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TITLE OF THESIS/*TITRE DE LA THÈSE* AN ACTIVITY SYSTEMS IMPACT ANALYSIS OF THE EDMONTON TRANSIT SYSTEM STRIKE - 1973 - 1974

UNIVERSITY/*UNIVERSITÉ* ALBERTA

DEGREE FOR WHICH THESIS WAS PRESENTED/*GRADE POUR LEQUEL CETTE THÈSE FUT PRÉSENTÉE* M A

YEAR THIS DEGREE CONFERRED/*ANNÉE D'OBTENTION DE CE GRADE* (1975)

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AN ACTIVITY SYSTEMS IMPACT ANALYSIS OF THE EDMONTON TRANSIT SYSTEM STRIKE, 1973-1974

by

© BENJAMIN GEORGE SMITH

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF ARTS

DEPARTMENT OF GEOGRAPHY

EDMONTON, ALBERTA

SPRING, 1975

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "An Activity Systems Impact Analysis of the Edmonton Transit System Strike, 1973-1974" submitted by Benjamin George Smith in partial fulfilment of the requirements for the degree of Master of Arts.

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Date...Feb...19.....1975.....

ABSTRACT

It is increasingly important that geographical research seek insights into the causes of observed patterns of spatial behaviour. This thesis attempts to gain such insights by analyzing the changes induced in household activity systems by a prolonged strike of the Edmonton Transit System. The activity systems conceptual framework developed by F. S. Chapin (1965, 1968) is employed because of its operational feasibility, and its explicit concern with relating patterns of spatial behaviour to the urban infrastructure within which the behaviour occurs.

The analysis is applied to a sample of regular transit system users who are students at the University of Alberta. Data are collected by means of two space-time budget inventories which seek to define both the pre-strike and strike-state patterns of spatial behaviour. Differences between the two sets of space-time budget data are attributed to the shock effect of the bus strike.

It is concluded that activity systems are subject to externally induced changes. Household time budgets are distorted during the strike, and major activity linkages associated with the journey to university, retail shopping trips, and social/recreational trips are significantly altered. Activity systems are thus seen to adjust themselves so as to reduce the impact of disequilibrium, and it is suggested that the temporary equilibrium established during the strike is characterized by boundedly rational or satisficer behaviour.

ACKNOWLEDGMENT

Thanks are due to my advisor, Dr. John Hodgson who provided incisive comments at various stages of draft preparation, and to Dr. Denis Johnson, who gave freely of his time, both in reading the thesis and in co-ordinating a myriad of technical details. In addition I thank John Bakker, Department of Civil Engineering, for his interest in this work.

My wife, Frances, provided valuable aid and advice in the preparation of the graphics in the thesis, and Dr. Derek Booth of Bishop's University devoted much time to reading and commenting upon early drafts. Dianne Dodd's expertise with the computer work is gratefully acknowledged as is Vivian Wenger's fast and efficient typing.

Special thanks are due to Dale Rhyason, City of Edmonton Transportation Planning and Dick DeRyk of ETS Operations for their help in collecting the data. Also, the ETS itself has been generous in providing duplicating assistance.

Finally, to Erica and Graham Seagel, I express my sincere gratitude for making my last weeks in Edmonton most pleasant.

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CHAPTER I

PROBLEM AND PERSPECTIVE

PURPOSE

This thesis examines the impact of the sudden removal of public transportation on the activity systems of university students in Edmonton, Alberta. The complex process of model building and simulation which might otherwise be necessary in order to fulfill such a purpose, was rendered unnecessary by a strike of the Edmonton Transit System (ETS). The data upon which much of the empirical portion of this research is based were gathered during the first two weeks of a seven week transit stoppage. Details of the data collection procedure are treated fully in Chapter III.

This chapter provides a description of the problem under consideration and a brief outline of the conceptual framework to be used in the analysis, that of human activity systems. In addition, reasons for undertaking this research project and for viewing it from the activities perspective are discussed. Finally, the research hypotheses are framed in the context of the transit strike.

THE NATURE OF THE PROBLEM

One of the major functions of cities is to provide a spatial organization which fosters the creation and maintenance of linkages, or interactions, between its spatially disparate elements (Wheeler and

Stutz, 1971). It is a characteristic of urban structure that the distribution of residences and ancillary services tends to require inputs of transportation in order for the city to function, that is, in order for the interactions between activities to occur (Guttenberg, 1960). This research examines one critical component of the urban infrastructure in Edmonton, the public transit system, and focusses upon the disequilibrious effects induced by the ETS strike on the activity systems of a sample of student bus users.

In order to analyze the impact of the removal of the ETS on activity systems it is assumed that just prior to the strike, Edmonton approximated a state of balance as an urban system. Furthermore, it is subsumed that prior to the strike most individual activity spaces were in equilibrium with the individual's perception of spatial opportunities, that most individual learning and information absorption processes relating to urban structure had slowed after an initial period of information assimilation, and that the behaviour in space of most individuals had become habitual and routinized (Horton and Reynolds, 1971).

THE PERSPECTIVE

The activity systems framework sees the individual as the fundamental building block in the urban system--the instrument of change--and it regards his decisions pertaining to spatial opportunities as critical inputs in a cognitive-behavioural paradigm of the city.

The notion of the activity system is a simple one. Each individual, in the course of going about his daily affairs, travels between his home and certain centers or nodes of activity in the city. For instance, a student day may consist simply of a trip from home to school

and back again, or it may be characterized by interactions with one or more activity nodes--a shopping center, a grocery store, a cinema. Those interactions which tend to be regular and routinized are called activity linkages (Mitchell and Rapkin, 1954), and the sets of linkages ordinarily maintained by the individual are collectively referred to as his activity system (Chapin, 1965).

As Brail (1969) and Anderson (1971) note, activity studies deal with both the spatial and temporal aspects of human interaction. In this thesis, the analytical emphasis is on spatially expressed activities, or between-node interactions, rather than on relatively aspatial, within-node activities.

THE RESEARCH HYPOTHESES

The ETS strike acted as a severe shock to the Edmonton urban system, throwing it out of kilter. This thesis attempts to observe how the activity linkages associated with school trips, social and recreational trips, and retail shopping trips were altered during the strike. In addition, it seeks insights as to why the activity systems changes occurred in the observed manner.

Accordingly, two hypotheses are formulated.

Hypothesis 1: Activity systems, which are spatially and temporally definable, are subject to changes induced by exogenous influences.

If the city is assumed to be in equilibrium prior to the strike, then the strike's shock effect may tend to alter the nature and configuration of activity systems. Fewer "discretionary" trips may be made as the general level of space stress increases (Haynes, 1969).

Hypothesis 2: Activity systems tend to a state of balance over time and will readjust themselves in order to reduce the impact of disequilibrium on the spatial system.

These readjustments from disequilibrium to a new spatial equilibrium may take a variety of forms. With regular bus users, travel mode is critically affected, and an analysis of the searching procedure applied to the problem of mode selection may provide insights into individual space preferences. Household time budgets may be distorted such that arrival and departure times for university trips are altered. As part of the readjustment process, individuals may experiment with different travel routes to avoid increased traffic volumes, or they may feel compelled to redirect certain trips such as shopping or social trips to less crowded or more accessible activity nodes. Consequently, individual awareness spaces may be augmented as new spatial discoveries associated with mode and route experimentation are made.

A corollary to the second hypothesis is that readjustment to the strike involves the establishment of a new, temporary equilibrium. This new equilibrium, having been established as a result of experimentation, learning and spatial discounting during the strike, may have lingering effects even after the urban system has returned to apparent normality. An investigation of some of the longer term, at-large effects of the strike is made in Chapter IV.

THE RESEARCH METHOD

Data pertaining to activity systems changes were collected by means of two postal questionnaires. These took the form of space-time budget inventories (see Anderson, 1971), and were administered during

the first two weeks of the transit strike, which itself lasted from November 29, 1973 until January 19, 1974. The first activity survey (Appendix A) was mailed to a 10 per cent sample selected from a universe of approximately 3,500 regular student bus users, defined as University of Alberta students who held three month term passes at the time of the strike. It was felt that a sample of regular bus users represented those individuals most directly affected by the strike, and that the analysis of changes in their activity systems would be potentially the most rewarding. The second activity survey (Appendix B) was sent to all those who responded to the first one, and to a sample of the population at large. This questionnaire was administered one month after the resumption of normal transit service.

THE RELEVANCE OF THE RESEARCH

It is increasingly important that geographical research confront the causes underlying observed spatial patterns. Research emphasis has long been placed upon the description of urban infrastructure, for example land use patterns, rather than upon the understanding of the processes which generate the infrastructure. The use of the activity systems framework in this analysis is an attempt to gain insights into spatial process.

Due to the severe time constraints imposed on researchers by shock events, little shock-effects literature exists (an exception is Scarlett, 1971). Also, no comprehensive analyses of transit strike or stoppage situations have been carried out in North America.[1] In these

[1] The following city transit departments and transit organizations were contacted regarding strike impact studies. None of the contactees

contexts, the empirical work documented here should help to fill a gap in urban systems literature.

SUMMARY

This thesis is a systems analysis of activity changes induced by the Edmonton Transit System strike. The research sample is composed of directly affected University of Alberta students. It is expected that the activity analysis will demonstrate that the strike altered household time budgets, simplified activity systems by curtailing many urban trips, especially trips to large shopping centers, and augmented individual awareness spaces. In addition, it is expected that the altered spatial behaviour patterns are the result of the collective adoption of more simplified behavioural correlates during the strike-induced disequilibrium.

Chapter II provides a brief and much simplified sketch of the development of modern geography, focussing on the activity systems conceptual schema within the context of the cognitive-behavioural approach. Also, a short survey of the activities literature is presented.

Chapter III deals explicitly with the urban infrastructure in Edmonton, particularly with the relationships between land uses, activity nodes, and the transit system. Furthermore, the research method in terms

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was aware of any such studies.

(1) Departments of Engineering and Transportation, Cities of: Calgary, Edmonton, Fredericton, Halifax, Hamilton, Kingston, London, Montreal, Ottawa, Quebec City, Regina, St. John, Saskatoon, Toronto, Vancouver, Windsor, Winnipeg.

(2) American Transit Association, Washington, D.C.

(3) Institute of Traffic Engineers, Arlington, Va.

of sample selection, sample composition, and questionnaire design and distribution is more fully treated.

Chapter IV presents a detailed activity systems analysis of the survey data, and Chapter V summarizes the research findings and offers arguments for the acceptance of the research hypotheses as well as a suggestion for future research.

CHAPTER II

PROCESS AND PRODUCT

CHANGING EMPHASES IN GEOGRAPHY

Geography is concerned with the description, analysis and explanation of phenomena which occur in space and over time, and with the establishing of principles relating to the distribution and interaction of such phenomena. As a discipline geography has lacked a consistent perspective from which to view spatial problems, and consequently various research methods find their way into the literature every decade or so.

Until the 1940's regional analysis and geographic exceptionalism prevailed. As Shaefer (1953) has noted, geography was less concerned with the development of spatial generalities or laws than with the description and classification of unique or exceptional geographic occurrences. By the mid 1950's geographers had begun to discover a neglected but powerful research tool, quantitative methods. This discovery, coupled with deepening interest in classical Central Place Theory, resulted in a large body of theoretical and empirical investigations, particularly the building and testing of interaction models (see Berry and Pred, 1965; Olsson, 1965; Berry, 1967).

As the value of quantitative methods became more appreciated, further research and experimentation using gaming, spatial diffusion, stochastic simulation and factor analysis models was undertaken (see

Gould, 1963; Hagerstrand, 1966; Clark, 1965; Davies and Barrow, 1973). Although the "quantitative revolution" undoubtedly paved the way for the tackling of a new and wider spectrum of spatial problems, some unfortunate excesses occurred.

In a timely essay entitled "The Spatial View in Context" Taaffe remarks that:

> A carelessness about the necessity for verbalizing conclusions (in quantitative research) rendered many potentially significant findings unnecessarily obscure and difficult to separate from relatively insignificant findings (Taaffe, 1974, p. 10).

Taaffe's point is that in some quantitative research, technique transcended subject matter to the detriment of the discipline.

Even as geographers' interest in quantitative methods per se ebbed, a redirection of conceptual thinking began to develop, fed by a dissatisfaction with many of the oversimplifying assumptions of various mathematical models; the significance of geographic process became much more appreciated.

THE DEVELOPMENT OF A PROCESS ORIENTED GEOGRAPHY

The literature dealing with the nature of urban structure, and with its explanation, has been dominated until recently by frameworks or models which attempt to explain structure on the basis of land rent theory (Alonso, 1964; Nourse, 1968). These models have variously emphasized the role of distance, accessibility, and "the market mechanism" in the development of spatial organization. Chapin (1968) questions any propensity to rely completely on one system of thought, particularly the market analog, simply because it has become well developed, and simply because its tenets are convertible into units which are conceptually easy to grasp.

The predominance of the economic model as a descriptive and explanatory tool in urban studies has tended to overshadow other conceptualizations of urban form. According to Chapin (1964) these other perspectives may be classified as being oriented towards:

1. communications theory;
2. human interaction;
3. urban images;
4. accessibility;
5. decision analysis.

Communications Theory

Meier (1962), in examining the problem of establishing a theoretical base to urban structure, has concluded that human communication provides a common element in societal organization. Cities exist to facilitate interactions or communications. Meier believes that by studying the nature of the content of information flows across a city, and by thus arriving at a set of "social accounts" based, for example, on individual time budgets, a representation of city structure supported by communications theory should be forthcoming.

Although the framework is appealing in that it recognizes that the city of the future will rely less and less on face-to-face contacts, it is none the less still in its formative stages, and the methods by which it might be operationalized are not clear. For example, in light of current controversy regarding individual rights to privacy it is not apparent how information flows would be sampled. However, Meier's notion of a social accounting system would seem to have immediate value in the characterization of the temporal aspect of human activity.

Human Interaction

Webber (1963) extends the premise of using interaction studies to define urban form. He envisions two kinds of metropolitan community which he calls the urban place, and the non-place urban realm. Webber believes that, due to greatly improved transportation and communications technology, it is possible for "linkages" or "invisible relations" to prevail between individuals, firms, and institutions, so that an essentially aspatial, non-place community can exist. This he terms the urban realm. The more familiar and spatially apparent forms of urban organization, cities, he terms urban places.

Webber's is a holistic concept, maintaining that both place and non-place interactions must be taken into account in any comprehensive theory as to the nature of urban structure. As Chapin (1964) notes, Webber strives to achieve an "internal logical consistency" in his arguments and in conceptual terms he is quite successful. Webber does concede that the operationalization of his ideas into a viable explanatory model remains to be accomplished.

Urban Images

A third schema focussing on urban imagery has been offered by Lynch and Rodwin (1958). The city is viewed as a set of "adapted spaces" accommodating various "flow systems." The authors are concerned with developing a method of analyzing urban form, so that when community-formulated goals are set against the form analysis, the "desired" city-type can be envisioned and, presumably, planned.

Urban form is analyzed on the basis of six interrelated parameters: element types (types of spaces, types of flow systems); element density; grain (differentiation and separation of elements);

focal orientation of elements; general spatial distribution of elements. While certain components of the framework, for instance the concern with individual perception of the environment, may provide valuable input into a general theory of urban structure, Chapin (1964) argues that the ideas expressed by Lynch and Rodwin, are directed more toward the development of a "city planning rationale" than toward a general understanding of urban dynamics.

Accessibility

Accessibility, or relative nearness, underlies virtually all conceptualizations of urban structure. Some theorists, notably Guttenberg (1960) and Alonso (1964), have made it the focus of their approach to establishing a theoretical basis to city form. The rationale in such schemata is that accessibility is a central organizing element, and results in what Guttenberg calls a community effort to overcome distance in the city. The argument is as follows: urban facilities may be spatially distributed or undistributed relative to residential location, and a variable input of transportation is thus required in order that the services and facilities be accessible to the residents.[1] A desire to maximize the time-distance accessibility of residents to services thus spawns a spatial organization. Transportation system efficiency is seen as the key to understanding this organization.

An appreciation of the organizing function of accessibility is implicitly expressed in all of the conceptual models discussed above.

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[1] If services and facilities are centralized, then an effective transportation system is required to provide accessibility. However, if services and facilities are distributed throughout the city, less emphasis need be placed on the transportation system.

The reader will note other similarities among them. For instance, Meier's communications flows, Webber's invisible relations, and Lynch and Rodwins's flow systems are all logically analogous as are the terms land use, activity node, and adapted space.

Decision Analysis: Activity Systems

While all of the conceptual formulations expressed above accommodate the essential role of human interaction in their tenets, the human element and human behaviour are treated largely at the aggregate level. Because of its expressed concern with the individual and his decision making process it is maintained that the fifth class of conceptualizations, decision analysis, offers most to the researcher who is attempting to comprehend changing urban structure.

Chapin (1965) has synthesized and collated the more tractable notions expressed in these diverse urban conceptualizations and added many of his own ideas pertaining to human activity systems. The resulting framework has a broad conceptual base which actively appreciates the significance of individual decision making in spatial process.

THE ACTIVITY SYSTEMS SCHEMA

The critical elements in the activities schema are a value systems component which operates on a choice mechanism which in turn produces an activity component (Chapin, 1968). Within the context and constraints of the urban social milieu, and within the context of a sense of destiny or purpose possessed by all individuals, a complex of motivations is seen to exist. The individual experiences both fundamental needs and supplemental needs (aspirations or wants) in the course

of attempting the achievement of some purpose.

When confronted with a set of potential opportunities, the influence of value system bias and motivational drive are seen to operate on internalized preference structures (Rushton, 1969) possessed by all individuals. Preference structures are the cumulative product of the individual's value system, his needs and wants, his aspiration horizon, his information, his past experience, and his socio-economic capacity. The nebulous preference structures provide the criteria for a decision-choice process, which in turn results in the generation of activity.

The decision-choice process, as conceived here, is based upon the hypothesis that " . . . it is possible from any consistent statement of preferences from the paired comparison of spatial opportunities, to derive a unique ranking of these spatial opportunities" (Rushton, 1969, p. 394). This ranking acts as the context for the decision and subsequent choice regarding a particular activity. Activity, then, is seen as a response to perceived spatial opportunity.

When cycles of the motivation-choice-activity process occur over time and are accumulated over both time and space for the urban population at large, systems of activity emerge. It is these " . . . behaviour patterns of individuals, families, institutions, and firms which occur in spatial patterns that have meaning . . ." which Chapin terms <u>activity systems</u> (Chapin, 1965, p. 224).[2]

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[2]According to Chapin (1965, p. 29) human behaviour "refers to the way in which people and groups conduct themselves, how they act in the context of the values and ideals they possess."

ACTIVITY SYSTEMS AND SPATIAL STRUCTURE

The aim of Chapin's conception of urban structure is to study the activity patterns of individuals and groups of individuals in an attempt to relate movements and interactions to the spatial infrastructure within which the activity occurs. The underlying postulate of the activity systems framework is that " . . . specific spatial structures and specific forms of spatial behaviour are the outcomes of the interaction between sets of environmental variables and the cognitive processes of individuals and groups" (Gollege et al., 1972, p. 76). Attempts to constructively characterize these interactions have engendered a set of terminologies which deserves clarification.

Spatial structure is viewed as a generalized description of the distribution of phenomena in geographic space-time (Horton and Reynolds, 1971). Urban spatial structure is such a distribution in the context of the city. Objective spatial structure refers to the location of the individual household relative to the actual locations of all potential activities. In viewing the interrelationship between structure and behaviour, the home is seen as the origin from which the perceived structure is utilized.

An action space is the physical area defined by the collection of all urban locations about which the individual has knowledge and utility preferences, and is sometimes called an awareness space (Horton and Reynolds, 1971). An activity space is the areal subset of action space defined by the actual, day-to-day contacts of individuals with nodes in the spatial structure. As noted in Chapter I, the interrelationships between individuals and various locations in the activity

space, when taken together, form an activity system.

Activities themselves are analogous to land uses. Webber (1963) has noted the ambiguous nature of the term land use, and points out that it refers simultaneously to the physical land itself, and to the activity which occurs on the land. He suggests that it is possible, and perhaps desirable, to extract the "use" or activity component from land use, and deal with it exclusively. Activities can thus be classified according to " . . . the social or economic functions they represent, the acts people perform while conducting the activities, (or) the kinds of goods or services involved . . . "(Webber, 1963, p. 90). Furthermore, since the home is seen as the origin and ultimate destination of all activity, the movement incurred in the utilization of urban structure is part of the activity. It is with this movement subcomponent of urban interaction that this thesis is especially concerned.

Chapin (1965) has developed a typology which relates activity agents (firms, institutions, households) and activity types (residential, general welfare, productive) to the resulting activity systems. In this thesis, only the household (or individual) activity agent and its associated activity systems are considered, because in general, they tend to be more amenable subjects for an activity analysis than are firms and institutions, and in the case of the bus strike, household activity systems are the most directly affected.

A MODEL OF SPATIAL CHOICE

The application of a cognitive-behavioural geographic rationale demands that some distinctions be made between the closely related processes of behaviour, decision, and choice. In order to help clarify the

interrelationships, in the context of this research, a simple model of spatial choice is offered here (Figure 1). Several of the notions introduced in the model will be treated more fully in the next section.

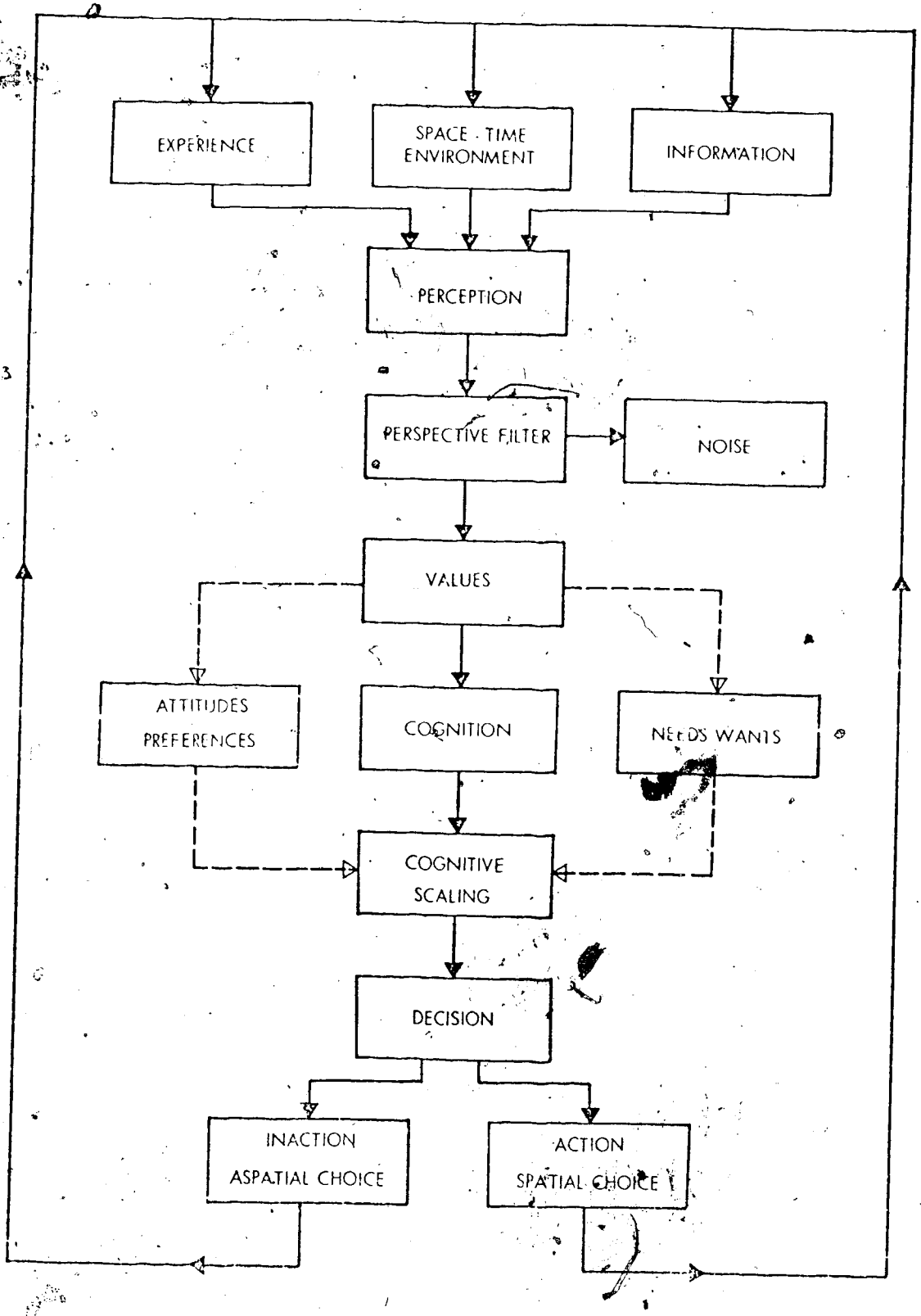
In the model, past experience and information complement the space-time setting providing input into perception. Perception may be defined as " . . . the process which occurs because of the presence of an object, and that results in the immediate apprehension of that object by one or more senses" (Downs and Stea, 1971, p. 14). Perceptions may be viewed as being relevant or irrelevant in a given decision-choice context. A perspective mechanism is seen to filter perceptions, ejecting irrelevant ones from the decision process as noise. The action of this perspective filter is partially a function of the previously introduced notion of socio-economic capacity. As an example consider two individuals of disparate economic status who are both subjected to the same exotic travel advertisement. To the individual lacking capacity, the perception is irrelevant; it is noise. To the individual with capacity, such a vacation may be feasible, and hence a ranking of the cognition assimilated from the perception is in order; a decision and choice is necessary.

