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From Census Tracts to Local Environments: An Egocentric Approach to Neighborhood Racial Change

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Abstract

Most quantitative studies of neighborhood racial change rely on census tracts as the unit of analysis. However, tracts are insensitive to variation in the geographic scale of the phenomenon under investigation and to proximity among a focal tract's residents and those in nearby territory. Tracts may also align poorly with residents' perceptions of their own neighborhood and with the spatial reach of their daily activities. To address these limitations, we propose that changes in racial structure (i.e., in overall diversity and group-specific proportions) be examined within multiple egocentric neighborhoods, a series of nested local environments surrounding each individual that approximate meaningful domains of experience. Our egocentric approach applies GIS procedures to census block data, using race-specific population densities to redistribute block counts of whites, blacks, Hispanics, and Asians across 50-meter by 50-meter cells. For each cell, we then compute the proximity-adjusted racial composition of four different-sized local environments based on the weighted average racial group counts in adjacent cells. The value of this approach is illustrated with 1990–2000 data from a previous study of 40 large metropolitan areas. We document exposure to increasing neighborhood racial diversity during the decade, although the magnitude of this increase in diversity—and of shifts in the particular races to which one is exposed—differs by local environment size and racial group membership. Changes in diversity exposure at the neighborhood level also depend on how diverse the metro area as a whole has become.

Keywords

neighborhood change; race-ethnicity; spatial scale; egocentric local environment; entropy index; diversity profile

Conflict of Interest Statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

1 Introduction

Historically, the emergence of neighborhood change as a research topic can be traced to the monitoring of local areas by Chicago School sociologists during the early twentieth century (Cressey 1938; Shaw and McKay 1942; Zorbaugh 1929). Subsequent studies have examined neighborhood trajectories in socioeconomic status, culture, and crime, to name but a few dimensions (Friedson and Sharkey 2015; Lloyd 2006; Owens 2012; Taub et al. 1984). The greatest emphasis, however, has been placed on racial and ethnic change. According to traditional and contemporary versions of the invasion-succession model, neighborhoods are likely to experience racial transition when demographic, developmental, and institutional forces lead to the competition-induced growth of one or more entering groups at the expense of some incumbent group (Gotham 2002; Hartmann 1993; Lee 2016). The direction of the transition is often, though not always, from white to minority. Together these localized trends in racial mix can reshape the distribution of ethnoracial populations across the metropolitan landscape. They are also vital to understanding the metro-wide consequences of residential segregation, not to mention its neighborhood-level effects (Cutler and Glaeser 1997; Duncan and Kawachi 2018; Kramer and Hogue 2009; Sharkey and Faber 2014; Steil et al. 2015).

Our interest here lies primarily in how neighborhood racial change is investigated. Conventional research conceives of neighborhood as a collective entity, an aggregation of residents in a fixed, bounded location. Of the various small area options on the Census Bureau's geography menu, the census tract is the most frequently used neighborhood surrogate.¹ Tracts are defined by members of local statistical area committees who ideally rely upon the same kinds of permanent, visible features of the landscape that frame the social construction of 'symbolic' communities, i.e., neighborhoods with recognized names and boundaries (Hunter 1974). But committee members must keep Census Bureau-imposed population size (an optimum of 4,000) and compositional (relative homogeneity) criteria in mind as well (U.S. Census Bureau 1994, 1997). The first demographic criterion carries heaviest weight, requiring that tracts be split, combined, or modified in response to patterns of growth and decline. Because altered boundaries can affect conclusions about racial change, care must be taken to maintain constant spatial units over time. Thanks to the increasing availability of GIS technology and harmonized longitudinal databases (Logan et al. 2014; Tatian 2003), this objective is now easy to fulfill.

