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RESIDENTIAL LOCATION OF AGE GROUPS:

DISTRIBUTIONS AND DYNAMICS IN AN URBAN AREA

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RESIDENTIAL LOCATION OF AGE GROUPS:

DISTRIBUTIONS AND DYNAMICS IN AN URBAN AREA

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Residential locations for age groups within Oklahoma City were analyzed in two parts; the structure of age and family life cycle stage patterns at 1950, 1960, and 1970, and the dynamics of aging and aging processes between the three dates. The utility of a factor analytic method in deriving family stages from an original set of age interval data was established. Most importantly, spatial regularities in age and aging were established, with the zonation of family stages evident in factorial ecology elaborated by the recognition of sectoral variation.

Separate models for age and aging were analyzed. Based on continued growth of the urban area, the first model proposed zonal patterning for age and family stages. Sectoral variation based on income differences was also incorporated. Factor analysis of age interval data for census tracts over three dates established that family stages were similar. These derived stages were subject to cluster analysis, incorporating effects of all stages on census tract characterization. Family stages were zonally arranged with child absent families near the city center, ringed by successive younger family compositions. Over time, older family stages encompassed more area, indicating locational stability for age cohorts. The high income sector had older ages predominating while younger ages were more evident in the low income sector. The black area appeared as a non-conforming region. Age differentiation was not evident for 1950, but by 1970 it developed its own zonation. The structural analysis established locational variation for age and family stages, and viewed over time, indicated an aging process.

The second model emphasized age change patterns and processes. Zonation of aging was proposed, based on maturation of locationally fixed age cohorts. Each zone had sectoral variation based on income or ethnicity. Results from factor analysis and clustering supported the model. The central area had a static age composition, surrounded by several maturing zones, each at a later maturation stage than its outlying neighbor. Sectoral variation was unexpectedly important with older ages dominant in the high income sector and younger ages in the low income sector. Spatial constraints for blacks were evident. With little original age differentiation, the black area developed an aging sequence similar to the rest of the city over time. Exceptions to the aging model were related to expansion of the housing stock, income differentials, and ethnic status.

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CHAPTER 1

INTRODUCTION

Age is a fundamental social element for it is a key variable in forecasting structural changes in an area's social organization (Bogue, 1969, 147; Smith, 1948, 88). Consequently, understanding processes that lead to spatial variations in age composition is a necessary prerequisite to comprehending spatial variations in social structure. Despite the important role of age in fostering structural changes, geographers have not focused their analysis on this key variable. Consequently, little is known about the spatial patterns of age compositions and the spatial dynamics of age change.

The relevance of age as an element of social change has been documented at different scales from the national to the local level.[1] The focus of this research is at the local level, primarily because it is at this scale that there is a major void in empirical and theoretical studies. Specifically, the interest is the intra-urban spatial variation of age compositions and age structures.

The problem investigated in this research is the identification and explanation of the spatial regularities in population age composi-

[1]For pertinent materials see the bibliographies in Bogue (1969, 171-172) and in Shyrock and Siegel (1973, 249-251).

tions and age dynamics within an urban area. As noted, most demographers and sociologists readily accept the key role of age in influencing social structure. However, statements about age composition within different portions of urban areas have been lacking in the literature. The importance of age has been overlooked in the quest for more elaborate and detailed models of urban socio-economic structure.[2] This has resulted in a serious gap in our understanding of urban spatial structure, a gap which demands careful attention by the urban researcher.

Importance of Urban Age Analysis

The rationale for focusing on age rather than the family life cycle in this paper is three-fold. First, age is the underlying variable in the determination of family life cycle stage. Use of age measures and the methods suggested herein can better define family life cycle stages than pre-imposed arbitrary groupings usually used. In turn, tightly defined family stages have advantages over the broad usage of family cycle within family or urban dimensions of factorial ecology. In factorial ecology family status is a complex of variables more or less differentiating between child and non-child family stages. The simple zonation resulting from these broadly defined stages may in fact be more complex in its spatial patterning when age and individual family stages are separately analyzed. Evidence hinting this has appeared in the literature (Sweetser, 1964; 1965; 1966; 1969; Janson, 1969,

[2]For examples see Colenutt (1970) and Sweet (1972).

Abu-Lughod, 1969; Berry and Rees, 1969; Rees, 1970) but no detailed investigation has come forth analyzing the patterning of age and family stages.

Additionally, because of their role in social change, age composition and age dynamics must be key elements in any planning activity (Chapin, 1965, 214). Age characteristics of a population, alone and as determinants of other population characteristics, are directly related to the social and economic character of small districts within urban areas. Age is a basis upon which community organization is constructed. Also, it is fundamental to urban differentiation; distinct age and sex combinations reside in urban sub-areas. Intra-urban variations in many socio-economic characteristics may be traced back to age as an underlying differentiating variable (Hoover and Vernon, 1959; Huff, 1960; Myers, 1964). Thus, provided with knowledge of urban age distributions and their evolving patterns, it becomes possible to anticipate changes in related socio-economic characteristics.

Also, age reflects the dynamic processes of urban growth and change in terms of the natural demographic factors of birth and death, and of selective migration. While age has been given consideration in social planning, age analysis in the context of urban planning has not received due attention. The case for urban age analysis has been stated by Coulson (1968, 155).

> Age structure is, potentially a very powerful planning tool. The potential, however, is largely unrealized in practical planning and indeed virtually nothing is known about within-city age structure distributions and their meaning. If efficient services

> are to be provided for the inhabitants of a neighborhood, then a knowledge of their age structure is essential. A park with swings and slides in an area of retired couples would look foolish: public ornamental gardens hardly suit the needs of young families. From a different perspective, what will happen to a neighborhood's age structure over the course of time? Are we building schools in new suburbs to serve a single generation of children? Should we build such services to last or should we gear them for later adaptation? Present knowledge scarcely scratches the surface of these questions. Yet how many of the necessary community services are dependent more on the age structure of the population than on any other single criterion?

Age as a Variable in Urban Analysis

There are several lines of inquiry that have addressed age distributions within urban areas. They constitute a framework for understanding the role of age in the broader context of the spatial configuration of urban social organization. Most relevant for our purposes are social area analysis and factorial ecology.

The operational techniques and theory of social area analysis have been presented in a series of papers (Shevky and Williams, 1949; Shevky and Bell, 1955; Bell, 1958; McElrath, 1965; McElrath, 1968). As originally formulated social area analysis was almost entirely descriptive in function. A social area consisted of census tracts which resembled one another on indices of social rank, urbanization, and segregation. The construct of urbanization was evidenced by a widespread variation in family types brought about by economic differences in societies. Social area analysis came under criticism both on theoretical and empirical grounds (Hawley and Duncan, 1957). Bell (1955; 1968) attempted to answer some of the empirical criticisms, resulting in modifying the original constructs to economic status, family status, and ethnic status.

Family status is more limited in intent than urbanization, referring to differences in preferences for family type. Family status centers on the variation of age composition and related socio-economic indices between census tracts, differentiating between small households of married couples and single individuals and larger households of families with children.[3]

Factorial ecology also recognized three dimensions in intra-urban variation. Additionally, each has distinct spatial structure. Economic status varies sectorally, family status varies zonally, and ethnic status has spatial variation centered upon nodes.[4] Berry (1965b, 115) states that these three factors and their associated spatial patterns are additive, and combined they define urban socio-economic spatial structure.

As in social area analysis, age is an important variable in the family status dimension of factorial ecology (Rees, 1970, 311). Children are absent from central areas of the city while they are relatively

[3]Timms (1971, 123-210) has a comprehensive discussion of social area analysis.

[4]Sectoral variation was originally proposed by Hoyt (1939), zonal variation by Burgess (1925), and nodal variation by Harris and Ullman (1945). Several comparative analyses of the original propositions for urban structure are available, as Murdie (1969, 10-17), Rees (1970, 306-311), and Timms (1971, 211-234).

abundant in outlying areas. Family structures in central areas consist primarily of young adults and old couples and singles, whereas in peripheral areas more typical nuclear families dominate.

Clearly, locational differences in family structure involve an age factor. Census tracts having older age compositions are found in central locations while tracts with young age compositions are located in peripheral areas of the city. Thus age is an important contributory variable in urban analysis, usually in the context of family differentiation, and when spatial variation is of concern, the zonal variation in family size.

Problems for Investigation in Urban Age Distributions

Variation in urban age distributions is well established by social area analysis and factorial ecology, but at an aggregate level of generalization and only in combination with other social variates. To date, little effort has been made to examine age compositions and age structures in detail for urban areas of North America (Coulson, 1968, 156). Until this is done, a gap remains in the knowledge of age and family stage patterning. Further, few attempts have been made to analyze age composition change over several decades for any major urban area.[5] Finally, results of principal components analysis indicate that

[5] The only intra-urban studies of age change known to this author are Franklin, Treeby, and Gibson (1963), Curson (1967), Sanders (1968), and Sanders and Adams (1971). Rikkinen and Alanen (1969) is the only study of areal age change to include territory beyond the settled margins of the urban area.

family status is not unidimensional (Janson, 1969; Berry and Rees, 1969). Depending upon the degree of economic development, the amount of minority segregation, and the number of age measures included for analysis, the number of family dimensions varies.[6] This strongly suggests the need for greater detail in the analysis of the role of age in urban differentiation.

The general statements about age made by social area analysis and factorial ecology indicate a detailed investigation of age variation within urban areas is needed. There are, however, several basic questions dealing with urban age compositions awaiting detailed analysis. First, what are the interrelationships among age groups when examined for small unit aggregates as census tracts? Until now only broad age categories have been analyzed, making statements about specific age groups impossible. Second, what spatial patterning do these interrelated age groups exhibit? Is there, as factorial ecology suggests, a zonal pattern to age distribution? Or, have analyses to date been too broad in approach, masking details that could be observed when considering age alone? Third, what are the dynamics of age in an urban area?

[6]Abu-Lughod (1969), in an analysis of Cairo, Egypt, found that social status and family status sets collapse to a single dimension, "Style of Life", in which class and family status are inextricably linked. In a study of the central city of Toledo, Ohio, the set of life cycle variables split into two subsets which appear on separate dimensions (Anderson and Bean, 1961). Sweetser (1965) reported that in an analysis of Helsinki, two family stage factors appeared. In another study of the same city using an expanded variable set, he recognized three family stages, "Progeniture" (young familism), "Established Familism", and "Postgeniture" (Sweetser, 1966, as discussed in Janson, 1969).

Are there changes in structural relationships among age groups over time? Also, what changes are there in the spatial arrangement of age groups over time? These are the specific questions to be analyzed in this research.

That age is elemental in any analysis of population composition is readily accepted. Thus, the study of spatial variation in age composition and change within urban areas is important to understanding urban social structure. Many types of planning, particularly planning of community institutions and services require knowledge of age composition. Age is an important variable in measuring potential school population, the potential voting population, potential manpower, and even growth potential of the population. Knowledge of age distributions is required for preparing projections of households, school enrollment, and labor force; and for projections of requirements for schools, recreation facilities, health services, food, and housing. This research begins to fill this gap by studying the variation in composition and dynamics of age within the urban area of Oklahoma City for several time periods.

CHAPTER 2

DEFINITIONS AND CONCEPTS IN THE ANALYSIS OF AGE

Age is that length of time, measured in whole years, since a person's birth (Shyrock and Siegel, 1973, 201). As a characteristic for study, it has the inherent advantages of 1) universality, it is present among all members of a population and can be measured for those members who are aware of their birth date, and 2) uniformity, everyone ages at the same rate. Except for sex composition, it is the most accurate and complete measure of population composition available (Shyrock and Siegel, 1973, 203). Its change over time can be associated with other characteristics, both for individuals and for population aggregates.

Despite the importance of age and the analytical advantages of using age as a social variable, much confusion exists in studies that focus on age. Much of this confusion is the result of misuse of concepts and lack of clarity in definitions. Because of this it is important that basic concepts and definitions be discussed so that the models presented in the research are not misinterpreted.

Composition-Structure

Age composition is the distribution of ages, over several age group intervals, for all members of a population (Chaddock, 1936, 185).

The group intervals may vary, but standard procedure normally uses five-year cohorts. Consequently, unless specified otherwise, age groupings used herein are five-year intervals of 0-4, 5-9, ..., 65-69, 70-74, and the final open interval, 75 and over. Age structure is a summary expression of age composition, the form that the total age composition takes on, as a population pyramid (Coulson, 1968, 155). Age dynamics is the change in age composition over a specified period of time. If the change is substantial the age structure of the population may be altered. However, change in composition by itself does not necessarily lead to structural change, since structure is a relative rather than an absolute concept.

Individual and Family Life Cycle Stages

Using single year intervals for age composition analysis is possible, but unnecessary. The variate age can be grouped into intervals characterizing stages in an individual's life cycle. Moreover, in a social context, life cycle is more significant than chronological age in its relationship to other social variables. While no categorization is ideal, two used by the Census Bureau (Table 2.1) are illustrative of widely accepted age categories.

Individuals, of course, do not exist in isolation. There are reciprocal relationships present among individuals in family groups, as parent and child, and husband and wife. The family life cycle refers to changing family compositions and individuals' position within the family

Table 2.1

Individual Life Cycle Stages

Detailed Stages	Ages	Ages	Broad Stages
Infancy	<1		
Early Childhood	1-5	0-8	Childhood
Late Childhood	6-8		
Preadolescence	9-11		
Early Adolescence	12-14	9-17	Youth
Late Adolescence	15-17		
Early Maturity	18-24		
Maturity	25-44	18-64	Adulthood
Middle Age	45-64		
Early Old Age	65-74	65 and over	Old Age
Advanced Old Age	75 and over		

Source: Bogue (1959, 96).

structure.[1] Family life cycle stages are based on the developmental sequence within a family and the position and age of individual family members. Transition from one stage to another is associated with change in family size and age composition of members.

[1]Extensive work on the family life cycle, its characteristics and attributes has been done by Glick (1947; 1955; 1957) and Glick and Parke (1965).

A substantial body of literature has developed dealing with family life cycle stages in the urban context.[2] Several typologies for family life cycle stages have been used (Rowe, 1966). The one used in this research (Table 2.2) consists of grouped five-year age intervals

Table 2.2

Family Life Cycle Stages

Stage	Typical Ages	Description
Young single	18–24	Establishment of separate household away from parental residence
Young couple	20–29	From marriage to birth of first child
Expanding family	25–34 0–10	Children being added to family
Stable family	30–44 5–19	Family size constant with children maturing
Contracting family	40–54 10–19	Children leaving parental residence, family size decreasing
Old couple	50–74	Children gone, family size constant
Old single	70 plus	Widow(er) living alone after death of spouse

Source: Author based on Glick (1947; 1955), Glick and Parke (1965), and Rowe (1966).

[2]Several examples are Lansing and Kish (1957), Foote, *et. al.* (1960), Leslie and Richardson (1961), Edwards (1970), Speare (1970), Brown and Holmes (1971), and Guest (1972).

which are sometimes overlapping and represent stages in the family cycle.

Areal Scale as a Limiting Factor

An important consideration in any geographic study of age is the areal scale of investigation. Age composition has been analyzed at national, regional, and state levels. However, the availability of data lessens and the number of studies diminishes with decreasing areal size. Smaller areas, as cities, usually are investigated as complete entities within a larger set of several cities. Studies of age variation within single cities are lacking.

The paucity of age analysis using small areal units as census tracts within cities is due in part to data deficiencies on the population dynamics of small areas. Age composition data is available for intra-city analysis at decade intervals, but data for population dynamics--natality, mortality, and migration--usually is unavailable for small urban districts. The rapidity with which migration can affect the population composition within an area means the absence of migration data is significant when trying to understand the processes influencing age composition. In its absence inferences about migration from age composition must be used.

Age Change: The Demographic Equation

Change in population characteristics of an area are limited by the processes of natality, mortality, and migration. This is expressed as:

$$C = B - D + M_i - M_o \, , \qquad (2.1)$$

where change in population numbers (C) is due to additions by birth (B) minus deletions because of death (D) plus in-migration (M_i) and minus out-migration (M_o) (Barclay, 1958, 2). Since net migration is a summary expression of the migration component, equation (2.1) is usually shortened to:

$$C = B - D \pm M \, . \qquad (2.2)$$

Natality, mortality, and migration all affect the age composition of a population. Mortality influences age composition by events like epidemics, wars, and rapid change in infant deaths. Natality, on the other hand, has more enduring effects. Moreover, differences in birth rates are the principal explanation for differences in age compositions for large areas (Bogue, 1969, 149).

The aging process for a population is a direct outcome of the demographic equation. Usually when births exceed deaths, or when there is a net inflow of younger age groups, and/or a net outflow of older age groups, a population becomes younger. Conversely, when deaths exceed births, or with a net outflow of younger age groups, and/or a net inflow of older age groups, a population is aging.

Migration is almost negligible in its effect on age compositions at national levels. Only where immigrant and emigrant populations are extremely large in comparison to total population is the process important to age composition. As the size of the study unit decreases, however, the importance of mobility increases (Bogue, 1969, 757). At the local level mobility is the principal cause of change. Also, at the local level mobility is indirectly responsible for age changes due to natality and mortality. For example, mobility influences the natality potential within small areas. Ages 20-35 have the highest propensity for movement of any age group, and this group also encompasses the major child-bearing ages (Bogue, 1969, 761 and 658).

Age composition is known at any time if the number of births, the age at death and number of deaths, and the age of each migrant is known. Of these migration data are least recorded and of poorest quality. Because of the absence of reliable migration data for intra-urban units alternate procedures for estimating migration effect are necessary.[3] Reliable estimates of net migration can be obtained by use of age specific birth rates and age specific death rates if the age composition for two points in time is known (Barclay, 1958, 203ff.). Although migration registers are not maintained in the United States, good quality records of births and deaths are available, rendering age composition and age dynamics the most complete and accurate measure of population characteristics and change available (Bogue, 1969, 154).

Age Change in a Spatial Context. The process of individual aging or a population becoming older is termed maturation or maturing. Individuals cannot become younger, however, it is possible for a population to become younger. The term youthing has been used for this situation

[3]For examples of methods to overcome the lack of migration data for small areas see Greenberg (1972) and Greenberg, Krueckenberg, and Mautner (1973).

(Shyrock and Siegel, 1973, 234). Youthing implies a gradual process typically observed when births exceed deaths and the percentage of the population in young age intervals increases. Rejuvenation has also been used to describe a youthing process (Rosset, 1964, Chap. 4), however, it implies sudden changes in age composition. In this research it is restricted to changes caused by movement where old members of a population are replaced by younger individuals.

Intra-Urban Spatial Variation in Age

There is a limited amount of literature dealing with age composition. The paucity of data and the problems in estimating age dynamics within small areas has caused most social scientists to ignore this intra-urban process. Age receives general recognition as a component of the family life cycle, but age by itself and as a means of delimiting family stages receives limited attention.

Sociological Studies. One of the few to deal with age composition variation within the city is Schmid. He described age structures for nine selected census tracts within Seattle for two dates (Schmid, 1944, 1968). For both, the selected tracts illustrate age structures for various locations within large American cities. Age structures typical of locations near the city center are characterized by population pyramids with excessive numbers of elderly individuals. Newer housing areas on the periphery of the city are where young children dominate. Schmid's characterizations have been accepted by many as being the typical intra-city age patterns (Table 2.3).

Table 2.3

Age Composition of Select Census Tracts,

Seattle, 1960

Description	Location	Age Composition Characteristics
Central Business District	CBD	Pronounced excess of males (85%) and very small proportion of children (1.4% under 15)
Apartment and rooming house	Central	High proportion of female (59%) and small proportion of children (2.4% under 15). Excess of elderly (27% over 65)
Old former satellite; business, industrial, residential district	Outlying node	Almost identical to entire city
Transitional areas a- Skid row b- Chinatown c- Unstable proletarian white	Adjacent to CBD	Heavy preponderance of male (73% to 89%) especially in older age categories
New growing middle class area	Periphery of city	High proportion of children (34% under 15) and few old people
Public housing project blue collar area	Not given	Extremely high proportion of children (48% under 15) and high proportion of adults in childbearing ages
Negro family area	Not given	Proportion of children above city average (32% under 15) and older ages below average

Source: Schmid (1968).

Schmid admits the nine types were selected because of their extreme compositions. Gradations, more informative because of their transitional quality, are not presented. Locational characteristics of each census tract are not detailed. One must generalize to all age compositions and all locations.

Myers (1964) analyzed age changes within census tracts for two cities, Rochester, New York and Seattle, Washington. The comparative aspect of the work was diminished because the age variables used were limited to percentages under age 15 and over 65. Goldscheider (1966), like Myers, examined longitudinal trends in age structure, considering age changes in Los Angeles from 1940 to 1960. Unfortunately, again the age characterizations were gross, under age 65 and 65 and over. He found both age groups increased in newly built areas but the under 65 group increased at a greater rate.

Age within the city has been dealt with by sociologists, but the approaches have not emphasized locational considerations. Usually, studies disregard location entirely or, as Schmid (1944, 1968), are too locationally specific. When location is considered as a variable, approaches have been too general in the categorization of age.

Zones of Age Recognized. Several works have dealt with the spatial variation of age composition and age dynamics within Australian and New Zealand cities. Franklin, Treeby, and Gibson (1963) present a description and classification of age structures within Wellington, New Zealand. Some use is made of five-year age groups, particularly for population pyramids. The bulk of the discussion, however, relies on only three age categories, percentage of the population aged under 15, 15 to 64, and over 64. Five demographic areal types are recognized and their pattern indicates concentric zonation about the CBD.

Curson (1967), dealing with Auckland, New Zealand, extended this typology of age structures to eight zonal types. He also considered changes in population age structures over time. Centrally located districts became older, eventually to a terminal state called senility. Outlying districts at any stage in the city's development had very strong youth components. Johnston (1971b) summarized these zonal types (Table 2.4), and Roland (1971) continued this line of inquiry, focusing on the sub-population of Maoris in Auckland, and their differentiation from the majority. Johnston's summary serves as a basis for the models developed in this research.

The most comprehensive analysis of the spatial variation of age within American cities is Coulson's (1968) study of Kansas City. An age structure index is used as a single expression for the age composition of any census tract. The index is derived from the slope of a fitted least squares line to the population in each five-year interval within a census tract. Multiple regression techniques are used to isolate variables that are statistically related to spatial variation in the age structure index.

Coulson's age structure index is used to investigate age changes in Cleveland's ghetto from 1940 to 1965 (Sanders, 1968; Sanders and Adams, 1971; Adams and Sanders, 1969). For Cleveland the oldest age structures are found in central ghetto locations at all dates. During

Table 2.4

Zonal Typologies of Urban Age Groups

City	Wellington, New Zealand, 1956		Auckland, New Zealand, 1961
Population	138,300		143,583
Study Units	36		65
Zone	**Description**	**Zone**	**Description**
I.	Senile CBD - dominated by young adults, especially males, ages 15 to 35. Also a fairly high percentage of old persons, and almost no children.	I.	Senile - dominated by ages 15-24 and 45-59.
II.	Old - high percentage of persons aged over 64.	II.	Old - slightly older persons and young adults than previous type.
III.	Mature - most even distribution of age groups for five types suggesting a mixture of households at all stages of the family life cycle.	III.	Late Mature - more balanced structure than above two types, but with continued dominance of young adults.
IV.	Early Mature - differs from Mature by larger number of children, modal age group 0-4.	IV.	Mature - similar to Late Mature, but smaller proportion of old persons.
IVa.	Composite Early Mature - bi-modal age composition, peaks for 5-9 and 45-49, indicating families beyond child bearing stage.	V.	Early Mature - modal ages 10-19 and 40-49.
V.	Young - up to 40 percent under age 15, characteristic adult ages 30-40 and very few old persons.	VI.	Transitional to Early Mature - almost one-third of population under 15.
		VII.	Late Youth - dominated by children but also small older element present from previous settlement.
		VIII.	Youth - one-quarter of population under 10 and very few over 45.