Relevant perceptions are processed by the value system intrinsic to the individual, and assimilated into cognitions. Cognition results from the interaction of " . . . perceptions, memories, attitudes, preferences, and other psychological factors" (Downs and Stea, 1971, p. 13). These cognitions are referred to by Festinger (1957, p. 9) as knowledges developed by the individual.

The individual, in the context of all previous system inputs, ranks or scales the cognitions with respect to his values, and his

FIGURE 1

A MODEL OF SPATIAL CHOICE



needs, wants, attitudes, and preferences. The cognitive scaling results in the making of a decision. The appropriate response to the decision may be inaction, which is termed aspatial choice in the context of this research. Alternatively, the appropriate decision response may be action, in which case a spatial choice is made with respect to a set of potential activity opportunities. In either case, the choice produces feedback into the initial system stages and acts as input into all future decisions and choices.

COGNITIVE IMAGES AND BOUNDED RATIONALITY

The preference structures maintained by the individual are seen to provide critical input into his decision and choice process. A second level of input into spatial choice is provided by the individual's mental map or cognitive image of the spatial setting (Gould and White, 1974; Downs and Stea, 1973). The existence of such images is implicit in both the activity systems schema and in the model of spatial choice discussed above. However, the concept is of sufficient importance to warrant a more explicit treatment.

Consider an individual who has taken up residence in the city, and who has negotiated the stages in the spatial learning process as posited by Horton and Reynolds (1971): he has overcome basic distance and directional biases and developed a skeletal impression of the city; his small action and activity spaces are expanded as he is subjected to further experience and incoming information; and finally he has reached a spatial equilibrium in which his activity space is in balance with his perception of opportunity within his action space.

It has been established that each individual develops values and

preferences based upon his perception and cognition of the environment. Because home is seen as the origin and ultimate destination of all activity linkages in the urban spatial system, it follows that spatial structure is viewed by each individual from a somewhat unique co-ordinate in space-time. Thus each individual may be seen to possess a unique mental map or cognitive image of the urban environment based upon his perceptions and cognitions of his spatial setting. The individual's action space defines the local spatial dimension of his mental map.

When confronted with spatial action alternatives the individual scans his mental map in order to better evaluate his potential opportunities. The maps are not eidetic in nature, and hence various biases and misconceptions possessed by the individual are introduced into the image, distorting his perception of space. Also, the map may be discontinuous; there may be gaps in the individual's information and resultant blank areas in his cognitive map (Gollege et al., 1972).

The mental map, then, is much less than a cartesian rendering of the city--it is a subjective and likely distorted representation of the urban environment as the individual sees it. An individual consulting his mental map as a part of his cognitive scaling procedure employs less than absolutely correct spatial input in his decision making process. Thus, it is unlikely that his decisions will be rational ones in a purely economic sense; more likely his decisions and subsequent choices will reflect bounded rationality (Simon, 1957). In order to deal with the complex problems which confront him, the individual builds a simplified model of reality, and acts objectively with respect to it. But since his reference model is not an absolute representation of the organized complexity which he faces, he can act only so as to achieve

a sub-optimal, satisficer solution, within the bounds of his simple model.

PERCEPTION AND COGNITION IN GEOGRAPHY

Much recent literature has been devoted to cognitive imagery, but the notion has far earlier origins. Some of the first work dealing with cognitive mapping was done by the psychologist, Tolman (1948) and his associates. Tolman believed that learning and subsequent behaviour involved a much more complicated mental process than mere stimulus-response. As a field theorist Tolman maintained that the brain was more like a " . . . map control room than . . . an old fashioned telephone exchange" (Tolman, 1973, p. 31). He felt that a holistic impression existed in the brain rather than a simple stimulus-response connection mechanism. As Tolman phrased it, " . . . the incoming impulses are usually worked over and elaborated in the central control room (the brain) into a tentative, cognitive-like map of the environment" (Tolman, 1973, p. 31). According to Tolman, it is this map which finally determines the behaviours which will be exhibited by the acting organism.

Geographic interest in imagery, and in its relationship to decision making began to develop in the early 1960's with the works of such researchers as Lowenthal (1961), Lee (1962) and Lynch (1960).

Lynch's investigation into the relative imageability of the downtown areas of American cities first explored the idea that spatial foci exist in the environment with which individuals can identify, and around which images of the city may be formed. It was recognized that the images maintained by individuals could influence spatial actions by affecting perceptions and cognitions. Because of the subjectivity of

image formation, and consequent eidetic inadequacies, decision processes came to be viewed in a different light.

Wolpert (1964) was one of the first geographers to strongly question the model of the economic man, and to attack the norms upon which the notion is based; namely that man has perfect knowledge of all the alternative courses of action in a given situation, and that he has a single desire to optimize his utility or productivity. Instead of these deterministic postulates, Wolpert envisioned a decision making process fashioned along the lines of Simon's principle of bounded rationality in which the individual's " . . . finite abilities to perceive and store information, to compute optimal solutions, and to predict the outcome of future events . . . " is recognized (Wolpert, 1964, p. 314).

In his examination of farming practises in Sweden, Wolpert found that it was necessary to dispose with all assumptions of economic rationality in order to explain the observed behaviour of farmers. Investigations such as Wolpert's into the satisficer nature of decision making initiated a wide spectrum of analyses into spatial behaviour.

Huff (1960) developed a simple descriptive model of consumer behaviour based upon the association of elements affecting individual space preferences. He suggests that before any spatial action can occur, there must be a reconciliation of various stimuli, values, and the individual's behaviour space perception. Huff's model was one of the first to incorporate the feedback effects of overt behaviour into the overall decision process. Though simple models helped to conceptualize complex processes at this early stage of development, they were of little empirical use.

Interest in perception and cognition and their influence on the generation of preference structures has expanded in the last decade. Following the early lead of Huff and others, Rushton (1969) examined spatial behaviour by studying revealed space preferences, and concluded that behaviour is determined by preferences only. He does concede that preferences are not independent of the spatial structure in which they are observed, but he maintains that preferences tend to be more stable than does structure and are thus invaluable objects of study.

Downs (1970) has attempted to empirically define the nature of a cognitive image, while Lee (1970) and Gollege et al (1969) have considered the influence of the differential perception of distance by urban residents on intraurban behaviour. Though both sets of researchers arrived at slightly different conclusions, they agree that distances in certain directions, such as toward key spatial foci may be under- or overestimated relative to other distances in the city. The implication of this finding in the context of spatial decision making is great.

On a slightly different tack Adams (1969) and Johnston (1971) investigated the shape, size, and orientation of mental maps of urban dwellers, finding that the maps tend to conform to wedge-like sectors, based around the residents' homes. Such channelized views of structure undoubtedly play a role in determining the nature of spatial choices.

Orleans (1968) has researched the problem of variable cognition in cities, finding that social scale affects the magnitude and degree of detail present in maps drawn by respondents. The more affluent, for example, tend to have a larger, more cosmopolitan awareness of the spatial structure and more widely dispersed contacts than do the less affluent.

At the macro scale Gould and White (1974) have found evidence of strong space preferences resulting in stereotyped images of various areas of the United States. They have produced sets of mental maps, each presenting a different residential desirability surface focussed on "attractive" or "unattractive" regions of the country.

PROCESS AND PRODUCT

The brief sketch of the development of a process oriented geography and the short notes on explorations into cognitive imagery are intended to place the research carried out in this thesis more firmly into a conceptual niche. Though this thesis attempts neither the explicit delineation of behavioural correlates nor the explicit examination of the composition of mental maps, in the final analysis certain inferential links between structure, systems change, and behaviour are made. No rigourous attempt to reify the mental maps of Edmontonians is made, but it is important that the reader be aware of the cognitive perspective and of its value as a conceptual aid and explanatory organizer.

The activity systems conceptual framework is essentially a behavioural one, and its concern with the individual as the building block of spatial structure has been noted. Before proceeding with a discussion of the means by which the activities framework may be operationalized, it would be worthwhile to consider the interrelationship of spatial structure and spatial process.

Several researchers have noted that structure and behaviour are mutually dependent (see Clark, 1972; Rushton, 1971). Certainly behaviour occurs within the constraints of an existing structure, but until recently, the significance of the obverse phenomenon, that of patterns

of behaviour giving rise to change in spatial structure, has been downplayed.

Clark (1972) has noted that certain types of behaviour, such as those embodied by the pursuit of leisure or recreational activities, may be much less constrained by structure than those behaviours embodied by residential location decisions. Still other behaviours, for example patterns of consumer movement, may affect the decisions of locators of facilities, resulting in a behaviourally induced change in structure (Rushton, 1971). Clark (1972) has offered a simple descriptive model of the relationship between structure and behavioural process which exemplifies the circuity of these elemental process-product inputs (Figure 2).

Though it is recognized that aggregate patterns of individual behaviours lead to structural alterations, the expressed concern in this thesis is with viewing patterns of individual movements over time in order to monitor the alterations in spatial behaviour induced by changes in the spatial system.

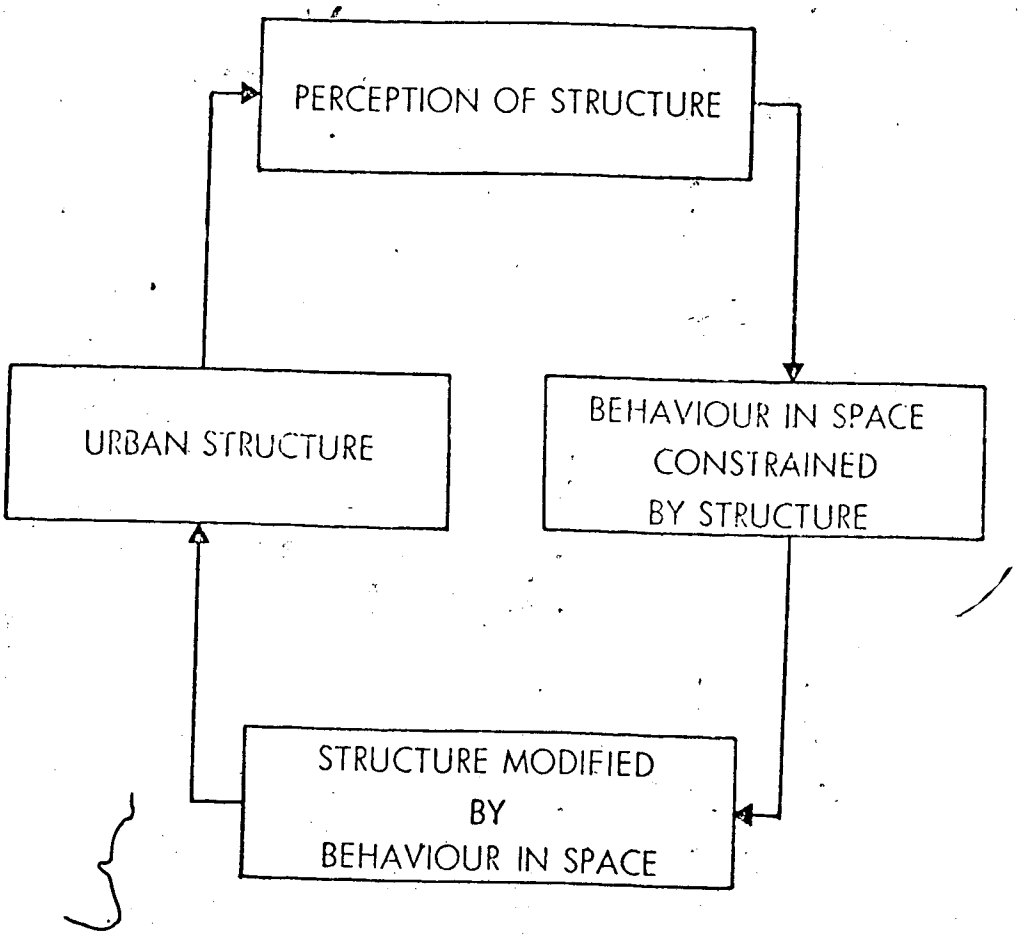
THE SPACE-TIME BUDGET

There is an important second dimension in the activities schema--the element of time. All human activity occurs in a continuum of both time and space, yet this fact has not been explicitly incorporated into the research framework outlined above.

Brail (1969) distinguishes between the time budget study and the activity study, noting that the latter is concerned with both time and space. According to Anderson (1971, p. 353) a time budget is a " . . . systematic record of a person's use of time over a given period.

FIGURE 2

THE RELATIONSHIP BETWEEN STRUCTURE AND BEHAVIOUR



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It describes the sequence, timing and duration of a person's activities, typically for a short period ranging from a single day to a week. As a logical extension of this type of record, a space-time budget includes the spatial coordinates of the activity locations."

All persons are seen to possess a budget of time which they allocate to the various activities which occupy their day. This allocation is made according to both the relative value placed upon the pursuit of the activity by the individual, and to the constraints imposed on the pursuit of the activity from exogenous sources (e.g. from the time demand of employment).

The rationale for using time budget analysis in urban research has been stated succinctly by MacMurray (1971, p. 201): "Time, along with space, is a universal container of human activity, and it is argued that because everybody must always be doing something (somewhere), time expenditure has the potential for placing a particular segment of human behaviour into useful perspective." It follows that an understanding of the way in which individuals choose to spend this precious commodity (time) may provide insights into some of the space-time values they hold, in much the same way as the manner in which individuals choose to spend certain incomes provides insights into their relative material values. In the empirical analysis undertaken in Chapter IV, a space-time budget analysis is undertaken.

A SHORT REVIEW OF ACTIVITY SYSTEM LITERATURE

The data collection mechanisms employed in activity studies are simple in fundament, but often, owing to the very detailed nature of the information required, they are difficult to execute.

Typically, the researcher requires data pertaining to the activity type, the activity participants, travel modes involved, trip frequencies, trip origins, trip destinations and purposes, as well as various time inputs, for example travel times, and activity duration times. Depending on the level of the study, records of face-to-face contacts may be elicited. The sum total of this activity accounting represents the space-time budget of an individual for a specified time period (Anderson, 1971).

Chapin (1965) has developed a comprehensive activity survey for household use. This survey is somewhat unique in that it attempts to account for respondents' attitudes and preferences for certain activities. Instead of directly asking the respondents for their preferences, which could introduce bias into the survey, Chapin proposes the use of a trade stamp game. Respondents are supplied with a fixed number of stamps, each representing a unit of time, and are asked to allot the stamps to time slots on a master activity sheet. Different preferences will give rise to different sets of time allocations, and hence trends in preferences may be determined.

Chapin (1965) has applied some of his theoretical and practical notions to a pilot study of activity in Durham, North Carolina. He mapped the spatial extent of certain sets of activity systems linkages across a sample population finding that certain types of activity systems are spatially less extensive than others, and that clusters of certain types of activity systems exist.

In a later, more rigourous activity study, Chapin and Brail (1969) analyzed daily activity patterns in the United States at the aggregate level. A nationwide survey of residential preferences and

moving behaviour undertaken by the Highway Research Board provided a 1,400 unit sample. A thirteen element activity classification was developed (Table 1) in which the continuum of activity from obligatory to discretionary is accommodated. The authors proceeded to analyze time expenditure data, seeking to determine what factors influence the propensity of an individual to pursue an activity, and what dimensions affect the mean duration of the activity.

An important contribution of the paper was the identification of a number of independent variables which were seen to affect both propensity and duration of activity on a typical weekday. These variables were incorporated into four dimensions: socio-economic status, stage in the life cycle, city structure, and sex-marital status. Significant di[redacted] activity systems composition were found to exist betwee[redacted]als exhibiting different intensities and combinations of thes[redacted]s.

In a se[redacted] comparative study, Brail and Chapin (1973) found that the time sp[redacted] on a variety of different activities varied between weekdays and wee[redacted]nds, and between sexes, age groups, and occupation groups. A dissa[redacted]isfaction with the inclination of many activity studies to employ a simple weekday-weekend dichotomy in differentiating the time continuum led to the testing in this thesis, of the hypothesis that activity pursuit varies in composition and intensity among weekdays, as well as between weekdays and weekends (Chapter IV).

Activity Interaction Studies

Boal (1969) investigated territoriality on the Shankhill-Falls divide in Belfast, N[redacted]thern Ireland, examining the activity patterns

TABLE 1

THE CHAPIN AND BRAIL ACTIVITY CLASSIFICATION

Relaxation
Arts, hobbies, sports
Reading
Television and radio
In-home family
In-home socializing
In-home obligatory
Out-of-home discretionary
Out-of-home family
Out-of-home socializing
Work related
Shopping and personal services
Out-of-home obligatory

SOURCE: Chapin and Brail, 1969, p. 114.

of a sample of Protestant and Roman Catholic working class families. The two groups shared a common spatial street boundary, but were highly segregated with respect to residential location. Boal was interested in assessing the degree to which activities between the two groups were segregated, that is, the extent to which the two groups interacted. He was able to make use of data collected as part of a larger study of activity in Belfast.

Boal examined the two areas in terms of both site characteristics (for example, newspapers read, place name identification, and football team supported) and activity characteristics (for example, shopping habits, bus stop used, visiting patterns, and pre-marriage address) finding overwhelming differences between the Protestant and Roman Catholic sectors in all cases.

For instance, 94 per cent of the Roman Catholics referred to their district as Clonard, while none called it Shankhill. In the Protestant sector, 77 per cent called their area Shankhill, and none named it Clonard, even though Clonard and Shankhill are contiguous. Each group had a fairly clear mental image of its own area, and acted so as not to infringe upon the opposing group's territory. The disinclination to cross into alien space was evident in the respective groups' selection of bus routes to travel downtown, and in social and visiting patterns. Grocery shopping behaviour had developed such that 93 per cent of Protestants shopped on the Protestant side of the invisible divide, and 90 per cent of Catholics, on the Catholic side. Other activity interactions investigated by Boal exhibited similarly high degrees of segregation.

Boal implies that it is important to investigate the manner in

which groups interact before superimposing changes in urban structure upon existing activity systems. In this light activity study enables a better understanding of the relationship between process and product, and a fuller appreciation of the likely behavioural ramifications of various urban renewal and redevelopment schemes.

Following Boal's lead, Western (1973) looked at the activity patterns of three social groups in Houma, Louisiana, the blacks, the Cajuns, and the white Americans. In an attempt to test a simple model of acculturation, Western analyzed sets of social contact linkages. He was able to determine that both blacks and Cajuns had spatially restricted activity systems, focussed on the central city, and that the newcomers, the white Americans, tended to exhibit extensive patterns of social interaction dispersed throughout the suburban fringe of the city. The activity linkage analysis enabled Western to verify his hypothesis that the activity systems of the black and Cajun cultures have become subsets of the more extensive activity spaces of the white Americans.

Wheeler and Stutz (1971) studied patterns of interpersonal communication in the city in order to achieve a partial understanding of the spatial dimension of urban social travel. Specifically, the authors tested two hypotheses: first, that the frequency of social trips declines as travel distance increases; second, that individuals of a given socio-economic status are more likely to interact with other individuals of similar status than with those of lesser status, the frequency of interaction decreasing with increasingly dissimilar status. Using data relating to visiting patterns of friends and relatives, the authors generally confirmed the two hypotheses. They did find, however, that because the more-well off suburban dwellers tended to maintain

social contacts with other suburban dwellers, some relatively long trips across town to other fringe developments were in evidence.

Horton and Reynolds (1971) conceive activity and action space formation as a learning process, and have developed a descriptive model which puts important formative elements into relative perspective (Figure 3). An empirical analysis was undertaken to test the model, using two contrasting but internally homogenous socio-economic population samples. Using a familiarity scaling technique, the authors found that aggregate action spaces do exist and that they closely reflect the objective spatial structures of the two sample groups. Furthermore Horton and Reynolds found that within the aggregate action spaces there existed sub-populations with internally similar action spaces not directly attributable to their home locations. The authors concluded that although objective spatial structure is a critical input variable in action space generation, other dimensions, as expressed in the model, do have significant impact on action and activity space development.

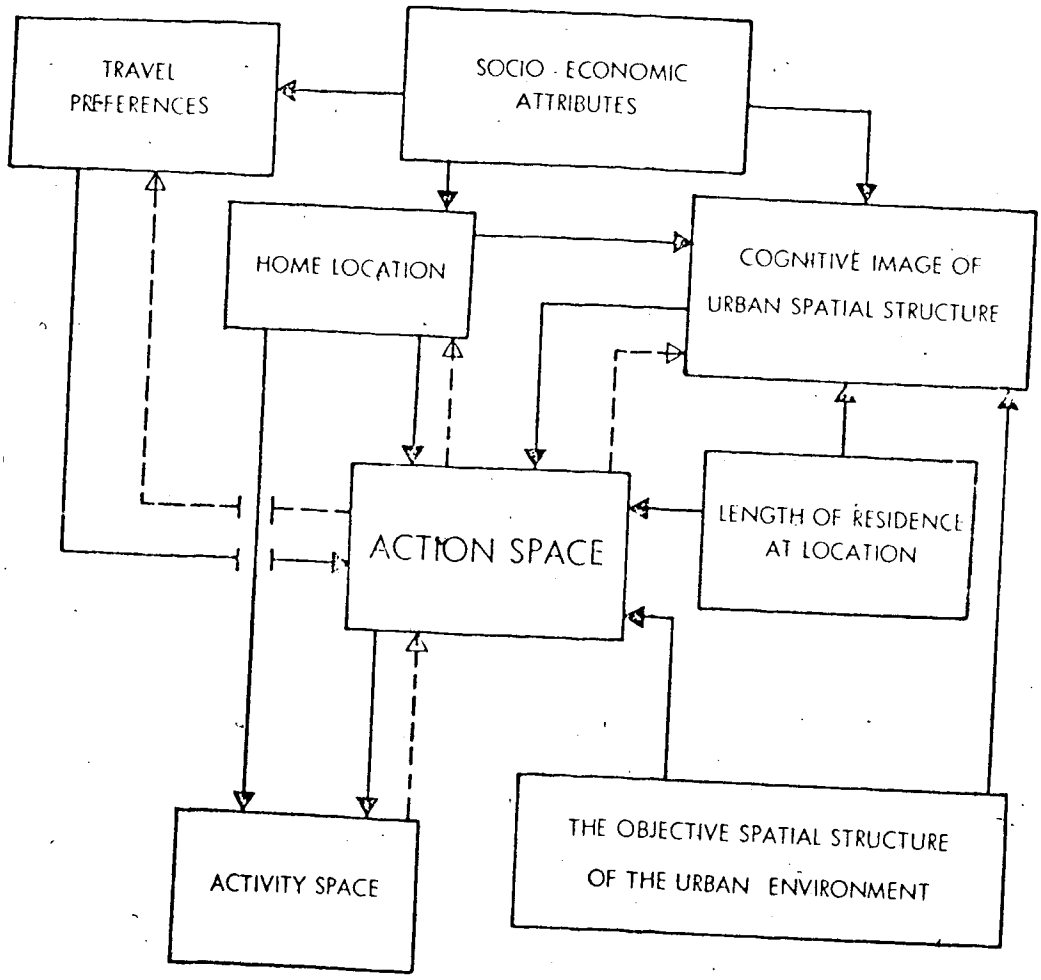
In addition to research concerned directly with activity study, a growing number of investigators now employ the activity systems framework as an organizer in diverse urban studies. The work reported by Buttimer (1972), Haynes (1969), Hemmens (1966), Steinitz (1968), and Tomlinson et al (1973) represents a cross section of such endeavours.

SUMMARY

Activity systems are studied so that a better understanding of the use of space and time in the city can be achieved. Patterns emerging from aggregations of individual activity systems study provide clues as to the complex relationship which exists between spatial behaviour and

FIGURE 3

A CONCEPTUAL MODEL FOR ACTION SPACE



AFTER HORTON AND REYNOLDS, 1971 P 41

city structure.

Human activity is the result of an iterative association of values, environmental influences, and cognitive interpretations which themselves give rise to decision and choice. Owing to the noneidetic composition of mental images, economically rational decisions are not usually possible; satisficer behaviour is characteristic. The cognitive dimension of spatial behaviour is difficult to operationalize.

Activity studies are concerned with both time allocation as an index of values, and space allocation as an index of revealed preferences. Linkages between activities are especially important in assessing the strength of the bonds between behaviour and structure.

Considerable time has been devoted to delineating the conceptual framework to be employed in the empirical analysis, and to placing activity investigations into context. It is most important to bear in mind that the notion of the activity system is primarily a conceptual aid. A conceptual framework may be likened to a set of eyeglasses. In themselves glasses contribute little to the solution of substance problems, yet when focussed on a particular object they remove fuzziness and help to organize nebulous forms into structured wholes. So it is with the concepts discussed in the previous sections--they do not comprise the rules of spatial behaviour, but they do provide a clarifying and organizing function which may facilitate the identification of such rules.

CHAPTER III

INFRASTRUCTURE AND RESEARCH DESIGN

INTRODUCTION

The two preceding chapters specify the conceptual framework used in the analysis and place the empirical investigation within the context of recent trends in geographical research. This chapter provides a brief description of the urban infrastructure in Edmonton. It is intended to place the major land uses and activity nodes into relative spatial perspective, and to identify the urban scale at which the analysis is undertaken. In addition, the research design itself is elaborated with respect to sample composition, data collection, and analytical foci.

INFRASTRUCTURE

Edmonton, the capital of Alberta, is a city of 438,425 persons located on the western Canadian prairies. It has undergone rapid growth since World War II, having increased in population by 158 per cent since 1951 (Table 2). The city has expanded to cover an area of 121 square miles.

As is the case in many prairie cities, the original street pattern was laid out as a rectangular grid. Both the central area of Edmonton and the older residential districts have grid road systems. The more recent outlying subdivisions, having been designed as

TABLE 2

POPULATION CHANGE: EDMONTON

Year	City Population	Metro Population
1901	4,176	-
1911	31,064	-
1921	59,860	-
1931	80,170	-
1941	96,306	-
1951	170,210	-
1961	314,824	330,129
1964	357,696	382,279
1971	438,425	495,915
1980	(570,000)	(643,000)
2000	(840,000)	(1,000,000)

Note: Brackets indicate projections

SOURCE: Derived from Bakker, 1968, p. 1 and Statistics Canada, 1971.

neighbourhood units, exhibit a more curvilinear street pattern. In addition to the grid and curvilinear layouts, a few major arteries cut obliquely across the grain of the city (Figure 4). The road pattern strongly influences both traffic and transit circulation.