Despite the convenience of tracts for analyzing neighborhood change, we argue that the value of the conventional strategy hinges on two important issues. First, do tracts capture the geographic scale and complexity of shifts in racial structure? Our concern is that, while the shifts may occur within a handful of contiguous blocks, they could just as readily affect a much larger region spanning several tracts. Patterns of change could also diverge by intra-

¹The census tract owes its existence to Dr. Walter Laidlaw, an administrator with the New York Federation of Churches who proposed in 1905 that New York City be divided into small, permanent spatial units to facilitate neighborhood comparisons over time. Adopting Laidlaw's plan, the Census Bureau collected tract data for eight cities in 1910 and 1920 and for 18 cities by 1930. Howard Whipple Green, a Cleveland statistician, further promoted the tract concept from his position as chair of a special American Statistical Association committee charged with examining census enumeration areas. In response to his efforts, the Bureau published tract tabulations for all large cities and many smaller ones beginning with the 1940 census. The scope of coverage gradually expanded until 1990, when the entire nation was divided into census tracts. For more detail on tract history, see U.S. Census Bureau (1994).

tract location. The second issue speaks to the lack of correspondence between the census tract and both (1) people's perceptions of their own neighborhoods and (2) the set of locations that they regularly visit (to work, attend school, shop, worship, etc.). A substantial literature in sociology, geography, and psychology, cited below, suggests that one's home anchors an activity space whose contours are shaped by daily routes and destinations. In such an individually oriented or *egocentric* neighborhood, the nature and magnitude of racial change might vary at different distances from the place of residence.

These issues are considered more fully in the sections that follow. After a review and critique of neighborhood change scholarship, we set tracts aside and move urban dwellers to center stage in a literal sense. Conceptually, our new approach is roughly equivalent to constructing multiple *local environments* (circular territories) around each person without regard for tract boundaries. The approach, which has been applied previously to residential segregation (Lee et al. 2008; Reardon et al. 2008, 2009), allocates census block populations to even smaller parcels of land in order to approximate egocentric environments.² The racial structure—that is, the overall diversity and detailed composition—of all environments of a given radius is averaged across individuals, then compared for distinct years. In theory, change can be assessed at any scale deemed meaningful by the researcher or salient to the individuals who constitute the environmental reference points. This egocentric approach to change is intended to refine and complement census tract analyses that treat neighborhoods as shared territories. We illustrate its value for 40 large U.S. metropolitan areas, with spatially reconfigured 1990 and 2000 census data on residents' exposure to whites, African Americans, Hispanics, and Asians in four types of local environments. The concluding section summarizes empirical insights from our new approach and discusses some of its limitations and extensions.

2 Background

2.1 Research Context

Tract-level studies covering recent decades (1970–2010) are the legacy of a pair of pioneering efforts that examined the urban racial landscape of the 1940s and 1950s. The first, by Duncan and Duncan (1957), employed a typology based on a neighborhood's stage in the succession process (invasion, consolidation, piling up, etc.) to document the high prevalence of white-to-black transitions in Chicago. A similar typology was used by Taeuber and Taeuber (1969), although their broader investigation—covering more years and cities—found some evidence of variation in black-white patterns by time and place. The Duncans and Taeubers firmly established the precedent for treating census tracts as neighborhoods. Yet they also were careful to warn about the dangers of doing so. Duncan and Duncan (1957:121), for instance, noted that “tracts are arbitrary units, not at all homogeneous in size of area or population.”

More contemporary analyses have been forced to adapt the methodology for evaluating changes in tract racial structure, given the dramatic Hispanic and Asian increases apparent

²See Kumar et al. (2013) and Omer and Benenson (2002) for discussions of other quasi-individual and household-level approaches to measuring segregation.

throughout the metropolitan United States. A frequent practice is to define from seven to 15 neighborhood types that reflect how many racial groups are present and which one, if any, achieves demographic hegemony (Alba et al. 1995; Denton and Massey 1991; Holloway et al. 2011; Logan and Zhang 2010; Wright et al. 2014; Zhang and Logan 2016, 2017). Tract distributions across these types can then be cross-classified for different census years; the resulting transition matrix shows where tracts begin and end the period in terms of racial structure. Typologies of change are common as well (Farrell and Lee 2011; Friedman 2008; Lee and Wood 1991). Some research focuses primarily on the emergence and fate of racially integrated neighborhoods (Ellen et al. 2012; Fasenfest et al. 2006; Flores and Lobo 2013; Lee et al. 2014). Needless to say, operational details differ from study to study, such as the number of groups recognized, the criteria for establishing a group's presence or dominance, and the time frames and sample sizes used.