Source: Franklin, Treeby and Gibson (1963), Curson (1967), and Johnston (1971b).

later years secondary centers of old age develop. All old centers are surrounded by tracts of youthful populations. The age structure of the peripheral areas is found to be a function of their distance from areas of old population. Over time this differentiation in age structure intensifies.

The Age Component in Urban Social Structure

Besides specific age studies, age as one component in urban socio-economic differentiation is the subject of a large body of literature including social area analysis and factorial ecology. In these approaches age usually is incorporated as a part of the family status or life cycle factor.

Social area analysis has been subjected to controversy. It has matured since its original formulation and now has some theoretical basis. However, it lacks the universal validity that was originally claimed. It appears to fit the structure of the modern city very well, and in an empirical context it provides a simple framework for comparative analyses (Timms, 1971, 209).[4]

Life-Style--Family Life Cycle Stages. On the basis of the family status construct in social area analysis Bell (1958) proposed life styles for urban dwellers consisting of career oriented, consumer oriented, and family oriented. In terms of spatial choice of residential location, career and consumer oriented opt for accessibility over space amenities

[4]Timms (1971, 150) lists over fifty studies illustrating uses of social area analysis.

and locate near the center of the city. Family oriented are thought to choose space amenities and opt for peripheral locations where space is relatively cheap and abundant (Johnston, 1972).

Life style orientations may be restated in terms of the family cycle. The family oriented life style is associated with the expanding, stable, and contracting family stages of the life cycle. Young couples, not yet at the expanding family stage, and old couples, beyond the contracting family stage, are likely to choose career and consumer oriented life styles. Old couples, however, often are reluctant to give up residential locations chosen during earlier family stages because of long term ties to a neighborhood (Land, 1969).

Hoover and Vernon (1959) document the variation in location for family stages within the Greater New York urban area. They state, "(f)amilies with children are more likely to locate in suburbs than single workers or childless couples, who more often gravitate to central areas" (178). Also, mobility is age selective. "Net migration into the suburbs (is) heaviest in age groups corresponding to young married couples and their children (25-34 and 0-9 years).... The higher the proportion of children in a household, the stronger is the incentive for a family of some given income to seek lower density, single-family housing ... in communities with agreeable neighborhood conditions and good schools" (177-178). Income differentials are also important in the location of age groups. High income families locate in low-density, usually peripheral, communities as soon as children appear whereas lower income families can not afford to make such moves (178-179).

Stage in the life cycle influences life style choice, and stage in the life cycle is directly related to age. Child absent families, especially the young, are more inclined to choose career and consumer oriented life styles. Valuing accessibility over space, they locate in central areas of the city. The family oriented are found in more spacious peripheral locations. Further, for the family oriented, differentiation in age is according to economic status. High income families seek peripheral locations at an earlier point in the family life cycle.

Age in Factorial Ecology. The validity of variables proposed by Shevky and Bell for social area constructs has been tested since their formulation. The constructs, economic status, family status, and ethnic status were validated in six of ten cities investigated (Van Arsdol, Camilleri, and Schmid, 1958). In four other cities, however, the results suggested the existence of constructs could be left to be empirically determined by the pattern of variables.

Schmid and Tagashira (1964) attempted to determine the number of variables necessary to encompass the three social area constructs and at the same time describe the spatial variation of each construct. By successively eliminating lesser important variables from principal components analyses of census tracts in Seattle, a set of ten variables was determined to sufficiently represent the three dimensions of social area analysis. The family status dimension was described by four age related variables, percentage less than age 15, percentage married, percentage of females in the labor force, and household size. Family status was found to be zonally arranged. Zones close to the city center had low family status, implying from the definition of family status, that proportionately few children were present. As zones became further removed from the city center, family status increased, indicating an increased presence of children.

Based on samples of census tracts in four cities, Anderson and Egeland (1961) also found a zonal patterning to family status. More recently, use of principal components analysis for intra-urban socioeconomic differentiation consistently shows the zonation of age and age related measures in the family status dimension.[5]

Family status is not always unidimensional (Janson, 1969). Depending on the number of age variables included and the absence of minority groups to form an ethnic status dimension, two or more family status dimensions may appear.[6] Splitting of the family status dimension is attributed to cultural differences and to the degree of spatial differentiation in housing choice within an urban area (Berry and Rees, 1969). Economically advanced cultures, with a spectrum of life style choices and equivalent residential locations, exhibit at least one family status dimension. Cultures where minority spatial segregation is minimized, or where significant minorities are absent, exhibit segregation by age groups and have two or more family status dimensions

[5] Many studies could be cited, instead the interested reader is referred to the comprehensive listings of intra-urban factorial ecology studies by Rees (1971; 1972).

[6] Janson's conclusion is based on the results of Sweetser (1964; 1965; 1969), and Janson (1968). It is also substantiated by Berry and Rees (1969) and Abu-Lughod (1969).

(Sweetser, 1964; 1965; 1966; 1969).

Summary

The presence of a family status dimension is well established for western societies having spatial segregation of minority groups. Family status varies concentrically within cities, with census tracts having older age compositions found in central locations and tracts with younger age compositions located in peripheral areas. Variation in age group distributions within urban areas is well established by social area analysis and factorial ecology.

It remains to be shown, however, that age has the same spatial configuration when examined independently. Except for the studies of Franklin, Treeby, and Gibson (1963), Curson (1967) and Sanders (1968), the dynamics of age within urban areas is yet to be investigated. Also, the appearance of two family cycle dimensions emphasizes the need for expanding the entire dimension for detailed analysis. Through such an expansion better understanding of the processes leading to spatial differentiation of such stages can be achieved.

CHAPTER 3

LOCATIONAL VARIATION IN AGE COMPOSITION AND AGE DYNAMICS: TWO MODELS

The spatial patterning of age composition as presented in social area analysis and factorial ecology consists of concentric zones about the city center. Both old and young, couples and singles without children are concentrated in interior locations. Older couples, families with adolescent children, and finally, expanding young families with pre-adolescent children are encountered at successively greater distances from the center. It remains to be established, however, whether age compositions and family life cycle stages, when analyzed separately, actually conform to this concentric zonation.

In this chapter, to evaluate the spatial patterning of age and family stages, several assumptions about population and housing characteristics within an urban system are offered. By relaxing certain assumptions, a general model for the locational variation in age and family stages is obtained. From this, an aging process for residential areas is proposed under conditions of no intra-urban mobility. Finally, a spatial model for age dynamics within an urban area is proposed, incorporating all elements of the demographic equation (Equation 2.2).

The Urban Population System

An urban area is not a closed population system. For several generations in most urban areas births have exceeded deaths. Also, there is constant movement in and out of the urban area with a net flow of in-movement. This net in-flow is present for all age groups, nevertheless it is age selective, with the greatest numbers for ages 20-35.

Net in-movement, along with natural increase, creates demand for additional housing. Also, most urban residents do not inhabit a single dwelling throughout their life (Land, 1969), and seek housing above previous standards when they move within the city. Consequently, there is continued mobility within an urban area, above that caused by creation and dissolution of households and in-migration. Migration, mobility, and natural increase all affect the distribution of age and family stages within an urban area. Their effect, however, is closely tied to the functioning of the urban housing system.

The Urban Housing System

All residents of an urban area need housing. The decision with regard to type and location of this need is to a considerable extent related to the age of the individual seeking housing. However, there are several factors to consider when dealing with the residential selection process.

First, all housing is not of the same quality. Determinants of quality are age of the house, quality of construction and maintenance, and usable space, both interior and exterior. Situational characteristics like the physical characteristics of the neighborhood, the social environment, quality of services and facilities, and proximity to employment, shopping, and schools also influence perceived housing quality (Brown and Moore, 1970; Moore, 1972). Still, if site and situation characteristics of housing were the only determinants of residential location preference, the problem of age distributions would be explainable in relatively simple terms. However, additional factors, like resource availability for housing consumption and changing demand for housing brought about by differential birth and death rates and population mobility, also contribute to differential age distribution. These must be incorporated into any model of urban age patterning.

Characteristics of Urban Housing. Home construction in United States cities has been subject to wild ups and downs (U.S. Bureau of the Census, 1966, Table A-1). This fluctuation is in part a function of the industry's narrow profit margins. Also, the industry must anticipate demand at least six months in the future to insure a competitive position. One result is that new housing construction usually occurs on the urban fringe, bypassing vacant lots in more interior areas (Hoyt, 1939, 95). This outward focus in construction results in zones of successively newer housing surrounding the central core of the city. Homes within each zone are homogeneous in terms of age.

Eight residential building booms have been recognized between the end of the Civil War and 1960, with each construction cycle subject to constraint by transportation technologies of its period (Adams, 1970, 48ff). Variation in dwelling arrangement and lot size arose within each zone, in order to maintain accessibility for new residents to the remainder of the urban area. After introduction of the automobile, the demand for multiple unit dwellings as apartments decreased. In their place arose units set individually on lots of ever increasing size. Eventually these new units increased in size, as real incomes rose and urban dwellers were able to consume more interior housing space.[1] Given locational inertia among older residents and current preferences for large interior spaces and large lot sizes, characteristics of the housing system along with those of urban populations combine to influence locational variation in age and family stage.

Households evaluate housing site and situation characteristics differently depending on stage in the family cycle. Characteristics that bear directly on the age of the population include size of dwelling, size of lot, and nearness to amenities. Large and expanding families have need for more interior space than families not in child rearing stages. Families with children also have need for open space as play areas around the house and in neighborhood playgrounds. Nearness to schools is important for child rearing families while proximity to social and recreational amenities is more important for child absent families.

[1]Not all older housing is smaller in interior space as Adams (1970, 50) and Firey (1947) recognize. Certain older residential areas are very high status locations and have retained this high status over many decades. Housing in these areas often is very large in interior space, larger than currently constructed housing.

Population, Income, and Housing Assumptions for Residential Location of Age

To establish locational variation by age and family life cycle stage some limiting assumptions for population and housing in an urban system are made:

Population Assumptions

1 - Closed system - no movement in or out of the urban area

2 - Stationary population - births equal deaths[2]

3 - Limited mobility - households once established in location do not move

Income Assumption

1 - Equal resource availability per person for housing

Housing Assumptions

1 - Stages of housing construction

2 - Zones of housing internally homogeneous by age of dwelling

3 - New housing added at margins of urban area

4 - Increase in total resources available for housing over each construction stage

5 - Increase in unit size over each construction stage

6 - Increase in lot size over each construction stage

[2]For a brief explanation of stationary population see Heer (1968, 81-82), also Hawley (1959, 370-372). A more complete work is by Beverage (1966).

Population and income assumptions are relaxed below. Housing assumptions are derived principally from Adams (1970) and are assumed to hold true throughout the following discussion. New housing is added at the urban margins in discrete temporal increments, thus within any zone housing is uniform in age. Also, between each stage interior and exterior space increases as the aggregate population has more income available for housing consumption.

In this system individuals enter only by birth and exit only by death. The number of individuals in any age interval remains constant over time. Mobility occurs only by family creation or dissolution. Death of a surviving spouse is the only way housing is released. Released housing is available only to newly created households since once established, households do not move. With equal resource availability competition for housing is not determined by income.

There is no need for additional housing since the population is constant. There are, however, inequities in allocation. Families do not move, except when new households are formed by marriage or households are dissolved by death. Consequently, there are no mechanisms to allocate housing by size, quality, location, or need. Likewise, there are space misallocations in homes inhabited by small households. Expanding, stable, and contracting families desiring commodious interior and yard space often would find it inaccessible because of the constraint of no movement. During the first generations after initial settlement of the city there would be excessive deaths among original settlers in central locations. Newly formed households would obtain these central locations. In the long term, however, a more or less random distribution of age and family stage would develop.

Housing Allocation Under Relaxed Assumptions

Population Assumptions Relaxed. If the assumption of no internal movement is relaxed, a better allocation of space according to family need is achieved. With equal resources per person, housing is now allocated on the basis of perceived need for space, rather than differential ability to pay for space. Smaller, centrally located housing, will attract small households with minimal space requirements. Large families with children will locate towards the periphery where more spacious housing exists. A zonal pattern based on family size results. Childless couples and singles dominate in central areas. Stable families, at maximum family size, are found in larger homes with peripheral location. Expanding and contracting families, intermediate in size, are also intermediate in location, outward of childless couples but inward of stable families.

Let the assumption of a closed population system and a stationary population be relaxed. Demand for additional housing is generated because of natural increase and net in-migration. This demand can be met by 1) vertical expansion, as apartment construction, 2) subdivision of existing units, or 3) horizontal expansion, by construction of new units on previously unoccupied land.

Typically, vertical expansion occurs on land found near the urban center, or close to major transportation arteries. Land costs are high because of accessibility to the remainder of the urban area offered by these locations. It is not possible to return a profit on investment in single family detached housing units on this land. To assure adequate returns under residential use, multi-storied, multiple dwelling unit complexes must be constructed (Yeates, 1965; Maher, 1974). Subdividing is possible anywhere housing exists, however, it occurs most often in older housing areas in more central locations. Horizontal expansion occurs where land is available and relatively inexpensive, in peripheral locations.

This additional housing stock is not only differentiated by location, but also by interior space. Subdividing, of course, decreases the space per dwelling unit. Apartments usually are less spacious in comparison to single family dwelling units of the same age. Hence, additions to the housing stock in interior locations, whether by vertical expansion or subdividing, are smaller in interior space than peripheral new housing provided by horizontal expansion.

Income Assumption Relaxed. To this point, given equal resource availability per person, small households will be found in small units with interior location and larger families will reside in larger units on the periphery of the city. Let the constraint of equal resource availability for housing be relaxed. If relaxed the quality of housing stock will not be uniformly distributed (Hoyt, 1939). Urban areas become differentiated by sectors of high and low status housing. Additionally, within any sector housing quality generally increases from the city center outward to newly constructed areas because of the history of urban residential construction.

Central housing is the oldest and smallest, built at the first stages of city development. As larger and better quality housing is constructed in later years, a filtering process occurs. The newer housing sought by higher income groups leaves the older, lower quality housing to filter down to lower income groups. This filtering process occurs in all sectors, differing between sectors only by value of the filtered housing (Lansing, Clifton, and Morgan, 1969).[3]

Filtering Versus Inertia. Filtering does not necessarily result in the youngest and/or largest families obtaining newer and more spacious housing on the urban periphery. Those with higher disposable incomes will acquire the more desirable units. Young expanding families usually do not have sufficient income to compete with stable or contracting families for housing. Their income is tied up in providing for family growth. Also, income usually increases with job longevity, a condition not yet achieved by younger workers (Glick and Parke, 1965; Landsberger, 1970).

Counter to location patterns implicit in filtering theory is the fact that there is considerable inertia in the residential relocation of

[3]Harms (1972) discusses why the filtering down of dwelling units to low income families does not operate as theory would suggest. Given excessive construction of new units and a resulting buyer's market, producers will cut back supply which inhibits filtering. Recession and tight money supply slow construction and also inhibit filtering. Demolition and urban renewal usually remove low income dwellings which are replaced by higher quality units. Also constrained markets as for blacks, and differing needs of in-moving poor and out-moving rich distort the operation of the filtering process.

households. After a residential location decision has been made, especially by home owners, the longer the family remains in a given location, the less the chance that it will move (Land, 1969). Accordingly, older families are less likely to take up roots and move to more desirable housing on the urban periphery.

Counter forces are present; inertia and high disposable income for older families and mobility and low disposable income for expanding families. If one accepts the existence of a filtering process, then later stages of the family cycle should dominate in peripheral locations. On the other hand, given inertia for older families, then few opportunities exist for expanding families to locate in already densely settled areas. They must seek housing in areas providing significant additions to the housing stock--on the urban periphery. The counter tendencies must be reconciled in order to anticipate urban locations for age and family stages.

One factor to consider is that intra-urban movement is strongly associated with change in family life cycle stage (Simmons, 1968). Chevan (1971) concluded that in the relationship between moving and the family life cycle, the major force is family composition. The birth of children is associated with higher rates of mobility and moving is the mechanism whereby housing space is brought in balance with expanding family needs. Movers have higher initial residential densities (persons/room) but after moving density is the same as non-movers. After initial high rates of movement that adjust housing to increased family size, moving rates decline.

What are the implications of this for age distributions? Evidently most families attempt to adjust space requirements immediately upon family expansion by moving to larger housing, however, no equivalent adjustment is made later with decreasing family size. Thus, young expanding families can be expected to locate on the margins of urban development, where, from the original assumptions, available and spacious housing exists. Expanding families then are found outward from older families, even though these older families may have higher disposable incomes for housing consumption.

Recent Distortions. Recent construction activity may be distorting residential location patterns of family stages (Galle and Carnahan, 1973). Construction of apartment units designed for small households is occurring in locations far removed from the city center. High accessibility is maintained because of proximity to major transportation arteries like freeways. Decreasing family size along with increased purchasing power has lessened needs for spacious housing. Concomitantly, wants for amenities as pools and recreation space have increased. Coupled with these trends is the development of a tight housing market, brought about by an increase in newly formed households and high interest rates which restrict housing starts. All these factors combine to emphasize construction of multi-family residential units in peripheral locations. These units attract young couples and singles that previously sought central locations.

Whether the appearance of young couples and singles in peripheral locations is of long enough duration and in adequate numbers to be noticed in the census data used herein is a question left to be answered by empirical analysis. Also, whether a sectoral bias may develop is an important question for empirical investigation.

A Model for Residential Location of Age Groups

From the previous discussion of the needs of various family stages, one can anticipate certain location patterns (Table 3.1). A zonation of stages should exist, with childless households, both young and old, located at and near the city center, successively ringed by families of decreasing age (Figure 3.1). Locations for family stages should be further differentiated by household income.[4]

Original Locations. Originally, small households of young and old families are found in interior locations; the old because of long term residence, the young because of lower incomes and lesser space requirements. Larger families are located further away from the city center. Because of income constraints, locations for expanding families vary. Those with severe income constraints reside in older, lower valued housing near the city center. Those without significant income constraints are found in newer, peripheral housing. Overall, there is a slight inward shift in age groups in the high income sector, since households with higher incomes are able to move to desired locations earlier in the life cycle. Assuming a fixed location after this origi-

[4]The letter 'S' represents a strong income constraint in Figure 3.1 and Table 3.1.

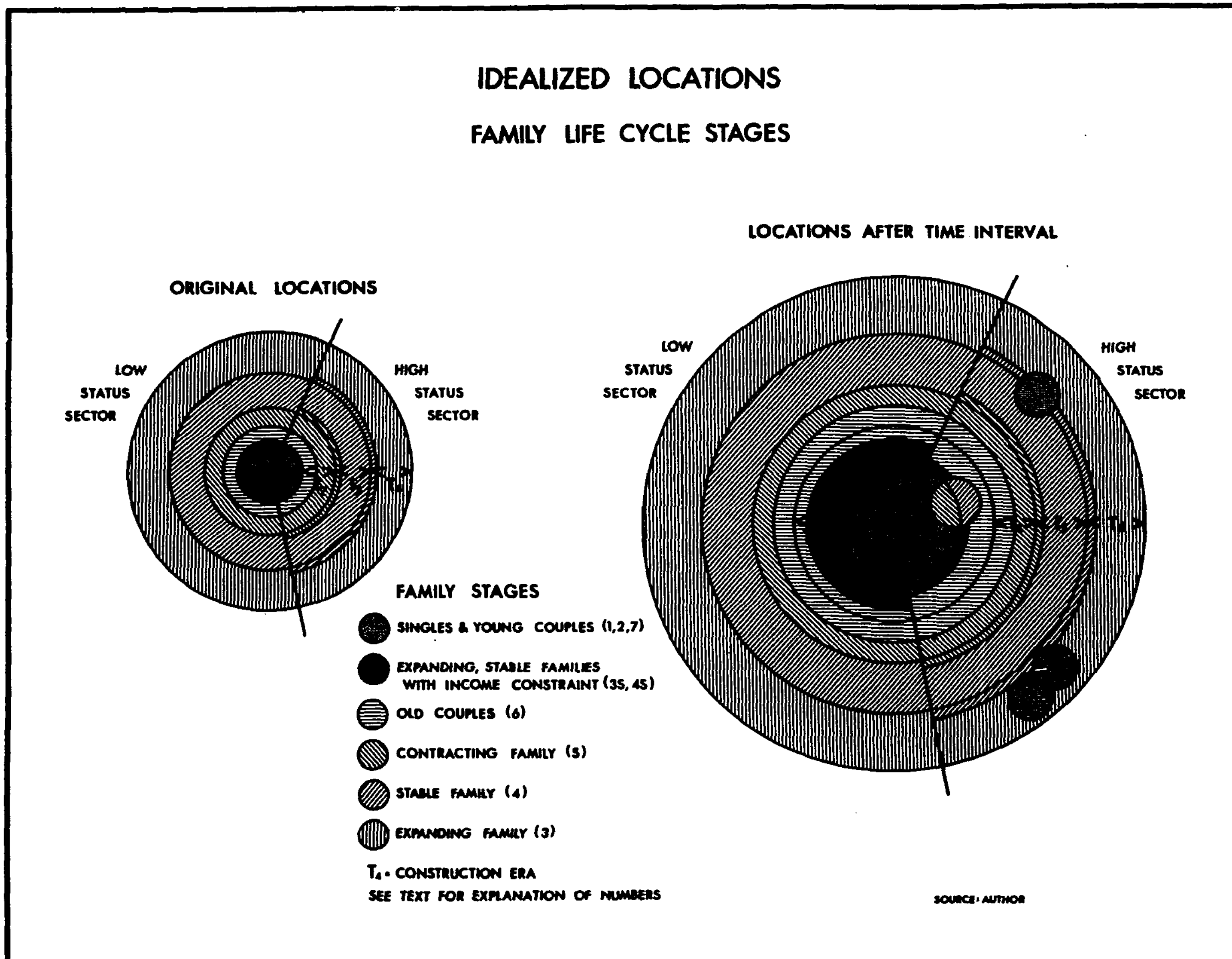
Table 3.1

Family Life Cycle Stage and Urban Location

Life Cycle Stage on Figure 3.1	Family Life Cycle Stage	Urban Location	Housing Characteristics
1 and 2	Young single individual or Young couple without children	Near city center or Peripheral apartment	Apartment, subdivided housing, or small old single family dwelling unit (SFDU)
3S	Expanding family, with income constraint	Near city center	Subdivided housing or small older SFDU
3	Expanding family	Margin of built-up area	New SFDU
4S	Stable family, with income constraint	Near city center	Subdivided housing or older SFDU
4	Stable family	Near city margin but interior to expanding families or In high status interior residential area	Recent SFDU or larger older SFDU
5	Contracting family	Interior to stable families	Older SFDU
6	Old couple	Interior to contracting families and exterior to young singles and couples	Still older SFDU
7	Old single individual	Near city center	Same as 1 and 2

Source: Author

Figure 3.1


IDEALIZED LOCATIONS
FAMILY LIFE CYCLE STAGES
ORIGINAL LOCATIONS
LOW
STATUS
SECTOR
HIGH
STATUS
SECTOR
LOCATIONS AFTER TIME INTERVAL
LOW
STATUS
SECTOR
HIGH
STATUS
SECTOR
FAMILY STAGES
SINGLES & YOUNG COUPLES (1,2,7)
EXPANDING, STABLE FAMILIES WITH INCOME CONSTRAINT (3S, 4S)
OLD COUPLES (6)
CONTRACTING FAMILY (5)
STABLE FAMILY (4)
EXPANDING FAMILY (3)
T_4 = CONSTRUCTION ERA
SEE TEXT FOR EXPLANATION OF NUMBERS
SOURCE: AUTHOR

nal move, they will be older than lower income households in equivalent locations who moved at later dates.