The city is bisected by the North Saskatchewan River whose flood plain lies about 250 feel below the plain upon which the city is built. As a consequence, the flow of traffic between the north and south sides of the city is constricted and channelized at several points. In total, nine bridges of varying sizes and capacities link the north and south sides of Edmonton.

It is the relative spatial distribution of land use in the city which gives rise to patterns of movement; Guttenberg's (1960) community effort to overcome distance. The generalized distribution of land use in Edmonton is shown in Figure 5. Industry is prominent in the northwest and southeast portions of the city. A large oil refining and chemical complex is situated just east of the city limits in the contiguous county of Strathcona. Residential areas have expanded to encompass the Industrial Airport, several industrial corridors, and the University of Alberta farm. The city has attempted to maintain the valley of the North Saskatchewan River and the ravines of its tributaries as public land and open space. This parkland buffer serves to further divide the city.

There are three major nodes of activity in Edmonton; the Central Business District (CBD), the University of Alberta, and the Government Center. The three nodes are in relatively close spatial proximity and each is a major traffic generator and destinator (Figure 5). The CBD provides jobs for approximately 40,000 persons,

FIGURE 4

GENERALIZED STREET PATTERN IN EDMONTON

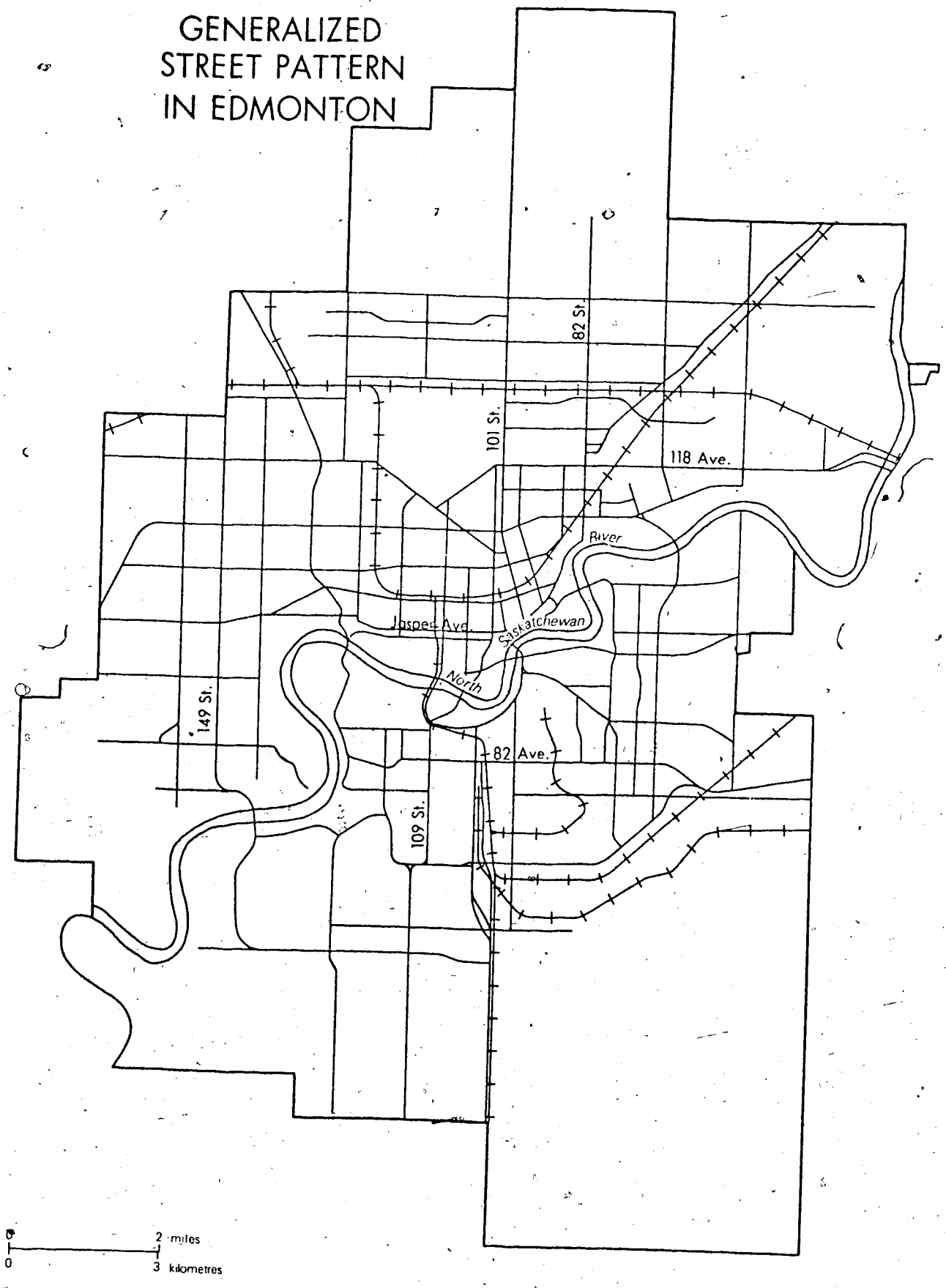
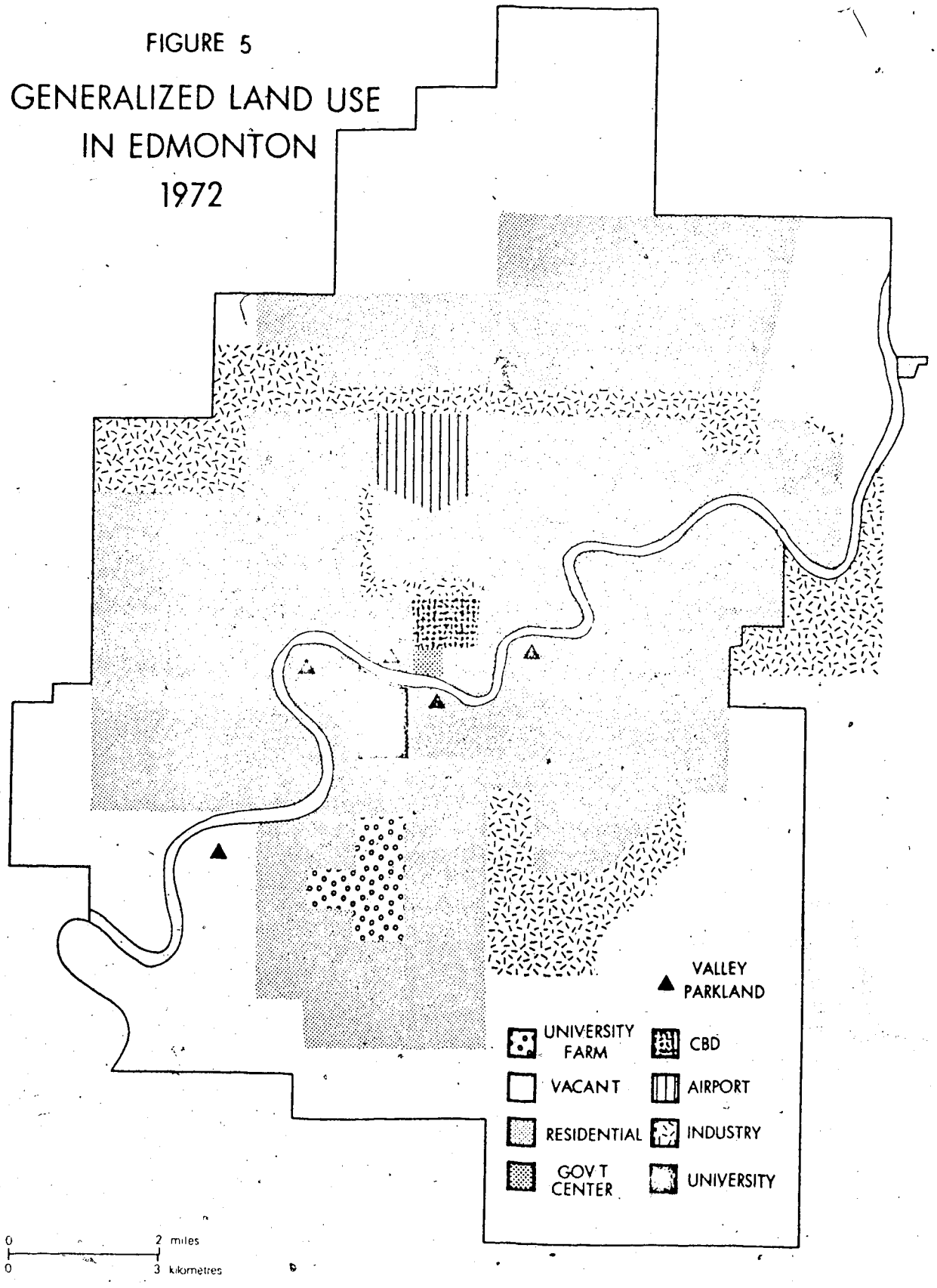


FIGURE 5

GENERALIZED LAND USE IN EDMONTON 1972



the University and its Health Science complex have a daytime population in excess of 25,000, and the provincial government employs another 7,000 (DeLeuw and Cather, 1971; City of Edmonton, 1971). The total number of transit passengers travelling to and from the University area is about 7,300 in each direction each day. This is half of all people arriving on campus in vehicular traffic daily (City of Edmonton, 1971). In view of the University's importance in Edmonton, it is one of the prime foci of this activity systems analysis.

Including the CBD, there are ten principal shopping nodes in the city (Figure 6). The characteristics of these centers are summarized in Appendix C.

THE EDMONTON TRANSIT SYSTEM

The ETS originated in 1908 as an electric street railway but suffered from excessive plant and capital burden as the city of Edmonton quickly expanded. During the Second World War the system operated profitably, carrying high passenger loads. The ETS converted from streetcars to trolley buses after the war and managed to operate at a profit until about 1960 (Bakker, 1971, p. 3). There has been a conversion from the electric trolley fleet such that, at the time of the strike, there were 87 electric trolleys in the 380 unit ETS rolling stock.[1]

Absolute ridership of the ETS has been increasing over the last ten years, and currently some 40,000,000 passengers are carried by the

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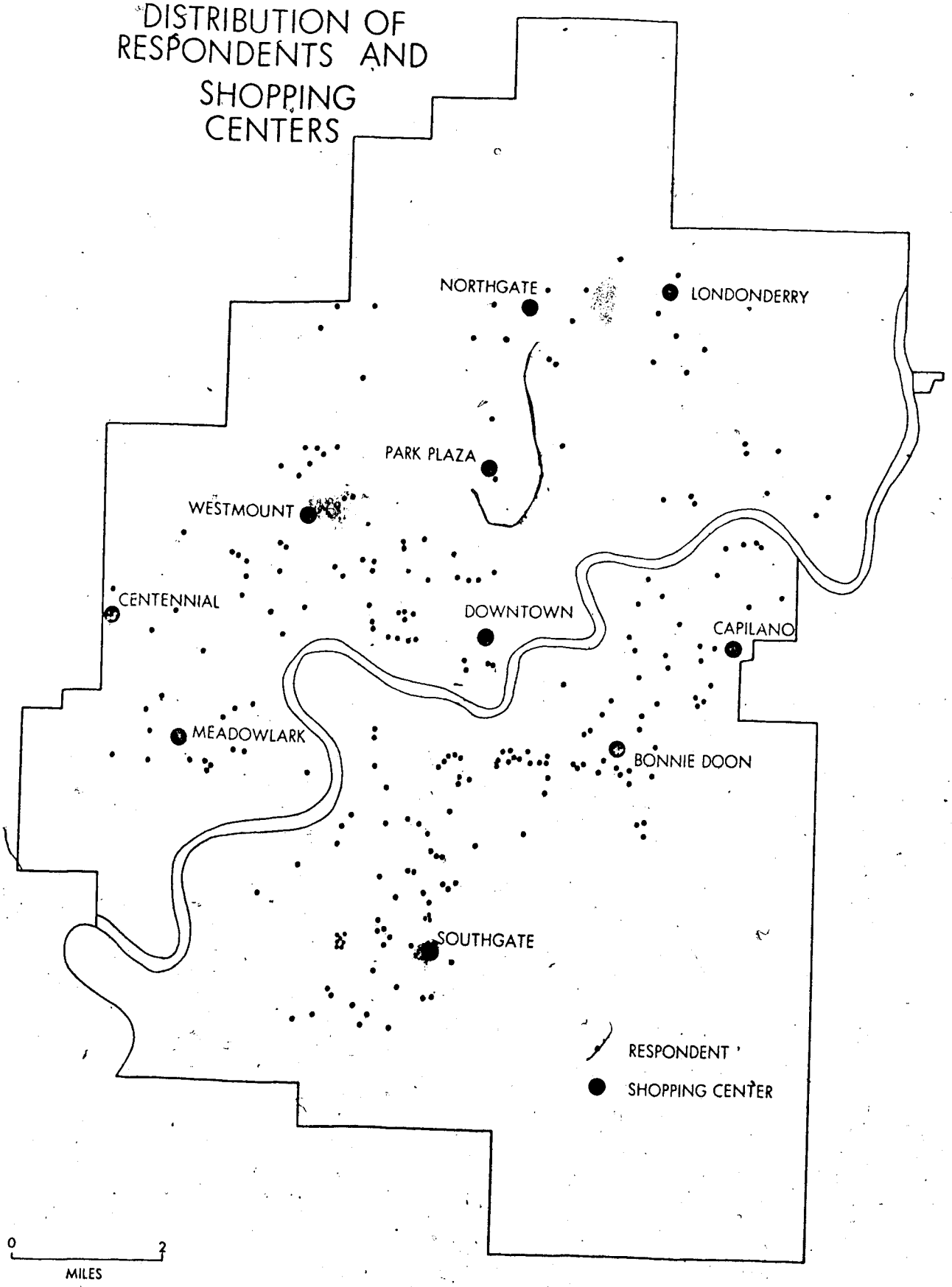
[1] Personal communication from M. Palmer, ETS Operations.

FIGURE 6

DISTRIBUTION OF RESPONDENTS AND SHOPPING CENTERS



system annually [illegible]tion, rides per capita have been steadily rising since 196[illegible]ation to transit systems in the rest of North America, [illegible] ETS [illegible]ying a rise in revenue passengers, while the mean reven[illegible]passe[illegible]r curve is falling in both the United States and Canada (Fig[illegible]e 7).

THE TRANSIT ROUTE NETWORK

The ro[illegible] network of the transit system is superimposed upon the city's stre[illegible]pattern. This is currently the only practical method of accommodating [illegible]ransit vehicles in Edmonton, although a private right-of-way Light Rail Transit plan is being developed (University Practicum, 1973).

Because pr[illegible]e autos and transit vehicles share the same road network, transit [illegible]tems are forced to compete with cars along all routes in attracting patrons. The result of this competition and the well documented trend toward higher auto ownership rates in North America is often a very low mode split[4] between transit and automobiles; that is, a much greater proportion of urban travellers choose to travel by car than by bus.

In 1961 it was realized that mode split in the outlying parts of Edmonton was very low. The route system then consisted of mainline

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[2]Unpublished data provided by D. DeRyk, ETS Operations.

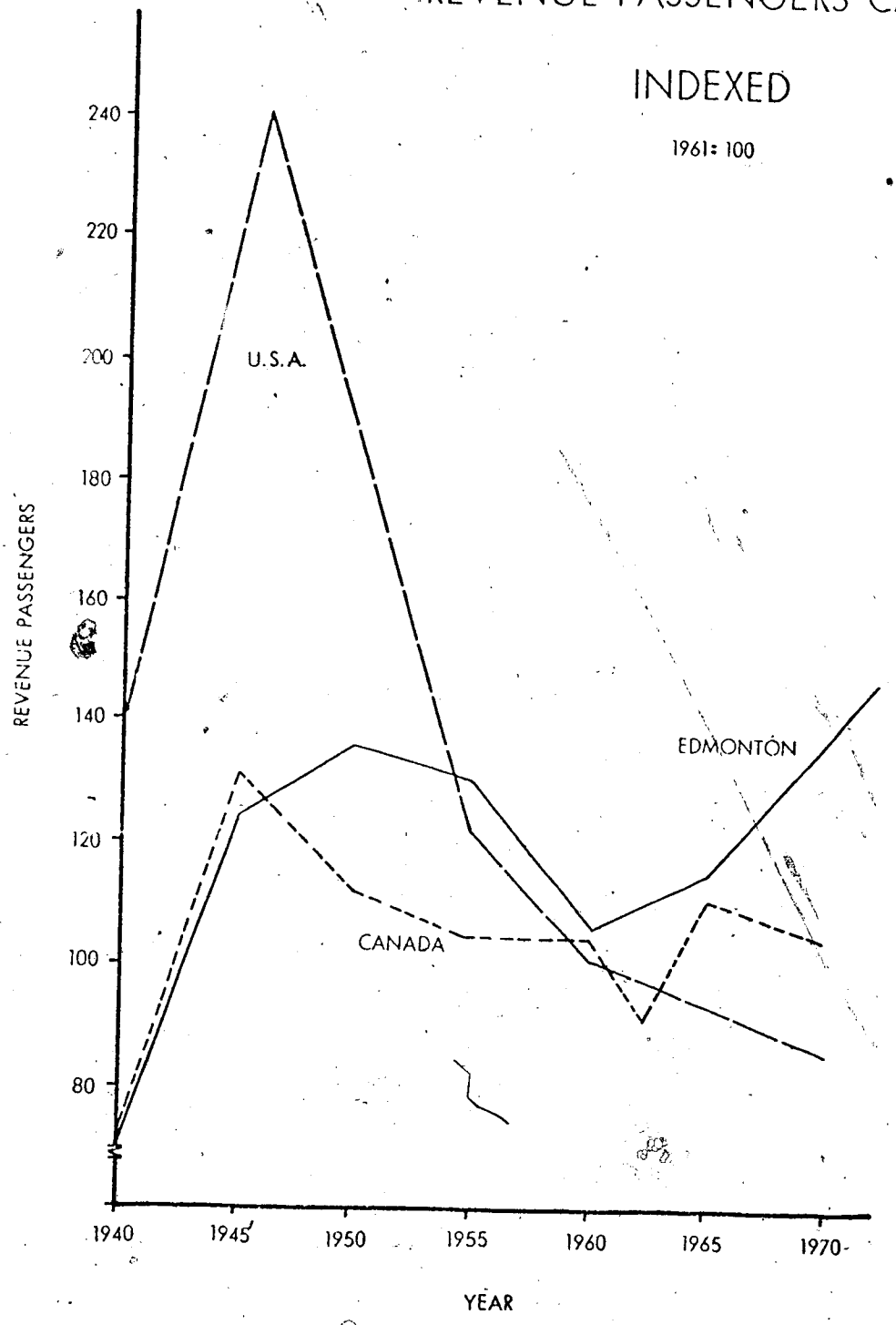
[3]Lecture material, Civil Engineering 619, University of Alberta, winter session, 1974.

[4]Mode split refers to the percentage of individuals travelling by a given mode (means of transport) for a given trip at a given time. Often a simple auto-transit dichotomy is employed, although additional modes may be considered.

FIGURE 7

REVENUE PASSENGERS CARRIED, INDEXED

1961: 100



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trolley routes with some additional feeder service (Bakker and Clement, 1974). Between 1961 and 1967 the ETS changed its route network in an attempt to demonstrate that by improving the level of transit service, gains in patronage could be effected. The new route system was primarily a radial one with transverse links, offering faster and more direct connections between the suburbs and CBD. Figure 8 shows the percentage of work trips made to the downtown core by transit for 1971; mode split exceeds 51 per cent in several of the traffic zones, indicating a high level of transit service. The increased level of service provided by the network restructuring led to an appreciable improvement in mode split. Overall, mode split for work trips to the CBD increased from 28 per cent in 1961 to 38 per cent in 1967 (Bakker, 1969, p. 1) and it has been steadily rising since then (Bakker and Clement, 1974).

Edmonton's population has increased another 13 per cent since 1967 (Statistics Canada, 1971) and the transit network has grown accordingly (Figure 9). Basic daytime service now consists of:

> . . .a bus every 30 minutes with 15 minute service in the peak hours . . . . Late night and Sunday service is reduced to 60 minutes in the outlying areas. Trolley routes and some main line routes have a daytime service of 10 to 15 minutes with a 5 to 10 minute service in the peak hours. Late night and Sunday service is 15 minutes. Because of the radial route system some routes overlap as they get close to the city center providing a more frequent service (Bakker and Clement, 1974, p. 10).

This service frequency coupled with the high degree of route coverage renders the ETS an effective alternate travel mode.

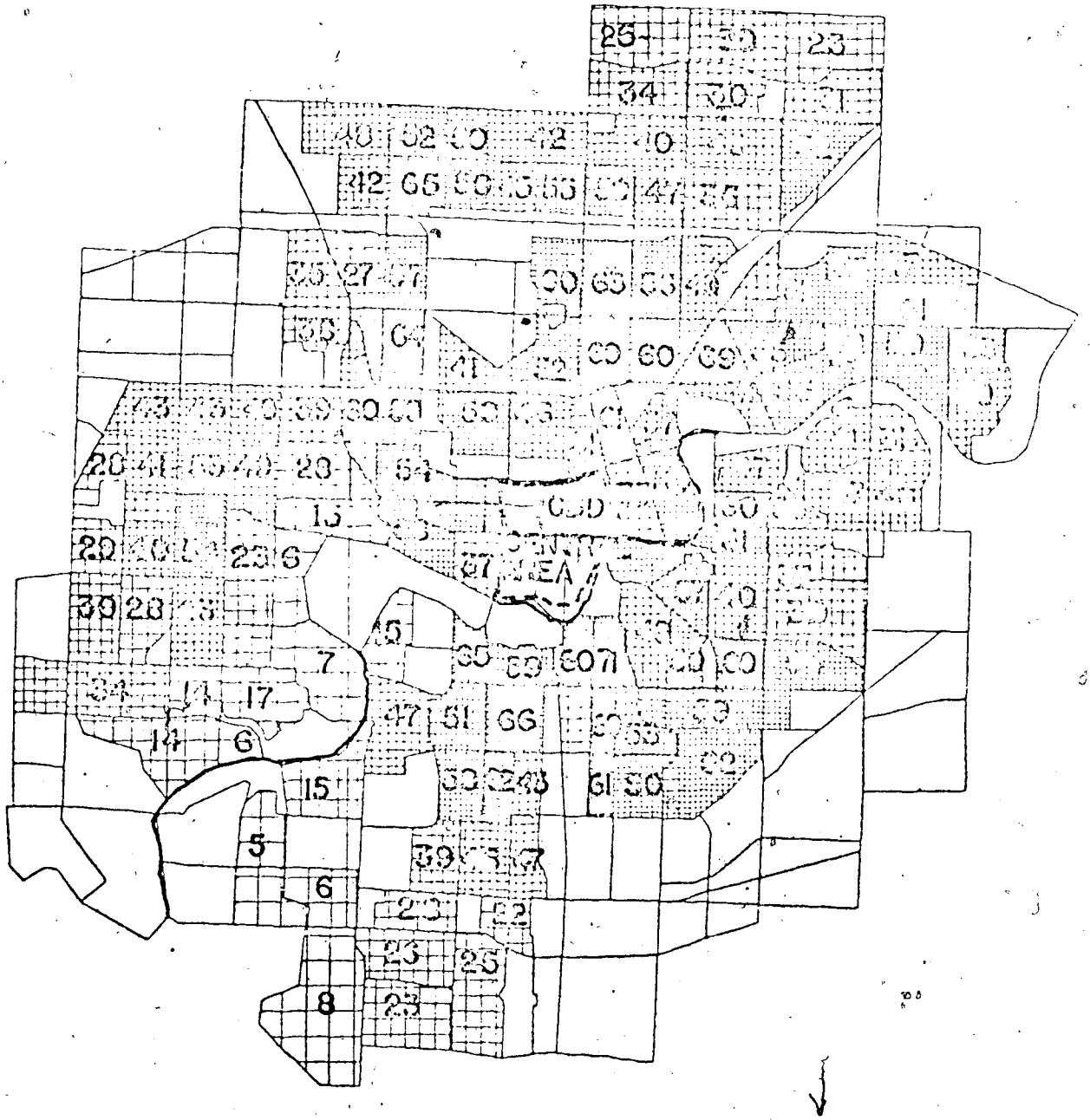
THE RESEARCH DESIGN

Sample Composition

In order to test the hypotheses framed in Chapter I--that

FIGURE 8

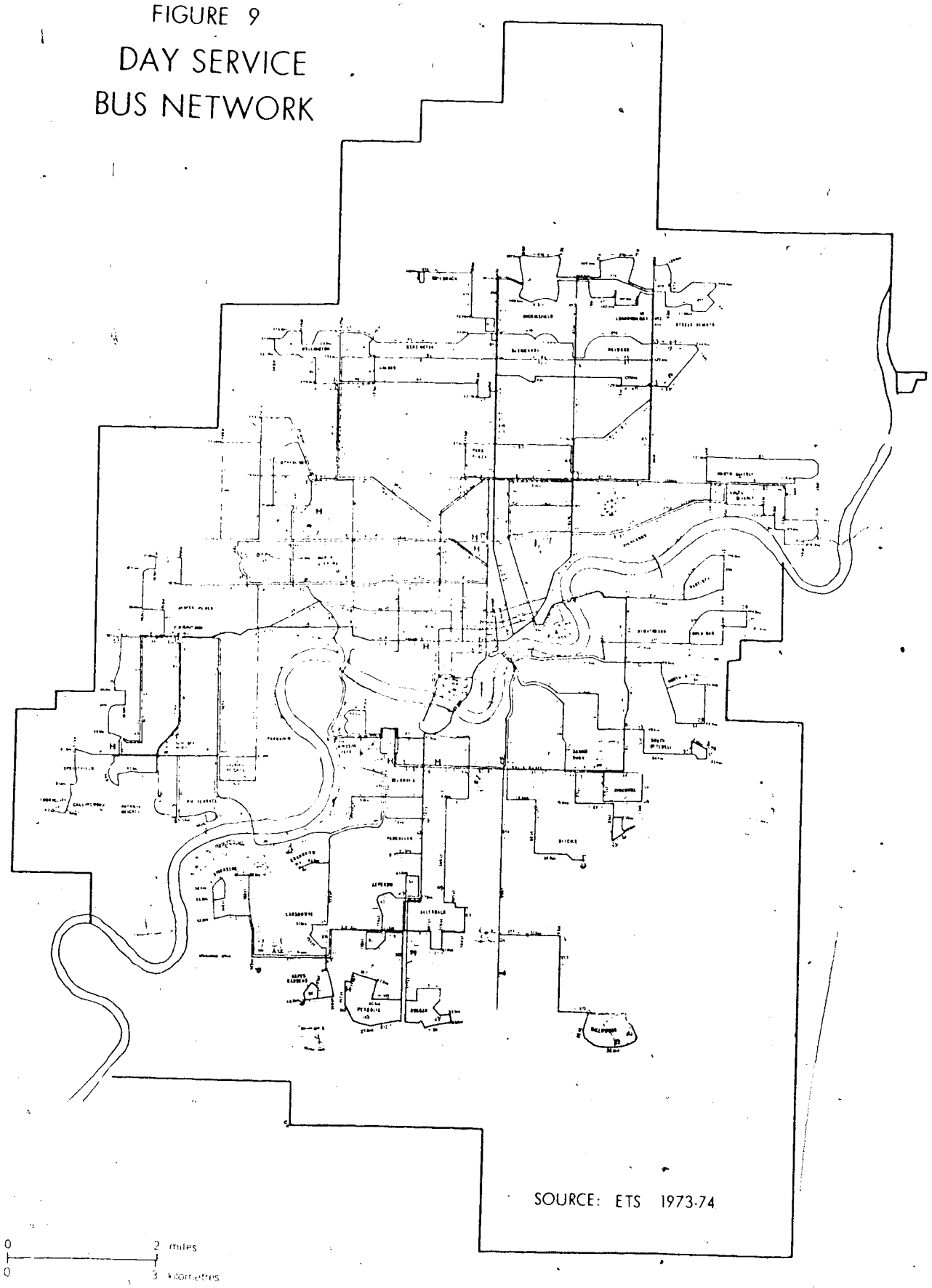
MODE SPLIT 1971



Derived from Bakker & Clement, 1974, p. 24.