Even with their non-comparable designs, these investigations reach consistent conclusions about neighborhood change. Unlike the era studied by the Duncans and Taeubers, when monoracial stability and occasional white-to-black transitions prevailed, recent work shows that people who live in large metropolises are exposed to increasingly diverse residential settings (Denton and Massey 1991; Farrell and Lee 2011; Holloway et al. 2011; Logan and Zhang 2010; Wright et al. 2014; Zhang and Logan 2016). The trend toward greater diversity manifests itself in fewer all-white census tracts, more multiethnic tracts, and a higher percentage of Americans—white, black, Hispanic, and Asian—occupying tracts in which no single racial group constitutes a majority. Many of these diverse neighborhoods persist over time, contrary to invasion-succession logic. Some, however, appear to be unstable, in part because white home-seekers are reluctant to enter such neighborhoods and thus fail to replace the whites who exit (Ellen 2000; Lee et al. 2014). Another dynamic underlying instability is the rapid growth of the Hispanic population. When succession occurs, Hispanics are as likely as blacks to spur the process (Lobo et al. 2002).

As the foregoing summary suggests, valuable lessons can be learned from the conventional tract-oriented literature.³ Our approach sharpens the precision of these lessons, bypassing the usual typological exercise for direct, interval-level measures of change in neighborhood racial diversity and composition. We also seek to reconceptualize neighborhood in a standardized yet flexible way that offers an egocentric (i.e., person-centered) alternative to the census tract and better taps relevant spatial domains of experience. The need for this alternative requires further justification.

2.2 Concerns about Tracts

What motivates us is the potential disjuncture between Census Bureau and 'real world' geographies at the neighborhood level. Local statistical area committees try to establish census tracts that are "as internally homogeneous as possible with respect to population characteristics, economic status, and living conditions" (U.S. Census Bureau 1994:10–1) and to demarcate them with major roads, rail lines, waterways, and other features widely perceived by metropolitan dwellers. Nevertheless, the meaningfulness of tracts often

³The tract-based findings are enriched by mixed-method case studies that examine neighborhood racial change from a more qualitative vantage point (see, e.g., Freeman 2006; Maly 2005; Wilson and Taub 2006; Woldoff 2011).

declines over time as their compositions shift and their boundaries are adjusted in response to population gains or losses.⁴ More generally, tracts, like all fixed units (e.g., block groups, ZIP codes), are insensitive by themselves to the *scale* of the racial residential landscape, a point that we develop more fully elsewhere (Lee et al. 2008; Reardon et al. 2008, 2009). The term ‘scale’ denotes the geographic domain over which any phenomenon of interest is organized, expressed, or observed (Smith 2000). Racial change may be quite limited in scope, affecting only a few city blocks at a time, or it may occur throughout a much larger region. In short, the scale of change, and hence the suitability of tracts for capturing it, could differ from one metropolitan area to the next. For the sake of illustration, picture a hypothetical pair of such areas. The first exhibits a micro-scale mosaic where racial composition (e.g., the percentage of black residents) varies significantly over short distances, both cross-sectionally and longitudinally. In the second, a macro-scale racial pattern is apparent, with entire sectors of the metropolis dominated by blacks. We worry that tracts may not be able to distinguish between the two cases.

This assumes, of course, that census tracts represent standard-sized chunks of territory. Social scientists’ view of the tract as a compact quasi-neighborhood remains at odds with how it is operationalized. Because population represents the decisive definitional factor (U.S. Census Bureau 1994, 1997), tracts tend to be spatially larger in low-density metropolitan areas and smaller in high-density areas. Of the 40 metro areas in our sample, Riverside-San Bernardino-Ontario and New York-White Plains-Wayne—with median tract sizes of 4.9 square kilometers (km²) and .21 km², respectively—fall at the low and high extremes of the density continuum. Intra-metropolitan variation is striking as well. Houston, Miami, Phoenix, Seattle, St. Louis, and 14 other metropolises among the 40 largest contain tracts that range in size from less than one-fourth of a square mile to 200 or more square miles (518 km²).