Locations After a Time Interval. With continued expansion of the urban population and housing stock, the effects of aging within the population are shown by the second diagram in Figure 3.1. Over a sufficient time interval old couples and singles (Number 6 on Figure 3.1 and Table 3.1) originally in central locations have died, releasing the small dwelling units. Some units are replaced by apartments or subdivided to accommodate additional small households, thereby attracting a mix of old and young, couples and singles. Also, some passes to younger households, expanding and stable families (3S and 4S) not economically able to compete for better housing located further away from the city center. Original stable and contracting families (4 and 5) have aged without changing residence, and after a generation are old couples (6). Expanding families at the starting date have matured to stable (4) and contracting (5) families.

Additional housing is constructed on the urban periphery to accommodate the increased number of households with family oriented life styles. These are primarily expanding families (3) wanting to move because of increased space requirements. For the later date, young couples and singles (1 and 2), restricted to central areas in the starting period, are locating in peripheral areas offering high accessibility.

Although families remain in place between the two dates, they have grown older. Consequently, there is an outward shift in the location of any given age group and family stage. Stable family compositions, originally in zone t_3, are in zone t_5 at the later date. Expanding family compositions, in zone t_4 at the first date, are now found in zone t_6.

Aging Processes for Urban Areas

Maturation. Youth, maturity, and old age describe stages in the aging process for resident populations of an area. Areas and their populations characterized by these stages are undergoing a maturation process. An area matures when mobility is low and there is little in- or out-movement. Maturation is eventually terminated by the death of older members of the population. Then a youthing process begins to operate as younger individuals replace those removed by death.

Effects of Mobility. Movement encompasses both migration and mobility. Migration refers to long distance movements as rural to urban, or from one urban area to another. The net effects of migration have been to increase urban populations. Mobility is movement contained within an urban area (Roseman, 1971). It has resulted in greater socioeconomic differentiation within urban areas. The concern here is mobility as an agent in determining urban age compositions and their differentiation.

The effects of mobility on age composition have not been considered until now. After an original move to establish a family household, it has been assumed that families do not relocate in later time periods. Changes in age composition for interior locations resulted only because of births, maturation, deaths, and associated family formations and dissolutions. Age compositions for peripheral areas have been attributed solely to growth by new settlement and then maturation. Actually though, age compositions are also a function of mobility.

An area's age composition can change when there is high in-movement to new housing units, but no corresponding out-movement. This usually occurs in peripheral areas. With the construction of new housing units, there is an influx of new residents, mostly younger age groups. The population experiences no unusual deletions, however, the relative composition becomes younger because of additions and there is a youthing process occurring.

Rejuvenation of an area's population also brings about a younger age composition. Rejuvenation, however, implies an interruption in the normal aging sequence, truncating it before completion. The population is replaced before completion of the family life cycle because of factors not directly related to age composition, as ethnic change, or some other shock to the normal maturation process.

Some areas with fixed housing characteristics serve households only during certain stages of the life cycle. Such areas have a static age composition, with individuals spending a short time residing in the area, and then being replaced by others of similar age. Examples are young singles and couples needing limited space until family formation, or older couples and singles moving to more limited quarters after children have left. This type area occurs in central locations where small residential units attract childless families. The term senility is applied to areas that reach a static age mix after passing through successive stages of youth, maturity, and old age.

A static age composition also occurs in residentially undesirable areas. Families unable to compete in the urban housing market settle in these areas. Financial resources, or lack thereof, is the determinant of locational selection. Since there is no mechanism for age or family stage differentiation, the age mix remains static. Such areas of poor housing are found in older deteriorating parts of the city. Oftimes, location is determined by non-residential factors as proximity to heavy industry, stockyards, or other undesirable features.

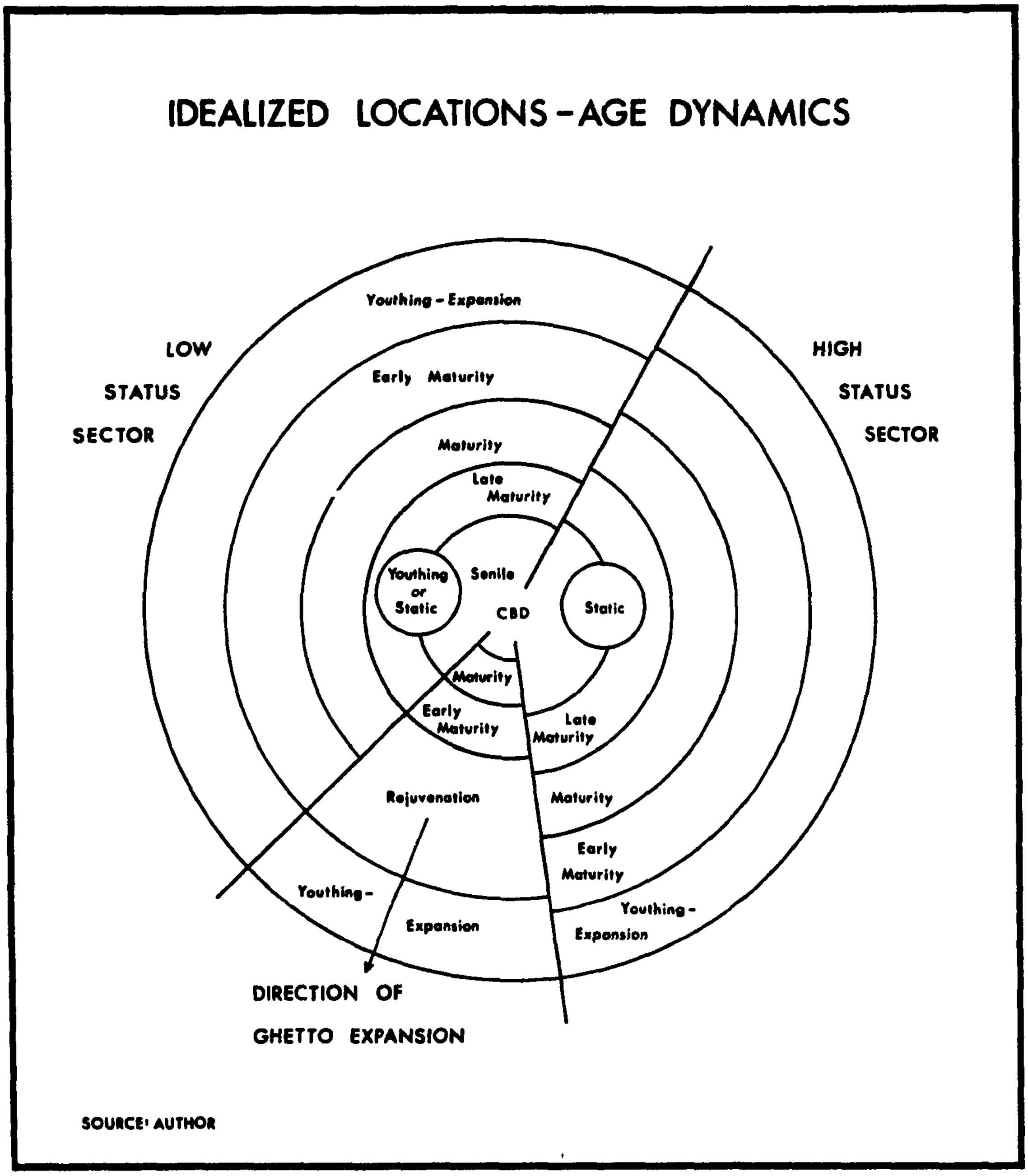
Age Dynamics in an Urban Area

Incorporating changes in age composition due to births, deaths, and mobility, a model for the expected spatial distribution of age dynamics in an urban area is offered. The model (Figure 3.2) graphically identifies patterns to be evaluated in the empirical analysis of age dynamics and family life cycle stage change in Chapter 6.

1. Areas nearest the city center consist of couples and singles, both young and old. These individuals, as life styles change or death intervenes, exit this type of housing, to be replaced by others with similar needs. Age composition remains static and such areas are characterized as senile.

2. Beyond the ring of static age composition are several family rings having sectoral variation based on income. Populations in all rings are growing older, with the oldest families found in interior rings and younger families in more peripheral rings. The aging process

Figure 3.2


IDEALIZED LOCATIONS-AGE DYNAMICS
LOW
STATUS
SECTOR
HIGH
STATUS
SECTOR
Youthing - Expansion
Early Maturity
Maturity
Late
Maturity
Youthing
or
Static
Senile
CBD
Static
Maturity
Early
Maturity
Late
Maturity
Rejuvenation
Maturity
Early
Maturity
Youthing -
Expansion
Youthing -
Expansion
DIRECTION OF
GHETTO EXPANSION
SOURCE: AUTHOR

is one of maturation for all these family areas. In zones equidistant from the city center, those in the high status sectors are at later maturation stages than low status sectors because of family stage differences at the date of original settlement.

3. Beyond maturing rings is a zone of current expansion in housing stock. In-movement of young age groups and their addition to the already resident population brings about a youthing process.

4. Older age groups, of course, reach the end of the life cycle first. This released housing attracts various age groups. The specific group depends upon the quality and location of the housing. In high quality areas replacement is by relatively old age groups, younger, however, than the replaced population. Viewed in decade intervals, as proposed herein, this replacement process may appear to be a static situation. Lower quality housing areas will attract age groups much younger than the replaced population. A youthing of the age composition results.

5. Certain areas are undesirable residential locations. Families residing in these areas are selected by income, and not correlates of family size or age. There is no differentiation by age, these areas have a static and heterogeneous age composition.

6. Some areas do not complete the normal maturation sequence. Replacement occurs before old age, with rejuvenation occurring. This is evidenced in areas of ethnic change.

Summary

Two models have been proposed. The first concerns the structure of age compositions over urban space and the second deals with the dynamics of aging over urban space. These models incorporate family life cycle stages to portray the static and dynamic patterns of age and aging. Both models essentially adopt the zonal patterning that is suggested for the family status dimension in other approaches to urban social differentiation. However, the models propose differentiation for all family life cycle stages, incorporating a much finer resolution of age intervals than any previous approach.

CHAPTER 4

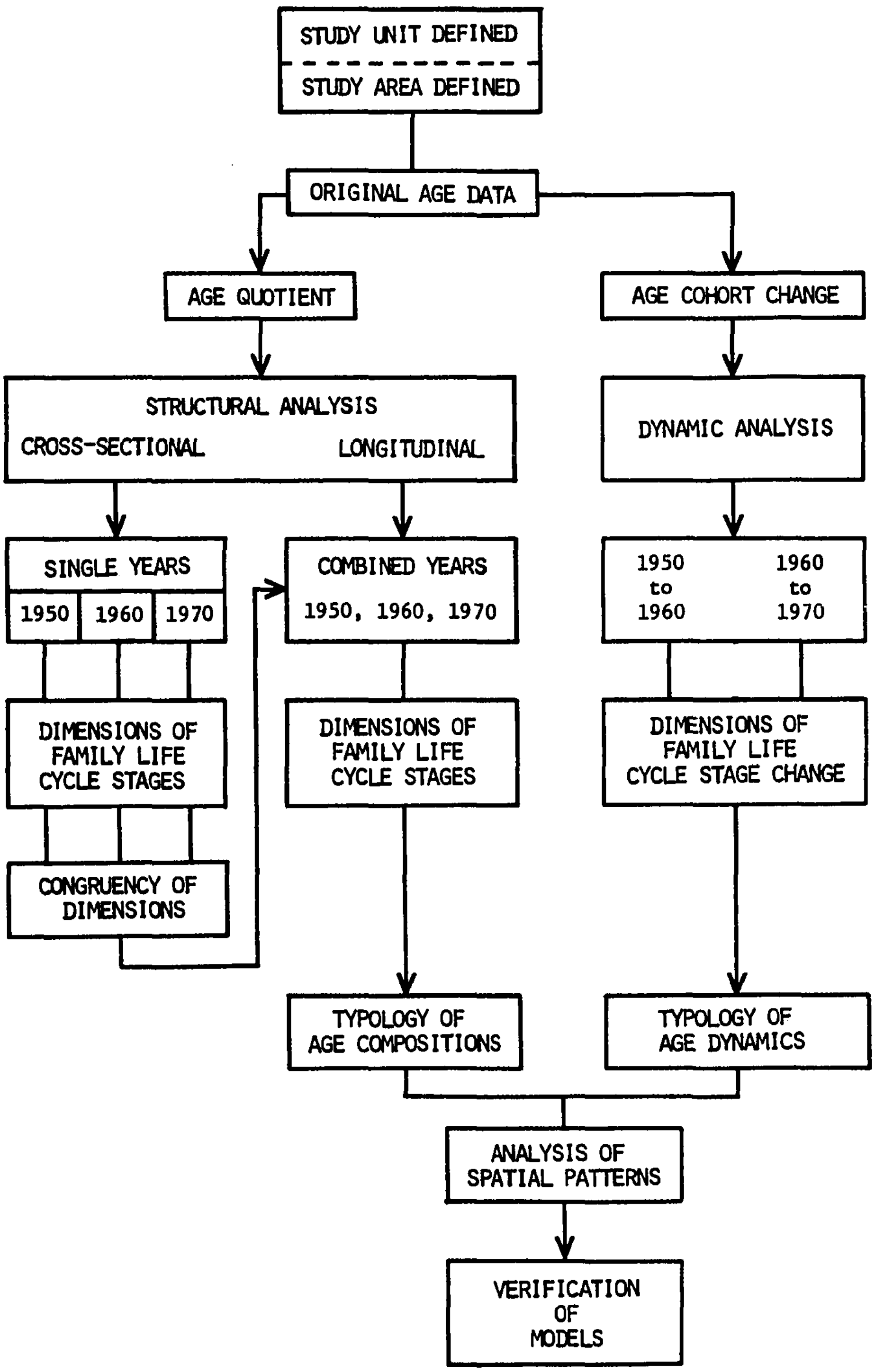
METHODOLOGY

Several methods for the measurement of age composition and age dynamics have been used in prior studies. Most have disadvantages when simultaneously portraying several age groups for several observational units. Too often, age cohorts are collapsed into the overly inclusive groups of 0-14, 15-64, and 65 and over. Alternatively, retaining numerous age intervals presents difficulties in comparison between an abundance of areal units. This typically leads to aggregation of units into larger and more heterogeneous groups. With the abundance of age categories and/or observational units available in urban age research, previous studies arbitrarily limited the inherent variation in the data by *a priori* groupings.

The methods used herein are designed to overcome both of these problems (Figure 4.1). First, age intervals are grouped according to the patterns which the variables themselves manifest, rather than some arbitrarily imposed grouping. Census tracts are grouped into larger areal units without losing the details of their age characteristics. Dynamic as well as static patterns are identified and analyzed by simultaneously grouping temporal and spatial items.

Figure 4.1

PROCEDURE FOR ANALYSIS



Unit of Analysis

The census tract is the basic areal unit of analysis. In theory "census tracts are small, relatively permanent areas... designed to be relatively homogeneous with respect to population characteristics, economic status and living conditions. The average tract has about 4000 residents. Tract boundaries are established with the intention of being maintained over a long time so that comparisons may be made from census to census" (U.S. Bureau of the Census, 1961b, 1). In fact, both population and area vary widely between tracts, and age characteristics of tract inhabitants can be quite heterogeneous. Also, changes in tract boundaries can pose a serious problem for comparative analysis.

Despite these problems several features permit comparison of tracts in this analysis without severely restricting the reliability of results. For one, the use of relative, rather than absolute age measures negates size influences. Also, shifts in tract boundaries during the study period are minor, and all are in areas of sparse population. Finally, where subdivision of tracts occurs during the study period, earlier tracts can be reconstructed since subdividing occurs entirely within previously whole single tracts.

The problem of heterogeneous age compositions within tracts is always present. Use of smaller study units, as city blocks, would lessen problems of heterogeneity, however, analysis then becomes even more difficult because of the number of units involved. The problem of heterogeneity as a function of unit size is discussed early by Gehlke and Biehl (1934). Results of correlation analysis between different size areal units may differ markedly, with the tendency for correlation coefficients to increase in magnitude as the size of the areal units under investigation increases (Robinson, 1950). Murdie (1969) carefully notes this in his use of census tract units, however Goheen's (1970) results for a series of social area factor analyses of both individual and various kinds of areal units in the city of Toronto in 1850 to 1900 suggest that the factors produced are not markedly different as the basic areal unit is modified.

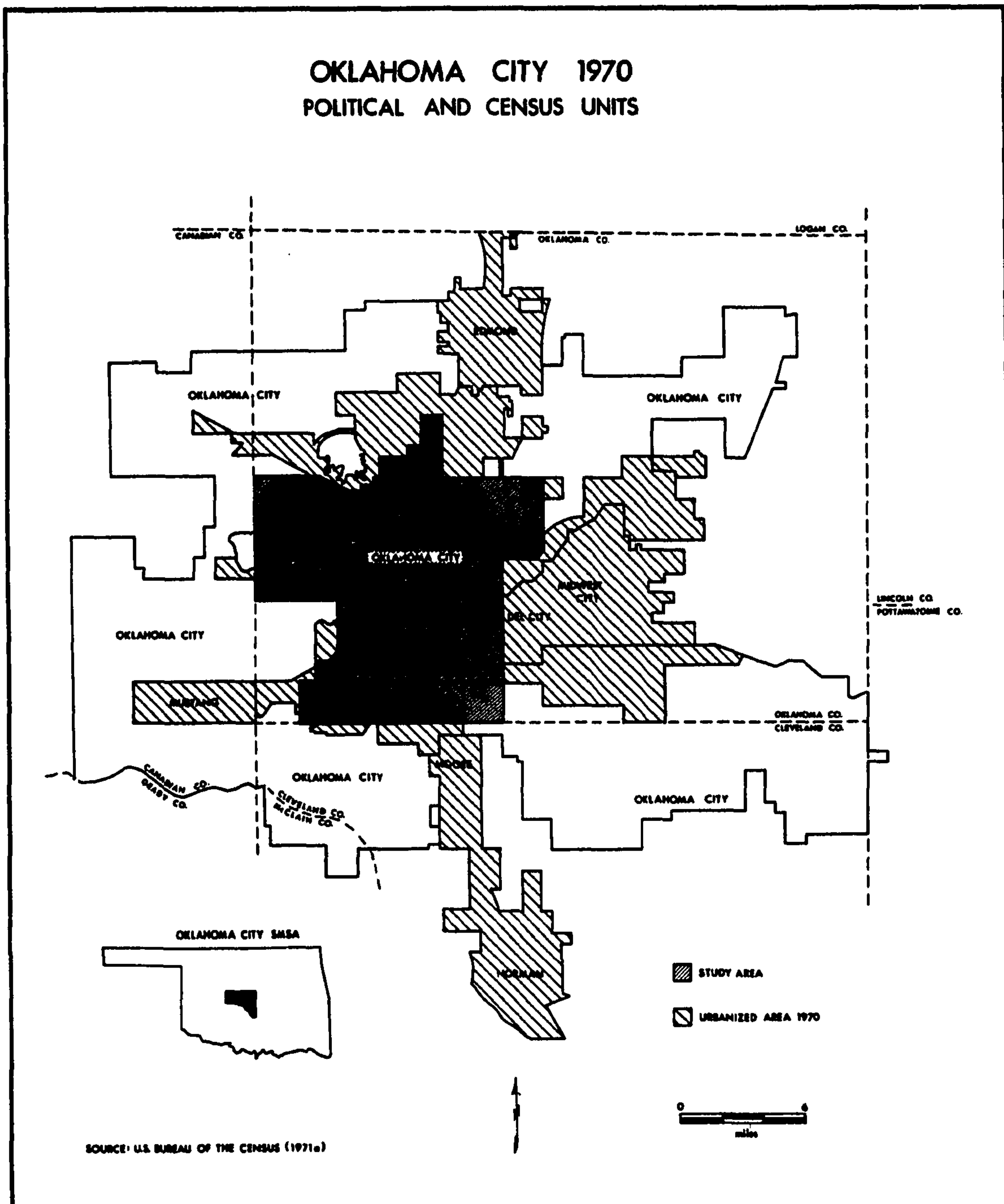
Choice offered in this analysis is census tracts or city blocks as the basic areal unit. Block data, while presenting the most disaggregate information available, were rejected because the number of missing observations within any unit would necessitate grouping of blocks. Also, compilation by one enumerator subjects block data to wider margins of error than expected for larger areas (U.S. Bureau of the Census, 1951b, 1).

Area for Analysis

Census tracts within a portion of the Oklahoma County part of the Oklahoma City Standard Metropolitan Statistical Area (SMSA) serve as the primary data base. Limiting the area to a part of Oklahoma County excludes portions of Oklahoma City proper. However, the city is presently overbounded, and large portions of the city and the county are not yet urban by Census Bureau definition (Figure 4.2).

Oklahoma City was chosen as the primary area for investigation because 1) it is a relatively fast growing SMSA, providing differentia-

Figure 4.2


OKLAHOMA CITY 1970
POLITICAL AND CENSUS UNITS
CANADIAN CO.
OKLAHOMA CO.
LOGAN CO.
OKLAHOMA CITY
OKLAHOMA CITY
OKLAHOMA CITY
OKLAHOMA CITY
MIDWEST CITY
DEL CITY
LINCOLN CO.
POTTAWATOMIE CO.
OKLAHOMA CITY
OKLAHOMA CO.
CLEVELAND CO.
OKLAHOMA CITY
OKLAHOMA CITY
CANADIAN CO.
GRADY CO.
CLEVELAND CO.
McCLAIN CO.
OKLAHOMA CITY SMSA
STUDY AREA
URBANIZED AREA 1970
0
6
miles
SOURCE: U.S. BUREAU OF THE CENSUS (1971a)

tion between old and new areas over a relatively short time span, 2) there are no major physical barriers to expansion in any direction, 3) there are several sub-nodes of development, and 4) the number of census tracts is large enough to permit areal differentiation even when grouped, yet small enough to be readily workable in this investigation.

Population data for the study area and several political and Census Bureau defined units in the Oklahoma City area are given in Table 4.1 for the decennial censuses 1930 through 1970. Apparent from this data is the recent and rapid growth in and around Oklahoma City. The study area includes a large portion of the population of Oklahoma City proper, but decreasing proportions of other Census Bureau units.