FIGURE 9

DAY SERVICE BUS NETWORK



SOURCE: ETS 1973-74

0 2 miles
0 3 kilometres

activity systems are subject to change induced by exogenous factors, and that activity systems tend to readjust themselves to reduce the effects of disequilibrium--it was necessary to evaluate the impact of the bus strike on a sample of Edmonton residents.

A primary research sample was chosen from a population of regular bus users for two major reasons. First, the expressed aim of the research is to study the strike's impact on urban activity systems, and it was felt that a sample of regular bus users would represent the most directly affected population, and provide a focal point against which to apply the conceptual framework. Second, using a sample with a common travel characteristic tends to reduce the number of extraneous variables in an already complex behavioural problem by keeping as much of the system as possible constant.

As a second stratification, the sample is composed of University of Alberta students only. The distinct advantage here is that the major tidal journey[5] element of the system is common to all sample units and thus various trip parameters of the sample units may be directly compared. In addition, inferences may be made regarding the perception of distances, and to the apparent significance of various distances in the spatial behaviour of individuals with proximate home locations.

Student tidal trips do exhibit the same peaking phenomenon as do "ordinary" work trips[6] and in many respects, students' spatial activity patterns are analogous to those of the population at large (see Tomlinson et al, 1973). However, there are some disadvantages to the sample

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[5]A tidal journey is a major ebb and flow of urban traffic, for example, the journey to and from the University.

[6]The peak period is actually from two to three hours in length. See City of Edmonton, 1971, p. 4.

composition. A cross section of population is not presented in terms of potentially significant predictor variables, for example age, and socio-economic status. Also, in the case of the transit strike many bus users other than students were affected but are not specifically accounted for. And, of course, no direct account is taken of any activity changes induced in the population in general.

A word of caution is in order; it is important to recognize that there are no foolproof techniques of activity analysis, or methods of surveying and identifying activity systems (Chapin, 1965). If the concepts discussed in Chapter II were well tested and fully operational ones, then certainly a very general analysis would be warranted. In the study of the shock event described here a general analysis is neither feasible nor practical; many of the survey questions and analytical representations are experimental and in many ways this strike impact analysis is a pilot investigation.

Sample Selection

In addition to its regular exact fare system, the ETS sells one month passes to the general population and special three month student passes.[7] Approximately 3,500 students at the University of Alberta hold student passes, and the passes are available only at the University of Alberta.[8]

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[7] An exact fare system has been operating in Edmonton since August 1972 charging 25 cents per ride. Monthly passes for the general public cost $10 and student term passes cost $30. Concession fares are also available to the elderly, the blind, and welfare recipients.

[8] In 1973 the student passes were available from September 4 - 14th at the Student Union building, University of Alberta.

Each student pass buyer registers his name and address with the ETS as he purchases his pass. The registration list, which is not filed in any systematic fashion (for example, alphabetically) is thus assumed to represent a statistically independent list of the students' names and addresses. The random order of the pass sales register enabled a systematic sample to be extracted from the population. Systematic sampling further reduced the chances of sampling student friends with spatially proximate home locations. Beginning with an arbitrarily selected name, 372 pass registrations were sampled--approximately every tenth entry--and the name and address information recorded.

The grid and street numbering system employed in Edmonton enabled the addresses of respondents to be quite accurately plotted (Figure 6). Note that when land uses are taken into account, the spatial coverage afforded by the sample is excellent. There is some linear clustering in the area of 82 Avenue just east of the campus where lower cost walk-up accommodation is available, and a cluster at the Michener Park student housing complex west of Southgate shopping center (Figure 6). Because of the nature of the sample, these minor concentrations are not surprising. Overall, there are 101 units north of the river (43 per cent) and 134 units on the University side of the river (57 per cent).

The Questionnaires

Data were collected using two questionnaires. The first one was distributed by post during the second week of the strike (the second week of December, 1973). This survey was quite detailed and gathered information relating to the space-time budgets of the students, for

both the pre strike and strike system states. Of the 372 questionnaires mailed, 235 usable replies were received, a 63 per cent rate of response. This survey appears in Appendix A.

Part of the purpose of the research is to investigate the notion that travel propensity is not constant throughout the week, to try to measure the size and shape of activity spaces both before and during the strike, and to test for any long lasting strike effects. A second survey was designed to fulfill these purposes, and is presented in Appendix B. This survey was mailed to all those sample units who replied to the first questionnaire and to a randomly selected sample of the population at large. Of the 345 surveys mailed in February, 1974 a disappointing 70 were returned, a 20 per cent rate of reply.

The Activity Classification

Both surveys were designed to monitor the space-time budgets in relation to spatially expressed activities. The activity code employed in the two questionnaires is a simplified version of the one developed by Chapin and Brail, (1969) and is presented in Table 3. Because this research is concerned primarily with between-node activities, home is used as a surrogate for the first seven elements in the Chapin and Brail tabulation. Most of the seven activities so replaced have no dynamic spatial expression, and are thus of little direct concern here. All out-of-home activities in the Chapin and Brail system are replaced by the social/recreational classification, and work and school activities replace the work related and out-of-home discretionary codes. The shopping activity system is broken down by order of good into a simple dichotomy: grocery shopping (lower order) and general shopping (higher

TABLE 3

ACTIVITY CLASSIFICATIONS

Chapin and Brail (1969)	This Research
Relaxation Arts, hobbies, sports Reading Television and radio In-home family In-home socializing In-home obligatory	Home
Out-of-home discretionary Out-of-home family Out-of-socializing	Social/Recreational
Work Out-of-home obligatory	Work/School
Shopping and personal services	Shopping (grocery and general)

order). This simple differentiation was made because distinctions between orders of shopping trips have been shown to produce spatially different behaviours (Berry, 1967).

SUMMARY

The research problem has now been defined in both conceptual and empirical terms, and the stage is set for the activity systems analysis.

CHAPTER IV

SURVEY RESULTS AND ANALYSIS

INTRODUCTION

Before discussing the results of the empirical analysis, a restatement of the research hypotheses is in order. The hypotheses, as discussed in Chapter I, are:

1. Activity systems, which are temporally and spatially definable, are subject to changes induced by exogeneous influences.
2. Activity systems tend to a state of balance over time and will readjust themselves so as to reduce the impact of disequilibrium in the spatial system.

These hypotheses are broad and embrasive, and are certainly not mutually exclusive. They are effective surrogates for the research questions posed in the first chapter. In attempting to test the hypotheses, several space-time budget parameters are investigated. First, though, the steady state of the spatial system must be defined.

THE SPATIAL SYSTEM IN EQUILIBRIUM

One of the underlying assumptions of this work is that prior to the bus strike, the Edmonton urban system was in a state of relative balance. Later discussion will be in the context of changes in this state, and hence it is necessary to first characterize the equilibrium phase of the system.

A crucial element in the spatial system is the set of linkages which serve to meld households, travel, and activities into activity systems. These linkages, or connections, may be more explicitly defined.

Two major types of activity linkages are of interest; they will be termed reflective and reflexive linkages, respectively. Reflective linkages are characterized by trips from a node A to a node B and directly back again. In contrast, reflexive linkages are characterized by trips from a node A, through any number of intermediate nodes, and back to A again. Reflective connections embrace single purpose urban trips, while reflexive links are embodied by multipurpose trips.[1] For example, the sequence of trips defined by a particular respondent for a given day might be: (1) home to school, (2) school to home, (3) home to grocery store, (4) grocery store to home. This represents a four trip sequence embodying two reflective linkages. On the other hand, the sequence: (1) home to school, (2) school to restaurant, (3) restaurant to cinema, (4) cinema to home, is a four trip sequence composed of four reflexive links. Home is assumed to be the origin and ultimate destination for all trip sequences. There is considerable evidence supporting this assumption (see Hemmens, 1966).

TRIP SEQUENCE TREES

The "yesterday surveys" carried out as part of the second questionnaire were designed to monitor the configuration and sequence of

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[1] Single purpose trips are those directed at one activity node, for example grocery shopping. Multipurpose trips are those directed at more than one activity node, for example shopping and visiting.

activity linkages in the equilibrium state of the system. The questionnaires were posted across all days of the week to ensure a proper representation of weekdays. Simple graph theoretic techniques were applied to the activity sequence data collected in the survey (see Kansky, 1963). The results were analyzed graphically by means of trip "sequence trees" (Figures 10 and 11). These sequence trees are abstract representations of the temporal and topological relationships between activity nodes and activity linkages.

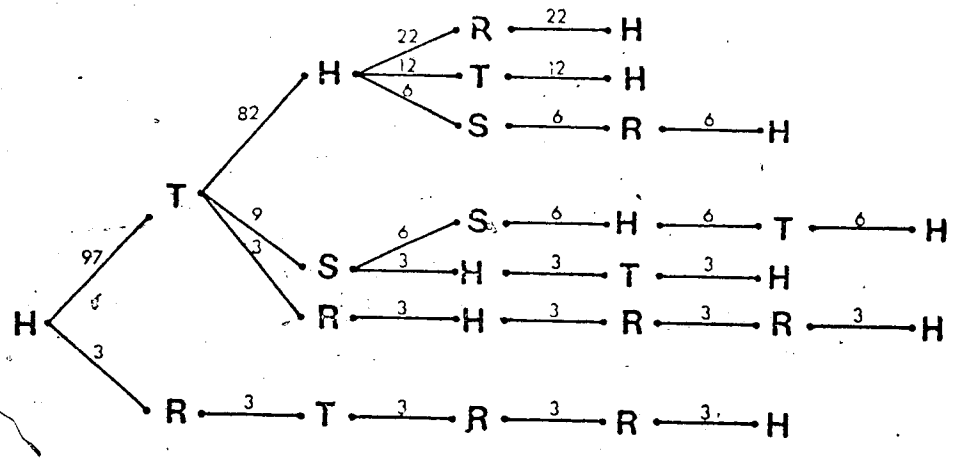
The trees are differentiated by day of the week with Figure 10 representing a composite of early week sequences (Monday, Tuesday, Wednesday), and Figure 11 representing the late week sequence composite (Thursday, Friday and Saturday). Saturday was grouped with Friday and Thursday because little difference was found to exist between these with respect to trip sequence lengths, travelling times and staying times, probably owing to the student sample. Sunday was found to be distinctly different from the other two day-groupings. The differentiation between early and late week was made to determine whether the homogeneity assumption so often applied to the typical weekday is valid.[2] It is concluded that there are significant differences between early and late week trip configurations which strongly affect patterns of activity. This conclusion is supported in the paragraphs below.

Consider the early week sequence tree (Figure 10). The large letters refer to the activity code and represent activity locations. In these trees, the tidal journey destinations (the University or work) are

[2] In many activity studies, any one day of the week is assumed to be like any other. Brail (1969, p. 171) notes that the typical weekday assumption is a dubious one, particularly when one is examining time expenditures for out-of-home activities.

FIGURE 10

SEQUENCE TREE, EARLY WEEK



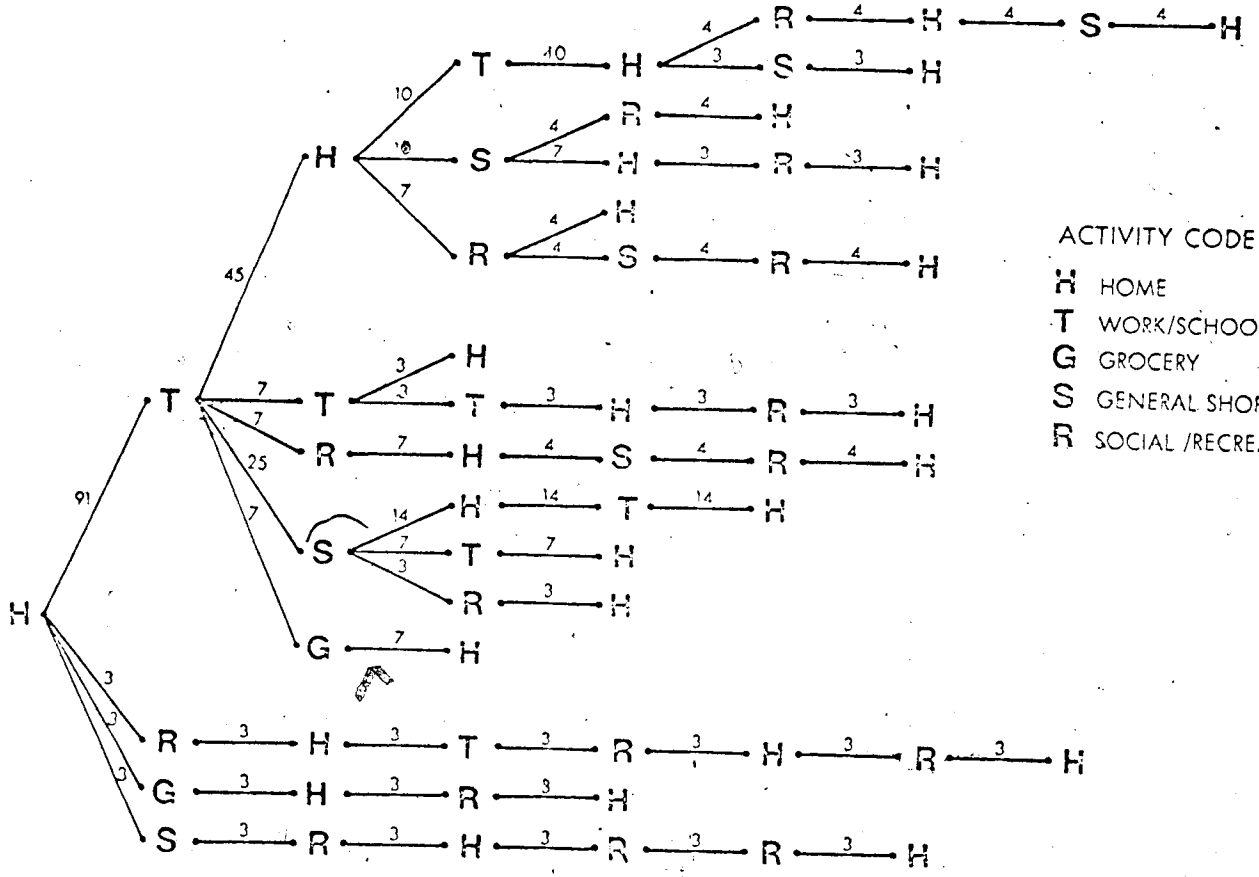
ACTIVITY CODE

H HOME
T WORK / SCHOOL
G GROCERY
S GENERAL SHOPPING
R SOCIAL /RECREATIONAL

STAGE COEFFICIENTS	100	97	55	55	21	9

FIGURE 11

SEQUENCE TREE, LATE WEEK



STAGE COEFFICIENTS 100 100 80 69 45 27 7 4

both defined by the same code letter. The straight lines joining the activity nodes are abstractions of the actual trips between the nodes. The numbers along the lines refer to the proportion of total respondents making that particular trip. For example, in Figure 10, 97 per cent of respondents make the tidal journey from home to school or work, 82 per cent of them return directly home, and only 40 per cent continue to make other trips from the home to other activities, presumably in the evening.

Summing down over all links in each stage, or time element in the tree, results in a series of stage coefficients (Figure 10). These coefficients indicate the rate at which individuals are dropping out of the trip making system. The coefficients may be plotted against the corresponding stage in the tree resulting in a simple degeneration function (Figure 12). A sharp drop in the stage coefficients, and thus in the slope of the degeneration function, indicates that individuals are making relatively few long trips, and are dropping out of the trip making system after fewer stages.

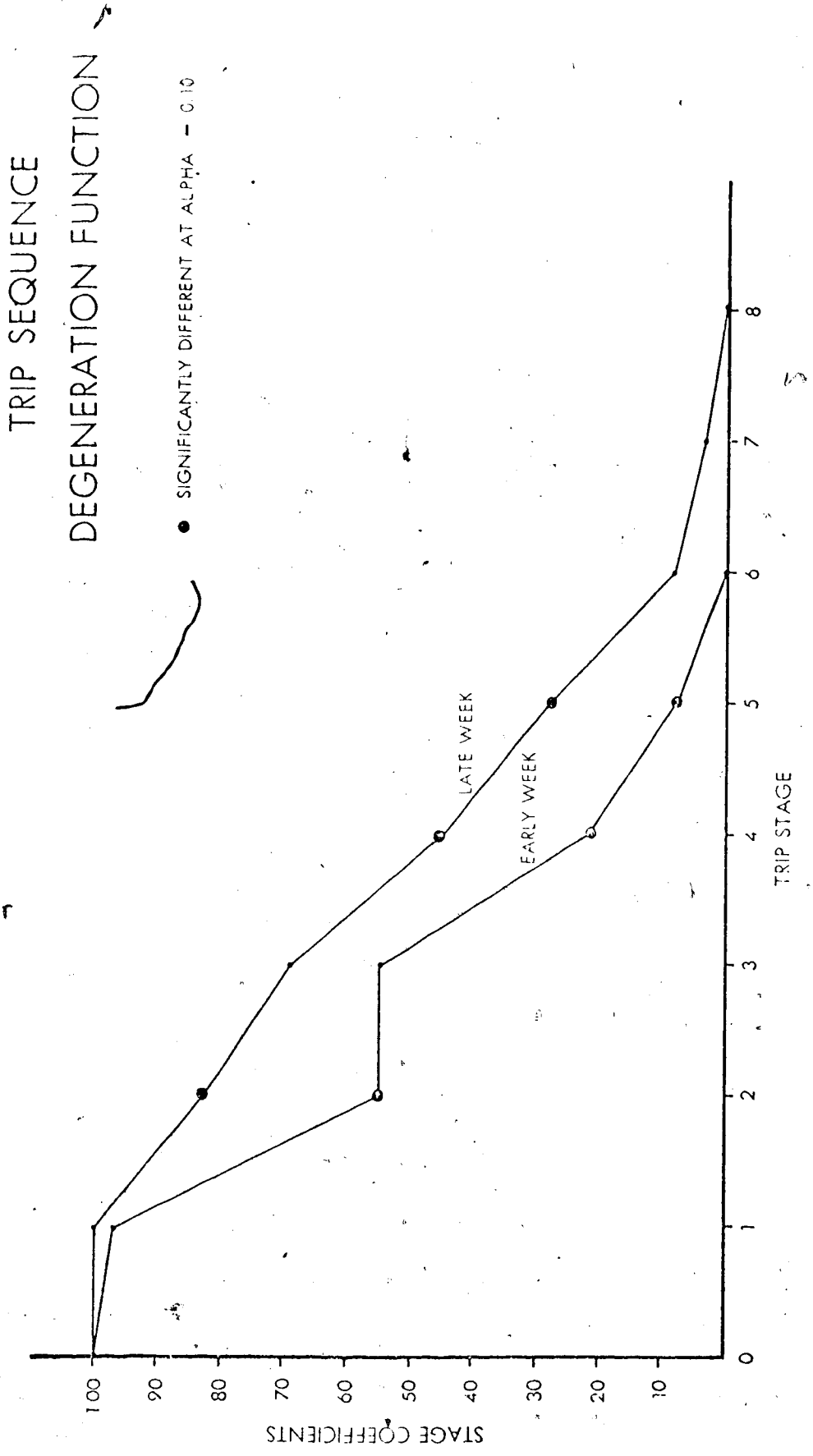
The diameter of the early week sequence tree is 6; that is, the longest direct path through the tree is six links in length. The smaller the diameter of the tree the more curtailed or restrained is the activity system involved.

The sequence tree representing the later part of the week exhibits a strikingly more ramified structure (Figure 11). More links are present, increasing the diameter of the tree to 8, and the stage coefficients decline much more slowly. Accordingly, the degeneration curve for the tree is much less steep indicating that in the late week, more respondents make more longer trips (Figure 12). Statistically

FIGURE 12

TRIP SEQUENCE

DEGENERATION FUNCTION



significant differences exist between the corresponding stage coefficients in the two trees (z test, $\alpha = 0.10$; Figure 12).

It is felt that the more developed sequence tree in the late week is due to a temporal rhythm imposed on human activity by the social and economic structures of modern society. The rhythm of the work week, with its morning and evening tidal traffic flows and with its tendency to support a more intense socialization toward week's end, are manifestations of this temporal flux.

In Edmonton, retail outlets are generally open until nine o'clock in the evening on Thursdays and Fridays, inducing more shopping trips. This, coupled with the ending of the work week and a concomitant increase in socialization opportunities, accounts for much of the difference between the early and late week trip sequence trees.

Table 4 relates the development of the two trees to their topological components. The index π is defined as:

$$\pi = C/d \quad \text{(Kansky, 1963, p. 20)}$$

where C is total trip distance and d is the tree's diameter. Because

TABLE 4

SEQUENCE TREE DEVELOPMENT INDICES

	Edges	Diameter	π
Early Week	28	6	4.7
Late Week	60	8	7.5

all trips are of unit length in the trees, C is equal to the number of links in the tree. The higher index of π in the late week indicates a more highly developed trip structure.

The time aspect is an important one in the characterization of the steady.state of the system. Figure 13 relates the time spent at each activity at each stage for the early and late week sequences, in terms of cumulative hours. In the late week staying times tend to be shorter, especially at the second stage (home) as more time is devoted to a wider variety of activity pursuits. Conversely, the early week staying times tend to be longer and drop off earlier because the sequence tree is more abbreviated. Fewer, but longer trips and associated stays are the rule here. Average travel times tend to drop off rapidly with increasing stage, the significant decreases occurring after the return tidal journey is completed, that is, in the third stage (Figure 14).

This cursory look at the normal state of activity in Edmonton sets the stage for the space-time budget analysis which follows. It is felt that the sequence tree conceptualization of urban spatial activity is a useful one in that it serves to clarify, organize, and impute meaning to the changes in activity systems induced by the ETS bus strike.

MODE CHANGES

The model of spatial choice discussed in Chapter II recognizes that the influence of external information sources on behaviour can be great. In the case of the ETS strike, there were two days advance warning given by the media that a strike might occur. Over half of the respondents (53.2 per cent) indicated that before the strike actually began, they had made alternate travel arrangements to be used in the event that the strike occurred. This is important; it indicates that just before the transit stoppage the previous state of spatial equilibrium was destroyed, and the alternate searching process begun.