Such inconsistencies in size, accompanied by the lack of a standard tract geometric shape, heighten the odds that macro-scale racial change will spill beyond the boundaries of tiny tracts or that micro-scale change will manifest a variety of forms within sprawling ones. Both scenarios alert us to a significant limitation of tract-based research: the inability to take proximity among residents into account. In Tract A of Figure 1, for example, Persons 1, 2, and 3 are considered equally near each other even though they live in distant corners of the neighborhood and could be exposed to very different racial distributions and changes. Residents of separate tracts, on the other hand, are assumed by aspatial analyses to have no proximity to one another. The circumstances of Persons 5 and 6 in Tracts D and I illustrate the problem. These people experience essentially the same racial mix within a particular radius from their homes. However, by virtue of their location on opposite sides of the street (which also happens to be a boundary between tracts), the typical neighborhood change study regards them as inhabiting spatially unrelated worlds.

⁴The extent of change can be substantial, as illustrated by boundary modifications detected from data in the census tract relationship files (<http://www.census.gov/geo/www/relate/>). Three-tenths (29.4%) of the 66,304 tracts delineated nationally in the 2000 census had 2.5% or more of their 2000 population located in a different 1990 tract. Tract splits, mergers, and boundary revisions account for this instability.

2.3 The Egocentric Neighborhood

It is tempting to dismiss the inflexible, arbitrary nature of tracts as a necessary evil when studying racial change with census data. But beyond the uncertain overlap between tracts and symbolic communities, a more fundamental conceptual problem remains: tracts often do not conform well to how metropolitan residents subjectively understand neighborhoods and invest them with meaning (Gieryn 2000). Empirical support for this point comes from a body of work by sociologists, geographers, and psychologists that has explored people's cognitive maps and their definitions of neighborhood in the abstract and their own neighborhoods in particular (Coulton et al. 2013; Lee and Campbell 1997; Regnier 1983). With respect to the spatial scale dimension, surveys in Chicago (Hunter 1974), Cleveland (Coulton et al. 2001), Los Angeles (Pebley and Sastry 2009), Nashville (Lee and Campbell 1997), and Seattle (Guest and Lee 1984) reveal marked differences among respondents in the perceived size of their neighborhoods. Such self-defined neighborhoods regularly incorporate territory from two or more census tracts (Coulton et al. 2001; Matthews et al. 2005).

One reason for the disconnect between tracts and subjectively defined neighborhoods is that the latter partially reflect the unique domains inhabited by metropolitan residents as they carry out their daily rounds. A burgeoning literature on these domains, known as activity spaces, confirms that tasks such as working, attending school, shopping, socializing, or going to a place of worship link people to multiple neighborhoods beyond their nighttime sleeping locations (Browning and Soller 2014; Jones and Pebley 2014; Matthews 2011). To date, activity space research has explored the range of residential and non-residential contexts in which persons are exposed to health risks, criminogenic forces, and socioeconomic disadvantage, among other conditions (Graif et al. 2014; Kestens et al. 2017; Krivo et al. 2013; Matthews and Yang 2013). For our purposes, activity spaces can be important as demographically diverse venues where urban dwellers—who often live in segregated neighborhoods—come into contact with members of ethnoracial groups different from their own.