The study area is shown in Figure 4.3 with census tracts and their boundaries identified. Other census and political units that are referred to throughout the analysis are included on this map; the Central Business District (CBD) as defined by the Bureau of the Census (1971b); the older suburbs of Bethany, Warr Acres, and Nichols Hills; portions of the newer suburb of The Village; and several minor suburbs each contained in less than one census tract. Also shown is the Capitol Hill district lying immediately south and across the North Canadian River from the CBD, and the black neighborhood to the north and east of the city center. Capitol Hill is singled out because of its long-time status as a recognized community within the city.[1] The black neighbor-

[1]Capitol Hill has a history dating back to 1904 when it was incorporated as a separate community. It was joined to Oklahoma City in 1910. As the first non-central commercial area, separated from the

Table 4.1

Populations: Oklahoma City Area,

Political and Census Units, 1930-1970#

Unit	1930	1940	1950	1960	1970
SMSA*		221,229	325,352	511,833	640,889
Urbanized Area**		211,016	275,091	429,188	579,788
Oklahoma County	221,738	244,159	325,352	439,506	526,805
Oklahoma City, total***	185,389	204,424	243,504	324,253	366,481
in Oklahoma County				322,355	354,928
in SMSA					356,661
Study Area			273,506	337,933	368,792

#See Figure 4.2 for most recent boundaries of units.

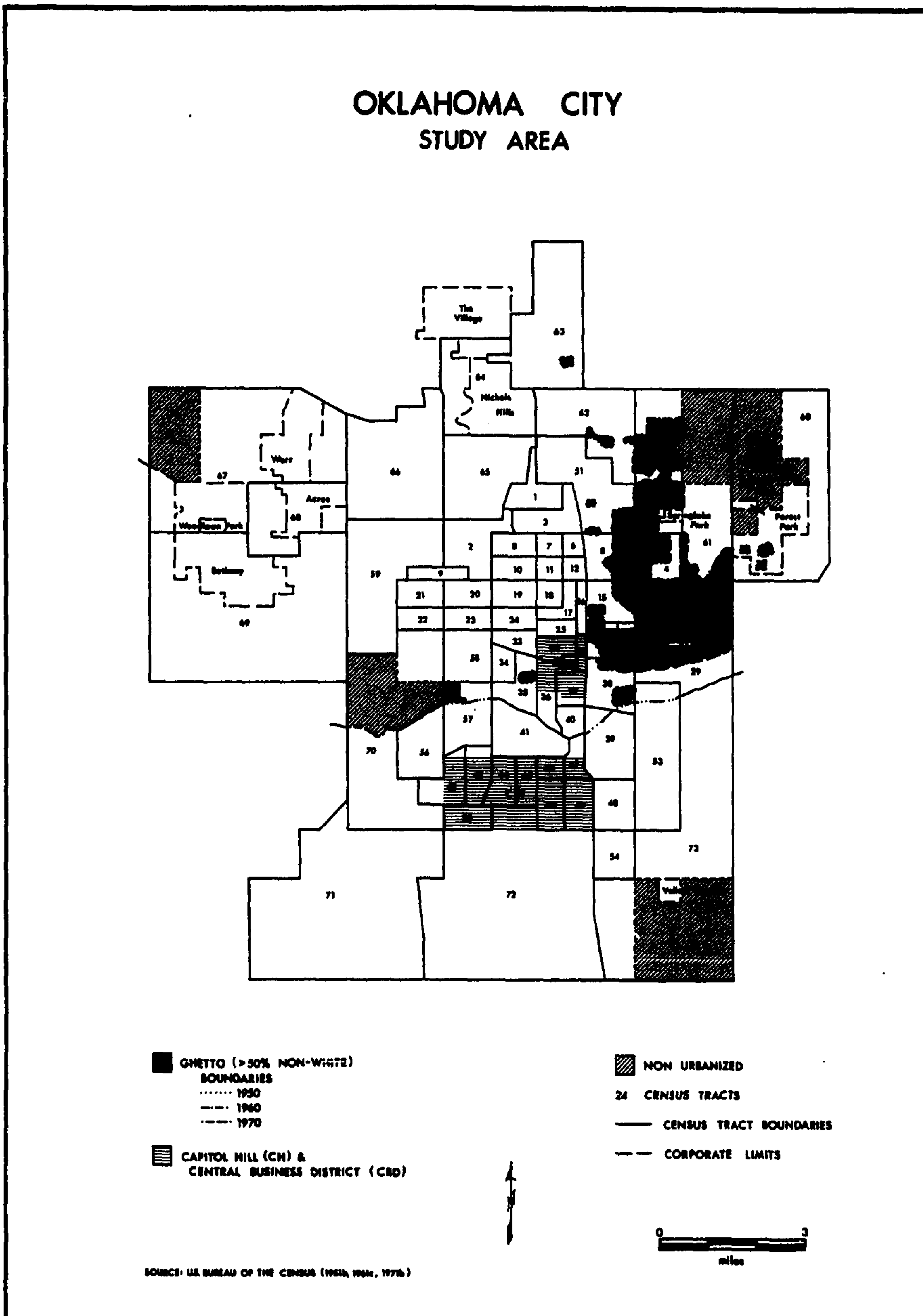
*Not defined prior to 1940. SMSA is Metropolitan District in 1940 and includes 180 square miles (of 720 in the county) in the southwestern corner of Oklahoma County; Standard Metropolitan Area in 1950, coincident with county boundaries; Standard Metropolitan Statistical Area in 1960 and 1970, including Oklahoma, Canadian, and Cleveland Counties.

**Not defined by Census Bureau until 1950. Data for 1940 calculated by subtracting rural farm and rural non-farm population from total population in Oklahoma County.

***Oklahoma City contained within Oklahoma County until 1950; parts of Cleveland and Canadian Counties added by 1960; parts of McClain and Pottawatomie Counties, not included in SMSA, added to city by 1970.

Sources: U. S. Bureau of the Census, for 1930 and 1940 data (1941); for 1950 data (1951a, 1951b); for 1960 data (1961a, 1961b); for 1970 data (1971a, 1972a).

Figure 4.3


OKLAHOMA CITY
STUDY AREA
GHETTO (>50% NON-WHITE)
BOUNDARIES
1950
1960
1970
CAPITOL HILL (CH) & CENTRAL BUSINESS DISTRICT (CBD)
NON URBANIZED
24 CENSUS TRACTS
CENSUS TRACT BOUNDARIES
CORPORATE LIMITS
0
3
miles

hood, defined here as areas of more than 50% non-white, is shown with its approximate boundaries for 1950, 1960, and 1970.[2]

One disadvantage in using Oklahoma City as the study area is the limited number of census tracts to draw upon for historical data. Table 4.2 gives the number of census tracts in Oklahoma County for the years 1940 through 1970. Changes in tract identification and boundaries

Table 4.2

Oklahoma County Census Tracts

1940-1970

Census Year	Total Tracts	Changes from Previous Census: Additional Tracts by Subdivision	Changes from Previous Census: Additional Tracts by Expansion	Changes from Previous Census: Major Boundary Revisions
1940	73	-	-	-
1950	73	0	0	almost all
1960	94	4	17	1
1970	169	75	0	2

Source: U.S. Bureau of the Census (1942, 1951b, 1961b, 1972a).

remainder of Oklahoma City by the North Canadian River and its extensive floodplain, its inhabitants have retained a sense of identity to this day (Capitol Hill Beacon, 1965). The area indicated as part of Capitol Hill in Figure 4.3 is only approximate, since boundaries no longer exist. The bounds of this area represent a consensus of the opinions of surveyed residents south of the North Canadian River as to what constitutes Capitol Hill (Krause, 1972a).

[2]Areas delimited are defined by population in census tracts for 1950, households by block for 1960, and population by block for 1970 (U.S. Bureau of the Census, 1951b, 1961c, 1971b).

between 1940 and 1950 are major, making meaningful comparisons difficult, if not impossible. However, boundary changes from 1950 to 1970 are minor. Increases in the number of tracts from 1950 to 1960 occur by addition, while increases from 1960 to 1970 occur by subdivision of existing tracts. In all cases for 1950, 1960, and 1970 population reassignments with boundary changes are minimal.

Complete data and relatively stable areal units enable the use of three census dates, 1950, 1960, and 1970, in this study. Recently subdivided tracts have been reconsolidated to their original boundaries. Census tracts 'th data records at all three dates are used, leaving seventy-three complete tracts for analysis. The study area includes most of the urban population of Oklahoma City and several suburbs (Table 4.1).

The data used in this study consist of individual ages as reported to the Census Bureau. The quantitative expression of age is the completed number of years elapsed since an individual's birth at the time of enumeration (U.S. Bureau of the Census, 1951b, 2; 1961b, 1; 1972a, App-3). The expression of age composition for a census tract is simply the summation of the number of individuals present within each five-year age interval. While inaccuracies are present even in complete enumeration data, age data generally are more comprehensive and accurate than most census data.[3]

[3]Age data for 1950 and 1960 are obtained from published materials and represent 100% enumerations of the population (U.S. Bureau of the Census, 1951b, 1961b); 1970 age data are obtained from census computer

Measures Used in Analysis

Utilization of population numbers within five-year age intervals was deemed inappropriate for this research since tracts vary greatly in areal extent and in the number of individuals present. If population numbers within age intervals were used, the results would be the differentiation of census tracts by population size and areal size, rather than characteristics of age. Thus, relative measures of age and aging that discount size differences between census tracts are proposed for the analyses of age compositions and age dynamics.

Age Composition Measure - Age Quotient. The measure used for analysis of age composition is the age quotient. It expresses the relative concentration of an age interval population within a census tract. The percentage of a census tract population in a given age interval is compared to the entire study area percentage for the same age interval.[4] Using this measure, all census tracts are equally weighted in their contribution to age composition variation. The age quotient is

$$A_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \Bigg/ \frac{\sum_{j=1}^{m} a_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{m} a_{ij}}, \qquad (4.1)$$

tapes and also are a 100% sample (U.S. Bureau of the Census, 1970; 1972b). For a general discussion of the accuracy and reliability of age data see Shyrock and Siegel (1973, 201-251), for a discussion of the 1970 Census see Siegel (1974).

[4]The age quotient is analogous to the location quotient. For a summary of the construction and use of the location quotient see Isard (1960, 123-126), and also Hoover and Vernon (1959, 229 and 283-287). Murdie (1969, 51-53) discusses the use of the location quotient as a measure for change in census tract characteristics.

where a = number of individuals in an age interval,

$i = 1,\ldots,n$ is the age interval,

n = number of age intervals,

$j = 1,\ldots,m$ is the census tract, and

m = number of census tracts.

Age quotients greater than unity indicate a concentration above the urban average for the age interval population within a census tract. Age quotients less than unity show that the census tract's share of individuals in the age interval is less than the overall urban average.

Age Dynamics Measure. In a study of age dynamics, measures of actual numeric change are not appropriate because of both spatial and temporal size differences in census tracts and their populations. Thus, a relative measure of aging is needed. This necessitates a choice between focus on age interval change or age cohort change.

When concern is for age interval change, a simple age quotient measure is appropriate. Such a measure is obtained by subtracting the age quotient at a starting date from the age quotient at a later date. The net change for an age interval is specified. Given a stable residential population, use of this measure produces a ripple effect, where a large age quotient at the starting date appears for a different age interval at the later date, as the resident population ages between the two dates. Chung (1969), in his study of demographic echo waves, illustrates this ripple effect on age composition change. Such a measure of age change is not appropriate for this research. It stresses change in age intervals rather than illuminating family life cycle changes and stability in residential location as suggested by the model of age dynamics (Chapter 3).

Relative Age Cohort Change. The construct age cohort is used by demographers to refer to a set of individuals, who together pass through successive age intervals. "A cohort is a population group that enters some stage of the life cycle simultaneously, hence may be looked upon as a group of people traveling through life together" (Bogue, 1969, 150). An age cohort matures just as an individual, and is represented by different age intervals over the life of the cohort. For example, the age cohort of all individuals born between 1921 and 1925 becomes the cohort of 35-39 in 1960 and 45-49 in 1970.

If the actual age composition remains static, *i.e.*, no in- or out-movement within any age interval for a census tract, then the expected composition after a decade is the original composition by cohort, with each cohort aged ten years, less the number of individuals lost by death during the decade. Thus, incorporating attrition due to death and ten years aging for the cohort, the actual age quotient at the end of a decade minus the expected age quotient results in relative age cohort change.

The age quotient (Equation 4.1) is reformulated in terms of age cohorts to give a measure of relative age cohort change.[5] This measure expresses the changing importance of an age cohort within a census tract relative to all other age cohorts. Values greater than unity indicate a

[5]For the mathematical derivation of relative age cohort change see Appendix A.

relative increase in an age cohort while values less than unity show a relative decrease in an age cohort. An age cohort can experience relative increase because of

1) in-movement of additional cohort members while other cohorts remain unchanged,

2) excessive in-movement of additional cohort members while other cohorts experience less in-movement,

3) no change while other cohorts experience losses because of death or out-movement, or

4) slight losses because of death or out-movement while other cohorts experience higher losses.

In all cases the relative importance of the age cohort population within the census tract increases over the decade. Measures detailed in this section, the age quotient and relative age cohort change, are used throughout the following analysis as the basic data items.

Methods of Analysis[6]

The primary analytic method is factor analysis. Its usefulness as a tool for urban ecological research is well documented (Rees, 1971; 1972). As a synthetic method of description and analysis, its application assumes no *a priori* theory. Rather, the goal is to establish generalizations that themselves can be subject to deductive hypotheses formulation and testing. "The approaches... of all factorial ecologies... cannot be evaluated from the scientific perspective of positivism, for *their essence is the idea that meaning in any situation has to be*

[6]A more detailed treatment of these procedures is given in Appendix B.

learned rather than posited by aprioristic theory" (Berry, 1971, 214, italics in original).

The use of factor analysis in this research is predicated on its ability, from an original set of age measures, to depict related age intervals (or age cohorts). The relationship among age intervals resulting from factor analysis is such that stages in the family life cycle are separately identified. The importance of an age interval within any family life cycle stage is quantitatively portrayed.

Also obtained from factor analysis are scores that indicate the strength of each derived family stage for each census tract. The distribution of separate family stages is portrayed by mapping these scores, however, several maps are necessary to encompass all stages. The relationship among stages within any census tract is not readily identifiable. Another method that shows the overall age character for census tracts is required.

This second method, generally called cluster analysis, objectively classifies census tracts on the basis of the relative importance of all family stages within each tract. Several classes result from clustering, each consisting of census tracts having a similar relationship among family stages. These classes are mapped and patterns are evaluated for correspondence with the models of family stages and age dynamics.

Types of Analyses

Structural Analyses. The basic data unit for the structural analysis of age composition is the age quotient. Two analyses are undertaken. The first establishes structural relationships among age intervals. The second evaluates spatial patterns of age compositions and family life cycle stages.

In the first, age compositions for each year 1950, 1960, and 1970 are considered separately. Separation of data by individual years presents cross-sectional views of age compositions and family stages. Variation in structures between dates is expected as the age composition of the study area changes. With age structures and family stages established separately for each date, congruencies between structures for the three dates are evaluated. Based on congruency of factor dimensions between separate analyses, data for all three dates are combined into a single analysis.

A single set of family stages results from this second analysis, giving a longitudinal view of the changing concentration of the stages within census tracts. Each factor dimension portraying one, or at the most two stages is separately mapped. Spatial patterning of these individual stages are evaluated for correspondence with the model of family life cycle stage distributions.

Finally, to better evaluate the combined effect of all family stages within census tracts, the clustering routine is used. Clustering produces several classes emphasizing combinations of family life cycle stages. The classes are mapped and the patterning of these combined stages is evaluated for correspondence with the model.

Dynamic Analysis. A similar procedure using the measure of relative age cohort change is employed for analyses of age change from 1950 to 1960 and 1960 to 1970.[7] Results are mapped to portray the spatial patterning of age dynamics. Again employing the cluster routine, classes of family stage change are obtained, mapped, and evaluated for correspondence with the age dynamics model.

In the next two chapters the empirical results of the analyses are described, with Chapter 5 considering the structure of age compositions and Chapter 6 devoted to the dynamics of aging. The effectiveness of the methodology is substantiated in the empirical investigation and results are used to establish the relevancy of the models proposed in Chapter 3.

[7]The first data set, change to 1960 consists of the actual age quotients in 1960, by census tract, minus expected age quotients based on estimated mortality within the 1950 tract population. The second date set, change to 1970, uses actual age quotients for 1970 and expected age quotients derived from 1960 population. Sixteen age intervals are used, beginning with ages 10-14 and ending with the open interval 85 and over. Data for children under ten years of age are excluded from analysis because of difficulty in obtaining reliable estimates of births for census tracts. Exclusion of this age group does not affect interpretation, except for factors including ages 20-29, where couples cannot be distinguished from expanding families. This limitation is not significant for interpretation.

CHAPTER 5

AGE COMPOSITIONS - STRUCTURE AND LOCATIONS

This chapter presents the results of empirical analysis of age distributions within Oklahoma City for the years 1950, 1960, and 1970. Results are compared to the model for location of family life cycle stages. Verification of the model is discussed and the underlying factors contributing to its validation are considered.

The zonal character of age and family stages within an urban area is established. This zonation is shown to be an outcome of residential selection on the urban periphery by young families, and then continued stability in age composition. Distortions in the zonal patterning are shown to be related to economic and ethnic characteristics.

In arriving at the above, it is first established that groups of associated age intervals exist. Based on an evident similarity in age groupings, age data for all three census dates are incorporated within a single analysis. From this, measures of each family stage within each census tract are obtained and mapped. The mapped patterns provide a basis for an evaluation of the model for family stage locations.

After utilizing a grouping procedure to establish the simultaneous contribution of all family stages within each census tract, patterns of family stages within the urban area are considered. These locations are also evaluated for conformity with the family stage model. Results of the analyses are summarized and contributing factors to the model's validation and operation are discussed.

General Form of Age Structures

Over the three census dates used, there have been changes in the age structure within the study area, and more generally, changes for the entire United States. The general form of age structures within the study area in 1950, 1960, and 1970 is evidenced by the percentage distribution of the population within each age interval (Table 5.1).

Table 5.1

Age Structure, by Percentage in Age Interval: Oklahoma City Study Area, 1950, 1960, and 1970

Age Interval	1950	1960	1970
0-4	10.66	11.57	8.34
5-9	8.06	10.18	9.58
10-14	6.63	8.64	9.50
15-19	6.51	6.62	8.51
20-24	8.44	6.63	8.40
25-29	9.35	6.89	7.39
30-34	8.02	7.06	5.88
35-39	7.95	7.13	5.47
40-44	7.70	6.19	5.91
45-49	6.62	6.09	6.12
50-54	5.47	5.75	5.27
55-59	4.29	4.96	5.00
60-64	3.46	3.88	4.59
65-69	2.80	3.13	3.64
70-74	1.84	2.42	2.71
75+	2.17	2.88	3.63

Source: Calculated by author.

It appears that Oklahoma City has been undergoing age processes similar to those encountered throughout the entire country. In the U.S., prior to 1950 the base of the population pyramid was constricted with numbers of adults actually greater than teens or children. This deformation was due to low birth rates and small families prevalent throughout the 1930's and to restrictions imposed upon family formation during World War II. Immediately after World War II the United States experienced a dramatic increase in births, reaching a peak in 1958. Each year since then has seen a decrease in the number of births.

This wide fluctuation in births has distorted population age structure, giving it in 1950 a constriction from ages 5 to 19. With maturation of these age cohorts and the rapid increase in births by 1960, there was a large number in the childhood years, then a constriction for the teen and young adult years, and a larger number again in the family years of ages over 30. By 1970, with births again declining, the ages of peak population were 5 to 14 and the age intervals 25 to 39 were constricted. Age compositions in Oklahoma City for 1960 and 1970 are more complex than 1950 because of the wave-like effects of various sized cohorts passing through successive age intervals. This changing age structure results in four factor dimensions of family stages in 1960 and 1970 rather than the three present for 1950.

Family Stages at Each Census Date. For 1950, each dimension is bi-polar (Table 5.2), containing both positive and negative loadings that contrast one set of age intervals with another. The first factor contrasts old couples and old singles with expanding families. Factor

Table 5.2

Factor Loadings for Age Intervals, 1950*

Interval	Factor 1	Factor 2	Factor 3	Communality
0-4	-898			920
5-9	-872			914
10-14	-640		698	927
15-19			795	699
20-24		-815		781
25-29		-603	-682	938
30-34	-569		-724	852
35-39		777	-404	798
40-44		870		873
45-49	571	725		865
50-54	810	484		890
55-59	927			917
60-64	951			915
65-69	939			886
70-74	924			871
75+	885			799
% of total variance	49.5	21.5	15.6	86.5
Description	Old couples and singles vs. expanding families	Contracting families vs. young couples	Teens (contracting families) vs. expanding families	

*All values multiplied by 1000 to eliminate decimals. Factor 2 reflected for comparability with other analyses. Values less than 400 not shown.

Source: Calculated by author.

two contrasts contracting families and young couples, while the third factor involves expanding families and teens as a part of contracting families. Particular emphasis is on young components of the population for 1950. Each factor includes at least one youthful group.

The first two factors in 1960 (Table 5.3) portray the same family stages as 1950. Factor three in 1960 contains portions of factors one and three in 1950. A stable family stage is represented, negatively associated with ages 70 and over. The final dimension highlights ages 15-24, an unlikely age grouping since some members live with parents while others reside in separate households. In this instance, from examination of factor scores and the original age data, the emphasis is upon non-family individuals resident in college areas and in centrally located census tracts. Eighteen and nineteen year old individuals have pulled the entire 15-19 age interval into this factor. Overall, dimensions for 1960 are similar in structure to 1950, with additional factors providing better definition to the family stages.

The first two factors for 1970 (Table 5.4) still include the stages found in 1950 and 1960. Factor one contrasts child and non-child family stages, with expanding families better defined. Factor two still exemplifies young couples versus contracting families, except the ages 0-4 found in 1960 have disappeared, reflecting the decrease of individuals within this age interval. The third factor contrasts stable families and old couples, with the primary emphasis on stable families. Finally, factor four emphasizes contracting families and the very old.

Table 5.3

Factor Loadings for Age Intervals, 1960*

Age Interval	Factor 1	Factor 2	Factor 3	Factor 4	Communality
0-4	-829	-440			912
5-9	-931				977
10-14	-941				929
15-19				973	964
20-24	611	-492		451	915
25-29		-928			917
30-34		-524	590		940
35-39			842		879
40-44		511	765		853
45-49		805			843
50-54	563	760			897
55-59	769	510			906
60-64	854				939
65-69	857				928
70-74	823		-466		936
75+	771		-456		806
% of total variance	43.3	22.9	16.2	8.5	90.9
Description	Old couples, singles and young adults vs. children	Contracting families vs. expanding families	Stable families vs. old singles	College age	

*All values multiplied by 1000 to eliminate decimals. Factors 1 and 4 reflected for comparability with other analyses. Values less than 400 not shown.

Source: Calculated by author.

Table 5.4

Factor Loadings for Age Intervals, 1970*

Age Interval	Factor 1	Factor 2	Factor 3	Factor 4	Communality
0-4	-852				852
5-9	-959				980
10-14	-931				935
15-19				922	898
20-24	583	-714			927
25-29		-476	756		834
30-34	-436		828		883
35-39	-409		687		833
40-44		557	525	515	852
45-49		909			844
50-54	504	649			797
55-59	598	404	-495		789
60-64	669		-523		906
65-69	578		-487	-585	920
70-74	651			-569	900
75+	671			-502	848
% of total variance	34.7	17.0	20.1	15.7	87.5
Description	Old couples, singles and young adults vs. expanding families	Contracting families vs. young adults	Stable families vs. old couples	Teens (contracting families) vs. old singles	

*All values multiplied by 1000 to eliminate decimals. Values less than 400 not shown.

Source: Calculated by author.