FIGURE 13

ACCUMULATED STAYING TIME VS TRIP STAGE

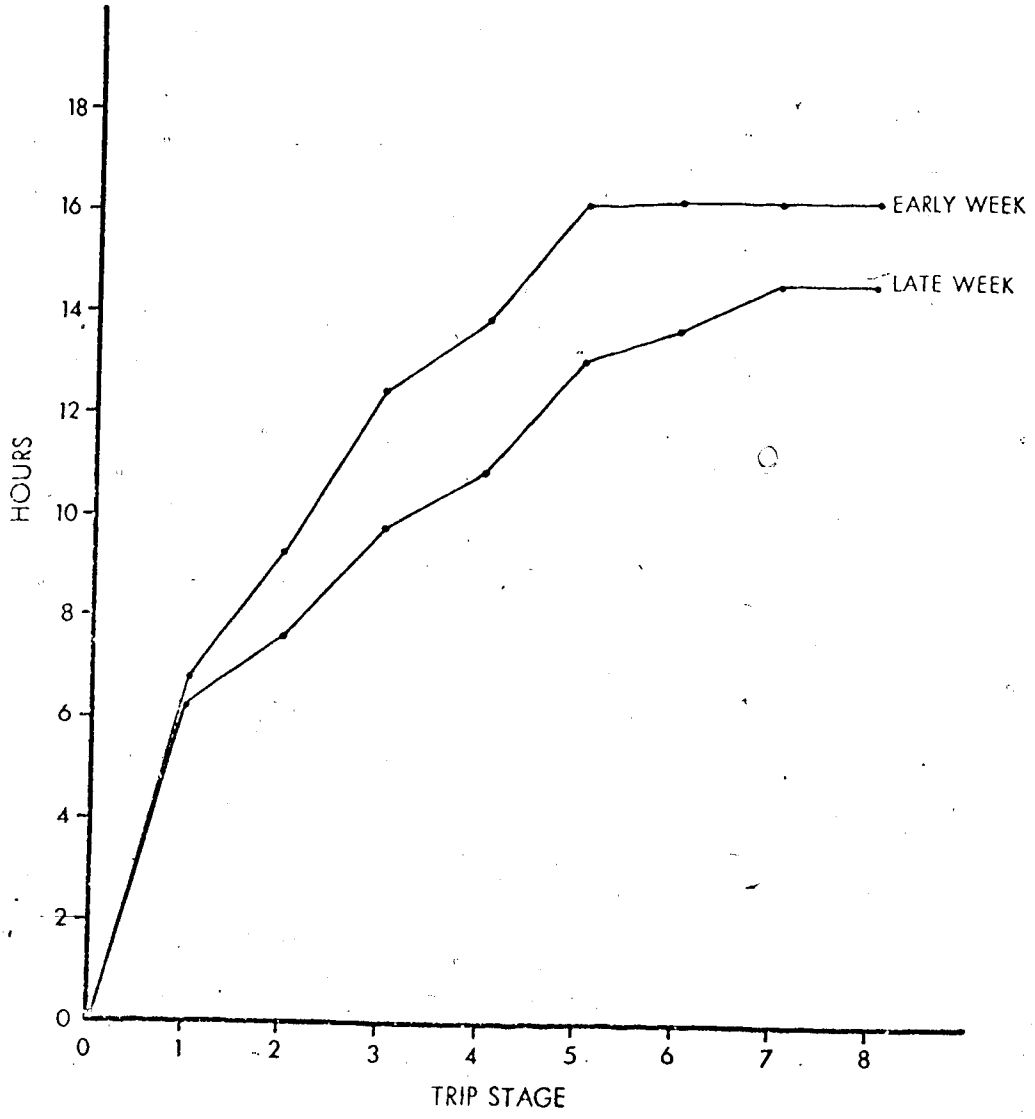


FIGURE 14

AVERAGE TRAVEL TIME VS TRIP STAGE

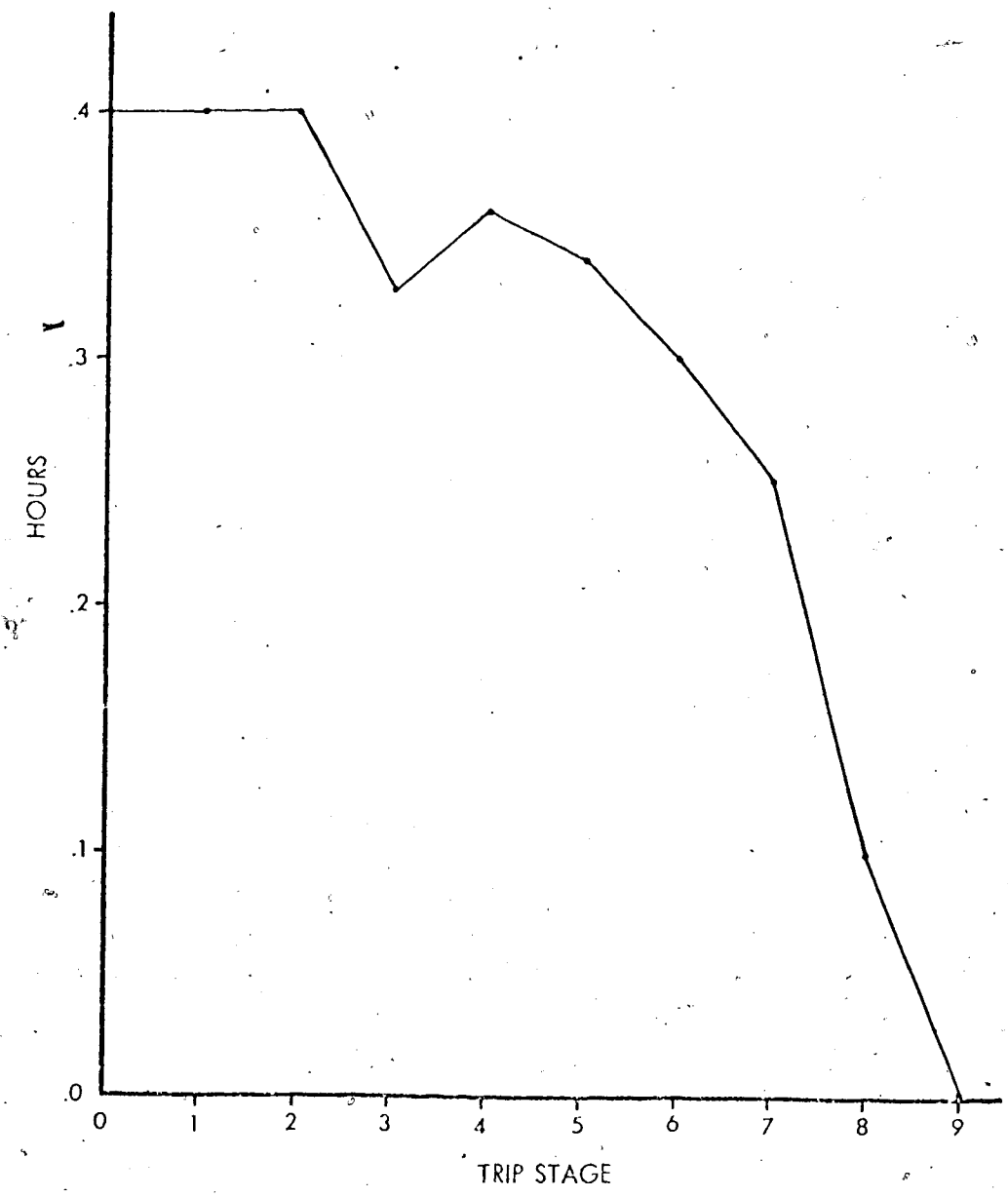


Table 5 summarizes the pre-strike state of bus use and auto access. As would be expected with a sample of bus pass holders, 97.4 per cent used the ETS for school trips. A significant finding, though, is that 46.8 per cent of respondents used the buses for shopping trips. This relatively high proportion would seem to add support to the ETS plan to redesign the transit route network so that several major activity nodes, including most of the major shopping centers, become network foci (see Bakker and Clement, 1974).

Somewhat surprisingly, 57.4 per cent of respondents had access to an automobile. This renders the high patronage rate of the ETS more interesting (Table 5B). Obviously, external diseconomies associated with private travel to and from the university, coupled with the parking problems at the campus, renders transit as the more attractive travel alternative. Close inspection of Table 5C reveals that of the 57.4 per cent of respondents with access to cars, only 38.3 per cent had such access for daytime university trips. Still, the rate of patronage of the bus system by those with autos is high.

Table 6 breaks down the pre-strike mode split for trips to and from the campus. As might be expected, bus trips totally dominate, and the usage of the car driver and the car passenger modes is very low.

On November 29, 1973 the transit strike began, throwing the city into a state of imbalance. Graphical representation of the strike state mode split for the first seven campus trips is revealing. Figure 15 shows the change in mean usage of mode for these trips. The bus users are distributed among car driver, car passenger, and hitch hiker modes, with car passenger mode being the apparent favourite. The tendency to prefer car pool arrangements would again seem to reflect an inclination

TABLE 5

PRE-STRIKE BUS USE AND AUTO ACCESS

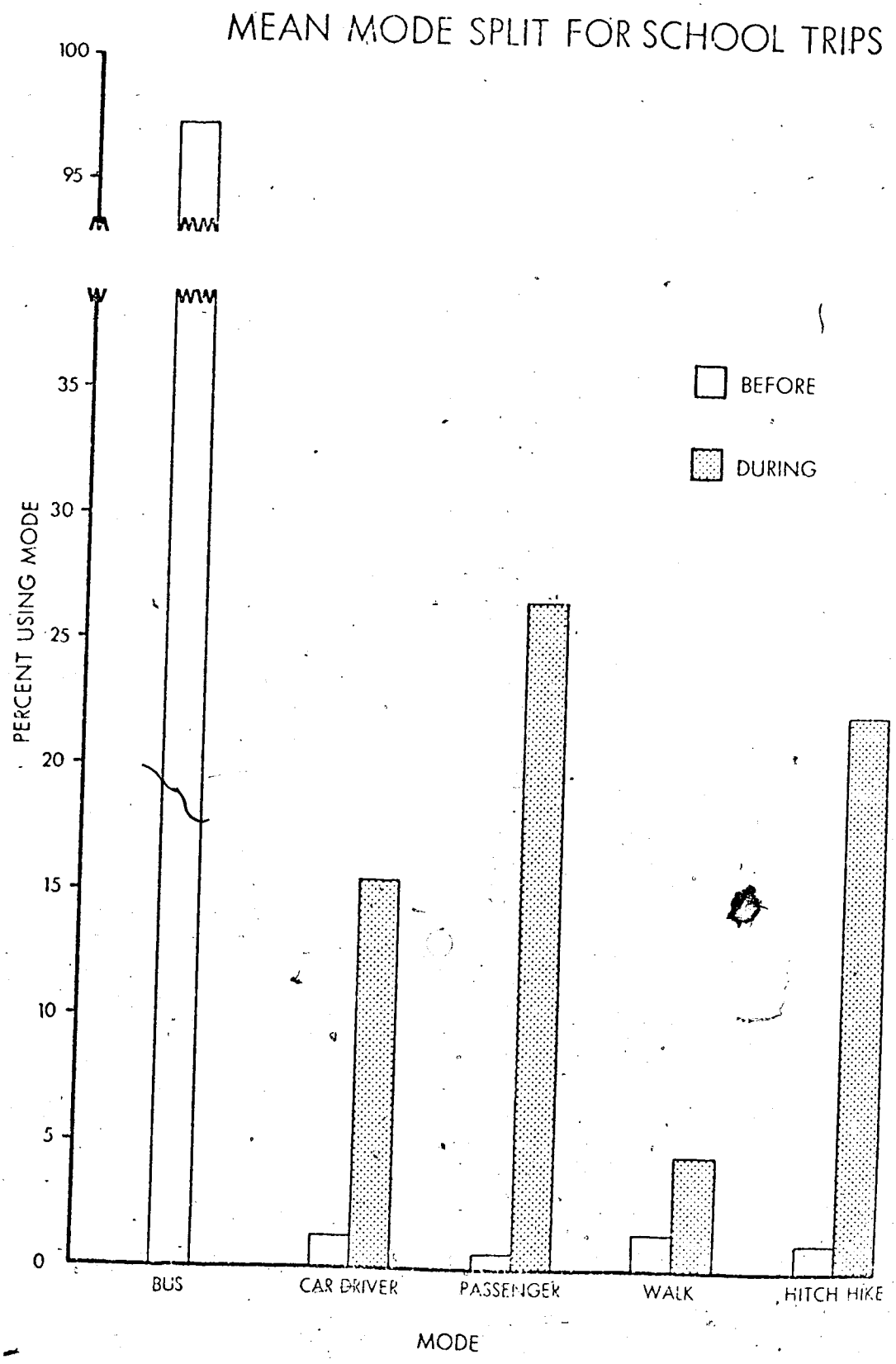
A % Using Bus by Trip Type		B % With Access to Car by Source		C % With Access to Car by Time	
School	97.4	Parents	28.5	Anytime	34.5
Shopping	46.8	Own	23.8	Day Only	3.8
Soc./Rec.	31.1	Friends	6.0	Evening Only	17.0
Miscellaneous	14.6	Bros./Sis.	3.8	Weekend Only	11.5
		Access	57.4		
		No Access	42.6		

TABLE 6

PRE-STRIKE MODE SPLIT TO AND FROM UNIVERSITY (IN %)

Mode	To	From	Both Ways
Bus	-	6.0	91.1
Car Pass.	-	-	0.4
Car Driver	6.8	1.3	0.9
Walk	1.3	0.4	2.1
Hitch Hike	-	1.3	1.3
None of These	-	-	-

FIGURE 15


MEAN MODE SPLIT FOR SCHOOL TRIPS
100
95
35
30
25
20
15
10
5
0
PERCENT USING MODE
BEFORE
DURING
BUS
CAR DRIVER
PASSENGER
WALK
HITCH HIKE
MODE

on the part of travellers to avoid parking inconvenience at the university.

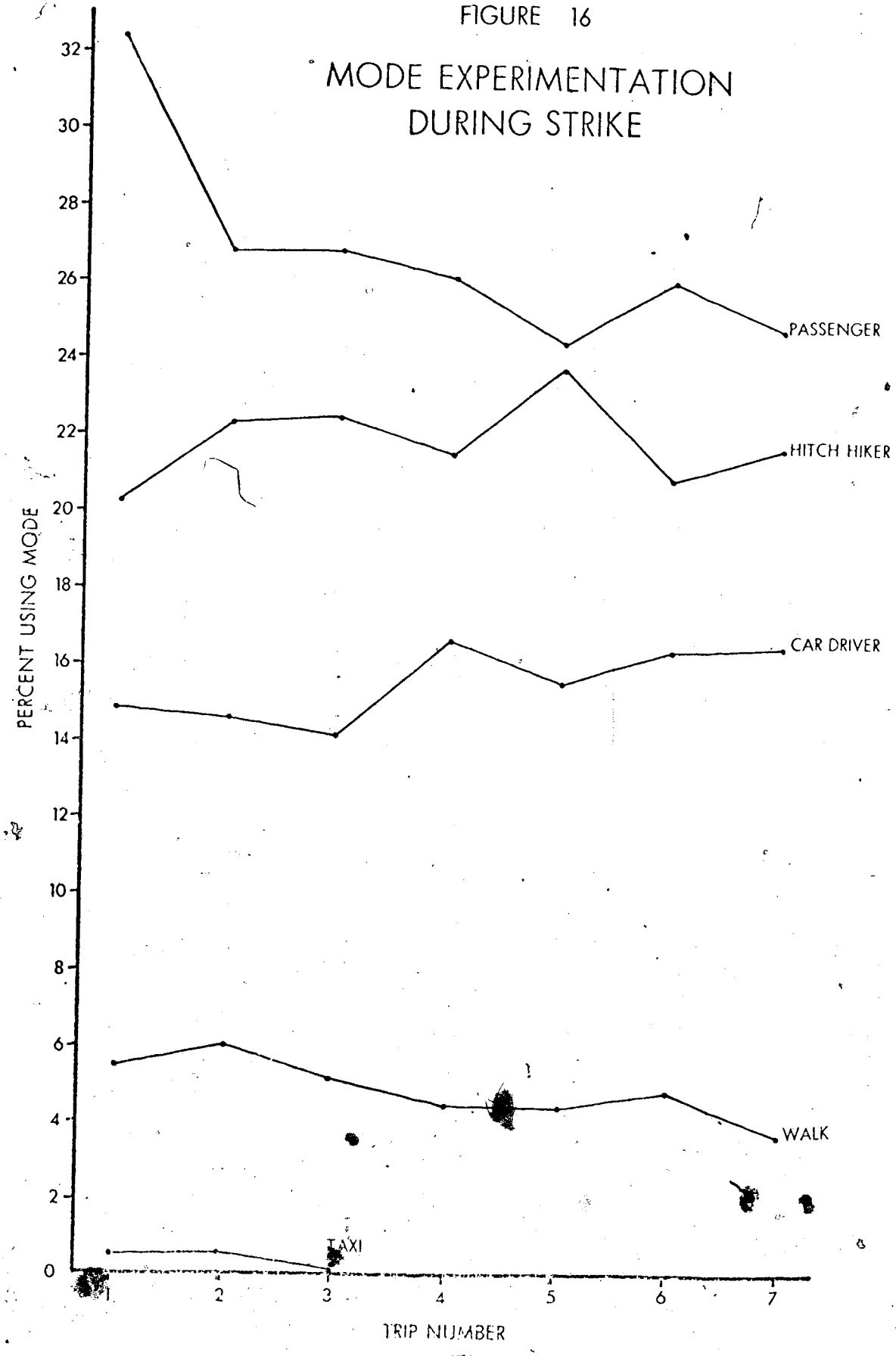
Figure 16 is most revealing. Bearing in mind the tenets of the conceptual framework, it would be expected that a discernable trend of "search and learning" would emerge as individuals experimented with various travel modes before deciding on the preferred one (Horton and Reynolds, 1971). This seems to have occurred, although no doubt exists that the fluctuations in the searching curves have been dampened by the aforementioned travel contingency plans made by nearly half the respondents. There is a sharp decline in passenger mode after the first trip, and a concomitant rise in both car driver and hitch hiker mode usage over time.

The following is a partial explanation of the trends shown in Figure 16. On the first trip of the strike many respondents had arranged to travel with friends in car pools. On the second trip, the passenger mode suffers a severe drop in use as respondents apparently opted to adopt travel modes offering a greater degree of independence--hitch hiking and walking. By the fourth trip, the independence theme encounters a rally as the car driver, then the hitch hiker modes sharply increase while the car passenger mode further declines. At the end of the time span covered, passenger mode seems to be suffering from a general decline in popularity as driver mode appears to be enjoying a slight general rise in preference.

In summary, after the first two trips, respondents began to realize that because of the large volume of traffic bound for the university during the strike, there was less need to organize structured car pools; hence the drop in car passenger mode. Hitch hiking became a

FIGURE 16

MODE EXPERIMENTATION DURING STRIKE



more viable and attractive alternative, one affording reasonable reliability without greatly compromising independence. The constraint against taking one's own auto to campus, which was seen to exist before the strike, appears not to have been removed. Car driver mode never exceeds 17 per cent, less than half of its potential (Table 5C).

A longer time series would no doubt have resulted in a clearer statement of mode readjustments. However, it is felt that respondents could not fairly be expected to recall their mode usage patterns over much more than half a dozen trips.

Stated reasons for the particular choice of mode during the strike are outlined in Table 7. Of the choices available to the respondents, 52.8 per cent cited reliability as a factor important in their selection of mode. Two of the decision making parameters from the economic man paradigm, time and cost, follow reliability in importance. The reliability factor is obviously of nebulous character; however, the respondents have indicated that they were collectively able to assign meaning to the term, and to rank it against ostensibly more concrete decision input components.

A question which comes to mind is whether, having discovered the relative merits and demerits of alternative travel modes, the respondents will revert to their pre-strike mode usage. In relation to the second questionnaire sample of both pass holders and non-pass holders, the usage of transit for school trips was reduced by 13.4 per cent from 77.8 per cent to 64.4 per cent approximately one month after the strike ended. A month after that, the university reported an 8 per cent decrease in patronage between November 27, 1973 and March 12, 1974.[3]

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[3] J. Williamson, University of Alberta Institutional Research and Planning, unpublished data.

TABLE 7

FACTORS* INFLUENCING MODE SELECTION (%)

Reliability	52.8
Time	39.6
Cost	37.9
Comfort	22.6
Other	13.2

TABLE 8

MODE USAGE CHANGES ACROSS ALL SYSTEM STATES*

Trip Type	% Unchanged
School	53.1
General Shopping	71.2
Work	71.9
Soc./Rec.	76.1
Grocery Shopping	93.9

*Sample was both student and non-student, Survey Two, Appendix B.

However, the ETS reported ridership up 1.9 per cent in February 1974 over the same month in 1973, and has subsequently enjoyed a year of increasing ridership.[4] In terms of mode usage alone, the strike appears not to have had major deleterious effects on the ETS itself.

Table 8 summarizes mode change by trip type across all system states, that is, before, during, and since the bus strike. It shows that school trips suffered the most impact in terms of overall mode change, while grocery trips were least affected. This is consistent with the unchanged patterns of grocery shopping preferences cited in a subsequent section.

TIME BUDGET CHANGES

Table 9 shows the average effect of the strike on campus arrival time, departure time, and st ying time. The minus signs in the table refer to earlier than usual arrivals and departures, with the corresponding pre-strike times serving as the "expected" reference.

The phraseology of the conceptual schema may be applied to appreciate the behaviour which generated these time changes. The respondents perceived that a strike situation would result in a general transportation system overload, and concluded that to try to offset the expected time loss to be incurred during the morning and evening travel peaks it was best to leave home earlier and depart from campus later than usual. According to Table 9, this decision resulted in individuals arriving on campus an average of 16.8 minutes earlier than usual, and departing some 9.0 minutes later than usual. This gave rise to an

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[4] R. Clark, Transit Development Supervisor, ETS, unpublished data.

increase of overall staying time at the campus of 25.8 minutes. The cumulative staying time curve would thus register a steeper rise in its early stages during the strike (Figure 13). The intensity and congestion of the peak period was reduced somewhat by this time budget readjustment.

The general delay in evening departure may have been the result of a conscious effort to "let everyone else go first," and thus minimize delay associated with the evening peak, or it may have been a function of university class scheduling. The student day tends to end somewhat earlier than the industrial work day, but since the majority of respondents relied on auto traffic for rides during the strike (Figure 16), it was probably necessary to wait until later in the day for the peak flow of traffic in order to get picked up.

The apparent effect of the university timetable on arrival and departure times is evident in Table 9. Tuesdays and Thursdays necessitated generally earlier arrivals, and much longer stays. The longer staying times are reflected in the trip frequency statistics (Table 10). Recalling the cumulative hour staying time curve from the equilibrium analysis, it would seem fair to state that during the strike, the corresponding curve would be steeper owing to fewer trips and longer stays in the earlier stages. During the strike, the number of double reflective links to and from the campus were significantly reduced (χ^2, $\alpha = 0.005$) and the number of single reflective links was significantly increased (χ^2, $\alpha = 0.10$). In other words, more respondents made only one return trip to campus, while less made two such trips. With respect to sequence tree trip characterizations, the size of the trees in terms of the π index would be reduced during the strike as the number of

TABLE 9

ARRIVAL AND DEPARTURE TIME CHANGES TO AND FROM CAMPUS, IN MINUTES

	Monday	Tuesday	Wednesday	Thursday	Friday	Mean
Arrived	-13.8	-23.4	-16.8	-18.6	-11.4	-16.8
Departed	+ 3.6	+26.4	- 3.6	+13.2	+ 5.4	+ 9.0
Stayed	+17.4	+49.8	+13.2	+31.8	+16.8	+25.8

TABLE 10

TRIP FREQUENCY CHANGES BY NUMBER OF RETURN TRIPS

	Monday	Tuesday	Wednesday	Thursday	Friday
1 Return Trip					
Before	206	194	198	198	207
During	227	210	216	218	229
2 Return Trips					
Before	26	34	33	33	23
During	9	15	13	10	7

TABLE 11

MEAN TRAVEL TIME CHANGES FOR CAMPUS TRIPS, IN MINUTES

	Monday	Tuesday	Wednesday	Thursday	Friday
Before To	27.4	26.7	26.7	27.2	26.9
During To	23.5	22.9	22.9	22.9	23.0
Shorter by	3.9	3.8	3.8	4.3	3.9
Before From	31.1	30.9	30.9	31.6	30.4
During From	28.4	27.7	27.5	28.5	27.7
Shorter by	2.7	3.2	3.4	3.1	2.7

multisegment trips decreased.

One of the more interesting time budget changes was that average travel times to the campus tended to decrease slightly, despite an increase in the volume of vehicular traffic. Table 11 summarizes the observed changes. Several factors could account for the differences. Over half the respondents had pre-arranged travel plans, and for these individuals, the problems associated with last minute adaptation to the new situation were minimized. The tendency for individuals to leave home earlier and depart from campus later than before the strike may have helped to flatten the morning and evening traffic peaks, thus helping to compensate timewise for greater absolute volumes of auto traffic.

It should be remembered that the pre-strike mode of travel for most respondents was the ETS, while during the strike the vast majority of individuals relied on auto travel in one form or another. The implication is that for students, and no doubt the general population as well, the automobile was still able to offer better travel times for the tidal journey under conditions of relative congestion than buses were able to provide under normal operating circumstances.

