Aging in Place or Functional Specialization? The Dynamics of Neighborhood Age Structure, 1970-2010

John Sullivan
University of California, Los Angeles

Introduction
There is considerable heterogeneity in the age distribution of American neighborhoods. Some are reputed as hubs for young people, destinations for retirees or great places for families with children. Are these characterizations temporary or do they persist for decades? For example, an "up and coming" neighborhood, may be experiencing an influx of young adults, uncharacteristic of its past, while rental housing near a university may consistently attract a young adults. Long-term residents that have spent much or all of their lives in the same neighborhood may characterize other neighborhoods. I use tract level census data from American metropolitan areas to trace the age distribution of individual neighborhoods over five decades. I attempt to determine whether neighborhoods fall into one of two ideal types based on long-run patterns of population succession. In the first type, the population of a neighborhood ages in place as a cohort. In the second, specific age groups (but different individuals) come to occupy a neighborhood consistently over time. I model the structural and social correlates of these two patterns of population succession on the neighborhood and metropolitan area level. I further suggest that these patterns have important implications for patterns of neighborhood change and residential segregation.

The idea that local areas have "specialized functions" goes back to some of the earliest demographic analysis of American urban areas (Wirth 1938). For example, Burgess and Locke (1960) extended Burgess's well-known typology of urban zones model to describe the distribution of age groups and family types in metropolitan areas. The Central Business District is characterized by non-family households, predominantly, single men between 35 and 54 years old and as one moves outward from the innermost ring "family disorganization" declines, with large "Matricentric Families" occupying the outer suburban ring. Indeed, there is considerable evidence for spatial differentiation by age and household type. White's (1987) latent class analysis of 1980s metropolitan area population identified a number of neighborhood types, like child-rearing middle-class neighborhoods. Single adults living alone are spatially concentrated, primarily in central city neighborhoods (Marsh and Iceland 2006; White 1987; Yi 2016). However, from 2000 to 2010 non-family households exhibited generally low levels of segregation from family households (Marsh and Iceland 2006; Owens 2016).

A number of studies use the concept of specialized functions to argue that community characteristics make an area more or less conducive to racial residential integration (Taeuber and Taeuber 1965; Farley and Frey 1994; Logan, Stults and Farley 2004; South, Crowder and Pais 2011). University communities may have low segregation because residents may also have progressive attitudes. Retirement communities may have high levels of segregation because of income differences between older blacks and whites that translate into different residential experiences in older adulthood and attitudes against integration (Farley and Frey 1994). Others note that neighborhood age structure and its implied vital rates, may make an area particularly amenable or resistant to neighborhood change (Simpson, Gavalas and Finney 2008).

Table 1 shows that there is some year-to-year continuity in the age distribution of census tracts. While a snapshot or brief time series can show the distribution of age groups across neighborhoods, following the same neighborhood over many decades can reveal long-run age dynamics[1] and provides a framework in which to explore associations between neighborhood age structure, neighborhood change and residential segregation.

Ideal Types

I propose two simplified models of neighborhood population succession. Under the first, individuals age in place. A cohort enters a population and members do not change neighborhoods or do so very infrequently. The age distribution of a neighborhood changes as the residents of that neighborhood change, by growing older and forming families. Children born in the neighborhood remain there. Vacancies arise after a death and are filled by members of the youngest cohort. I call this the ***aging in place*** model. Under the second model, specific age groups (but different individuals) inhabit a neighborhood, year after year. As individuals age out of a neighborhood's specialization, they move on to one that better suits their needs at that point in their life. Neighborhoods maintain relatively consistent age distributions, but this needn't be due to an entirely homogenous age distribution, the neighborhood could include a stable mix of the same age groups over time. I refer to this model as ***functional specialization***. These two models are ideal types. Few neighborhoods behave precisely as described and many may be a blend of both models.