Similarity Among Family Stages. Family stages obtained from the three analyses have a strong similarity with the proposed stages (Table 2.2). All suggested stages appear within each year's analysis (Table 5.5). The major deficiency appears to be that the childhood years to age 15 and ages 15-24 are not always associated with their respective proposed family stages. Rather, ages under 15 usually appear together on one factor and ages 15-24 appear as a separate factor.

A congruency test (Rummel, 1970, 461-462) shows that there is a strong continuity in the underlying structure of age compositions (Table 5.6). The strongest coefficients of congruency are for dimensions judged to be similar in the above discussion. Similarities indicate that combining data into a larger matrix will not destroy its basic patterning. Thus, factor scores from a single analysis may be used to show spatial patterns of family stages at each date while maintaining a uniform basis for comparison.

Family Stages for Three Census Dates. Analysis of data for all three census dates indicates all family stages are present (Table 5.7), with only minor changes from the single year analyses (Table 5.5). For the three dates, factor one contrasts old couples and singles (ages 50 and over) and young adults (ages 20-24) with expanding families (ages under 15 and 30-39). This factor indicates the presence or absence of children. Factor two highlights ages 35-49 and represents stable families. The third factor contrasts contracting families (ages 45-54) and young couples/expanding families (ages 20-34). The final factor places emphasis on teens and young adults. Factor scores representing the

Table 5.5

Family Life Cycle Stages and Component Age Intervals

<table>
<tr><th rowspan="2">Family Life Cycle Stage</th><th rowspan="2">Proposed Ages</th><th colspan="4">Results from Factor Analysis</th></tr>
<tr><th>1950</th><th>1960</th><th>1970</th><th>Combined</th></tr>
<tr><td>Young single</td><td>18-24</td><td rowspan="2">20-29</td><td rowspan="2">20-24</td><td>20-24</td><td>20-24</td></tr>
<tr><td>Young couple</td><td>20-29</td><td>20-29</td><td>20-34</td></tr>
<tr><td>Expanding family</td><td>25-34
0-10</td><td>30-34*
0-14
and 25-39</td><td>20-34*
0-4
and 0-14</td><td>30-39
0-14</td><td>30-39
0-14</td></tr>
<tr><td>Stable family</td><td>30-44
5-19</td><td>missing</td><td>30-44</td><td>25-44</td><td>35-49</td></tr>
<tr><td>Contracting family</td><td>40-54
10-19</td><td>35-54*
and 10-19</td><td>40-59</td><td>40-59*
and 15-19</td><td>45-54</td></tr>
<tr><td>Old couple</td><td>50-74</td><td rowspan="2">45+</td><td>50+</td><td>50+
and 55-69</td><td rowspan="2">50+</td></tr>
<tr><td>Old single</td><td>70+</td><td>70+</td><td>65+</td></tr>
<tr><td>Unaccounted age Intervals</td><td></td><td></td><td>15-24</td><td></td><td>15-24</td></tr>
</table>

*There are two factor dimensions for this life cycle stage.

Source: Author.

Table 5.6

Congruency Between Factors: 1950, 1960, and 1970

		1960 Factor			
		1	2	3	4
1950	1	.952	.654	.375	-.091
Factor	2	-.041	.724	-.653	.286
	3	-.057	.434	.353	-.426
		1970 Factor			
		1	2	3	4
1950	1	.917	.396	-.649	-.553
Factor	2	-.075	.912	.103	.111
	3	-.189	.160	-.474	.175
		1970 Factor			
		1	2	3	4
1960	1	.978	.135	-.667	-.551
Factor	2	.362	.861	-.542	-.181
	3	-.477	.438	.804	.564
	4	.181	-.228	-.069	.524

Source: Calculated by author.

strength of family stages within each census tract are mapped for each census year (Figures 5.1 to 5.3).[1] Maps are arranged by factor, thus locations for any family stage are easily comparable from one date to another.

[1]All maps in Chapters 5 and 6 were drawn on a drum plotter by a routine described in the CALFORM Manual (1972). A standard black, fine line ballpoint pen was used to produce all lines and shading, except the isolines on Figure 6.3. Cartographic notation as legends, scale, and titles was added by more usual methods. All maps were plotted at an original scale of 1:125,000 and were photographically reduced by a linear factor of 3.0 for inclusion herein. (Figure 6.5 was reduced by 1.78). The maps vary in quality. All are included, however, to provide

Table 5.7

Factor Loadings for Age Intervals: 1950, 1960, and 1970 Combined*

Age Interval	Factor 1	Factor 2	Factor 3	Factor 4	Communality
0-4	-855				888
5-9	-973				966
10-14	-889				924
15-19				950	949
20-24	465		-588	475	924
25-29			-909		890
30-34	-594		-535		875
35-39	-476	761			851
40-44		928			879
45-49		704	521		853
50-54	691		476		864
55-59	826				854
60-64	896				920
65-69	870				911
70-74	865				908
75+	822				818
% of total variance	47.3	17.8	15.9	8.2	89.2
Description	Old couples, singles and young adults vs. expanding families	Stable families	Contracting families vs. young couples and expanding families	Teens and young adults	

*All values multiplied by 1000 to eliminate decimals. Factor 3 reflected for comparability with other analyses. Values less than 400 not shown.

Source: Calculated by author.

Spatial Patterns for Individual Family Stages

The Elderly and Young Adults. The strength of non-child families in central areas of the city is evident for each of the three census dates (Figure 5.1). Census tracts with positive values indicate concentrations above the area-wide average for families of old couples and old singles along with young adults. There is outward expansion of non-child areas during the three time periods, and new nodes of possible further expansion appear. The process of aging among relatively fixed age cohorts is operating.

The urban age model (p. 39) proposes zonation of family stages with older ages found near the city center and ever younger ages arranged in zones surrounding this center. Here, the locations for a fixed family stage actually move outward over time. There is a central core of elderly in 1950, with additional areas added by 1960 as residents age into the category. By 1970, as the original core diminishes in importance, areas on its periphery are added. Also by 1970 new nodes develop in areas removed from the central core. Though contrary to model expectations they are not totally anomolous for they have evolved in areas with well-defined commercial nodes; nodes similar but smaller than the CBD. These new nodes may serve as areas for future expansion of this age category.

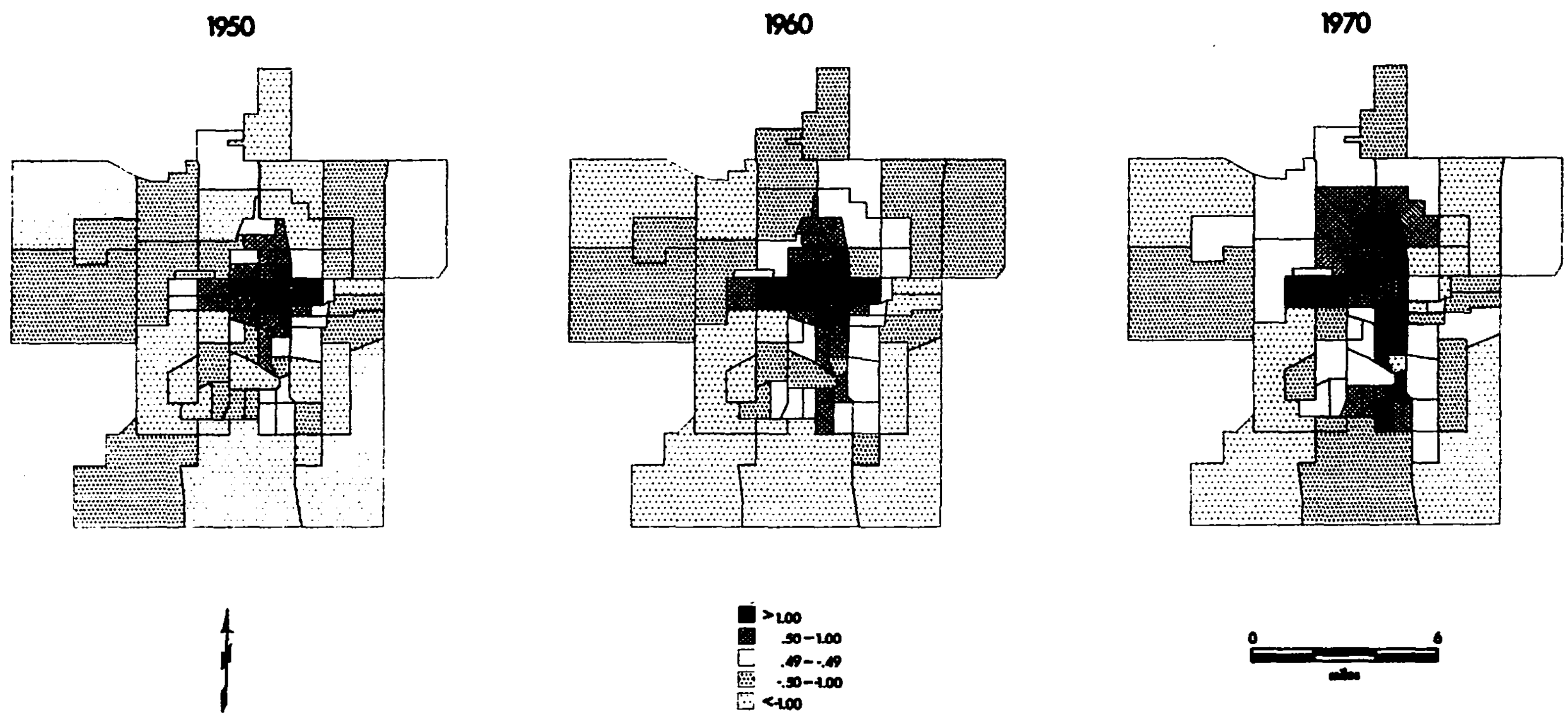
examples of the possibilities and limitations of line work in computer cartography. For a general discussion of the utility of computer mapping see Goldstein (1972).

Figure 5.1

Non-Child and Expanding Families

AGE COMPOSITIONS—FAMILY LIFE CYCLE STAGES

FACTOR 1



SOURCE: AUTHOR'S CALCULATIONS

Expanding Families. The other portion of factor one highlights expanding families with negative values indicating concentrations (Figure 5.1). Expanding families dominate the peripheral zone in 1950. At later dates, however, the original area matures to a stable family composition and expanding families locate in new developments outside the study area.

Thus, for factor one in 1950, a core of non-child families, usually old age inhabitants, is completely surrounded by expanding families. This aged core expands outward, and its gain in census tracts offsets concomitant losses in expanding family tracts. By 1970, the aged category is developing three new centers for possible future expansion. Meanwhile, locations for expanding families move beyond the limits of the study area with expanding families remaining dominant only within black neighborhoods.

Stable Families. Tracts classified as stable family evidence the same process (Figure 5.2). In 1950, stable families are strongly concentrated to the near north and northwest of the CBD. Two lesser concentrations also are present, one in Capitol Hill, and another beyond the 1950 black neighborhood boundaries. These areas are all located outward of the non-child areas but inward of expanding families (Figure 5.1, 1950 map).

An outward movement for stable family locations is evident by 1960. Areas of relative absence appear in the central portion of the city where none were present in 1950. By 1970 this type is absent in all interior portions of the city, and dominant only on the western mar-

Figure 5.2

Stable Families

AGE COMPOSITIONS–FAMILY LIFE CYCLE STAGES

FACTOR 2

SOURCE: AUTHOR'S CALCULATIONS

gins of the study area. Locations for stable families, like those for non-child families, move outward over time.

Expanding Families and Contracting Families. Patterns for expanding and contracting families are not as clearly defined as the previous two factors (Figure 5.3).[2] A crude zonation is present for all three dates. Negative values in the CBD probably represent young adults, involving the same age intervals as expanding families. Beyond the CBD is a discontinuous ring of contracting families. In turn, this zone is surrounded by a discontinuous set of expanding family tracts. The zonation corresponds with that proposed by the model. Contracting families are located outward of the elderly and young adults but inward of stable and expanding families.

Also of note is the persistence of contracting families in Heritage Hills (tract 17).[3] At later dates Heritage Hills is surrounded by old singles and young adults on its interior side and by old couples on its outer margins. It has resisted encroachment and retained its prestige because its housing is affordable only to the well off. Ownership of such housing is usually achieved at a relatively advanced stage of the life cycle when children are in the process of leaving the parental home, thus enabling it to retain status as a contracting family area.

[2]Negative values are associated with expanding families and positive values with contracting families for this factor.

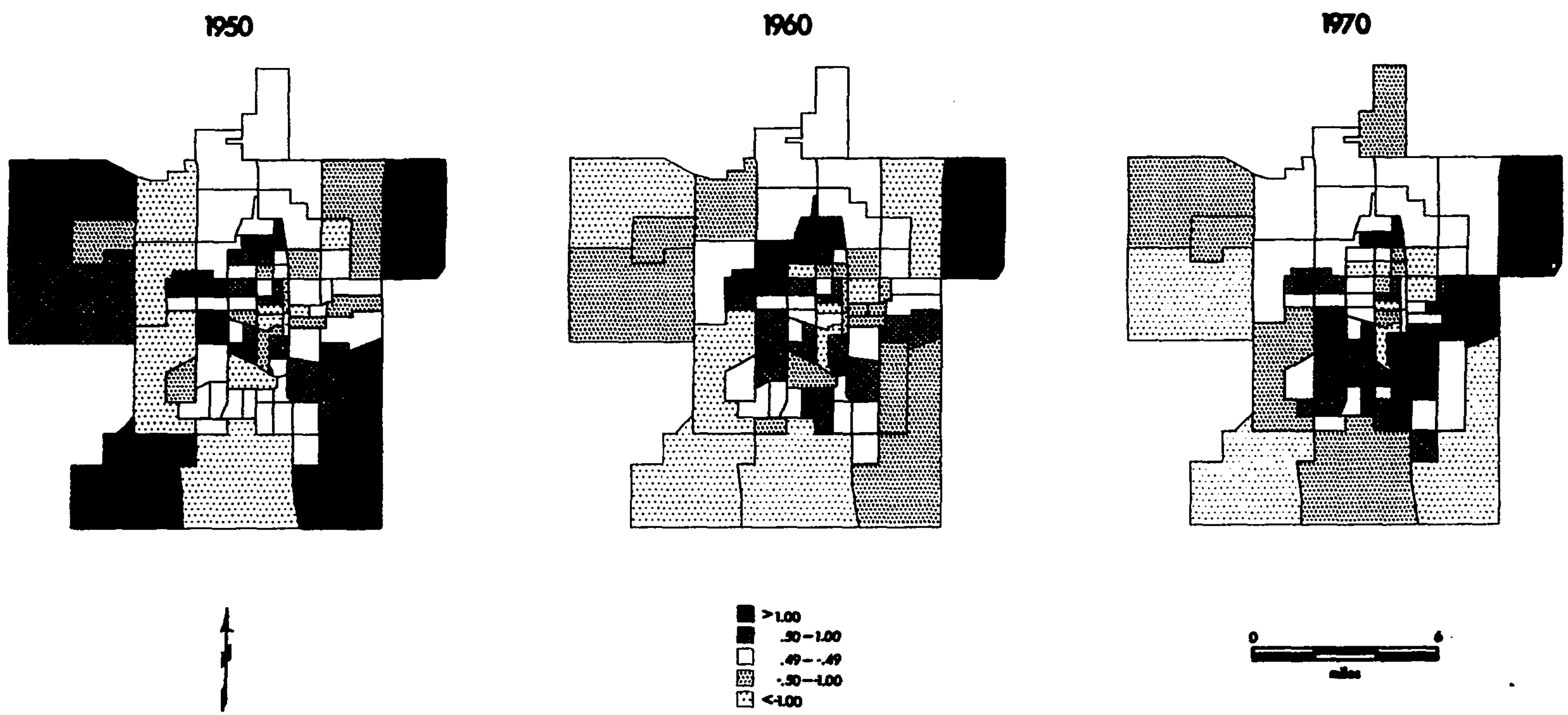
[3]The occurrence of a relatively permanent, very high status interior residential area has been observed previously (Firey, 1947; Yeates, 1965; Johnston, 1971b).

Figure 5.3

Expanding and Contracting Families

AGE COMPOSITIONS—FAMILY LIFE CYCLE STAGES

FACTOR 3



SOURCE: AUTHOR'S CALCULATIONS

The fourth factor has not been mapped. Essentially it represents the late childhood stage within contracting families along with young adults no longer in the parental home. Because of the disparate life style areas included in this factor, as family areas, and college and perhaps youth culture districts, no apparent pattern for factor scores is evident.

Structural Analyses Summarized

Two structural analyses have been presented. In the first the derived family stages are not presumed to have correspondence. Upon examination, however, all major stages are present and remain relatively stable over time. By combining data in a second analysis, a longitudinal view of the same cross-sectional data is presented. A single set of family stages results, whose locations can be traced through time.

Aging of populations within census tracts is evidenced by the increasing importance of older aged family stages at later dates. For the most part age cohorts remain fixed in location over the several dates investigated. The resident population, in addition to losing younger age groups by separate family formation and resultant out-movement to new housing areas, also experiences aging among the remaining residents.

Additionally, a regular zonation of census tracts based upon age characteristics is evident. Old age tracts are located closest to the center of the city. Contracting, stable, and finally expanding families are found at respectively greater distances. This zonation is an outcome of aging within residentially stable cohorts. Interior areas of the city--early settled by then young families--have seen the residents age to become the elderly of today. Zones further removed from the city center--developed at somewhat later dates--have seen residents age to constitute the contracting and stable families of today. Areas of current development are typified by expanding families.

The sequence of aging is not operating within black neighborhoods. Rather, the process is truncated when blacks move in and a new sequence of aging begins from date of black inhabitation.

Finally, the presence of a diffusion process is seen, whereby concentrations of old age, originally centered at a single node, move outward. As the original node diminishes in importance, newer nodes in the path of movement become dominant centers.

Family Stage Classes - Locations and Change Over Time

The preceding portrayal of individual factors gives the relative importance of separate family stages and their changing urban location. However, to fully evaluate the model of family stages and urban location, the simultaneous effect of all stages must be considered. To do this, a cluster analysis procedure is employed.[4] Nine classes resulting

[4]Input consists of weighted factor scores from all three census dates along with standardized X and Y coordinate locations for each census tract. The weightings consist of the proportion of total variance contained within a given factor. Factor scores for each census tract on the first dimension are weighted by .473, the contribution of factor one to total variance. Similarly, factor scores on the remaining dimensions are weighted by .178, .159, and .082 respectively. For a description of the cluster routine and the variables used, see Appendix B.

from this clustering procedure are given in Table 5.8, along with a description of each family stage emphasized. Locations for the classes are mapped in Figure 5.4.

Old Age Population - Central Locations. The first class is an old population, aged 50 and over, located in the central core area. Change in location is quite evident as this aged area expands during each decade. In 1950, there is only one aged tract, the exclusive residential neighborhood of Heritage Hills just north of the CBD. By 1960 this area expands to the west of the original node.

Census tracts in this class are not identical to those included in the first dimension of the preceding factor analysis, for the effect of younger ages is removed by the clustering. There are, however, strong similarities. The same central location pattern is present. Also the movement trend is similar--expansion outward from the original core with a separate node appearing at the most recent date.

Contracting Families - Two Classes Differentiated by Age and Socio-Economic Status. Expansion and movement in the aged class is at the expense of the second class. It consists of slightly younger ages with emphasis on contracting families and old couples.[5] Census tracts

[5] In the factor analysis, old couples and singles constituted a portion of one factor while contracting families were a part of another factor. Here, working with nine classes there is much better resolution in family stages and their respective locations. This resolution is fine enough that overlapping family stages constitute certain classes. There is one for contracting families and old couples and another for contracting families and expanding families. The overlapping brings us one step closer to reality in the location of age groups. No census tract consists totally of one age group, but actually involves a complex mixture of all ages with emphasis on the categories singled out for discussion here.

Table 5.8

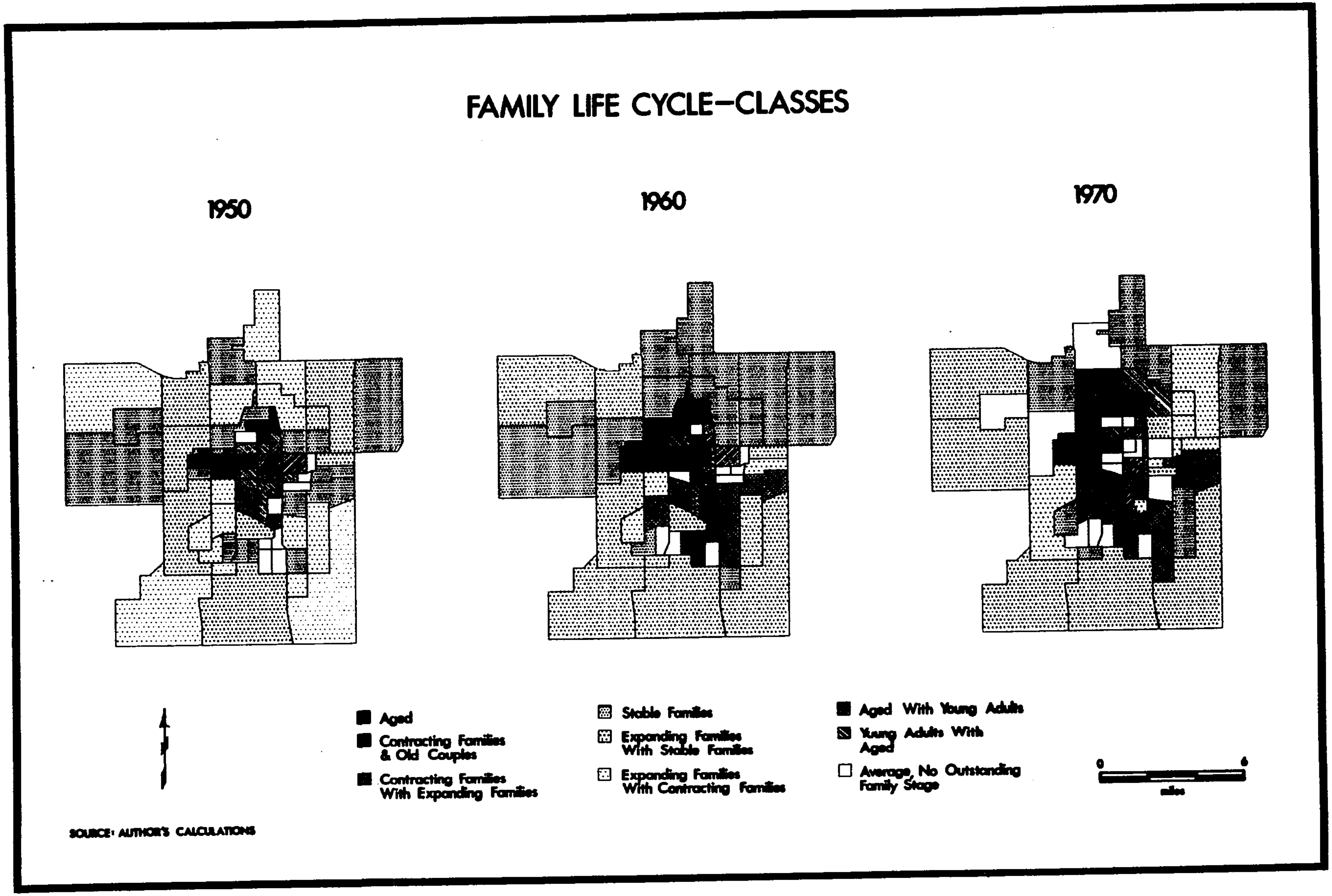
Family Life Cycle Classes*

Class	Description	Average Unweighted Score, by Factor				Average Standardized Coordinate with Reference to CBD		Number of Tracts, by Year		
		1	2	3	4	X	Y	1950	1960	1970
1	Aged	1202	-765	412	457	469	245	1	9	13
2	Contracting families and old couples	559	915	1130	080	690	507	6	11	2
3	Contracting families with expanding families	431	-836	711	135	-017	-342	3	8	11
4	Stable families	-568	834	056	010	278	717	17	15	7
5	Expanding families with stable families	-1137	120	-1336	-696	697	-186	8	10	7
6	Expanding families with contracting families	-1282	620	460	203	235	134	15	3	8
7	Aged with young adults	1778	186	-943	-174	-063	457	6	6	8
8	Young adults with aged	807	332	-804	1150	209	511	8	2	2
9	Average, no outstanding family stage	300	-258	035	234	225	036	9	9	15

*All values multiplied by 1000 to eliminate decimals.