Figures 17 and 18 are isochronal accessibility maps compiled from survey data indicating, respectively, the travel time surface for buses before the strike and cars during the strike, to the University of Alberta. The general configuration of the surfaces is similar, owing to the identical infrastructures upon which the two modes operate. However, note that from most areas of the city, and particularly for middle to long distance trips to the campus, auto travel is quicker in the strike state than bus travel is in the normal state. Of course, this is not really surprising. Characteristically, buses travel less direct

FIGURE - 17

PRE-STRIKE TRAVEL TIME TO UNIVERSITY BY BUS

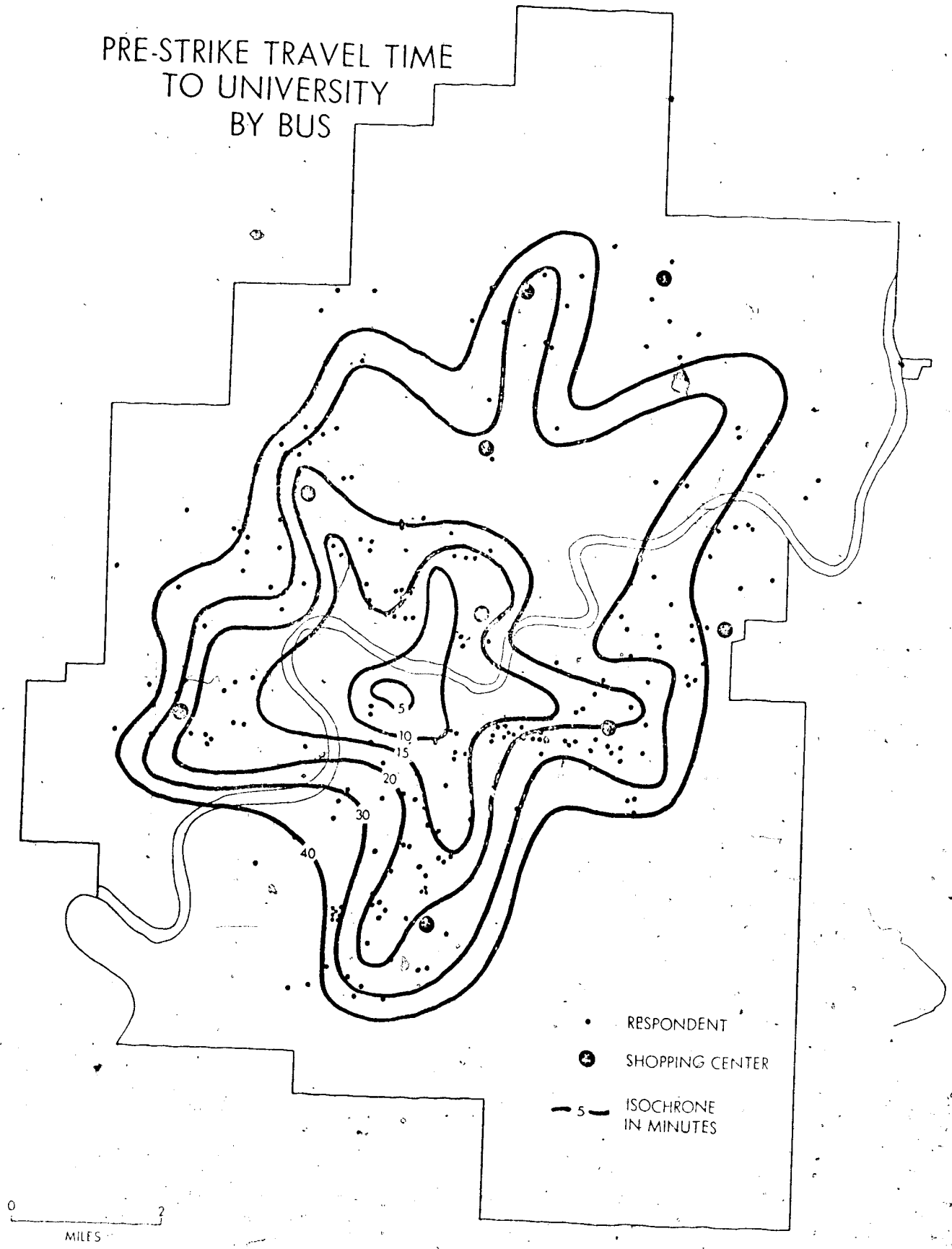
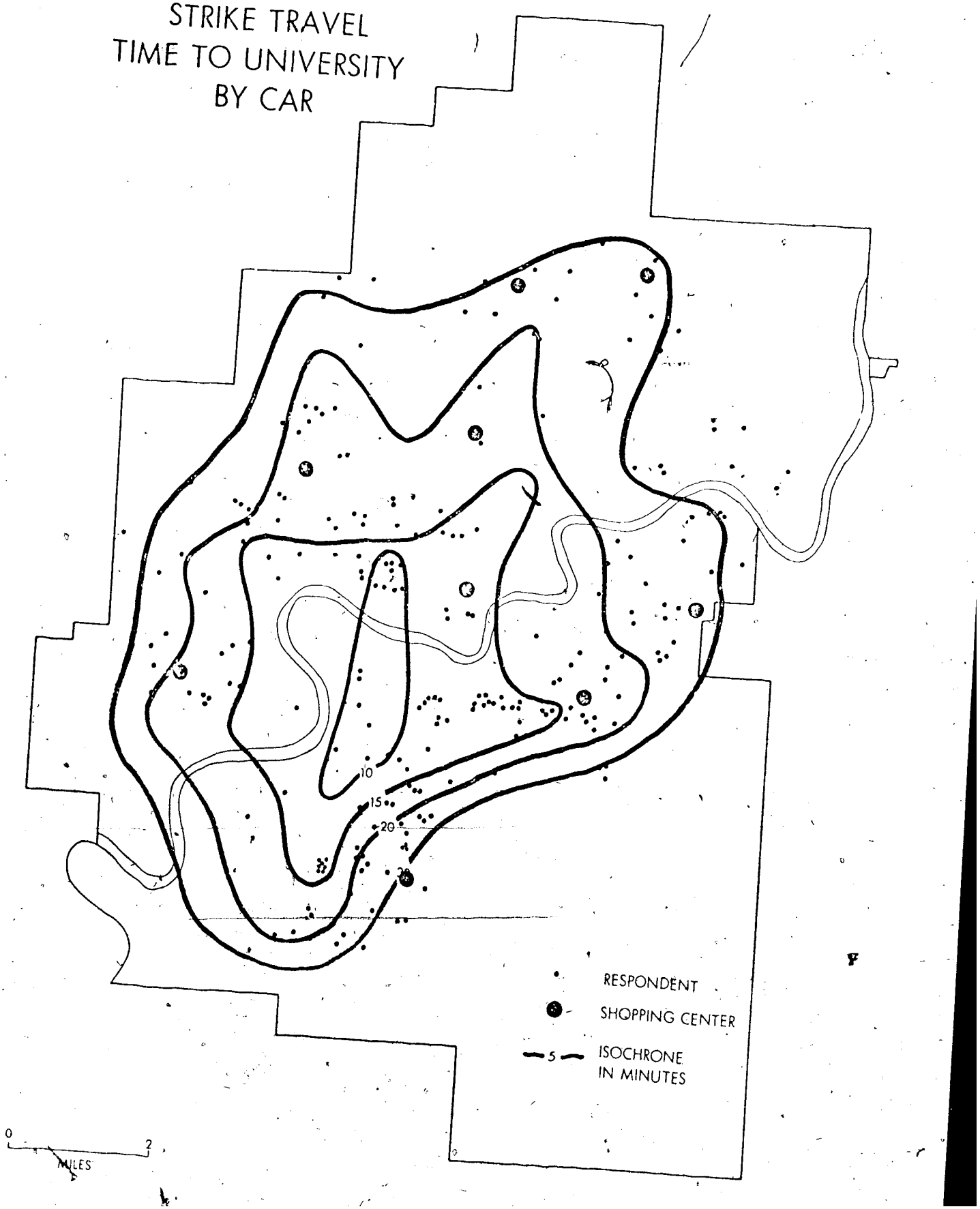


FIGURE 18


STRIKE TRAVEL
TIME TO UNIVERSITY
BY CAR
10
15
20
30
RESPONDENT
SHOPPING CENTER
5
ISOCHRONE
IN MINUTES
0
2
MILES

routes at slower average speeds than do cars, and bus travel entails considerable more waiting both at stops and for transfers; hence the higher isochronal accessibility of the university during the strike.

One final caution in interpreting these figures is in order; for regular bus users, a slower trip in an auto may seem shorter than a faster trip in a noisier, more crowded, less comfortable bus. Perception anomalies may skew the travel time data in favour of the auto to some degree. At any rate, the role of the ergonomist in designing transit that is effective, should not be downplayed.

AGGREGATE ACTIVITY SPACE CHANGES

If the search and learning hypothesis and its corollary systems adjustment hypothesis have meaning, then the activity spaces of respondents should have been altered in some manner during the strike.

It has been noted already that there were experimentations with various modes early in the strike. These experimentations should have had a spatial component as well--new travel routes should have been tried and either assimilated or discounted, and different shopping, social, and recreational establishments frequented as adjustment to the spatial disequilibrium was effected. In fact, there were surprisingly large changes in these activity spaces.

Table 12 tabulates the percentage of respondents who made new activity discoveries in the city during the bus strike; 23.6 per cent of the students made such discoveries. The most frequent additions to the respondents' awareness spaces were speciality stores, followed closely by social establishments.

Consider for a moment the implication of the magnitude of this

TABLE 12

ACTIVITY SPACE CHANGES

A: % Discovering New Establishments by Type

	Yes	No
Specialty	14.9	84.7
Social Establishments	10.2	89.4
Grocery	3.8	95.7
Chain Stores	3.4	96.2
Unchanged	76.4	23.6

B: Trip Type on Which New Discoveries Made (%)

	Yes	No
Campus	10.6	12.3
Shopping	7.7	15.3
Soc./Rec.	5.1	17.9
Miscellaneous	4.7	18.7

C: % Including Discoveries into Activity Space

	Yes	No
Instead of Usual	7.2	92.3
In Addition to Usual	8.1	91.5
Not Included	83.8	15.3

D: Activity Type Incorporated Into Activity System (%)

Specialty Stores	8.9
Social Establishments	6.8
Chain Stores	2.1
Grocery Stores	1.3

awareness space augmentation; almost one person in four learned something new about the arrangement of activity in Edmonton that they did not know before. This is even more striking given that 75.3 per cent of the students indicated that they were permanent residents of Edmonton, and the mean length of stay in the city was 10.5 years. In view of these data, it may be assumed that most of the respondents had reached the equilibrium phase of the activity space generation process as conceived by Horton and Reynolds (1971).

The fact that such a large proportion of respondents made new discoveries during the strike would seem to imply that ordinarily, activity spaces are stereotyped, that activity systems do quickly develop into routinized spatial statements, and that after the initial stages in the learning process are negotiated, very little new information is assimilated into activity systems. The strike destroyed the previously existing spatial equilibrium, giving rise to a regression of learning to the search and experimentation stage. This, in turn, resulted in the relatively high proportion of respondents being exposed to new spatial information about Edmonton. Most of the new activity discoveries were made on trips to the campus, not surprising since many respondents were no doubt following new routes to school complementary to their new modes (Table 12B).

An important consideration, in terms of the potential lasting impact of the strike, is whether or not the augmentations of awareness space became incorporated into the activity spaces of individuals. According to the data in Table 12C, 65 per cent of those who made new discoveries frequented these activities instead of or in addition to their usual corresponding activities. The kinds of establishments

incorporated into the activity spaces were most frequently higher order speciality stores and social establishments (Table 12D). Thus, not only were awareness spaces expanded, but a large proportion of respondents actually readjusted their activity systems to include new activity locations.

In terms of the distribution of social and recreational trips, the bus strike had significant effects (Table 13), reducing the numbers of such trips greatly (χ^2, $\alpha = 0.01$). Most affected were trips to the CBD and to the university campus. One exception to the general decline in trips was in the case of club and community activities, which enjoyed a modest rise in pursuit. The sharp decrease in social trips to the university is consistent with the finding in Table 10 that double reflective linkages to the campus were severely curtailed during the transit stoppage. Recalling the sequence tree conceptualization of urban trip making, it would appear that less extensive and diverse trip sequence patterns characterized the strike readjustment phase.

Travel times for social/recreational trips were generally lower though the reduction was not significant. Interestingly, there was no large scale redistribution of pre-strike bus users to auto mode for most trips (Table 14, 15). The evening social activity system would thus appear to be one where pre-strike bus users were especially hard hit.

One interesting conjecture may be offered regarding the already noted increased incidence of club and community trips during the strike. Table 13 shows this rise, while Table 14 indicates that travel times decreased most for the club and community trips. It is thus possible that more individuals made shorter, within-neighbourhood social trips to participate in community events during the transit strike.

TABLE 13

CHANGED DISTRIBUTION OF SOCIAL/RECREATIONAL TRIPS

Destination	Frequency	
	Before	During
University	88	67
CBD	93	65
Friends/Family	131	112
Nightspots	41	39
Sports Events	40	31
Club/Community	14	19

TABLE 14

TRAVEL TIME CHANGES FOR SOCIAL/RECREATIONAL TRIPS IN MINUTES

Destination	Before	During
University	26.1	25.3
CBD	23.2	23.2
Friends/Family	25.4	23.7
Nightspots	18.6	18.9
Sports Events	25.9	22.8
Club/Community	22.8	18.5

TABLE 15

AUTO-TRANSIT MODE USE FOR SOCIAL/RECREATIONAL TRIPS (%)

Destination	Auto		Transit	
	Before	During	Before	During
University	14.5	17.9	22.1	-
CBD	13.2	18.7	24.3	-
Friends/Family	31.5	38.7	22.1	-
Nightspots	11.1	11.9	2.1	-
Sports Events	10.6	11.9	5.1	-
Club/Community	2.6	5.1	3.4	-

CHANGES IN SHOPPING ACTIVITY SYSTEMS

The arguments for closely scrutinizing shopping activity systems may be summarized in the following manner; shopping is a major urban activity, it tends to be spatially focussed facilitating change analyses, and it is highly routinized.

Eight major shopping centers and the downtown retail area were chosen as potential shopping nodes.[5] Table 16 lists these centers showing the distribution of patronage by gross trip order, in both the pre-strike and strike states of the system.

There is no significant change in low order incident trips or in multipurpose, dual order trips. However, there was a significant drop in the use of the centers for higher order retailing only (χ^2, $\alpha = 0.01$). According to Table 16, very few respondents used the centers for grocery shopping only, no doubt availing themselves of a local outlet closer to home. Although slightly more respondents used the centers for both lower and higher order retailing, incident trips for general shopping only, totally dominate.

According to Berry (1967) consumers are normally willing to make longer trips to effect higher order purchases. During the strike, this correlate is altered. Table 17 gives an interesting breakdown of factors influencing respondents' selection of shopping place. The table shows that for the higher order functions, significant differences exist between the pre-strike and strike perceptions of the choice influencing

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[5] The centers were selected on the basis of number of establishments; site acreage; area of building space; and number of parking places (see Appendix C). One small, peripheral center, Centennial was inadvertently omitted from the first activity questionnaire. The omission is unfortunate, but little generality is lost in the analysis.

TABLE 16

SHOPPING CENTERS VISITED (FREQUENCY)

Center	Before Grocery	Before General	Before Both	During Grocery	During General	During Both
Downtown	6	91	21	4	49	14
Southgate	8	55	19	4	41	18
Bonnie Doon	5	37	8	4	29	10
Westmount	4	20	14	3	16	14
Londonderry	1	28	6	1	16	5
Capilano	3	15	10	3	17	18
Meadowlark	1	11	14	1	10	4
Northgate	1	11	4	1	7	4
Park Plaza	3	7	1	3	2	0

TABLE 17

FACTORS INFLUENCING CHOICE OF SHOPPING CENTER (FREQUENCY CITED)

	Before Grocery	Before General	Before Both	During Grocery	During General	During Both
Distance	41	61	57	38	78	63
Selection	10	79	30	9	49	19
Quality	7	32	17	5	20	15
Cost	13	17	16	9	12	10
Other	4	9	3	4	12	5

factors. Distance increased in importance, that is as a perceived obstacle to trip making, while all other factors, especially goods selection, decreased in perceived importance (χ^2, $\alpha = 0.01$).

Note that in the normal state of the system, the selection of goods available was deemed more important than distance, and that quality ranked above cost. There is a hint here that during the strike, a more simplified, economically rational type of spatial behaviour manifested itself. A simpler correlate, distance, seems to be operating during the strike, as opposed to the more complex pre-strike correlate, selection. At the most general level, it would seem that respondents adopted a simpler, boundedly rational model of behaviour during the strike, in accordance with Simon's notion of satisficer solutions.

The factors influencing the choice of grocery shopping place, where distance bias is seen to be very strong, show no significant change in relative importance between system states.

For multipurpose trips (both orders) there was a significant change in the cited importance of the same parameters, with distance increasing slightly in importance, and selection dropping greatly (χ^2, $\alpha = 0.10$). The less pronounced increase in the perceived importance of distance in this instance is probably due to the multipurpose nature of the trips. Combining trip purposes enables an economy of distance expenditure and results in less concern with the distance factor per se.

Table 18 shows the distribution of incident trips to the shopping areas in both states of the system. Note the sharp decrease in trips to the larger centers, particularly the Downtown, Southgate, and Londonderry. The effect of the strike was to significantly reduce the total number of shopping trips made (χ^2, $\alpha = 0.005$). In terms of complexity

TABLE 18

DISTRIBUTION OF TOTAL INCIDENT SHOPPING TRIPS (FREQUENCY)

Center	Before	During	Chi-Square
Downtown	117	67	21.36
Southgate	82	63	4.40
Bonnie Doon	50	43	0.98
Westmount	38	33	0.66
Londonderry	35	22	4.83
Capilano	28	28	0.00
Meadowlark	16	15	0.06
Northgate	16	12	1.00
Park Plaza	11	5	3.27

of trip making, it appears that the sequence trees of the respondents were significantly curtailed during the strike, with both the number of linkages and the number of incident nodes declining.

There is no systematic relationship between the Chi-square contribution of each center and increasing distance from the CBD. Hence no apparent distance bias from the central city area to outlying centers exists (Figure 19).

There is a definite curvilinear relationship between Chi-square contribution and shopping center size. Figure 20A shows that in general, the larger shopping centers were more affected by the transit stoppage in that they suffered the greater declines in incident trips and offered the higher Chi-square contributions. Problems of scale affect this relationship such that both the very small and very large suburban centers suffered relatively large trip deletions. The moderately sized centers were only marginally affected (Figure 20B).

INDIVIDUAL SHOPPING SPACE CHANGES

To enable a spatial analysis of changes in individual shopping spaces, and enable a meaningful graphic interpretation of the results, a subsample of 62 units was randomly selected (25 per cent of total sample). The home addresses of the subsample units were located and the shopping trip linkages for all orders of trips mapped according to questionnaire responses, for both system states.[6] Figures 21 and 22 are, respectively, the pre-strike and strike state shopping space diagrams.

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[6]The use of desire line mapping of trips precludes the representation of reflexive linkages. No data were collected on the sequencing of shopping trips.

FIGURE 19

DISTANCE FROM CBD VS CHI - SQUARE

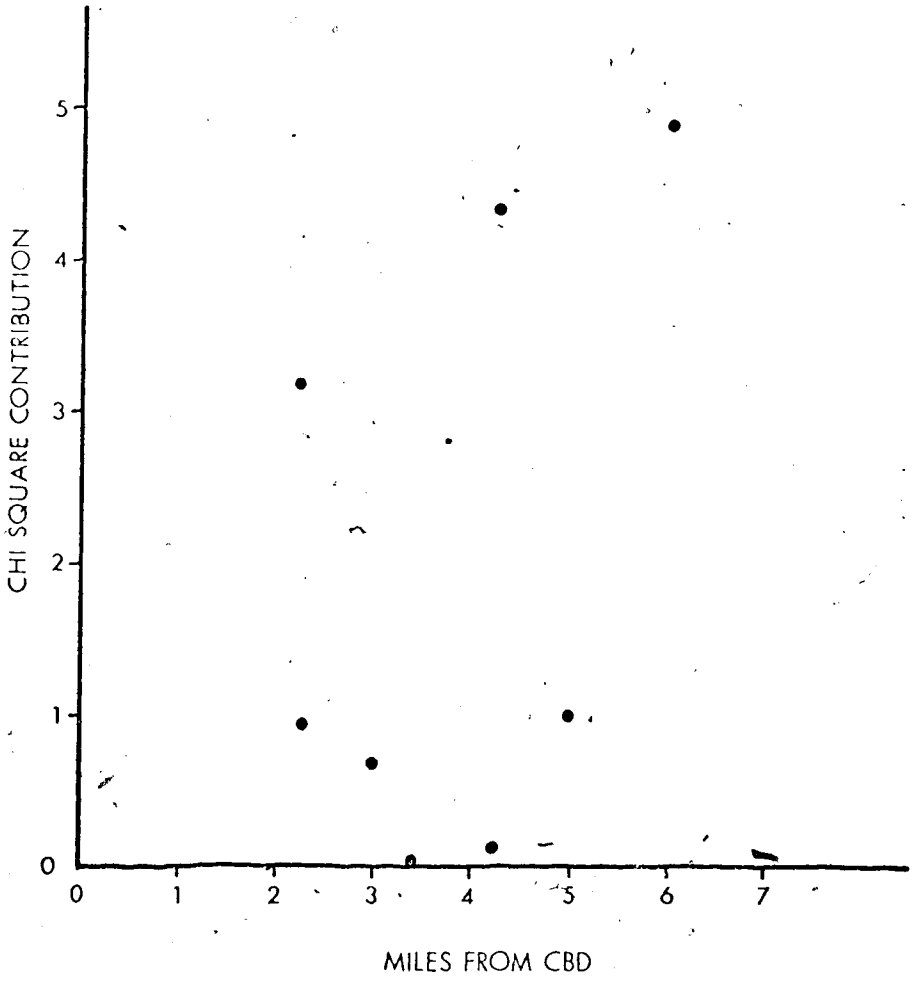
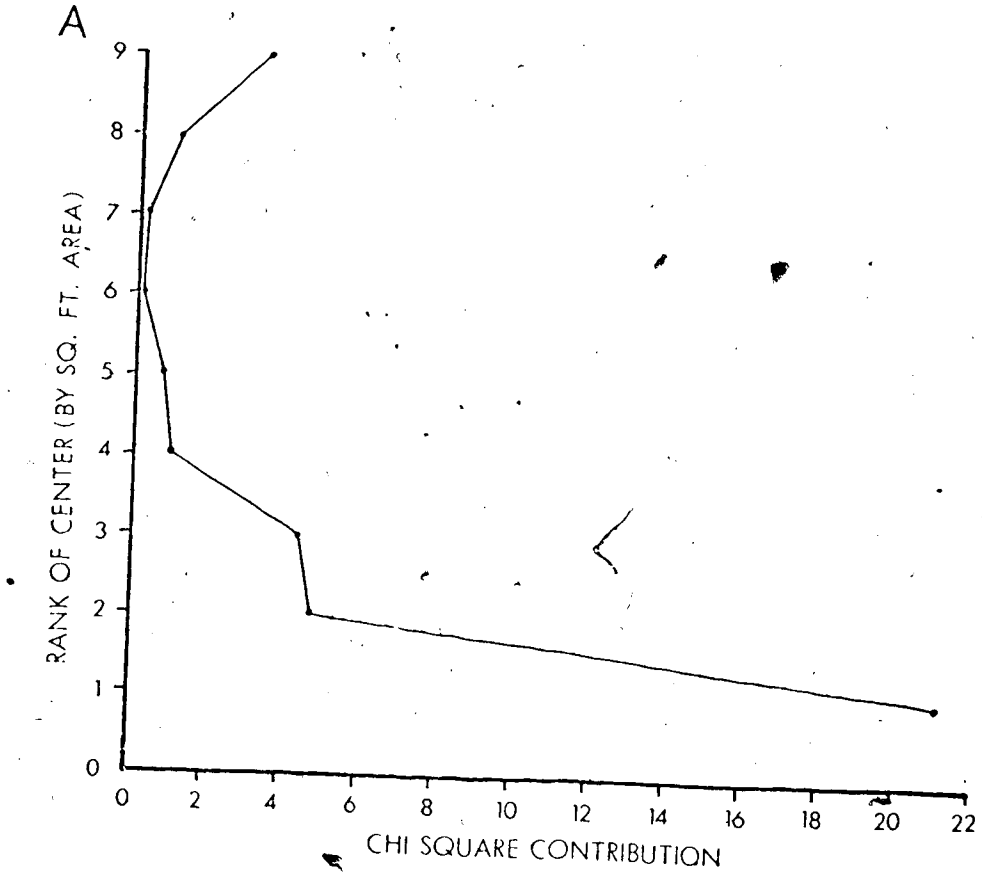