In some historical periods, one of these models may better characterize a city's neighborhood than the other. For example, following World War II, many cities grew rapidly on their suburban fringes. New housing developments opened large tracts of housing to young working or middle-class white families. These new residents were largely from the same cohorts and household heads were entering years of declining residential mobility. Likewise, urban "revitalization" in the 1950s and 1960s, or contemporary actions associated with gentrification today, may reset the age and household distribution of a neighborhood. A neighborhood may appear to resemble one model for one racial group and the other model for another racial group (Finney 2013). For example, generations of young whites may live in parts of a city that are occupied by cohorts of non-whites who are largely aging in place (Bader and Thomas 2016).

Neighborhood and metropolitan area characteristics may be associated with the prevailing pattern of population succession in a neighborhood. Individual preferences for certain types of housing units, racial diversity, or proximity to peers, employment or schools vary during one's life. For example, central city neighborhoods attract those in their early 20's, but many people move to the suburbs as they marry, bear children and approach their 50's (Boustan and Shertzer 2013; Sampson and Sharkey 2008). Young people, 25-34, are more likely to live in urban zip codes with high non-white populations, few college graduates and "transgressive" cultural scenes (Silver and Nichols Clark 2016). University neighborhoods offer many amenities that consistently attract a population of young adults. These neighborhoods are close to the academic institution, often have many apartments, bars, restaurants and retail stores that cater to the young clientele. Central business districts, at least historically, offered amenities, like low-rent small

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[1] Rogerson and Plane (1998) propose a projection model of the long-term age dynamics of neighborhoods, but this model is not tested on observed neighborhood data.

[2] For 1970 the figures come from Table NT2A (Count 1), for 1980 the figures come from tables NT10A, NT15A, NTPB5A from SF1, SF3 and

apartments and easily accessible shopping and transportation, that drew or retained a population of older adults and unmarried singles. Cultural amenities, businesses or institutions may express "specialized functions" as they are associated with the distribution of age groups and household types, at least in the short-term (Silver and Nichols-Clark 2016). Large institutions, like universities or hospitals, that remain in a neighborhood for many years may encourage a consistent population composition, for example, consistent racial integration (Ellen 2000) or a consistent population of young adults (Moos 2014).

To explore these issues, I propose two research questions,

1. *Are neighborhoods places for "aging in place" or places of age-specific "functional specialization"?*
2. *How are characteristics of the housing stock and population associated with each pattern of neighborhood level population succession?*

Data

I characterize the pattern of population succession (aging in place, functional specialization or mixed) in metropolitan census tracts according to their age distribution at each decennial census from 1970 to 2010[2]. For each tract, I create a 50-cell table of age-specific population counts of ten 10-year intervals (from age 0 to an open ended interval at ages 90 and older) for each decennial census. I use the Geolytics Neighborhood Change Database and the LTDB to find characteristics of tracts such as vacancy rates, poverty levels and housing stock[3]. Table 2 shows preliminary descriptive statistics for Census tracts from 1970 – 2010.

Methods

I estimate three log linear models of age-specific population counts separately for each tract, a model of functional specialization (*eq. 1*), a model of aging-in-place (*eq. 2*), and a saturated model (*eq. 3*). Neighborhoods in which the age structure changes over time (aging-in-place) will exhibit cohort effects, but no age effects. Conversely, neighborhoods that have a consistent age structure over time will exhibit no cohort effects (age-specific population size will be independent of time). The models take the forms,

$$log(m_{ij}) = \lambda + \lambda_i^A + \lambda_j^P \qquad (1)$$

$$log(m_i) = \lambda + \lambda_i^C \qquad (2)$$

$$log(m_{ij}) = \lambda + \lambda_i^A + \lambda_j^P + \lambda_{ij}^{AP} \qquad (3)$$

Where m_{ij} is the expected value of the population count in row *i* and column *j*. λ_i^A and λ_j^P are row and column marginals, parameterized as a set of dummy variables for the 10 age categories and a set of dummies for period (the 5 decennial census from 1970 to 2010), respectively. λ_{ij}^C is a series of dummies for the 14 birth cohorts that appear in the 50 cell table. Model 1 estimates parameters for a neighborhood characterized by functional specialization, in which the age

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[2] For 1970 the figures come from Table NT2A (Count 1), for 1980 the figures come from tables NT10A, NT15A, NTPB5A from SF1, SF3 and SF4, for 1990, Table NP11 (SF1), for 2000 Table NP012B (SF1) and for 2010 Table P12 (SF1).