Source: Calculated by author.

Figure 5.4



FAMILY LIFE CYCLE–CLASSES
1950
1960
1970
Aged
Contracting Families & Old Couples
Contracting Families With Expanding Families
Stable Families
Expanding Families With Stable Families
Expanding Families With Contracting Families
Aged With Young Adults
Young Adults With Aged
Average, No Outstanding Family Stage
0
6
miles
SOURCE: AUTHOR'S CALCULATIONS

in this class are located adjacent to, but outward from aged census tracts identified in class one. Proximity in location occurs for all three dates. As the area of aged population expands after 1950, it is at the expense of contracting family census tracts, supporting the idea of an aging process for census tracts.

Contracting families are also important in the third class, however, associated stages are children and expanding families, rather than aged. Locations are adjacent to, and south of the CBD in 1950, with a major expansion to the south occurring over the next two decades. Most census tracts in this class are characterized by low socio-economic status. In the family stage model this is an area of expanding and stable families having a major income constraint on housing consumption. Families are unable to compete for peripheral locations and locate in older housing and/or undesirable sites they are able to afford. These tracts serve as a staging area for expanding families, residing in inexpensive housing during early family stages. Some families eventually acquire sufficient capital to move, only to be replaced by new expanding families. Others, unable to upgrade their housing, remain and contribute to the dominance of contracting families.

Contracting families in class two are associated with aged, while in class three they are integrated with expanding families. Class two areas are almost all high socio-economic status tracts. Housing is not accessible to expanding families, and there is continued maturation of residents. In contrast, class three areas are uniformly low status tracts with housing accessible to expanding families. Since several tracts retain their designation over one or two decades, they are not undergoing a maturation process. Rather, continued influx of young age groups leads to a retention of age characteristics.

Stable Families - Effects of Changing Population Structure. The fourth class is characterized as stable families. Census tracts in this group are very dispersed in 1950. Several nodes are present but none consists of more than three census tracts. There is a similarity in these locations however. One area to the east of the CBD is the older part of the black neighborhood. Others are high status suburban developments settled before World War II. By 1950 all have matured to have stable families dominating.

This class dominates the entire northern half of the study area in 1960 as separate nodes of 1950 coalesce to form one large area. This increase is a direct outcome of changing population structure between the two dates. Recall from earlier discussion, the tremendous increase in the number of births immediately after World War II. A corresponding building boom to accommodate new families resulted in the development of peripheral locations within the study area. Expanding family areas of 1950 (class five below) have matured to stable families in 1960 and contribute to the rapid increase in this category. By 1970, stable families diminish in importance and are replaced by contracting families and special classes not yet discussed.

Expanding Families - Two Classes Differentiated by Ethnic Status. Class five is dominated by expanding families, however, stable families are also present. All ages to 39, except for ages 15-24, are relatively important. Tracts in this class are generally located on the periphery of the study area.[6] Areas in this class usually mature to a stable family category (class four) at later dates.

Class six also typifies dominance by expanding families, but in association with contracting families. This apparent contradiction is clarified when viewed in a locational context. In 1950, tracts in this class have peripheral location and are just undergoing urban development. In-moving expanding families are added to the resident contracting families. With maturation of young families, most tracts become typified as stable family by 1960. In 1970 an area appears in the northeast having a mix of in-moving, expanding black families and already resident, contracting white families. Rejuvenation is occurring with replacement of older white families by younger black families.

The Very Old and Young Adults - Areas of Terminal Stability. Classes seven and eight both represent combinations of aged and young adults, with class seven emphasizing the former and class eight the latter. Both represent terminal stability, or senility, a stage occurring after passage through old age when a mix of residual elderly and in-moving young adults is present.

Areas in these two classes are in and around the CBD in every period. They are static areas, serving only a limited range of family types, in this case childless families. The mix of the two classes changes over time. In 1950 young adults are emphasized. In 1960 and

[6]Their location, however, is inward of the suburbs with a longer history of settlement and development. These tracts actually are filling in after the original thrust of development leaped over them.

1970 the old age component is emphasized. Only one tract--the site of Oklahoma City University--remains dominantly young adult. The lessening dominance of young adults may reflect the increasing attraction of apartments in peripheral locations. The young are locating in new apartment units and becoming hidden among other age groups in outer census tracts.

Age Mixture - A Result of Ethnic and Economic Factors. The final category, class nine, has no outstanding age group with average scores for all family stages. Two low income areas of the city have this average composition in 1950 and 1960--parts of Capitol Hill and the black neighborhood. By 1970, Capitol Hill is still represented and new locations appear, including an interior high income area (tract 17) and the suburbs of Bethany-Warr Acres and Nichols Hills. All locations have relatively long histories of habitation and, except for the black area, housing is uniformly single family dwelling units. Selection of residents is strongly based on ethnic or economic characteristics, rather than correlates of age or family stage.

For the black residential area, families are constrained within a delimited space. With this constraint, a full range of residential selection is unavailable and there is no sorting according to age or family stage. Note however that with the rapid expansion of the black neighborhood between 1960 and 1970, this undifferentiated age composition disappears. With a wider selection of residence, the distribution of family stages begins to resemble the remainder of the study area.

Ability to pay for housing determines family selection in other high and low income areas. High income groups are able, by devices like prior site selection and strong influence on land use change, to preserve the high status of any location they choose. Conversely, the lowest income groups are unable to affect the location process and must reside in situations not desired by other economic groups. Evidently, neither group participates in age sorting by location to the extent found in middle income groups.

Family Life Cycle Stage Model Evaluated

Correspondence of Actual Family Locations. The location of family stages originally offered (Figure 3.1) is supported by the results. Oklahoma City has a general zonation of family stages with older residents at and near the center, ringed by successively younger family stages. Young adults are associated with old couples and singles near the center, typifying the area as non-child, appealing to a limited range of family types. From 1950 to 1970 this non-child area expands and increases in importance as suggested by the model.

Within the zones of family types there is differentiation by economic status. Oklahoma City has two broad sectors, the higher status area to the north and west of the CBD and lower status locations south of the CBD. Older families are strong in high status sector while younger families are more evident in the lower status sector, indicating some sorting of families based on income constraints. Several census tracts of non-differentiated age composition appear in each sector. Residential selection within these tracts is based strongly on income.

The overall zonal arrangement of family types is interrupted by the black residential area, which within its bounds also is beginning to develop a zonation of family types. Highly constrained in space in 1950 with a corresponding non-differentiated age composition, by 1970 it has a gradation of family types from old, resident within 1950 bounds, to young, residing in recent expansion areas.

Over the three census dates, an outward movement of family stages is noticeable. Areas originally classified as expanding family in 1950 are stable or contracting family by 1970. Contracting family areas of 1950 become aged by 1970, and there is an increase in the number of senile (terminal stability) tracts during each decade. This outward movement of family types strongly indicates an aging process for residential areas.

Factors Contributing to Operation of Model. Correspondence between actual family distributions and those suggested by the model point toward certain factors contributing to the model's performance. The dominant process operating is stability for age cohorts within census tracts. Tracts dominated by young cohorts at an early date retain these cohorts and are later characterized by successively older age compositions. The addition of housing stock at the urban periphery (to be considered in more detail in the next chapter) strongly contributes to the perpetuation of zones of age distributions. With young families added in a zone surrounding the already settled area, and with stability in the location of age cohorts, zones of family stages result.

Categories of family stages change in location over time, actually moving outward and away from the city center. Areas consisting of expanding families at an early date are characterized as stable family and contracting family at later dates. It is possible and quite probable that movement is occurring within and between these areas. However, even with movement of residents, most zones are maturing over the time period of analysis. If replacement is occurring, the in-moving population has the same age characteristics as those moving out.

Growth in population and expansion of the housing stock are direct contributors to the operation of the model. The study area experiences population growth in all age intervals (except ages 20-29 between 1950 and 1960, and ages 0-4 and 30-39 between 1960 and 1970). Growth brings about demand for additional housing. Without the addition of housing at the urban margins, newly formed families would look elsewhere for housing. If so, these families would be a replacement population rather than a population of addition. Replacement would occur in areas already characterized by older age compositions. Given such conditions, the influx of young families to older areas would severely distort the observed zonation of life cycle stages.

Filtering of the housing stock is not evident, except perhaps in newer portions of black residential areas.[7] This does not preclude the existence of filtering, just that it is not evident when examining age distributions at the level of aggregation used herein. If filtering is

[7]The same observation has been made by Johnston (1969) dealing with alien immigration in London.

occurring, in-moving families have the same age compositions as families leaving for better dwellings.

The emphasis has been on family stages in a static context, viewing their distributions at each of three dates, and comparing observed patterns. From this, it is seen that residential stability among age cohorts and the addition of new families at the urban periphery are prime contributors to the zonation of family stages in the urban area. This zonation conforms to the model developed to explain intra-urban family stage patterns.

CHAPTER 6

AREAL AGE DYNAMICS

Changes in age compositions and family stages for residential areas are areal age dynamics. They are examined by means of factor analyses of relative age cohort change variables, thereby stressing changes within census tracts over decade time intervals. The last chapter emphasized structure at separate dates and by comparing results cross-sectional views of structural change were obtained. In this chapter the processes of change leading to structural differences are highlighted by using a direct measure of change. Emphasis is on the why of change as well as the types of age composition modification.

Dimensions portraying broad family stages are used in identifying processes of areal age dynamics. Initially, the spatial distributions of individual factors are examined to ascertain aging processes within census tracts. Then the combined effect of all factors is considered in developing a typology of areal age dynamics. Throughout, the emphasis is on change for areas--the areal differentiation of age dynamics.

Expected Patterning of Family Stage Change

The dimensions of age dynamics (Tables 6.1 and 6.2) are structurally similar for both decades, 1950-60 and 1960-70. They differ only by

Table 6.1

Factor Loadings for Age Dynamics, 1950 to 1960*

1960 Age Interval	Factor 1	Factor 2	Factor 3	Factor 4	Communality
10-14				892	849
15-19			898		894
20-24			884		916
25-29				-765	758
30-34			-817		875
35-39			-479	678	820
40-44				869	780
45-49		675			624
50-54		865			809
55-59		810			854
60-64		728			770
65-69		722			794
70-74	690	519			827
75-79	927				926
80-84	911				909
85+	871				930
% of total variance	23.6	22.7	18.2	18.8	83.3
Description	Aging-Old couples and singles	Aging-Contracting families and old couples	Youthing-Young adults vs. Aging-Stable families	Aging-Contracting families vs. Youthing-Expanding families	

*All values multiplied by 1000 to eliminate decimals. Factor 3 reflected for comparability with other analyses. Values less than 400 not shown.

Source: Calculated by author.

Table 6.2

Factor Loadings for Age Dynamics, 1960 to 1970*

1970 Age Interval	Factor 1	Factor 2	Factor 3	Factor 4	Communality
10-14		-548	-501		641
15-19			742	580	922
20-24			953		926
25-29		-431		-729	747
30-34			-866		882
35-39			-772	400	819
40-44				869	799
45-49		729			681
50-54		803			756
55-59		790			736
60-64	526	665			751
65-69	587	610			717
70-74	773	447			808
75-79	849				799
80-84	925				879
85+	827				723
% of total variance	23.3	22.2	20.1	13.2	78.8
Description	Aging- Old couples and singles	Aging- Contracting families and old couples	Youthing- Young adult vs. Aging- Stable families	Aging- Contracting families vs. Youthing- Expanding families	

*All values multiplied by 1000 to eliminate decimals. Factor 3 reflected for comparability with other analyses. Values less than 400 not shown.

Source: Calculated by author.

one or two age intervals within comparable dimensions.[1] The four factors respectively portray age dynamics for the very old, for contracting families and old couples, for stable families versus young adults, and for contracting families versus expanding families.[2] Before examining the actual distributions of these dimensions, a review of expected changes is in order (see Figure 3.2).

At and near the center of the urban area the expected composition is a mixture of young and old. Moreover, the composition should remain static with no further change anticipated. Since the current analysis is one of change, this area should not appear.

Outward from the city center, several zones of maturing age com-

[1]The strength of similarity for comparable dimensions is shown by the coefficient of congruency test (Rummel, 1970, 461-62).

		1960-1970 Factor			
		1	2	3	4
1950-	1	.942	.425	.404	.097
1960	2	.663	.962	.249	.363
Factor	3	.453	.260	.887	.294
	4	-.118	-.038	-.368	.795

[2]The first two factors deal exclusively with aging. Factor one for both decades highlights the very old population, ages 70 and over in 1960 and ages 60 and over in 1970. Factor two encompasses ages 45-74 in both decades, highlighting aging for contracting families and old couples. For 1970 this factor also contains weak negative values for ages 10-14 and 25-29, indicating an opposing net change within these age cohorts.

Factors three and four have both aging and youthing components. In factor three ages 15-24 are positive and ages 30-39 are negative during both decades. In the later decade ages 10-14 are also negative, linking this cohort with ages 30-39. The dimension contrasts youthing for young adults with aging for stable families. The final factor assigns positive values to ages 35-44 and negative values to ages 25-29. For each decade another cohort is associated with ages 35-44, ages 10-14 for 1960 and ages 15-19 for 1970. Expanding families versus contracting families are identified by this dimension.

position should be evident. First is a late maturing zone where old couples and singles are increasingly important. Next is a maturing zone of contracting families and old couples, followed by an early maturing zone with stable families. Finally is a peripheral zone of youthing where expanding families are increasing. Table 6.3 identifies the expected association between zones and factors.

Table 6.3

Age Dynamics, Expected Zones and

Related Factor Dimensions

Zone (Figure 3.2)	Factor Dimension
Senile (terminal stability)	not present
Late Maturity	one
Maturity	two
Early Maturity	three
Youthing-Expansion	four

Source: Author.

Included in the model of age dynamics are sectoral variations based on economic status. High status sectors are further advanced in the aging sequence because of the earlier establishment of residence by long term inhabitants. Within Oklahoma City three sectors exist, the high status northwest, the low status south, and the black area in the northeast (Krause, 1972b).[3] For aging differentiation the northwest sector should be further advanced in the maturation sequence than the southern sector.

Also recognized in the age dynamics model are the effects of a segregated ethnic population. The black sector should have its own distinct zonal sequence of aging. Assuming the black area develops at a later date than its housing and that expansion has not occurred until recently, its zonation would not have had enough time to evolve a full sequence. Thus its innermost zones are maturing or early maturing. Outward is an area of rejuvenation, where the original white population at maturity is being replaced by a younger black population.

Finally, areas of static age composition must be considered. Within the high status sector is a static area attracting only those able to afford the high costs of housing. Families with incomes sufficient to purchase such housing are at later stages in the life cycle. Thus age compositions should remain static or regress from late maturing back to an earlier maturing stage. In the low status sector, static age compositions characterize locations that are undesirable for all urban dwellers. Only families unable to afford other locations will be found. There is no differentiation by age, rather the major locational determinant is income.

[3]Approximate boundaries for these sectors are seen in Figure 4.3 (p. 54). The south and north sectors are separated by the North Canadian River, which itself runs west to east halfway between Capitol Hill and the CBD. The two northern sectors are separated by the Santa Fe Railroad tracks which trend north-south and form the eastern boundary of the CBD.

Age Dynamics Zones - Individual Family Stages

The distribution of age dynamics for census tracts during the 1950-1960 decade is shown in Figure 6.1, and the 1960-1970 decade in Figure 6.2. Factor scores showing the strength of age change are mapped separately for each factor.

Positive values for factor one on both figures indicate areas where the elderly are increasing in importance. A zonal pattern is evident with the dominant aging area located northwest of the CBD. A secondary area is located around the core of Capitol Hill. This is the late maturity zone, encompassing the first zone beyond the CBD. The high status portion of this zone is further removed from the city center and encompasses a larger area than in the low status portion, supporting sectoral differentiation by income. Negative values show areas where the elderly are of lessening importance; in the CBD itself, in tracts achieving a black majority in population during the decade, and in several peripheral census tracts.

The second factor portrays aging areas for contracting families and old couples. Positive scores indicate maturing to late maturing census tracts, located in Capitol Hill and to the north and west of the CBD. This zone is found outward of the one identified by factor one, and the higher status northern portion is further removed from the city center than the southern portion.

Factor three must be viewed from two aspects because of its bipolar loadings. Areal patterns are simple however. A central core of positive values is encircled by peripheral tracts with negative values.

Figure 6.1

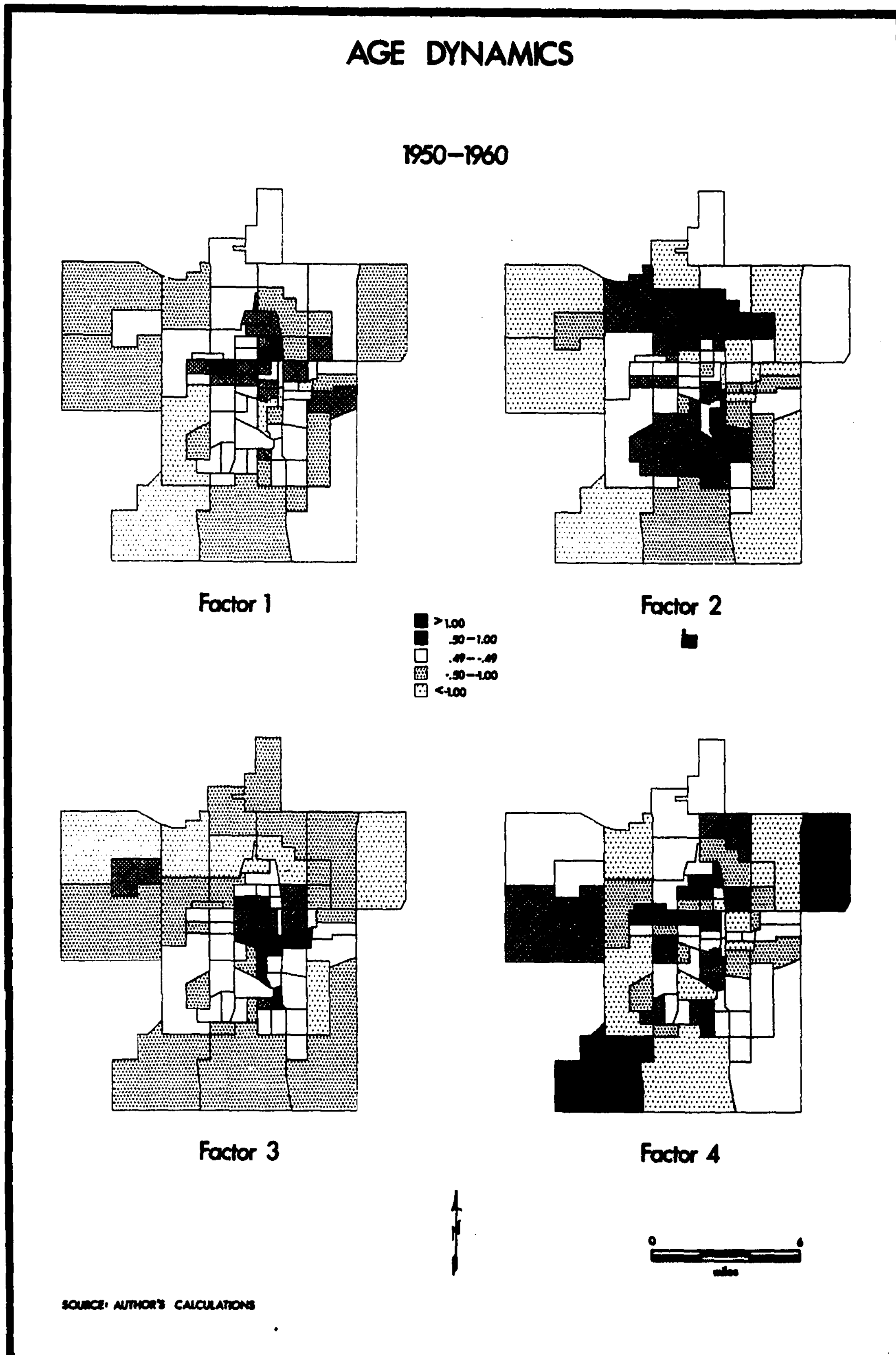
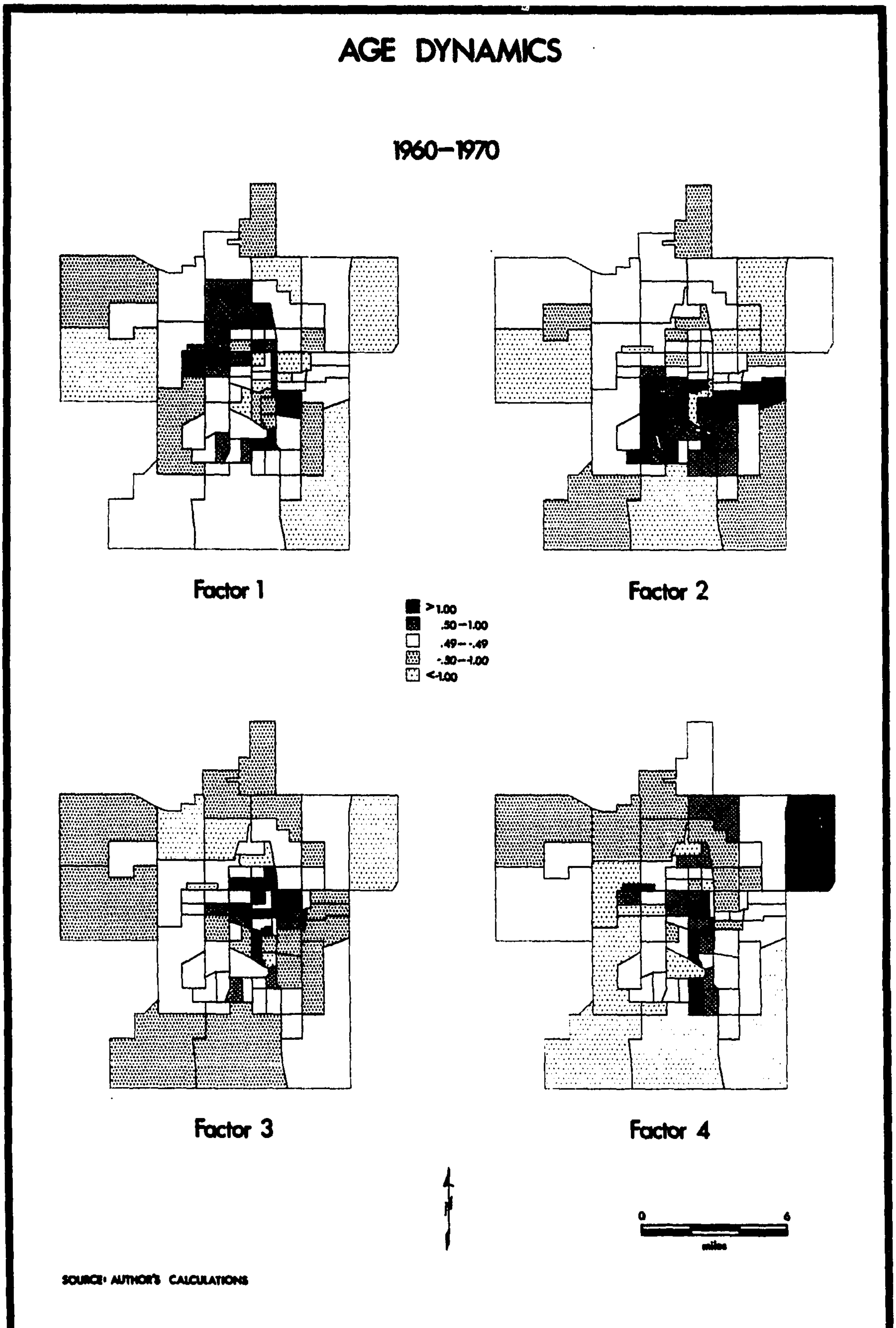

AGE DYNAMICS
1950–1960
Factor 1
Factor 2
>1.00
.50–1.00
.49–-.49
-.50–-1.00
<-1.00
Factor 3
Factor 4
N
0
6
miles
SOURCE: AUTHOR'S CALCULATIONS

Figure 6.2


AGE DYNAMICS
1960–1970
Factor 1
Factor 2
>1.00
.50–1.00
.49–-.49
-.50–-1.00
<-1.00
Factor 3
Factor 4
N
0
6
miles
SOURCE: AUTHOR'S CALCULATIONS

Positive scores indicate relative increases to young adults, and/or relative decreases in stable families. Conversely, negative scores show relative decreases in ages 15-24 and/or increases in ages 30-39.