FIGURE 20

CHI - SQUARE VS SHOPPING CENTER RANK



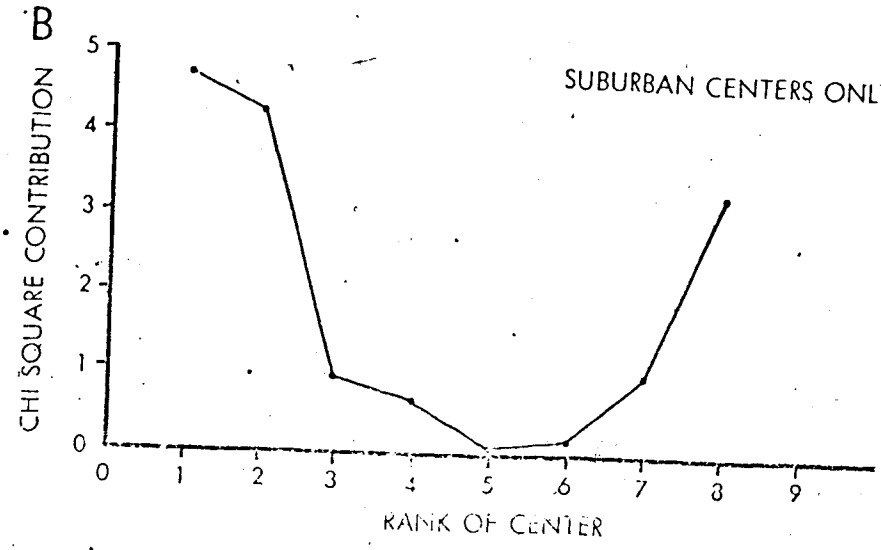


FIGURE 21

SHOPPING TRIPS BEFORE STRIKE

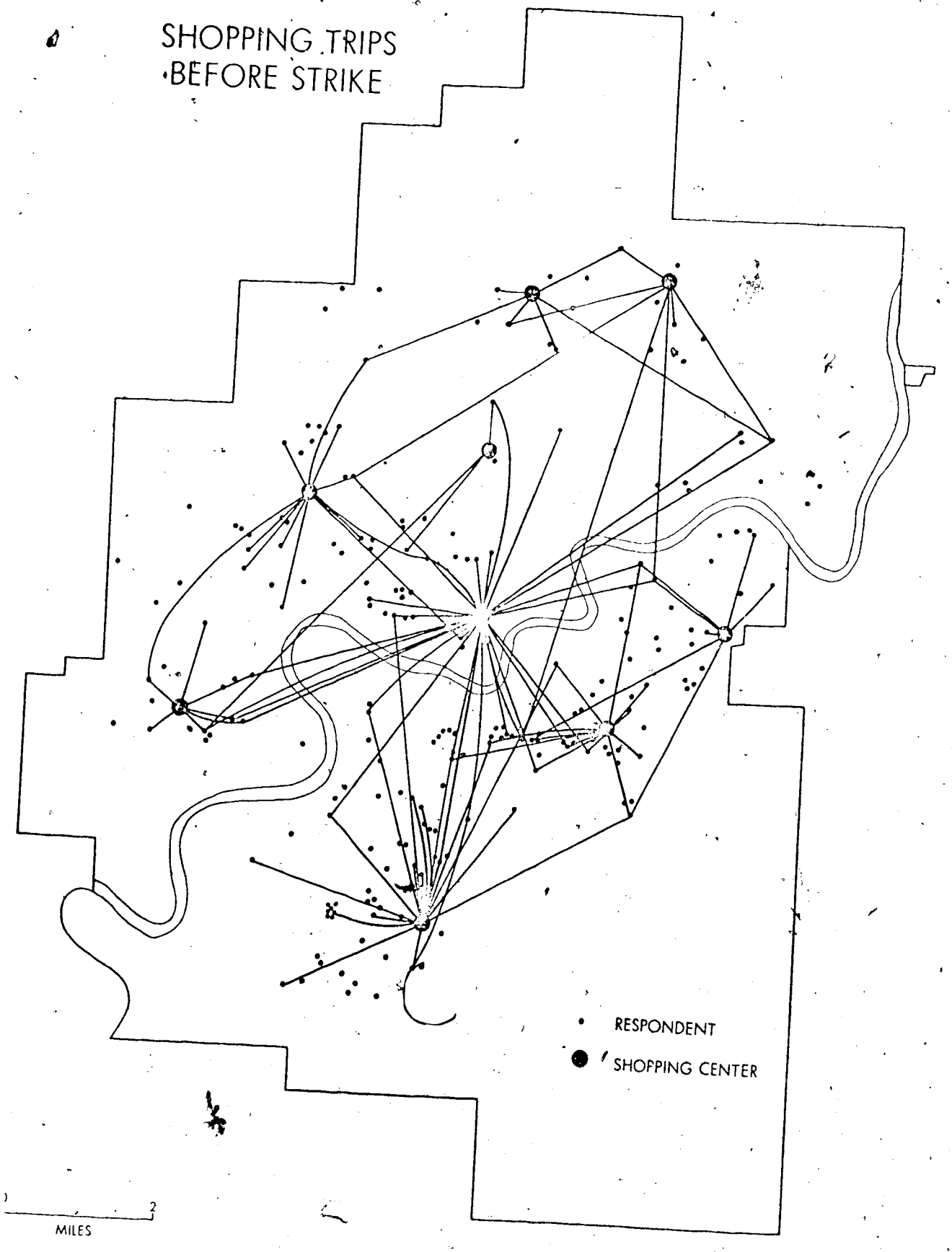
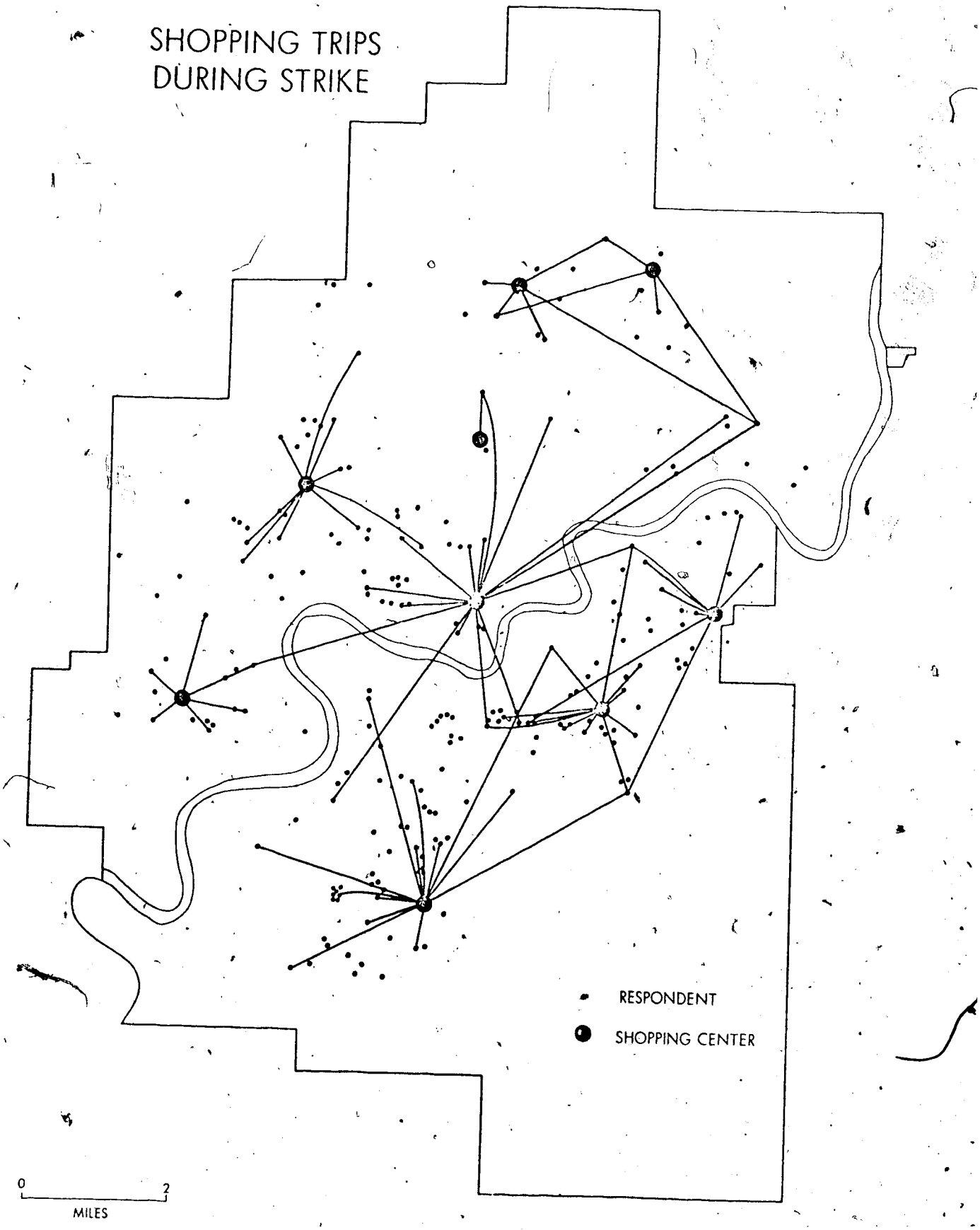


FIGURE 22

SHOPPING TRIPS DURING STRIKE



There are immediately apparent differences between the two figures. In the pre-strike equilibrium condition, more multiple linkages exist as many respondents visit more than one center regularly.[7] When more than one center is visited, it tends to be the nearest center to the respondent's home, and the Downtown.

The Downtown, Southgate, and Bonnie Doon emerge as the most frequented shopping nodes while Downtown and Londonderry emerge as the nodes with the largest trade areas.

It is not surprising that the trade areas of most suburban shopping centers are nested within that of the CBD. Londonderry's spatial drawing power may be attributed to its size, but also to its late store hours and its newness. It is the most recent addition to the growing number of large centers in Edmonton, and is open weekdays until 10:00 p.m.

During the strike it is apparent that the number of shopping linkages is reduced, and hence individual activity spaces contracted. In terms of the propensity to make shopping trips, activity spaces in all areas of the city are significantly reduced (χ^2, $\alpha = 0.10$).

DISTANCE BIAS

In the city of Edmonton where major expanses of grid street pattern exist, and where few radial streets penetrate the grid, it is not realistic to consider a desire line metric as a distance measure. What is needed is a distance metric which compensates for the indirect paths

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[7] The overall frequencies of shopping center patronage are as follows: 125 respondents visited only 1 center, 65 visited 2 centers, 32 visited 3 centers, and 5 visited more than 3 shopping centers. The question asked respondents to indicate the center they visited most often. (Appendix A, question II-1.)

which must generally be followed by consumers making shopping trips.

The general distance metric in Euclidean geometry is defined as:

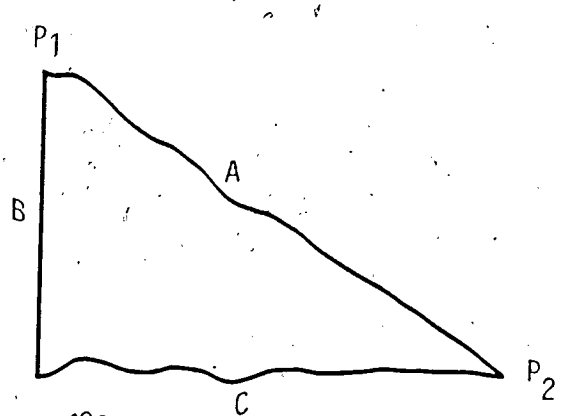
$$dij^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2$$

for two dimensional space. This formula calculates the straight line distance, dij, between any two points $P_1(x_1y_1)$ and $P_2(x_2y_2)$.

In contrast, the "Manhattan metric" is defined as:

$$dij = |x_1 - x_2| + |y_1 - y_2|$$

for two dimensional space. This metric defines the right angle distance between the same two points, P_1 and P_2 (see King, 1969, pp. 230-31). The diagram below illustrates the relationship between the two metrics.



Suppose P_1 represents the home location of a consumer, and P_2 a shopping center. The Euclidean metric gives the distance between the consumer and his store as A units. On the other hand, the Manhattan metric accounts for infrastructural constraints which impose deviations on desire line travels and calculates the distance between P_1 and P_2 (B + C) units. In the discussion of distance relationships which follows, it is the Manhattan distance which is being referred to.

Table 19A indicates the equilibrium and non-equilibrium distance relationships. The distances have been stratified by north and southside trips, to test for any gross areal differences in distance changes.

TABLE 19

DISTANCE RELATIONSHIPS FOR SHOPPING TRIPS
IN MANHATTAN MILES (N=62)

A:

	Total Distance	Mean Distance
NSB*	105.23	3.51
NSD	61.20	2.04
SSB	118.39	3.70
SSD	67.84	2.05

B: Significant Changes in Distance Travelled
(1 indicates significant difference at alpha = 0.05)

	NSB	NSD	SSB	SSD
NSB	-	1	0	0
NSD		-	0	0
SSB			-	1
SSD				-

C: Average Length of Trips Deleted

	Mean	Mean Deleted	Significantly Different
NSD	2.04	5.31	Yes
SSD	2.05	3.54	Yes

*NSB - Northside Before
NSD - Northside During
SSB - Southside Before
SSD - Southside During

Table 19B demonstrates there was a significant change in mean distance travelled to shopping centers between the two system states. No significant differences exist between north and southside trips in either state.

The decreases in distances travelled during the strike may be attributed to an increase in what Haynes (1969) has called behaviour space stress, that is, an increase in the physical and psychological elements which tend to inhibit movement in space. This greater degree of space stress was a result of the ETS strike. According to respondents' perceptions, the significance of travel distance in impeding movement to shopping centers increased during the strike (Table 17). Thus, as a readjustment to the strike disequilibrium, mean distance travelled to the shopping activity significantly decreased.

Also, the links which were deleted during the strike tended to be the longer ones. Table 19C shows the average length of link existing during the strike compared to the average length of the links deleted during the strike. The links dropped during the strike were significantly longer than the mean of existing links (t test, $\alpha = 0.05$).

DIRECTIONAL BIAS

Research investigations into the shape and directionality of mental maps were discussed in Chapter II. To test for the influence of directional bias on activity space changes, trip linkage data were analyzed from two standpoints.

In the first instance an eight equi-sectored circle was centered on each shopping center in Figures 21 and 22, and the number of incident links in each sector accumulated. Table 20 shows the resulting sector matrices for the two system states. The higher the entry in

TABLE 20

DIRECTIONAL BIAS FOR INCIDENT SHOPPING TRIPS BY SECTOR

A: Before

Center	Grid Aligned N	E	S	W	Σ_i	Grid Non-Aligned NE	SE	SW	NW	Σ_i
Downtown	4	2	6	4	16	2	2	4	2	10
Southgate	9	0	1	3	13	3	0	1	1	5
Bonnie Doon	1	0	1	3	5	2	1	3	1	7
Capilano	1	0	0	1	2	1	0	2	2	5
Londonderry	0	0	3	1	4	0	1	1	1	3
Northgate	0	0	0	2	2	1	2	1	0	4
Westmount	1	0	1	0	2	2	2	4	1	9
Meadowlark	1	2	0	0	3	1	1	1	1	4
Park Plaza	1	0	0	0	1	0	0	2	0	2
					$\Sigma_i\Sigma_j=48$					$\Sigma_i\Sigma_j=49$

During

B:

	Grid Aligned N	E	S	W	Σ_i	Grid Non-Aligned NE	SE	SW	NW	Σ_i
Downtown	4	1	2	3	10	2	0	2	1	5
Southgate	4	0	1	3	8	3	0	1	1	5
Bonnie Doon	1	0	1	3	5	2	1	2	1	6
Capilano	1	0	0	2	3	1	0	2	2	5
Londonderry	0	0	1	1	2	0	1	0	1	2
Northgate	0	0	0	1	1	1	2	1	0	4
Westmount	1	0	0	0	1	2	2	3	1	8
Meadowlark	1	1	0	0	2	1	1	1	1	4
Park Plaza	1	0	0	0	1	0	0	0	0	0
					$\Sigma_i\Sigma_j=33$					$\Sigma_i\Sigma_j=39$

any given cell of the matrices, the more the corresponding sector contributed to incident shopping trips.

The table is divided into grid aligned and non-aligned components, the hypothesis being that desire lines might tend to be aligned with the road pattern, especially during the strike, if the grid does exert influence on desire paths.

The table indicates that before the strike most shopping trips to Downtown originated from the south, although most of the grid aligned sectors are well represented. Southgate's trade area exhibits a strong bias to the north, with 9 of its 18 incident trips coming from that sector. The other centers have less striking directional components. Westmount does show a strong bias toward non-aligned sectors in general, and the southwest in particular. No general relationship between the trips and their sectors of origin appears to exist.[8]

It may be hypothesized that during the strike, "crossgrain" trips--those whose desire lines are oblique to the grid--would tend to have been deleted in favour of more direct ones, especially for those previous bus users. A comparison of the cell entries in each sector on the respective system indicates that this did not happen (Table 20). For instance 13 of the 18 incident trips to Southgate were from grid aligned sectors. Five trips to Southgate were cut out during the strike, all of them from the aligned sectors. For many of the smaller centers, deleted trips tended to be from the aligned sectors, and overall more trips were deleted in the aligned sectors (48 to 33) than in the non-aligned ones (49 to 39).

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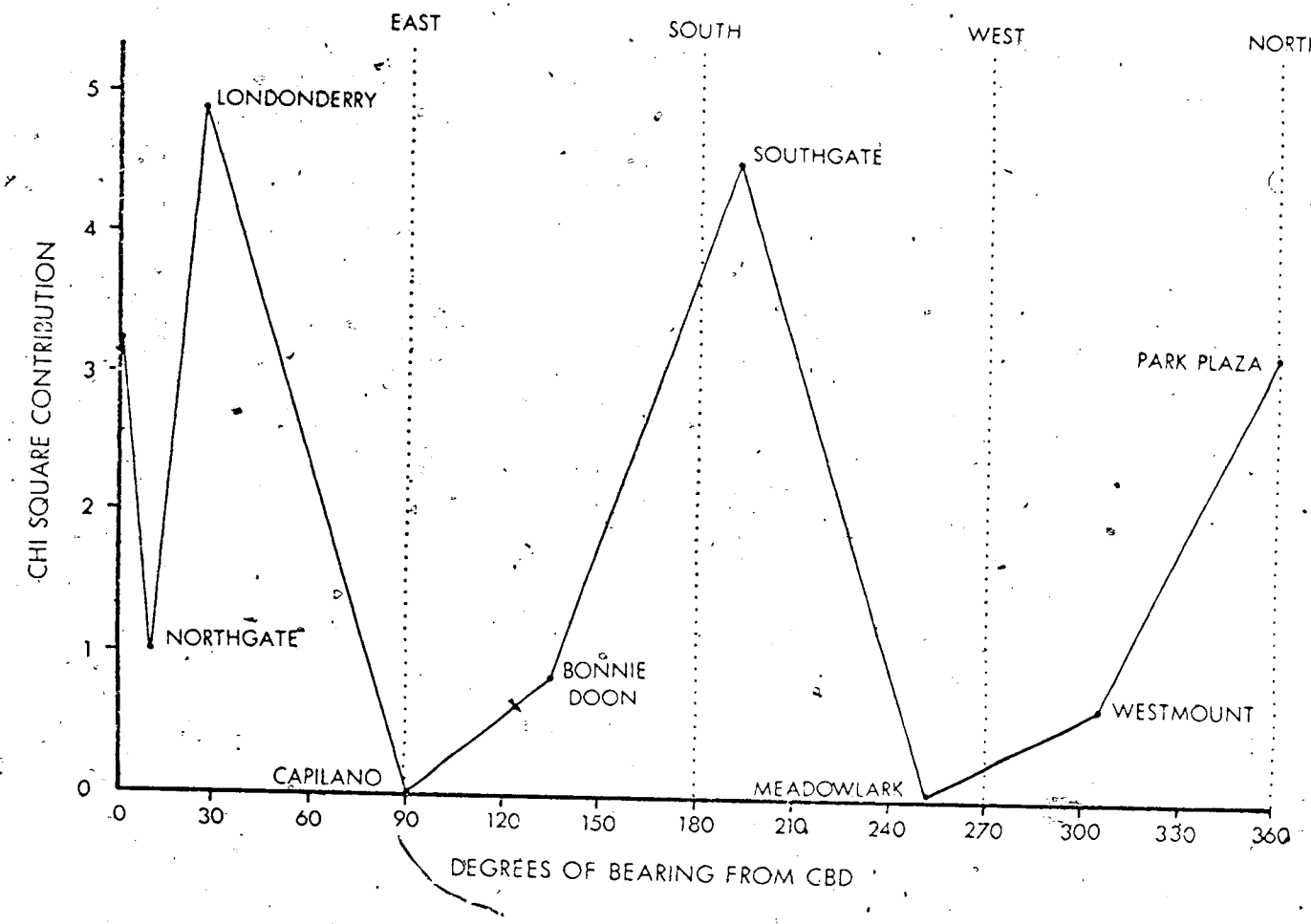
[8] Lee (1970) postulates the existence of a definite bias toward the CBD in low order shopping activity spaces.

At first glance, the lack of directional bias during the strike would seem to suggest that the grid pattern does not affect shopping desire paths. More likely though, a behavioural correlate is being manifested; when faced with the choice between a programmed action and an unprogrammed one, the individual try will select the familiar or programmed one (MacMurray, 1971, p. 202). During the strike individuals made shopping sacrifices by cutting out certain shopping trips, but the trips they continued to make were to previously frequented centers, that is, the trips were familiar ones. Thus, directionality--the route selection component--does not appear to change during the strike (z test, $\alpha = 0.10$). Remember, though, that the desire line is an inadequate abstraction by which to represent trip changes, especially when route selection is a factor. No conclusive statement can be made regarding the strike and directional biases.

Figure 23 demonstrates that a directional component appears to operate with respect to the overall strike impact on the shopping centers. The figure shows the Chi-square contribution of each center (taken from Table 18) plotted against angles of bearing from the CBD. The graph clearly shows peaks at two of the four grid aligned sectors, indicating that trips to the north and south areas of the city tended to be deleted during the strike. However, as Figure 20 demonstrates, shopping center size may provide the causal variable in this relationship. The pattern revealing itself in Figure 23 is undoubtedly a function of both center size and directional elements. There would appear to have been a reorientation of shopping patterns such that the north-south shopping axis saw its importance decreased during the strike.

FIGURE 23

DIRECTIONAL BIAS



THE QUESTION OF COGNITIVE MAPS

The last question in the second survey attempted to spatially monitor changes in aggregate activity spaces (Appendix B). This question was not successfully answered, no doubt owing to the complexity of the instructions, the degree of recall required, and the apparent unfamiliarity of respondents with city structure. This querie undoubtedly would have been more successful in a personal interview situation.

CHAPTER V

SUMMARY AND CONCLUSIONS

INTRODUCTION

The activity systems analysis undertaken in the last chapter monitored a wide variety of space-time budget changes. In the paragraphs below the many significant and intriguing findings of the analysis are synthesized into a summary statement regarding the impact of the ETS strike. Arguments for the acceptance of the two research hypotheses are presented, and a modification of the spatial choice model is introduced. Finally, a suggestion is offered for future activity systems research.

FINDINGS

In an attempt to describe the equilibrium state of the Edmonton urban system the trip sequence tree was introduced and was found to be an effective device by which to characterize the temporal and topological relationships between linkages and activities. A temporal rhythm imposed on individuals by modern society resulted in very different urban trip configurations between the early and late portions of the week. The homogeneity assumption of the typical week day would appear to be a questionable one.[1]

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[1] Sullivan (1963) argues that differentiation of trips by purpose, as is the case in the sequence trees, points out the fact that there are significant differences between the days of the week with respect to trip configuration.

In the early stages of the ETS strike there was a discernable trend of search and experimentation among bus users for an alternate strike phase travel mode. Most respondents opted to use car pool arrangements for tidal trips to the university, although as time passed, respondents redistributed themselves to both car driver and hitch hiker modes. It is surmised that respondents learned quickly that structured car pools were not necessary to ensure a reliable trip to and from the campus due to large volumes of university oriented traffic--car pool usage thus decreased.

Car driver mode did not even approach its full potential usage of 38.3 per cent during the strike, probably owing to cognized travel and parking diseconomies associated with campus auto trips. Reliability of mode was revealed to be the most important factor in mode selection during the strike, more so than travel time, cost, or directness. In terms of mode usage, the strike had no significant long term effects.

Personal time budgets were distorted in such a way that individuals arrived on campus an average of 16.8 minutes earlier than usual during the bus strike. Average campus departure times were increased by 9 minutes resulting in a total lengthening of the school day by some 25.8 minutes. The extended day was most likely a semi-conscious attempt by respondents to stretch and flatten the morning and evening peaks in the traffic volume curves, a move directed at minimizing the strike's disruptive effects.

Average travel times to and from the University were reduced by about 4 minutes in the morning and 3 minutes in the afternoon. The travel time decrease during the ostensibly more congested strike phase is a function of the pre-strike mode of respondents; the ETS offered

slower trips in the normal state than did automobile arrangements for corresponding trips during the strike.

Double reflective linkages for campus activities were significantly reduced, while single linkages significantly increased; more respondents made only one return trip to campus and less made two, indicating a disinclination on the part of respondents to attempt extra trips during the strike.

Perhaps the most significant finding was that 24 per cent of respondents made new discoveries in the city during the disequilibrium. This implies that normally, activity spaces are quite small in relation to total city size and that a considerable number of new spatial perceptions were made by individuals during the strike. Because the majority of these new discoveries were incorporated into the activity spaces of individuals it may be said that the new perceptions were assimilated into cognitions or knowledge about the spatial structure of Edmonton.

In terms of the shopping activity system, significant reductions in incident trips were registered during the transit stoppage, with the very large and very small centers bearing the brunt of the decrease in trips. The importance of distance as an inhibitor of movement increased during the strike for general shopping, replacing goods selection in cited importance as a shopping center choice factor. The average length of shopping trip was significantly reduced reflecting increased space stress in the city during the strike.

In the pre-strike state, a north-south shopping axis appears to have existed, in terms of incident shopping trips. During the strike, this axis was much less apparent as many shopping linkages along it were deleted. In relation to individual directional biases, it was

hypothesized that the deleted shopping trips would tend to be those whose desire lines flowed obliquely to the road grid. This hypothesis could not be verified satisfactorily, owing in part to the inadequacy of the desire line for representing route selection components of trips.

An attempt to cartographically reify the cognitive maps of the respondents was not successful. The lack of success was due primarily to the lengthy and perhaps complex instructions given to respondents. and to the respondents unpreparedness to locate actual activity nodes on a much simplified map of Edmonton.

Essentially, then, the ETS bus strike had significant impact on patterns of behaviour, shrinking and curtailing activity spaces and systems, distorting time budgets, and augmenting awareness spaces.

ACCEPTANCE OF THE HYPOTHESES

The two general research hypotheses framed in Chapter I would appear to be valid. First, activity systems <u>are</u> subject to changes induced by exogenous influences. The ETS strike initiated significant changes in the space-time budgets of individuals. Twenty-four per cent of respondents discovered some new element in the spatial structure of Edmonton, thereby augmenting their awareness spaces. Changes in spatial choice were apparent in relation to the shopping activity system as well. During the strike, the number of linkages were significantly reduced and the magnitude of the average shopping distance expenditure was greatly decreased.

These changes take on clearer meaning in the context of the model of spatial choice introduced in Chapter II. Initially, changes occurred in the space-time environment in the form of the transit strike.

Information and experience acted as new input into the continuously operating decision process outlined in the model. The disequilibrium was perceived by individuals as being relevant to their day to day experience and on the basis of cognitions subsequently assimilated, a ranking of potential action opportunities was derived. This cognitive scaling was made with respect to some set of fundamental preference structures, and was designed to fulfill as closely as possible the objectives of the individual. Thus, individuals were seen to readjust their behaviour and thence their activity systems, by attempting to minimize conflict between spatial structure and spatial behaviour.

