	KURTOSIS	TRANSFORMATION
Number of Reported Points (X_0)	-0.346	0.764*	logarithmic
Mean Distance (X_1)	-0.152	0.688	untransformed
Length of Residence (X_2)	0.111	0.590	logarithmic
Social Status (X_3)	-0.182	0.968**	untransformed
Residence Type (X_4)	0.096	0.400	untransformed
Occupation Level (X_6)	0.582	0.627	untransformed
Income Level (X_7)	0.303	0.557	untransformed
Education Level (X_8)	0.184	2.233**	untransformed

* = Significant at the 0.05 level

** = Significant at the 0.01 level

APPENDIX 6

ANALYSIS OF VARIANCE OF NUMBER OF REPORTED POINTS:

SUMMARY TABLES

6.1 ANALYSIS OF VARIANCE OF NUMBER OF REPORTED POINTS: THE TWO-WAY CLASSIFICATION MODEL AND HYPOTHESES

(i) THE TWO-WAY CLASSIFICATION MODEL

$$\mu_{ij} = \mu + \alpha_i + \beta_j + \gamma_{ij}$$

where:

μ_{ij} = the mean number of reported points for the (i,j)th population;

μ = the mean number of reported points for the entire population;

α_i = the main effects of the length of residence population (i);

β_j = the main effects of the social status population (j);

γ_{ij} = the interaction effects of the length of residence population (i) and the social status population (j).

(ii) THE HYPOTHESES

(a) MAIN EFFECTS OF LENGTH OF RESIDENCE

H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$

H_1: At least one of the α_i's is not equal to zero.

(b) MAIN EFFECTS OF SOCIAL STATUS

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

H_1: At least one of the β_j's is not equal to zero.

Nb., See Chakravarti, I.M., et.al. (1967), op.cit., pp.344-45, for a general discussion and presentation of the two-way classification model.

6.2 ANALYSIS OF VARIANCE OF NUMBER OF REPORTED POINTS: SAMPLE MEANS

(a) Length of Residence Samples

	$\bar{x}$ (number of reported points)
≤ 4 years	3.98
5-18 years	6.05
19-35 years	8.03
≥36 years	9.07

(b) Social Status Samples *

	$\bar{x}$ (number of reported points)
26-64	10.40
65-84	7.51
85-100	5.88
101-128	4.04

* The samples are defined by point ratings on the Index of Social Position scale.

6.3 ANALYSIS OF VARIANCE OF NUMBER OF REPORTED POINTS: SKEWNESS AND KURTOSIS VALUES OF THE SAMPLES

Length of Residence Samples	Skewness	Kurtosis
≤ 4 years	-0.381	0.531
5-18 years	-0.119	0.438
19-35 years	0.085	0.622
≥36 years	0.462	0.522

Social Status Samples *	Skewness	Kurtosis
26-64 points	0.463	0.522
65-83 points	0.443	0.496
84-100 points	0.210	0.232
101-128 points	0.501	0.377

* The samples are defined by point ratings on the Index of Social Position scale.

6.4 ANALYSIS OF VARIANCE OF NUMBER OF REPORTED POINTS: BARTLETT'S TEST FOR THE EQUALITY OF THE SAMPLE VARIANCES*

(i) Test for Length of Residence Samples

H_0: $\sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2$

H_1: The variances are not all equal

Significance level: $\alpha = 0.05$

Critical region: $B > 5.991 (\chi_\alpha^2)$

Sample Variances

$\leq$ 4 years : $s_1^2 = 4.781$

5–18 years : $s_2^2 = 4.968$

19–35 years : $s_3^2 = 5.210$

$\geq$ 36 years : $s_4^2 = 5.902$

$b = 1.468$

Since $\chi^2_{0.050}$ (5.991) > 1.468 accept H_0

*Bartlett's test is described in Walpole R.E., Introduction to Statistics, MacMillan, New York, 1968, pp.299-300.

(ii) Test for Social Status Samples

$H_0 : \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \sigma_4^2$

H_1 : The variances are not all equal.

Significance level : $\alpha = 0.05$

Critical region : $B > 5.991 \ (\chi^2_\alpha)$

Sample Variances *

26-64 points: $s_1^2 = 8.897$

65-83 points: $s_2^2 = 5.214$

84-100 points: $s_3^2 = 5.876$

101-128 points: $s_4^2 = 5.485$

$b = 3.324$

Since $\chi^2_{0.050}$ (5.991) > 3.324 accept H_0

* The samples are defined by point ratings on the Index of Social Position scale.

6.5 ANALYSIS OF VARIANCE OF NUMBER OF REPORTED POINTS:

TABLE OF RESULTS

Source of Variation	Sum of Squares	Degrees of Freedom	Sum of Squares	Source of Variation
Length of Residence (Unadjusted)	1415.638	3	1206.721	Length of Residence (Adjusted)
Social Status (Adjusted)	655.602	3	864.519	Social Status (Unadjusted)
Interaction: Length of Residence x Social Status	103.923	9	103.923	Interaction
Between Cells Total	2185.163	15	2185.163	Between Cells Total
Within Cells Total	2440.307	390	2440.307	Within Cells Total
TOTAL	4625.470	405	4625.470	

Nb., the adjustments of the sums of squares are in accordance with the number of observations per cell. See Chakravarti, I.M. et. al.(1967), op.cit., pp.350-51.

6.6 ANALYSIS OF VARIANCE OF NUMBER OF REPORTED POINTS:

THE VARIANCE-RATIO TESTS

Source of Variation	Degrees of Freedom	Mean Square	F
Length of Residence (adjusted)	3	402.240	64.286*
Social Status (adjusted)	3	218.534	34.926*
Interaction : Length of Residence x Social Status	9	11.547	1.845
Error	390	6.257	

* = significant at the 0.05 level.

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