The central zone is typified as youthing.[4] In the model this zone had a static age composition consisting, in part, of young adults. Evidently the central zone is not yet at an equilibrium and young people are still being attracted to the area. This may be due to the youthfulness of Oklahoma City. The peripheral zone has an increase in stable families and especially a decrease in young adults. It is early maturing and lies outward of the previously identified more advanced aging zones.

The final factor contrasts changes for contracting families and expanding families. Patterns for both decades are broadly similar. Positive values portraying aging of contracting families are to the near northwest of the CBD and in Capitol Hill. Negative values showing youthing for expanding families are in a peripheral zone. Mobility within the 25-29 age cohort makes a strong contribution to the spatial patterning of this factor. The interior zone experiences a decrease in this age cohort attributable to out-movement. Concomitantly, increases

[4]The measure used in analysis brings about an emphasis upon young, highly mobility age groups. These age groups appear in factor three as young adults, ages 15-24, and in factor four as expanding families, ages 25-29. Age intervals used in labeling factor loadings refer to cohort age at the end of the decade. Thus cohorts aged 5-14 at the beginning of a decade are the cohorts aged 15-24 at decade's end. A majority of cohort members leave the parental home during the decade, thus changing its relative importance within census tracts. Family zones have out-movement and corresponding decreasing importance for these cohorts while other zones receiving these newly created households experience youthing.

in the peripheral zone are attributable to this cohort establishing new households. This peripheral zone of youthing completes the proposed zonation. Rings of ever younger age change encircle the city center.

Influence of Original Settlement Nodes on Zonation. An overall zonal pattern for age dynamics is apparent, however, distortions in the configuration are also evident. This is due to the existence of three settlement nodes rather than a single focus.[5] The evolution of the zonal patterning is tied to the origins of these nodes, which in turn are related to the historical development of Oklahoma City. Consequently, to understand aspects of the zonation requires an appreciation of its historical context.

The original nucleus of the city was settled in one day, April 22, 1889, and today is part of the Central Business District (Oklahoma Gazette, May 21, 1889, as quoted in Knowles, 1965, 13-14). Expansion north of the Canadian River has progressed from this node. With the river presenting a major barrier, a second node soon developed on its south bank. The existence of this node was formally recognized in 1904 when it was incorporated as the city of Capitol Hill (Capitol Hill Beacon, 1965). While no longer a legal entity, Capitol Hill retains its identity as a distinct residential, commercial, and social node (Krause, 1972a). The third node consists of the older parts of the black residential area. By 1903 blacks were confined to a small area east of the

[5]One node is the CBD with its development directed to the northwest. A second node is in Capitol Hill, influencing patterning in the south. The third node, not as clearly defined, lies to the east of the CBD and is correspondent with the core of the black residential area.

CBD and Santa Fe Railroad tracks. Early expansion was constrained to the north and east, usually east of the railroad tracks (Knowles, 1965, 16). This line of demarcation exists yet today.

The three nodes are recognizable today by differences in dwelling densities and arrangements. Dwelling arrangements in the CBD are typically multiple unit apartments (Table 6.4). The black area also has many multiple dwelling units but structures usually contain fewer units, as duplexes and subdivided housing rather than large apartment buildings. Capitol Hill is an area of detached single family dwelling units.

Dwelling densities are shown on several maps portraying the growth of Oklahoma City from 1920 onward (Figure 6.3).[6] In 1920 the nodes are distinctive in their dwelling densities, but by 1970 differences from surrounding tracts diminish. The tri-nodal pattern has evolved into a zonal distribution with the original nodes only weakly evident.

The zonal pattern of age distributions and age dynamics is related to the current patterning of dwelling densities, however, the

[6]The number of dwelling units per acre, by census tract, are mapped for the years 1920, 1930, 1950, and 1970. The number of units per acre is based on gross acreage within census tracts, measured from a map of 1970 tract boundaries (U.S. Bureau of the Census, 1972a). Dwelling unit age was calculated from reports on year of construction given by residents in 1970 (U.S. Bureau of the Census, 1972a). A single reporting year was used because of boundary changes in census tracts from previous censuses and the absence of data prior to 1940. Based on this author's observation, there apparently is underestimation in the age of residential units. Numbers of units reported as constructed during recent decades sometimes increase after the end of the decade. An increase such as this can only arise by underestimation in the age of older dwelling units.

Table 6.4

Dwelling Units, by Units in Structure: Selected Census Tracts, Oklahoma City, 1950 and 1970

Year	Area	Percentage of Units, by Number in Structure				
		1	2	3 & 4	5+	(50+)
1950	CBD*	15.7	15.8	23.5	45.0	
	Black area	26.8	19.7	23.6	29.9	
	Capitol Hill	54.7	24.2	11.5	9.6	
1970	CBD*	9.9	7.7	14.3	68.0	(14.4)
	Black area	29.0	13.3	20.4	37.2	(6.0)
	Capitol Hill	58.5	16.2	14.2	11.0	(0.0)

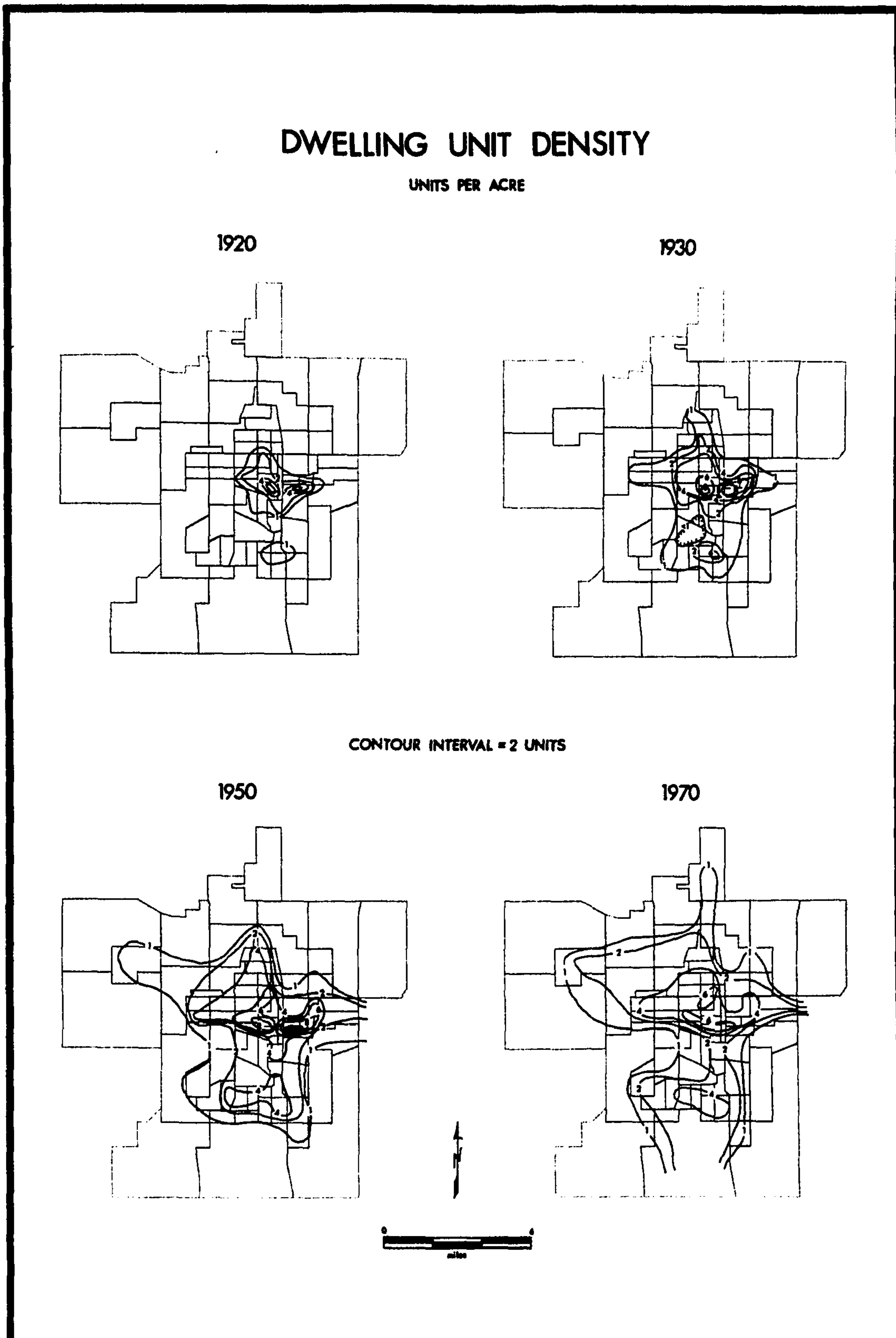
*CBD census tracts are 25 and 32, black census tracts are 26 and 30, Capitol Hill census tracts are 46 and 47.

Source: Author's calculations based on U.S. Bureau of the Census (1951b, 1972a).

influence of the original nodes is noticeable. Capitol Hill and the area emanating from the central node follow the same aging sequence, however, patterns seen in 1960 in the northwest do not appear until 1970 in Capitol Hill. The black neighborhood has a trend counter to the other areas, with changes emphasizing younger age groups predominating. Even so, by 1970 contracting families are increasing in older portions of the black area.

Zonation Related to Housing. The zonal patterning of age dynamics is related to the incremental expansion of housing portrayed in Figure

Figure 6.3


DWELLING UNIT DENSITY
UNITS PER ACRE
1920
1930
CONTOUR INTERVAL = 2 UNITS
1950
1970
N
0
4
miles

6.3. Expanding families who settled at the periphery of the city in 1920 have aged to become the older component of the city's population in 1970. The peripheral census tracts of 1920 are the late maturity and senile areas of 1970. The peripheral areas of settlement in 1950 have stable and contracting family compositions in 1970 and are the maturing zone. The peripheral area of 1970 is the zone of current youthing.

The maps of age dynamics (Figures 6.1 and 6.2) clearly show this aging by the outward shift in family stages. In 1960 an area adjacent to the CBD has an elderly composition; by 1970 this composition shifts outward to the northwest. In 1960 there is only one tract in Capitol Hill having an increase in the elderly composition; by 1970 the area expands to include three additional tracts. In the south an area of increase for old couples and contracting families expands and intensifies during the two decades. All groups except young adults shift outward in location between the two decades.

Aging Classes and Expected Locations

To this point the analysis has been of individual factors with the emphasis on one, or two contrasting age groups and their associated family stages. The spatial patterning of age dynamics is reasonably established by these individual factors, but the simultaneous influence of the several age groups has not been considered.

A cluster routine is again employed to develop a typology of age dynamics areas.[7] Six classes resulting from this grouping are listed in Table 6.5, along with the unweighted factor score averages for the included census tracts. Classes for 1960 and 1970 are comparable, consequently, the decades are discussed simultaneously.

Tracts in the first class, designated senility, have experienced relative increases in child absent family types, with the disparate ages of 60 and over, and 15-19 emphasized. Senile areas are past the stage when they appeal to families since the mix of housing can only accommodate very small households. Areas in this class for 1960 should remain so in subsequent time periods, as any change in family composition must result from replacement of existing small housing units to attract other family types. The class should maintain its location in and around the CBD because of the older multiple dwelling units.

The second class, late maturity, has a relative increase in the elderly.[8] This class is reaching the normal end of the life cycle. As the older, long time residents die or move to other accommodations, areas in this class should experience replacement by younger age groups.

[7]Grouping of census tracts is based upon weighted factor scores for each of the four dimensions. Weightings consist of percentage contribution to total variance by each factor as given in Table 6.1 and 6.2.

[8]In 1960 the elderly are associated with an increase in young adults, ages 15-19 and decreases for stable families, ages 30-39. A stronger emphasis on young adults and somewhat weaker emphasis on the elderly suggests passage into rejuvenation rather than senility. In 1970, the class is primarily late maturity having an increase in the elderly and a decline in ages 45-74. There is some replacement occurring since stable families also exhibit increases.

Table 6.5

Age Dynamics Classes

1950-1960

Class	Description	Average Unweighted Score, by Factor* 1	2	3	4	Census Tracts in Class
1	Senile	502	-045	1763	040	3
2	Late Maturity/ Early Rejuvenation	669	063	1162	-414	14
3	Maturity	031	728	-324	390	27
4	Late Youth	-427	-1234	-842	1048	9
5	Youth	-218	-112	-553	-1127	15
6	Rejuvenation	-607	-629	492	198	5

1960-1970

Class	Description	Average Unweighted Score, by Factor* 1	2	3	4	Census Tracts in Class
1	Senile	1786	-111	1090	-578	6
2	Late Maturity	704	-419	158	535	10
3	Maturity	196	747	-113	292	28
4	Late Youth	-337	-898	-1784	2893	2
5	Youth	-170	-187	-361	-968	19
6	Rejuvenation	-1048	-1342	1293	264	8

*All values multiplied by 1000 to eliminate decimals.

Source: Calculated by author.

Urban location for this class should be in the first zone outward of the senile area.

The third class, designated maturing, has increases for contracting families and old couples (ages 45-74) and stable families (ages 10-19 and 35-44). Since it consists of younger individuals than the late maturing class, its location should be outward of the late maturing zone. The fourth class is late youthing.[9] It is characterized by relative increases for stable families and decreases for all other age groups. It should be located outward of the maturing zone. The fifth class, with increases among ages 25-34 and decreases for ages 10-24 connotes youthing. Consequently, according to the age dynamics model it should be peripheral in location.

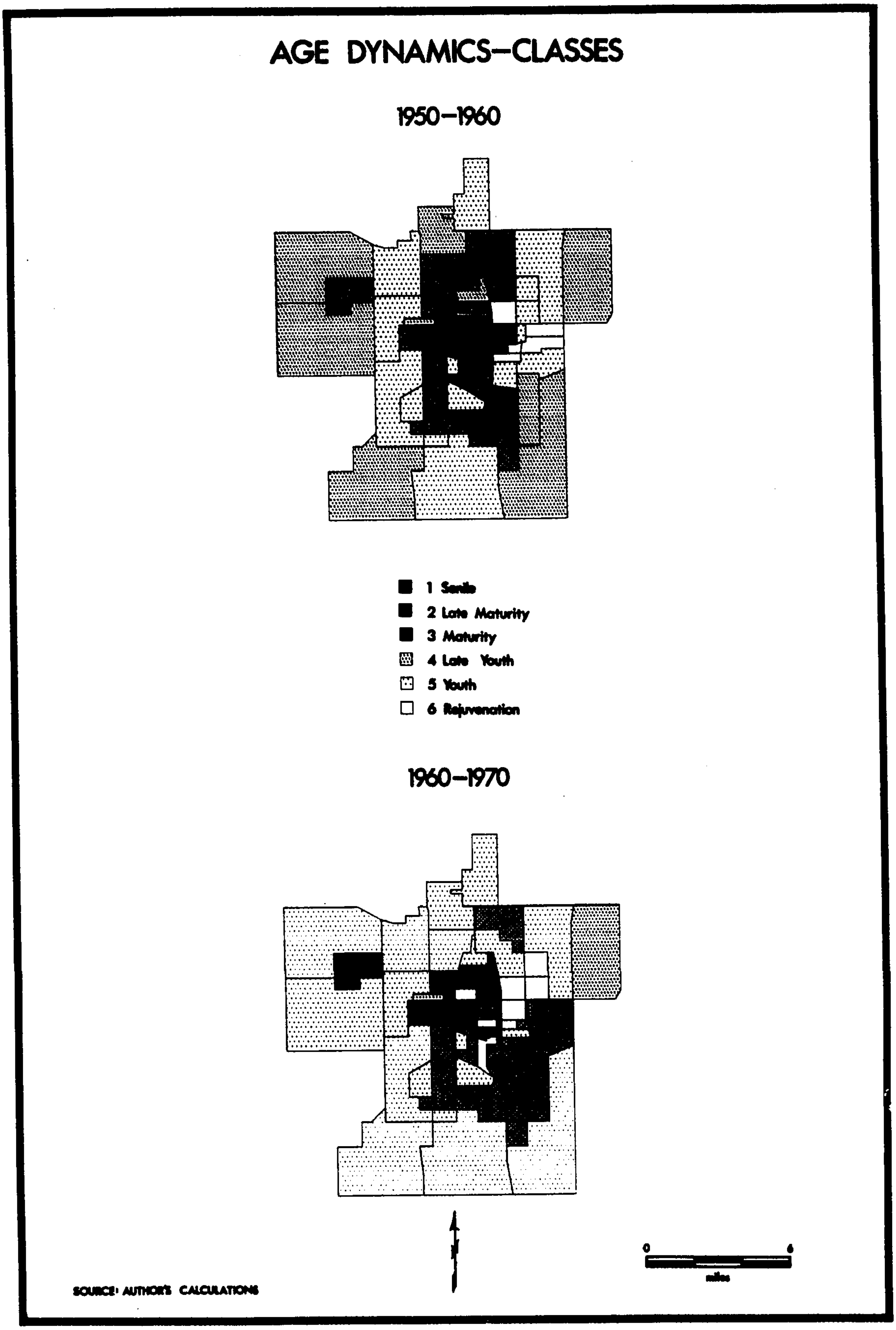
The final class, rejuvenating, has relative decreases among ages 45 and over and increases for all younger ages, with particular emphasis on ages 15-29. Locations for this class should be associated with areas experiencing ethnic change, where old white residents are being replaced by younger black families.

Areal Age Dynamics

The spatial patterns for these six classes of age dynamics (Figure 6.4) are similar for both dates and have the same zonal arrangement as the individual factors. Radiating outward from the CBD, stages in

[9]The class is synonymous with the early maturing class in the age dynamics model and is called late youthing because of some evidence of in-movement by youth couples and expanding families.

Figure 6.4


AGE DYNAMICS—CLASSES
1950—1960
1 Senile
2 Late Maturity
3 Maturity
4 Late Youth
5 Youth
6 Rejuvenation
1960—1970
0
6
miles
SOURCE: AUTHOR'S CALCULATIONS

the aging sequence are from senility and late maturity to youthing.

Senile areas, the terminal class, are close to the CBD. Over two decades they retain their identity and even expand in area. The availability of small apartment units and intra-urban accessibility attract these non-child households.

In 1960 late maturity tracts are adjacent to senile tracts, forming a tight cluster in and immediately north of the CBD. By 1970 outward movement occurs, toward the northwest. Additional isolated tracts in this class in 1970 are the older suburbs of Warr Acres and Bethany, the core of Capitol Hill, and an older part of the black residential area.

A maturing area forms a continuous band encircling late maturing tracts on three sides in 1960. The only break in this zonal pattern is the black neighborhood. Almost all maturing tracts south of the CBD retain their status from 1960 to 1970, however, they are conspicuously absent from northern parts of the study area.

The model suggests complete zonation for late maturity and maturity, with a slight outward displacement of each stage in the high status sector. Within Oklahoma City in 1970 sectoral differentiation in aging is stronger than originally proposed. Rather than displacement, the late maturity class is dominant in the high status sector, while the maturing stage dominates the lower status sector. Despite this exception, the premise of maturing areas surrounding the central area of senility is supported.

Suburban tracts with a similar history of development but not spatially contiguous to other maturing areas follow an aging sequence from maturity to late maturity between 1960 and 1970. Also parts of the black residential area, originally rejuvenating in 1960 assume a maturing status by 1970. Although these black tracts lag behind the remainder of the study area, they give every indication of an aging process.

Late youthing areas for 1960 are two disparate types. First, on the north are old suburbs with high socio-economic status and high quality housing. Their inclusion in late youthing indicates an attraction for stable families able to afford the high housing costs. Similarly, two interior tracts also are characterized by high status and attractiveness to stable families. Second, minor changes in population composition of part non-urban census tracts in the southern corners of the study area results in their identification as late youthing. By 1970 only two tracts remain as late youth, apparently appealing to a limited segment of the population in the stable family stage.

Other peripheral areas for 1960 and 1970 show youthing with relative and absolute increases in the youthful proportion of the population. Thus for both decades late youthing and youthing are located outward of maturing areas, once again emphasizing the regular patterning in the aging process.

The final class, rejuvenation, is characterized by relative losses in aged residents and increases in the youthful population. Replacement of older segments of the population is occurring before the end of the life cycle is reached. Rejuvenating tracts for 1960 are all located in the older part of the black area. By 1970, with the expansion of the black residential area, this region shifts northward. Also a young adult population contributes to rejuvenation within a university area (tract 10) in 1970.

Regressing Areas-Change Not Explained by Model. The zonal patterning of age dynamics is well established for the two decades. However, several census tracts do not follow the aging sequence implied in the model. Table 6.6 shows changes in classification over the two time periods. Of special interest are entries below the diagonal, representing regression in the proposed aging sequence. Eight entries are rejuvenating tracts and have been discussed. The spatial pattern of the remaining fourteen tracts is shown in Figure 6.5 where each tract is identified by its regressive type.

Areas passing from late youthing to youthing are all peripheral census tracts. The apparent regression in aging is the result of an influx of large numbers of relatively young families into lightly settled areas.[10] Youthing by expansion is occurring with large numbers of young individuals being added to the resident population. This is in accordance with the model.

Census tracts undergoing transition from maturing to youthing also encompass relatively large areas with sufficient space to accommo-

[10]Between 1960 and 1970 these five census tracts had a 139% increase in the number of dwelling units and a 99% increase in population, while the entire study area increased only 16.9% in housing units and 9.1% in population (U.S. Bureau of the Census, 1961b; 1972a).