As a consequence of the readjustment process, respondents continuously rearranged their personal space-time budgets. Each decision acted as input into experience and information, and as time passed, decisions were effected with greater responsiveness to the initial change in the space-time setting. The travel mode search and learning procedure which was seen to exist, exemplifies these feedback effects in the readjustment process. Decisions pertaining to the maintenance or deletion of certain shopping linkages, and to the incorporation of spatial discoveries into activity spaces are further results of readjustment. The second hypothesis, that activity systems adjust to reduce disequilibria, is accepted.

The corollary to the second hypothesis suggested that changes in individual activity systems have impact on the spatial system at large. Inasmuch as the spatial system is composed of sets of decision makers, each attempting to fulfill some sense of destiny, changes in the patterns of spatial decisions have direct impact on the urban system as a whole. For instance, many shopping centers were deleteriously affected during

the transit stoppage because the frequency of total retailing trips declined. The readjustment in spatial choices induced decreased patronage in some retailing establishments, especially in the Downtown. The patronage cut lessened the need for full staffs in many outlets; some job layoffs occurred along with some curtailment of business hours.

A second instance of the at-large effects of changed activity systems was induced by the peak period redistribution of bus users to the automobile. A general increase in auto traffic for the tidal journeys resulted in the circulation system at large suffering increased congestion and time diseconomies. Hence, not only were bus users directly affected by the removal of transit service; the general population suffered as well.

These two illustrations indicate the nature of the general systems changes which can result from alterations in individual activity systems. Here, the interdependency of spatial structure and spatial behaviour is particularly well exemplified.

SATISFICER STRIKE BEHAVIOUR

It is important to consider the general implications of the decision making process hypothesized in the model of spatial choice (Figure 1). In the empirical analysis a simple attempt to monitor fundamental preferences was attempted. The mode experimentation which occurred in the early stages of the strike, and the changing patterns of incident shopping trips provide cases in point.

According to respondents' preferences for travel mode during the strike, two parameters of the economic man formulation of spatial behaviour, time and cost, were exceeded in importance by a more embrasive

parameter, reliability. In connection with the factors influencing respondents' choice of shopping center before the strike; goods selection exceeded travel distance in importance as a decision input, while goods quality was deemed more important than goods cost. During the strike, simple distance increased in significance for the general shopping trips, exceeding both selection and cost in relative importance. Distance expenditures for shopping trips declined greatly.

These results imply that simpler decision making objectives operated during the strike. Revealed spatial choices would seem to suggest that before the strike individuals were acting with respect to a more complex cognitive model of the real world than they did during the strike. This would help to explain the aforementioned suggestion that a simpler economic parameter (distance) was of greater perceived importance during the strike, replacing previously more important and complex parameters (selection and quality).

The disequilibrium model of behaviour may be likened to Simon's (1957) notion of the satisficer, or boundedly rational individual who constructs a simplified version of the real situation in order to deal with it, and who behaves rationally within the bounds of this simpler model. Confronted with the strike situation, individuals adapted by rebuilding their cognitive model of the real world so that a course of action which was just "good enough" given the circumstances resulted. This is consistent with the finding that 28.1 per cent of respondents indicated they were completely satisfied with their means of movement during the strike and 63.0 per cent said they were "satisfied under the circumstances."

Considering the model of spatial choice again, it would appear

that a modification is in order (Figure 24). Respondents knew, or at least strongly suspected, that the ETS labour conflict would eventually terminate, and the city would return to normal. Accordingly, their disequilibrium decisions were made with an eye to making choices which were adequate to fulfill their objectives during the temporary imbalance. No doubt simpler objectives prevailed; less socializing and fewer shopping trips were tolerated to avoid being unduly affected by a malfunctioning urban system. In conceptual terms, an additional stage may be introduced into the model, accounting for the satisficer nature of the behaviour, particularly adjustment behaviour as it is construed here. Figure 24 illustrates the addition of a "satisficer" stage into the hypothesized decision sequence and suggests that cognitive scaling of potential opportunity is made with respect to an appropriate cognized satisficer abstraction of the real world. Strike induced changes in the input variables and in feedback both give rise to alterations in the decision process resulting in boundedly rational spatial choice during the strike.

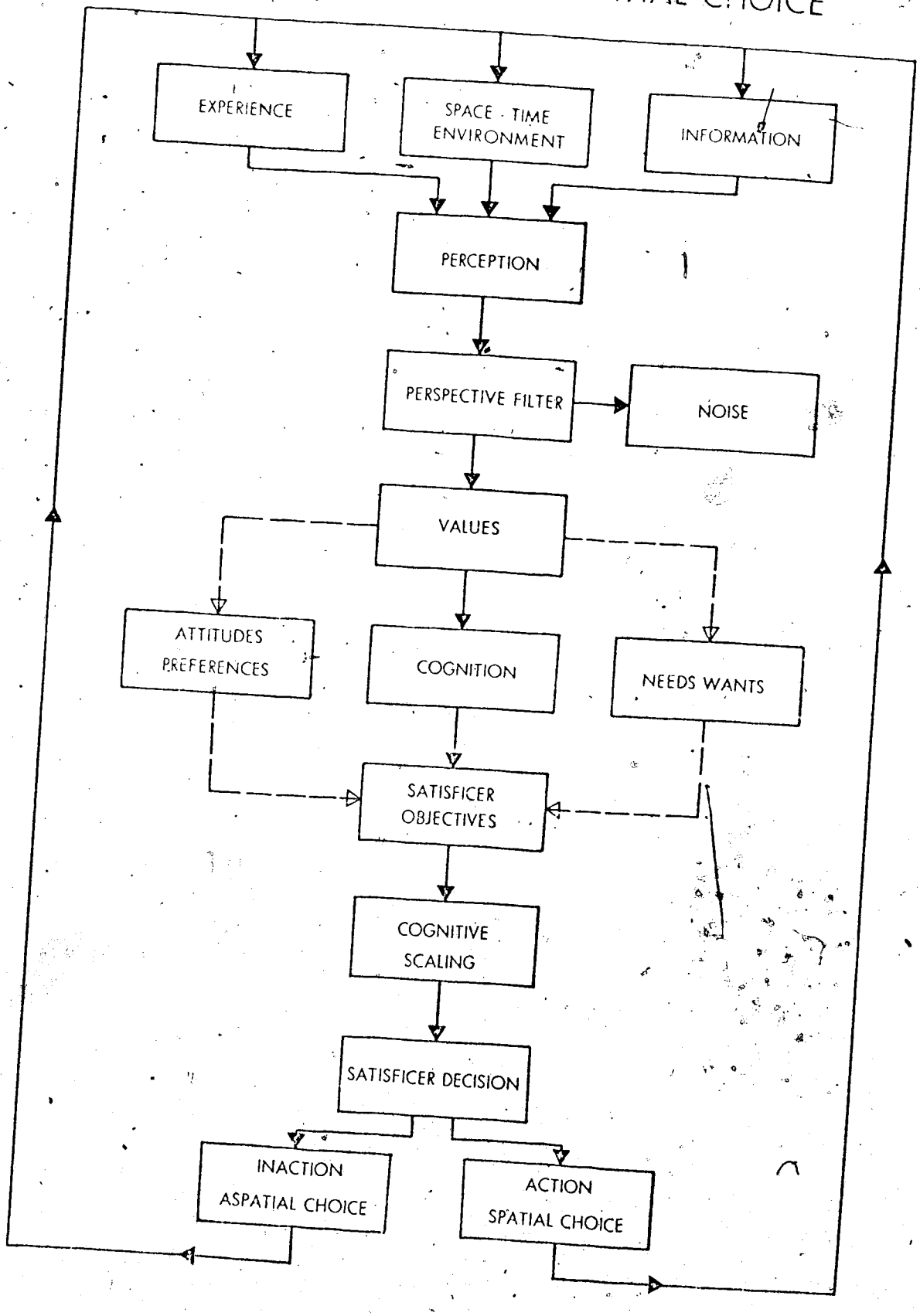
A SUGGESTION FOR FUTURE RESEARCH

It has been emphasized that this activities impact analysis is a broad attempt to operationalize activity system concepts and to experiment with their representation. This thesis has shown that, notwithstanding severe time and data constraints, it is possible to use shock events as objects of behavioural study, and to use the activity systems framework as a conceptual organizer.

In an alternative sense, both Brail (1969) and Chapin (1971) note that there exists a great potential for activity study in the

FIGURE 24

SATISFICER MODEL OF SPATIAL CHOICE



prediction of human spatial behaviour at all levels. In this context, the methodology employed in this thesis and many of the thesis' findings, may be aptly applied to the problem of modelling activity systems change.

The Light Rapid Transit (LRT) scheme proposed for Edmonton provides a case in point (University Practicum, 1973). This plan calls for a major rapid transit line to be superimposed upon existing sets of activity systems. Here, an activity analysis might be used to provide valuable input into transit station location decisions by revealing where existing activity linkages intersect. Unfortunately, many route alignment and location decisions are made with respect to readily available rights-of-way, whether or not the rights-of-way coincide with extant patterns of human behaviour. Space-time budget analysis can help the planner find the point of balance between the path of least resistance and the path of optimum system sensitivity.

The LRT plan also envisages the creation of low order service nodes in the vicinity of the transit line stations. These nodes would house banks, newsstands, even theatres. Again, an analysis of existing activity linkages in the nearby area would provide criteria for evaluating the viability of the proposed nodes, and for assessing the economic impact these nodes may have on other comparable neighbourhood outlets.

In all of these contexts, activity analyses can contribute greatly to the urban planner's understanding of spatial structure, and can aid him in his attempts to respond to the needs and demands of urban residents.

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APPENDIX A

DEPARTMENT OF GEOGRAPHY
TELEPHONE (403) 432-3274

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA T6G 2H4

December 10, 1973.

Dear Fellow Student,

I am a graduate student in the Department of Geography at the University of Alberta, and as a part of my M.A. work I am investigating the impact of the Edmonton Transit System bus strike on students' travel patterns in the city.

The questions which follow are designed to help me interpret what effects the strike may have had on your movements, both in terms of where you travel, and how you travel.

I realize that this is a hectic part of the school year, but I would be most grateful if you would take a few moments to complete the enclosed questionnaire.

Your name has been selected completely at random, and all questionnaire results will be kept confidential and anonymous.

Because of the immediacy of the strike situation it is important that you answer the questions as soon as possible. Return the completed questionnaires in the envelope provided.

I thank you in advance in anticipation of your help.

Sincerely,

B. G. Smith

B. G. Smith

Section I General Travel Information

CHECK THE APPROPRIATE SPACE OR SPACES

1. There was a brief advance warning that a bus strike might occur. Did this prompt you to make any alternate travel arrangements to be used in the event of a strike?

   (a) Yes ___ (b) No ___

2. For which of the following types of trips do you generally use the city buses, when they are operating?

   (a) school trips
   (b) social trips (e.g. to the movies, dancing, etc) ___
   (c) shopping trips (e.g. for groceries or general shopping) ___
   (d) other (please specify)..... ___

3. Do you have access to an automobile?

   (a) your own ___
   (b) father's or mother's ___
   (c) brother's or sister's ___
   (d) aunt's or uncle's ___
   (e) a friend's ___
   (f) other (specify) ..... ___
   (g) do not have access to a car ___ (if (g) go to question 5)

4. Do you have access to the car

   (a) any time ___
   (b) during the day ___
   (c) in the evenings ___
   (d) on weekends ___

5. How do you generally travel to and from the campus when the buses are operating?

	TO	FROM
(a) take bus	___	___
(b) drive car	___	___
(c) passenger in someone else's car	___	___
(d) walk	___	___
(e) hitch hike	___	___
(f) none of these	___	___

6. At approximately what time do you arrive on campus? When do you leave?

		MON.	TUES.	WED.	THURS.	FRI.	SAT.	SUN.
Before Strike	ARRIVE	___	___	___	___	___	___	___
	LEAVE	___	___	___	___	___	___	___
During Strike	ARRIVE	___	___	___	___	___	___	___
	LEAVE	___	___	___	___	___	___	___

7. What is your approximate travel time to and from the campus (in munites)?

		MON.	TUES.	WED.	THURS.	FRI.	SAT.	SUN.
Before Strike	TO	____	____	____	____	____	____	____
	FROM	____	____	____	____	____	____	____
During Strike	TO	____	____	____	____	____	____	____
	FROM	____	____	____	____	____	____	____

8. What is the number of return trips you make to and from campus? (One return trip is from home to campus and back home again.)

	MON.	TUES.	WED.	THURS.	FRI.	SAT.	SUN.
Before Strike	____	____	____	____	____	____	____
During Strike	____	____	____	____	____	____	____

9. In each of the columns below indicate the means of travel you used on the first, second, third, etc., times you travelled to and from campus during the bus strike. If you made two trips on one day, use "1st time" for the first trip, "2nd time" for the second trip and so on.

	1st time TO	1st time FROM	2nd time TO	2nd time FROM	3rd time TO	3rd time FROM	4th time TO	4th time FROM	5th time TO	5th time FROM	6th time TO	6th time FROM	7th time TO	7th time FROM
a. walked														
b. hitched														
c. drove a car														
d. passenger in someone else's car														
e. took a taxi														
f. none of these														

10. Which of the following factors influenced your choice of means of travel?

(a) travel time ____
(b) travel cost ____
(c) reliability ____
(d) comfort ____
(e) directness ____
(f) none of these ____

Section II Information on Movement Patterns

1. Which of the following major shopping centers do you most often visit?

	Before Bus Strike		During Bus Strike	
	Grocery	Other	Grocery	Other
(a) Londonderry	____	____	____	____
(b) Capilano	____	____	____	____
(c) Westmount	____	____	____	____
(d) Meadowlark	____	____	____	____
(e) Northgate	____	____	____	____
(f) Southgate	____	____	____	____
(g) Bonnie Doon	____	____	____	____
(h) Park Plaza	____	____	____	____
(i) Downtown	____	____	____	____
(j) none of these	____	____	____	____

2. Is your selection of shopping place influenced primarily by

	Before Bus Strike		During Bus Strike	
	Groceries	Other	Groceries	Other
(a) distance from home	____	____	____	____
(b) selection of goods	____	____	____	____
(c) quality of goods	____	____	____	____
(d) cost of goods	____	____	____	____
(e) none of these	____	____	____	____

3. In choosing your means of transportation for shopping trips which of the following is most important?

(a) travel time ____
(b) travel cost ____
(c) reliability ____
(d) comfort ____
(e) none of these ____

4. In travelling in the city during the strike what kinds of different establishments you you discovered? (e.g. different clothing stores, drugstores, bookstores, restaurants, bars, nightclubs, movie theatres, grocery stores, etc.)
Please list _____

_____

5. Have most of your discoveries been made while

(a) travelling to campus ____
(b) on shopping trips ____
(c) on social trips ____
(d) miscellaneous ____

6. Have you since been prompted to visit any of them

(a) instead of your usual ones ____
(b) over and above your usual ones ____
(c) visited your usual ones ____

If (a) of (b) what kinds? (e.g. clothing store, bar, etc.)

Please list _____

_____

7. Where do you travel for social, recreational, or nightlife activities? Please specify means of travel used and travel time

	Before Strike			During Strike		
	Visit	Means	Time	Visit	Means	Time
(a) friends or family	____	____	____	____	____	____
(b) U of A campus	____	____	____	____	____	____
(c) Nightspots near home	____	____	____	____	____	____
(d) sporting events	____	____	____	____	____	____
(e) club or community events	____	____	____	____	____	____
(f) downtown	____	____	____	____	____	____
(g) none of these	____	____	____	____	____	____

8. What is your attitude toward the means of travel which you used during the strike?

(a) completely satisfied ____
(b) satisfied under the circumstances ____
(c) not satisfied ____

Age ___

Sex M___ F___

Years lived in Edmonton _____
OR
If Edmonton is not your permanent resident, what is the number of winter sessions spent at U of A including the present one? _____

Live at home? (with your family) _____

Approximate annual income

(a) less than $1000 ____
(b) 1000 - 2000 ____
(c) 2000 - 3000 ____
(d) 3000 - 4000 ____
(e) 4000 - 5000 ____
(f) more than 5000 ____

Thank you very much.

APPENDIX B

DEPARTMENT OF GEOGRAPHY
TELEPHONE (403) 432-3274

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA T6G 2H4

January 30, 1974.

Dear Edmontonian,

I am a graduate student in the Department of Geography at the University of Alberta and as a part of my M.A. work I am investigating the impact of the recent Edmonton Transit System bus strike on the ways in which people move about in the city. The questions which follow are designed to help me in this regard.

You have been selected from a random sample of Edmonton addresses and will remain anonymous. All questionnaire responses will be kept strictly confidential and will be used only as part of my thesis research.

Some of you have received a questionnaire from me before. In that case the present one will serve to clarify your previous replies. In any event none of you will be contacted again in any way.

I would be most appreciative if you would take the few moments necessary to fill in the survey. Return it to me in the stamped envelope provided.

Thank you very much.

Sincerely,

B. G. Smith

GENERAL ACTIVITY QUESTIONNAIRE
Complete the questions below by checking the appropriate space or by filling in the correct blank.

1. Today's date is: Day___ Month____

2. Match the means of transportation used more than any other under the conditions of "before strike", "during strike", and "since strike", with the type of trip.

   B refers to before the ETS strike
   D refers to during the ETS strike
   S refers to since the ETS strike

TRIP TYPE	AUTO B D S	BUS B S	WALK B D S	HITCH B D S	PASSENGER IN AN AUTO B D S	TAXI B D S	OTHER B D S
(a) work trips							
(b) school trips							
(c) grocery trips							
(d) general shopping trips							
(e) social/recreational trips							

3. If you visit one grocery store more than any other what is its approximate address?

   [redacted] and _____Ave.

4. If you visit one social or recreational establishment more than any other what is its approximate address? What is the nature of the establishment (e.g. nightclub, theatre, Legion, club, etc.)

   _____ and _____Ave. Nature of establishment _____

5. As best you can recall what time did you leave for work or school, as a rule, and what time did you arrive at work or school (Students use Monday-Wednesday-Friday as a guideline).

	Left at	Arrived at
Before Strike	_____(a.m.)(p.m.)	_____(a.m.)(p.m.)
During Strike	_____(a.m.)(p.m.)	_____(a.m.)(p.m.)
Since Strike	_____(a.m.)(p.m.)	_____(a.m.)(p.m.)

7. Suppose the location of each of the activities listed below is represented by the number to the right of it:

(a) home..... 1
(b) work..... 2
(c) school..... 3
(d) grocery store..... 4
(e) general shopping place..... 5
(f) social/recreational spots..... 6

You will notice that the things we do on any given day can be characterized by a sequence of numbers, the numbers representing the order in which we go about the activities listed above. In the spaces below fill in the sequence of activities which you followed yesterday, along with the times that you spent travelling from activity to activity, and the times you spent at each activity. For example, yesterday I went from home (1) to the University (3) and the trip took ten minutes. I stayed at school for 6 hours, then returned directly home, again taking ten minutes. After spending about an hour at home I went downtown to a movie (6). The trip downtown took about 25 minutes and I stayed downtown about 3 hours. I then returned home, taking about 20 minutes, and stayed home for the rest of the day. (For purposes of this table, one day runs from midnight to midnight.) According to the time sequence of activities above I would fill in the table as follows:

(a)	to (b)	Time Travelling	Time at (b)
1	3	10 min	6 hrs
3	1	10 min	1 hr
1	6	25 min	3 hrs
6	1	20 min	rest of day

Using the table below, and using my example as a guide, put your sequence of activities for YESTERDAY, along with the appropriate times, in the proper places. Not every activity need occur - mark only the ones you experienced yesterday.

(a)	to (b)	Time Travelling	Time at (b)

8. Again let the following activities be represented by the characters appearing to the right of them. This time the NUMBERS will refer to the location of the activities NOW, and the LETTERS will refer to the location of the activities DURING THE BUS STRIKE

ACTIVITY	NOW	DURING STRIKE
home	1	a
work	2	b
school	3	c
grocery store	4	d
general shopping place	5	e
social/recreational spots	6	f

PART I On the enclosed generalized map of Edmonton mark the location of your home, place of work, and so on, using the activity code above. For example, to mark the location of your home, make a small dot in the correct place on the map and label it "1". Do the same for your place of work and label it "2", and so on.

PART II If, during the bus strike any of the activity locations were different from what they are now, mark them in the appropriate places on the map, this time using the corresponding letter code. It is unlikely that the location of your home, school or job was different during the bus strike, but it is possible that during the strike you decided to shop at a different place, or visit different social/recreational spots. If this was the case, mark the "during strike" locations of the activities on the map using, for example, "d" for grocery store, or "f" for social spot. If the strike did not affect the location of any of these activities you need do only PART I.

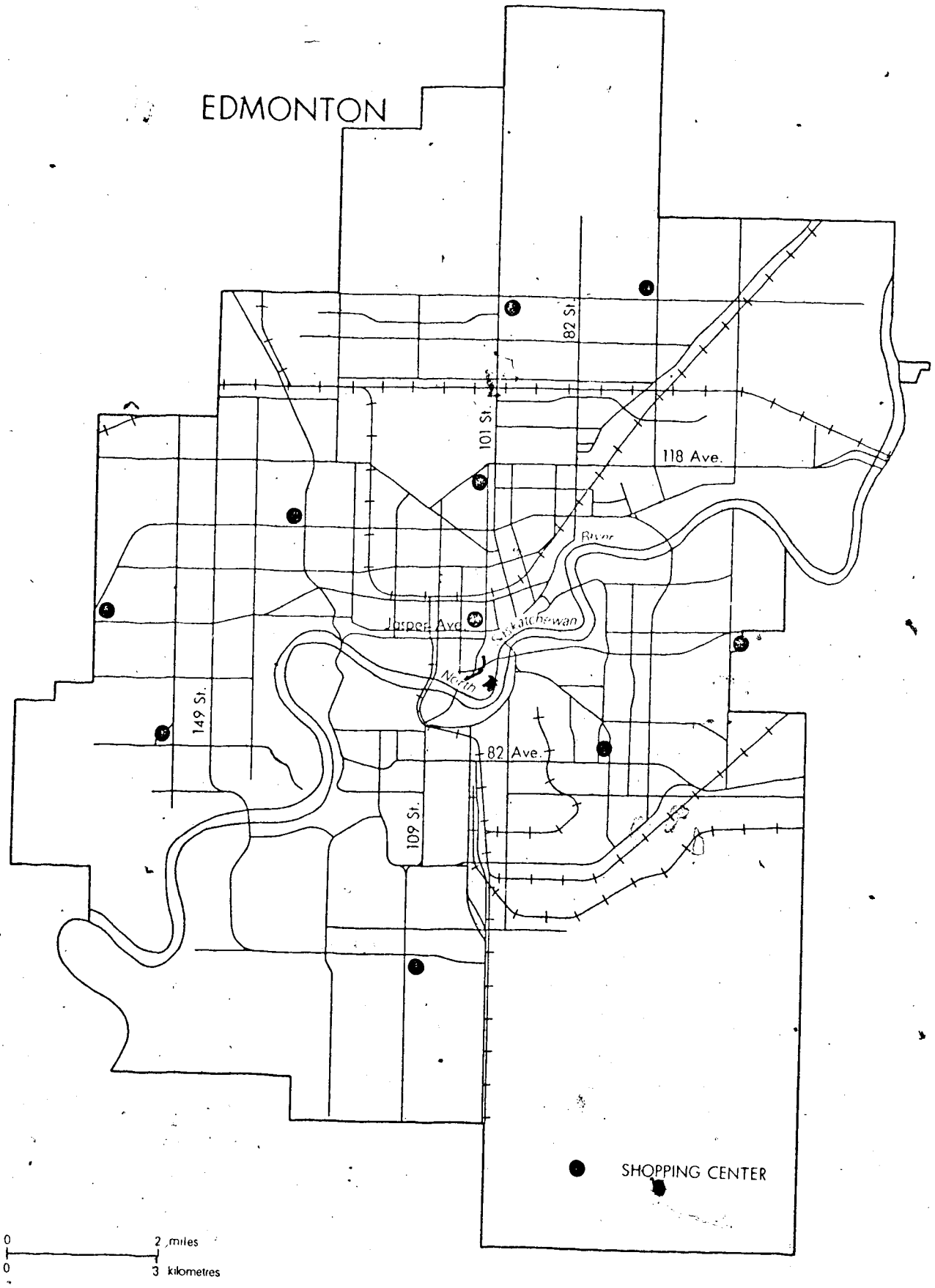
9. Age _____ 10. Sex M_____ F_____ 11. Years lived in Edmonton ___

12. Rent apartment _____ OR Rent House _____ OR Own house _____.

13. Approximate annual income _____

14. Please add any general or specific comments as to how the ETS bus strike affected you:

Thank you very much.


EDMONTON
82 St.
101 St.
118 Ave.
River
Jasper Ave.
North Saskatchewan
149 St.
82 Ave.
109 St.
SHOPPING CENTER
0
2 miles
0
3 kilometres

APPENDIX C

APPENDIX C

CHARACTERISTICS OF EDMONTON SHOPPING CENTERS

Center	No. of Stores	Building Space	Parking Space	Rank (Area)
Downtown	-	2,000,000+	-	1
Londonderry	84	705,831	3,604	2
Southgate	45	686,184	3,500	3
Bonnie Doon	62	494,850	2,500	4
Westmount	48	420,000	2,500	5
Capilano	46	370,000	2,700	6
Meadowlark	80	360,000	3,000	7
Northgate	21	300,000	2,000	8
Centennial	27	282,931	1,500	9
Park Plaza	19	260,000	1,235	10

SOURCES: Brown, 1974, p. 40;
City of Edmonton Planning Department.