[3] If necessary I can use the IPUMS data to produce metropolitan area level estimates of additional characteristics.

distribution of a neighborhood is independent of time or census period (constant over time). Model 2 estimates parameters only for birth cohorts and a collapsed version of age or period. Age-specific population is restrained to be solely a function of cohort progression (aging-in-place). Model 3 allows all parameters to be unrestricted and completely defines all cells in the table[4]. I will use the model results to assign a pattern of population succession (aging in place, functional specialization or mixed) to each neighborhood. Specifically, I will develop a decision criteria that compares the fit of each model, using the BIC and p-value on the G^2 test[5].

After assigning a pattern of population succession to each neighborhood, I estimate a multinomial logistic regression model to describe the factors that are associated with each type of neighborhood. The model will take the general form,

$$Pr(y_i = j|x_i) = \frac{exp^{(x_i \beta_j)}}{1 + \sum_{j=1}^{J} \exp^{(x_i \beta_j)}} \tag{4}$$

Where $P_{ij} = Pr(y_i=j \mid \mathbf{X}_i), J = 0, 1, 2$. The subscripts *i* and *j* index tracts and pattern of population succession (either *aging in place*, *functional specialization* or *mixed*), respectively, and **X** is a vector of neighborhood and metropolitan area covariates such as home ownership, vacancy rate, racial composition, proportion married, population size, housing cost, median income, age of housing units, average number of rooms, distance from city core, other measures of land uses, region and a metropolitan area fixed effect.

I will present descriptive statistics for the distribution of neighborhood types and map this distribution for select metropolitan areas. I will present and discuss results from the model described by *eq. 4* and conclude with a discussion of how these patterns have important implications for patterns of neighborhood change and residential segregation.

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[4] Age, period, cohort models are unidentified because cohort is a direct product of age and period. There are a few ways to avoid this problem in order to identify the aging-in-place model. I can collapse age or period categories in the design matrix, so that the parameterization of age or period differs from the observed distribution. For example, I collapse period from each decennial year to two periods, 1970 – 1990 and 2000 – 2010.

[5] Following Bader and Warkentien (2016), I could use additional information like the Entropy Index or z-scores to calculate an age diversity score separately for each neighborhood at each point in time and rank-order correlate these measures.

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Table 1. Average Rank-Order Correlation of Selected Age Categories for Census Tracts within Metropolitan area, 1970 – 2010.

Percent 0 to 19 years old.

	1970	1980	1990	2000	2010
1970	1				
1980	0.69	1			
1990		0.77	1		
2000			0.81	1	
2010				0.82	1

Percent 25 to 44 years old.

	1970	1980	1990	2000	2010
1970	1				
1980	0.57	1			
1990		0.67	1		
2000			0.71	1	
2010				0.74	1

Percent 65 and older.

	1970	1980	1990	2000	2010
1970	1				
1980	0.73	1			
1990		0.75	1		
2000			0.79	1	
2010				0.77	1

Tables 2.

Descriptive Statistics of Census Tracts, 1970 - 2010

All Tracts

	% Married		**% Fam. w/ Child**		**% 18 - 24**		**% 25 - 59**		**% 60 and older**	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1970	63.58%	10.36%	50.21%	15.19%	9.50%	7.52%	41.12%	5.20%	12.94%	8.21%
1980	57.72%	12.74%	41.32%	13.94%	10.23%	7.02%	46.36%	11.56%	14.31%	9.49%
1990	55.53%	12.96%	37.79%	12.25%	12.94%	7.02%	47.26%	6.94%	16.98%	8.73%
2000	54.13%	12.93%	36.45%	12.05%	11.07%	6.79%	48.41%	7.08%	16.70%	8.39%
2010	49.29%	14.37%	33.13%	11.21%	9.91%	8.16%	47.46%	7.04%	19.25%	8.83%