Table 6.6

Change in Age Dynamics Classes

			1950–1960 Class						
			Senile 1	Late Maturity 2	Maturity 3	Late Youth 4	Youth 5	Rejuvenation 6	Totals
	1	Senile	2	3	1	-	-	-	6
	2	Late Maturity	-	-	8	1	-	1	10
1960–1970 Class	3	Maturity	-	7	15	1	3	2	28
	4	Late Youth	-	-	-	2	-	-	2
	5	Youth	-	-	3	5	10	1	19
	6	Rejuvenation	1	4	-	-	2	1	8
		Totals	3	14	27	9	15	5	73

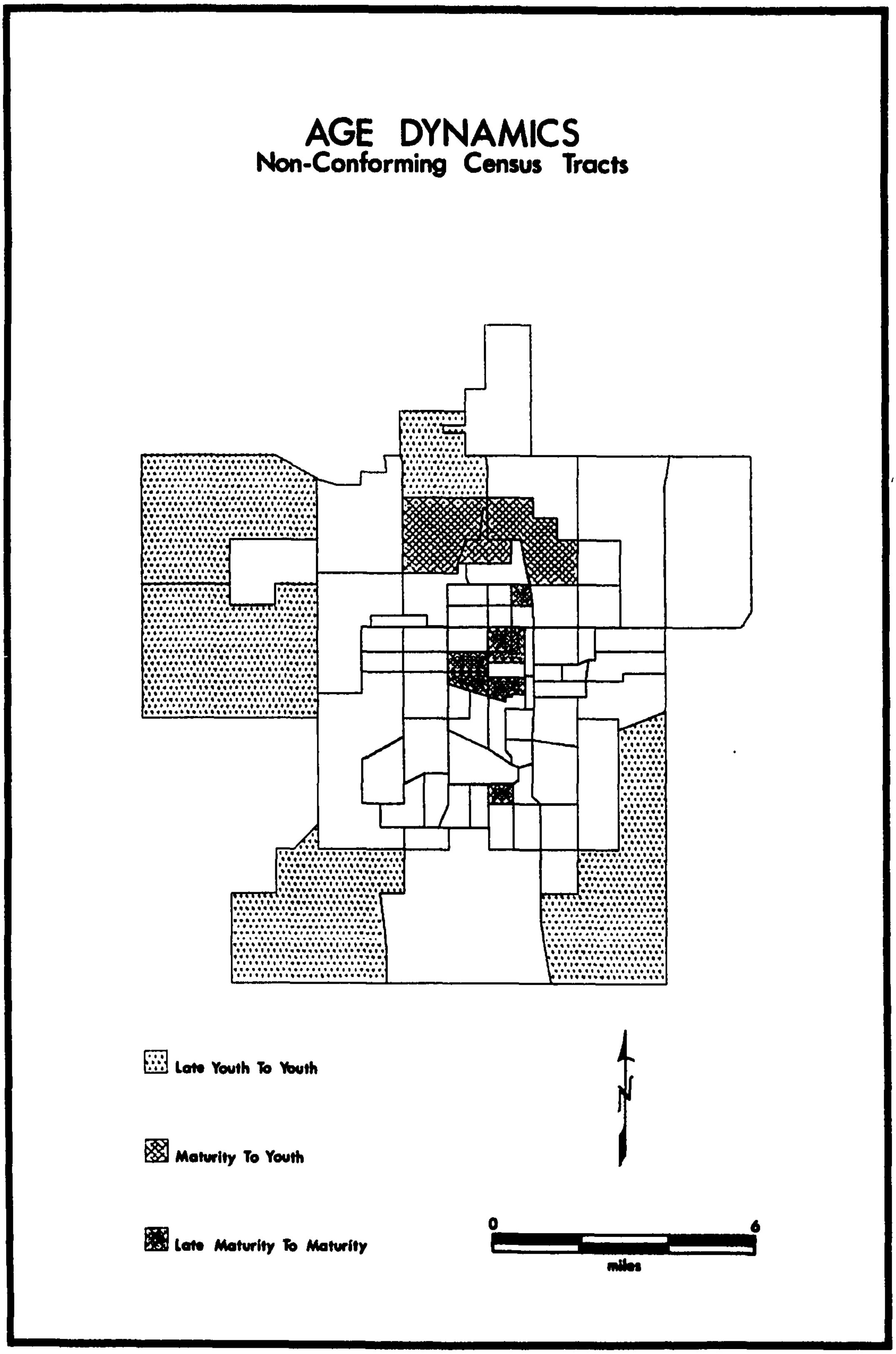
Source: Calculated by author.

date additional construction and increased population. This construction and the corresponding influx of younger ages has sufficiently influenced the total age composition to bring about a regression from maturing to youthing.[11]

Census tracts in the final regressive aging sequence, late maturing to maturing, all lie immediately northwest of the CBD in an older

[11] The three census tracts had a 46.4% increase in dwelling units between 1960 and 1970 while the population grew by 28.4%.

Figure 6.5


AGE DYNAMICS
Non-Conforming Census Tracts
Late Youth To Youth
Maturity To Youth
Late Maturity To Maturity
N
0
6
miles

relatively high status area of the city. This area is not static as proposed. Rather, as the end of the life cycle is reached by long time residents, replacement is by stable and contracting family compositions. Youthing occurs but only to a maturing stage and not complete rejuvenation to a youthful composition.

Processes in Age Dynamics. Comparison of the maps (Figure 6.4) leads to several conclusions about processes for age dynamics within an urban area. First, both maps have the same overall pattern, one of zonation with the oldest age change areas at and near the city center, ringed by successively younger age change areas. The only interruption to this zonal pattern is the intrusion of the black neighborhood. After rejuvenation, it follows the sequence evident for the remainder of the study area.

Although zonation dominates in both periods, the location of age dynamics is not constant. There is an outward movement of age dynamic zones. Maturing areas of 1960 become late maturing in 1970. Late maturity tracts of 1960, representing the last stage in a normal aging sequence, are found in several classes by 1970. Some move into senility while others, more suited to family residence, become rejuvenating tracts. A few with high quality housing regress to a mature status, with in-movement by a slightly younger population.

Many census tracts have the same classification in both decades. Mature status for both periods is not unusual because of the broad definition of the class. However, census tracts remaining in late youth and interior tracts retaining youthful status are not typical of the aging sequence. Two tracts retain late youth status because of limited appeal to families able to afford the high status housing. Interior census tracts retaining youthing status (tracts 34 and 41) are low socio-economic status areas. They are "staging" areas for in-migrants to the city and for newly formed families. Upon acquisition of means to relocate, families exit these staging areas for more desirable locations, to be replaced by similar age compositions. These late youth and youthful tracts appeal only to certain segments of the population and for limited periods of the life cycle.

Finally, a number of census tracts regress in their aging characteristics. Areas passing from late youthing to youthing and areas moving from maturing to youthing are undergoing current expansion in the housing stock. Change in classifications represents an influx of younger ages being added to the resident population. The area immediately northwest of the CBD passes from late maturity to maturity and also represents an influx of a younger population, in this case stable families into an elderly age composition.

Summary

The age dynamics model is supported by the pattern of aging in Oklahoma City. One minor exception is the distorting influence of multiple nodes. A more serious deficiency in the model is the breakdown of late maturing and maturing zones. Instead of separate zones within high and low status sectors, the late maturity zone dominates in the high income sector and the maturing zone dominates in the low income sector in 1970.

The patterns offered in Chapter 3 for urban age dynamics are supported. Childless couples are located around the city center. Their age composition shows little change over time. In turn, the core is surrounded by several zones of aging populations, with each zone at an earlier stage in the aging sequence than its more interior neighbor. Also, within zones there is sectoral variation based upon income. The high income sector is further advanced in the aging sequence than the low income sector. Static areas of little or no age change appear in the high income sector. Also, a static area of heterogeneous age compositions appears in the low income sector. Finally, an area of ethnic change is characterized by rejuvenation. Overall, the reality of age change in Oklahoma City conforms to the intra-urban model of age dynamics.

CHAPTER 7

SUMMARY AND CONCLUSIONS

"You're only as old as you feel."

"You're not getting older, you're getting better."

These aphorisms may apply to individual age and aging. For population aggregates, however, it has been demonstrated that structural regularities exist. There are spatial regularities in age and aging and their patterns and processes can be identified and portrayed.

Two models for age and aging have been put forth. Both models incorporated spatial structures derived from social area analysis and factorial ecology. However, the approach and methods of this research allowed for a much more detailed exposition of the spatial regularities present in the age and family life cycle stage aspect of the more general approaches.

The first model proposed zonal patterning for age and family life cycle stages. In deriving the structure of age distributions at separate times, continued growth in the urban population was assumed. Zones differentiated by family stage were thought to be associated with the time of settlement. Additionally, sectoral variation was anticipated, with the high income sector having equivalent ages displaced slightly outward because of earlier dates of inhabitation.

The second model proposed the spatial patterning of aging for intra-urban locations. It too was primarily a zonal model. It suggested that age change within the city should be zonally arranged with a focus upon the city center. Sectoral variation by income and ethnicity was incorporated. Both models were supported by the analysis.

Summary

Age Patterns. The empirical analysis of age compositions first established similarity among structures for several dates. Then location patterns for separate family stages were analyzed. A regular zonation was evident. Child absent families--older ages along with young adults--were concentrated close to the city center. At respectively greater distances from the center were contracting, stable, and expanding families. This patterning was not present in black residential areas however.

In a temporal context aging was evident even when examining distributions at separate dates. Older aged life cycle stages became more important at later dates, indicating locational stability for age cohorts. Cohorts remained fixed in location and evidenced increasing age. The black neighborhood did not conform to the implied aging sequence. Rather, the age composition underwent change as older whites were replaced by younger blacks.

Finally noticed was the occurrence of multiple nodes for the location of old age categories. The original single concentration of old age moved away from the city center at later dates. As the original node diminished in importance, newer nodes in the path of movement became the focus of old age concentrations.

An analysis of the simultaneous effect of all life cycle stages was undertaken to better grasp the distribution of age patterns. Nine classes of age areas resulted. Their spatial patterning was predominantly zonal, however, sectoral variation associated with income and ethnic status was also observed. The zonal configuration remained the same as for the individual family stages. Sectoral variation superimposed upon the zones indicated that older ages were stronger in high income areas while young ages were more evident in low income areas. Certain census tracts within each sector had heterogeneous age compositions. Residential selection was based upon income, rather than age characteristics.

The black residential area appeared as a non-conforming region within the zonal pattern. Little age differentiation was seen at the early date of analysis, but over time the black area developed its own zonation. It merely lagged behind the remainder of the city in the time at which the patterns appeared. The structural analysis not only established locations for age and family cycle stages, but when viewed in a temporal context gave strong indication of an aging process.

Aging Patterns. Several zones of maturing age compositions were recognized for age dynamics. The central area at a stage of terminal stability did not exhibit age change. Rather, a static mix of old and young was present. Surrounding the central core were several maturing zones, each at a later stage of maturation than its outlying neighbor.

Sectoral variation for aging was unexpectedly important. Rather than small shifts in zonal locations between sectors, older ages were found to be especially important in the high income sector, while younger ages dominated in parts of the low income sector.

Effects of spatial constraints for the black population were evident. The black area had little age differentiation at the first date of investigation, but over time began to develop the same aging sequence observed in the remainder of the city.

Again an analysis of the simultaneous effect of all ages and life cycle stages upon aging characteristics resulted in several classes. A zonal patterning of aging was evident. Exceptions to the aging model were analyzed and found to be related to expansion of the housing stock, income differentials, and ethnic status.

Expansion of housing attracted younger families and initiated a youthing process. Areas at opposing ends of income distribution within the city showed no evidence of aging. This suggested residential selection for the rich and poor was not based on age characteristics but rather income. Areas undergoing ethnic change regressed in the aging sequence as younger blacks moved into previously all white residential areas.

Conclusions

That spatial regularities in age and aging within an urban area exist has been firmly established. The simple zonation of family status put forth in social area analysis and factorial ecology has been modified. Detail has been added to the knowledge of locational differences in age and aging. The zonal pattern has been elaborated by the addition of sectoral variation--until now hidden in the broader approaches. Also, similar age patterns and aging processes have been established for black residential areas, differing from the remainder of the city only by the time of origin.

Variation in age composition over several time periods was analyzed by employing a temporal dimension within the analysis. This itself has not received sufficient attention in previous literature. The utility of factor analysis as a method in deriving family stages from an original set of age interval data has been established. Principally however, the spatial patterning proposed for age and aging has been supported.

The Future

This research has been productive, however, it represents only a beginning. The knowledge of age and aging presented here will add to the fields of social area analysis and factorial ecology. Both have dealt with urban socio-economic differentiation, but have been limited by the scale of areal investigation to census tract units. Similarities have been established between age and aging in this analysis and the family dimension in the more general approaches. Additional detail provided here indicated sectoral variation based on economic and ethnic differences. With similarities and additional detail established, it is possible to move to other areal scales of investigation. Because of its wide availability at several areal scales, age may be used as a surrogate for measures unavailable in other analyses.

A next step should be the documentation of age and aging patterns for other urban areas. This research considered a recently settled, relatively fast growing city of medium size. Whether similar results will be obtained in other urban contexts remains to be determined, however, the strong correspondence with results of factorial ecology suggests that similar results can be expected.

Age is fundamental in urban socio-economic differentiation. The detail of its patterning and spatial processes evidenced here may serve as beginning points for future research and policy formulations dealing with urban populations. By delimiting aging processes for urban areas, future locations of various age groups may be anticipated. Having evidence of aging patterns, planning for community institutions and services may incorporate this fundamental variable in future activities.

Until variation in age and aging are understood and incorporated in current research, more sophisticated inquiry into intra-urban socio-economic differences have a quality of superfluousness. This research has recognized its importance and delimited its spatial variation. A first step towards the better understanding of age and family stage distributions, and aging patterns and processes has been supplied.

APPENDIX A

Relative Age Cohort Change

Actual change in an age cohort within a census tract over a decade is

$$\Delta a_{kj} = a_{kjt_{10}} - a_{ijt_0}, \tag{A.1}$$

where a = number of individuals in an age cohort,

i, j, m, n, are as defined in Equation (4.1),

k = i + 2, a five year age interval representing an original cohort that has aged ten years, *i.e.*, two age intervals, and

t = time in years from initial observation.

Additions to the tract population because of births may be ignored in cohort change study since births represent new cohorts, not change in already present cohorts. Thus from the demographic equation (2.2), cohort change, Δa_{kj}, is a function of movement (M) and deaths (D),

$$\Delta a_{kj} = f(M,D) \tag{A.2}$$

such that change in an age cohort for a census tract is equal to net change because of in- and out-movement, less the attrition due to deaths. That is

$$\Delta a_{kj} = m_{kj} - d_{\Delta ij}, \tag{A.3}$$

where Δi is the changing age interval encompassing a given age cohort.

Incorporating attrition due to deaths, the expected number of individuals in an age cohort at the end of a decade is defined as

$e_{kjt_{10}}$, obtained from

$$e_{ijt_1} = a_{ijt_0} (1 - d_{it_0})$$

$$e_{ijt_2} = e_{ijt_1} (1 - d_{it_1})$$

$$\ldots$$

$$e_{hjt_5} = e_{ijt_4} (1 - d_{it_4})$$

$$e_{hjt_6} = e_{hjt_5} (1 - d_{ht_5})$$

$$\ldots$$

$$e_{kjt_{10}} = e_{hjt_9} (1 - d_{ht_9}),$$

where years $t_0,\ldots,t_4$ include the original age interval i for the age cohort, years $t_5,\ldots,t_9$ include the age interval $i + 1 = h$ for the same cohort aged five years, and year t_{10} includes the age interval $i + 2 = k$ for the cohort aged ten years at the end of a decade.[1]

The difference between the expected number in an age cohort and the actual number at the end of a decade is the population change attributable to movement. Call this estimated population change g_{kj} such

[1]Estimates of deaths by age are obtained from ${}_nq_x$, the proportion of persons alive at the beginning of an age interval dying during the interval, contained in the abridged life tables published yearly by the U.S. Public Health Service (1954-1960, 1961, 1963-1971). These estimates are based on the entire population of the United States, however, they are deemed adequate for use in census tract analysis. Differential mortality statistics by age for small areas are unobtainable on a yearly basis. With the exception of recent studies by Pyle and Rees (1971), Griffiths (1971), and Fox (1972), differential mortality for small areas remains to be investigated.

that

$$g_{kj} = \Delta a_{kj} - e_{kj}. \tag{A.4}$$

Thus, actual change $\Delta a_{kj} = f(M,D)$ minus expected change $e_{kj} = f(D)$ gives estimated change $g_{kj} = f(M)$.

Finally define relative age cohort change for an age cohort within a census tract over a decade as the actual age quotient minus the expected age quotient,

$$C_{kj} = A_{kj} - E_{kj}, \tag{A.5}$$

where E_{kj} is defined in the same manner as A_{ij} (Equation 4.1).

APPENDIX B

Principal Components Analysis

Factor analysis is a mathematical procedure, useful in synthesis of large data matrices.[1] The method of factor analysis used in this research is principal components, with unities used for communality estimates. Orthogonal rotation to varimax solution is used for all extracted factors, according to the computer routine in Dixon (1973, 255-268). In all cases rotation is limited to those factors having eigenvalues equal to or greater than unity.

Alternative factor structures were investigated. Oblique rotation solutions resembled orthogonal rotations for all analyses, and low correlations were present among the oblique factors within each analysis.

Procedure

The derived age measures, the age quotient and relative age cohort change, are elements in a data matrix where rows are census

[1]A good introduction to factor analysis is in Rummel (1967) who also gives a comprehensive treatment of the subject (Rummel, 1970). For a mathematical presentation of factor analysis see Harmon (1967). Berry (1971) discusses the theory and methods of factor analysis, and Janson (1969) and Johnston (1971a) consider limitations and problems of factor analytic procedures. Hunter (1972) offers a critique of the method and a proposal for alternative approaches.

tracts and columns are age measures. Use of these age measures, in addition to avoiding problems of size differentials among census tract populations, avoids the possibility of matrix singularity which occurs when simple percentage data is employed in factor analytic procedures.

The procedure of principal components as employed herein involves the following steps. First, given observations consisting of n census tracts and m variables of age measures, the original data matrix is replaced by a standard score matrix, with standard scores for each of the n observations on the m variables. From the standard score matrix an m by m correlation matrix is calculated, containing the simple correlation coefficients between each variable and every other variable.

Then, principal components resolves the correlation matrix into an m by r factor loading matrix, where r equals the number of factors with eigenvalues greater than or equal to unity. This matrix is rotated to orthogonal solution, that is, factors are orthogonal or uncorrelated to one another. Since this research uses orthogonally rotated factors for analysis, the remainder of the discussion applies specifically to the rotated solution. However, the description applies equally to an unrotated factor solution.

The elements in this new m by r matrix are factor loadings and are equivalent to correlations between factors and the original variables, and like correlation coefficients takes values ranging from -1.0 to +1.0. The column sum of squared factor loadings for each factor are eigenvalues and indicate the amount of the total variance in the original data accounted for by each factor. An eigenvalue divided by m, the number of original variables, results in the proportion of explained variance accounted for by a factor. (Explained variance is used below as weightings in the determination of factor contributions). The row sum of the squared factor loadings for each variable are communalities and gives the proportion of the total variance of each variable that is accounted for by the r factors combined. The sum of the eigenvalues divided by m is equal to the sum of the communalities, and both are equal to the proportion of variance explained by all factors.

Finally, through mathematical procedures an n by r matrix of factor scores is obtained. These scores, normalized to zero mean and unit variance, provide a measure for each original observation (census tract) on the rotated factors.

Factor scores for each original observation serve as input to a clustering procedure.

Cluster Analysis

Cluster analysis is a general term applied to a set of techniques used to objectively classify n observations (census tracts) on the basis of their r values (factor scores).[2] The cluster technique used here groups observations in stepwise fashion, based on the minimum increment to the pooled within-group sum of squared distances.[3]

[2]Several methods of clustering are possible. See for example Sokal and Sneath (1963), Harvey (1969, 326-348), Lankford (1969), and Everitt (1974).

[3]Results are obtained by use of a computer routine in Krause (1974, part A, 8-10). The method used is derived from Ward (1963) and

The several factor scores for a census tract are weighted by the contribution of the factor to total variance in the original data.[4] These weighted scores represent the relative importance of life cycle stages and together establish a unique point for each observation in r-dimension space. Thus, each census tract has a point location based on the varying importance of life cycle stages. A measure of similarity between census tracts is the distance between points,

$$d_{ij} = \sqrt{\sum_{k=1}^{r} (s'_{ik} - s'_{jk})^2} \qquad \text{(B.1)}$$

where s' = a weighted factor score,

i, j = census tracts,

$k = i,\ldots,r$ a factor dimension, and

r = number of factor dimensions.

Selecting the minimum distance d_{ij}, representing those two tracts that are most similar, a group is formed and assigned a new location of the unweighted mean of the s' values. Then for the new set of $n - 1$ points, another d_{ij} that results in minimum increment to pooled within - group sum of squared distance is determined and another group formed. This process continues until the desired number of classes is obtained.[5]

its application is illustrated in Berry (1961; 1965a), Ray and Berry (1965), and Grimshaw, Shepherd, and Willmott (1970).

[4]Weighting of factor scores is suggested in Abiodum (1968).

[5]There is no absolutely objective method for determining the level at which to select final classes (Lankford, 1969, 199).

<u>Relative Location Coordinates</u>. In the analysis of family stage patterns (Chapter 5), coordinates of relative location with respect to the CBD are also included in clustering since location is postulated as important in the spatial arrangement of life cycle stages. X and Y coordinates for each census tract are scaled with respect to the mean distance of all census tracts from the center of the CBD. These scaled coordinates are used as surrogates for distance and direction from the CBD.[6]

The CBD is used as the base point in calculation of census tract location since the model proposes that family stages are zonally arranged about the CBD. It may be argued that using location as part of the input in clustering predisposes the results to correspond with the model. However, the weighting of each coordinate variable is arbitrarily set equivalent to .07 of the combined weighting of the four factors. Thus the use of coordinate location is more of an ordering device to inhance contingulty of census tracts, rather than of sufficient strength to predispose the outcome of clustering towards regular zones and sectors.

[6]Standardized X and Y coordinates are based on the mean absolute distance from a central point in the CBD. To arrive at these coordinates for each census tract the following procedure was used. The absolute east-west distances from the CBD for each census tract are summed and divided by the number of census tracts to arrive at the mean absolute X distance. Then the actual X distance of a tract from the CBD, where west of the CBD is arbitrarily designated as positive and east as negative, is divided by the mean absolute distance to arrive at a standardized X distance. The same procedure is followed from north-south distance with north designated positive and south negative. Standardized X and Y distances for each census tract are used as surrogates for

Analysis of Spatial Patterns

The final grouping configuration consists of several sets of census tracts, each set formed on the basis of similarity among members with respect to life cycle dimensions. Determine the average factor score values for each set of census tracts over all life cycle dimensions,

$$v_{hk} = \frac{\sum_{i=1}^{m} s_{ihk}}{m} \tag{B.2}$$

for all factor dimensions k = 1,...,r, and for each group h = 1,...,q,

where r = number of factor dimensions,

q = number of census tract groups,

m = number of census tracts in any group,

i = a census tract, and

s = a factor score.

Analysis of these average factor score values gives a qualitative evaluation of the family stage(s) portrayed by any class.

straight line distance and direction because no other useful expression of relative location could be devised and incorporated into this analysis.

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