Building on the insights of activity space scholarship, we propose that neighborhood change research may benefit from consideration of a series of local environments that vary in scale. These local environments approximate egocentric neighborhoods, that is, circular territories of increasing radii with an 'anchor' individual (such as Person 4 in Figure 1) in the middle.⁵ Our approach, for which Reardon and O'Sullivan (2004) laid the groundwork, offers a spatially sophisticated alternative to the traditional strategy of relying only on home tracts or other fixed statistical aggregations. In egocentric local environments, people are never located near the edge of an artificially bounded unit. Rather, each person constitutes the focus of his or her turf. This orientation—inside looking outward—receives abundant support from studies of subjective neighborhood definitions as well as activity spaces. Regardless of the methodology employed, a person's house, apartment building, or face block typically serves as the primary reference point.⁶

⁵Past researchers have proposed concepts similar to the egocentric neighborhood, including home range (Everitt and Cadwallader 1972) and personal arena (Hallman 1984). Operationally, recent work by Hipp and Boessen (2013) comes closest to our approach but census blocks rather than individuals anchor the circular territories in their scheme.

The limits of local environments are likely to vary by a person's demographic attributes, and they may expand or contract over the life course in response to changing needs. However, they will depend most heavily upon how far afield one's routine activities reach. With this in mind, we investigate racial change in four types of potentially salient local environments suggested by the activity space scholarship already cited. The smallest environment, demarcated by a 500m radius, corresponds to a pedestrian neighborhood in which chats with neighbors, dog-walking, and visits to a park or playground are common. At the opposite extreme lies the 4,000m-radius macro-environment, covering nearly 20 square miles. Recent evidence suggests that church participation, shopping, visits to a health care provider, and high school attendance often occur in a domain of this size (Hu and Reuscher 2004; Sastry et al. 2002). We also examine two intermediate local environments, with radii of 1,000m and 2,000m, which are intended to resemble daycare or elementary school catchment areas, police substation zones, and similar institutional jurisdictions. Of the four types of environments, the 1,000m one is most similar to the average-sized census tract, keeping in mind the impressive deviations from that average (Lee et al. 2008).

Our approach makes the simplifying assumption that local environments are uninterrupted by physical barriers (e.g., a freeway or river) and thus that the portions of these environments closest to the focal individual will matter most. Consider the environments (concentric circles) surrounding Person 4 in Figure 1. Even in the smallest (500m) environment—equivalent to the immediate, walkable neighborhood—Person 4 is likely to be affected more by proximate than distant neighbors. Accordingly, we give nearby neighbors greater weight. Now imagine constructing a local environment of the same radius for the thousands of people inhabiting tracts A through F, then repeating the procedure for local environments of larger size. The proximity-weighted racial composition of those environments in different years can be used to study egocentric as opposed to tract-based neighborhood change at different geographic scales.

3 Methodology

3.1 Sample and Data

To illustrate our approach, we employ a dataset originally assembled to study 1990 and 2000 patterns of racial residential segregation for the 40 U.S. metropolitan areas with the largest populations in the latter year. The dataset, which contains all of our required variables at the appropriate levels of aggregation, covers a period—the 1990s—when metro areas recorded major diversity gains (Lee et al. 2014). The '90s also fall in the middle of the three-decade span (1980–2010) featured in many recent analyses of neighborhood change. We rely on metropolitan definitions issued by the Office of Management and Budget in 2003 (Frey et al. 2006) to insure over-time comparability in metropolitan boundaries. The definitions include 11 metro areas with populations exceeding 2.5 million, such as Dallas-Ft. Worth-Arlington; these have been broken down into their divisional components (e.g., Dallas-Plano-Irving and Ft. Worth-Arlington), which we treat as separate cases. A little more than one-half (53%) of

⁶McKenzie (1923:351) drew much the same conclusion nearly a century ago, noting that the average denizen of Columbus, Ohio considered 'neighborhood' that "area within the immediate vicinity of his home, the limits of which seem to be determined by the extent of his personal observations and contacts."

metropolitan residents nationally lived in our sample metro areas in 2000. New York-White Plains-Wayne (11,296,377) ranked first in population among the sample areas, and Providence-New Bedford-Fall River (1,582,997) ranked last. All 40 areas are listed in the appendix.

The dataset contains information on racial/ethnic structure drawn from Summary Tape File 1 and Summary File 1 of the 1990 and 2000 censuses, respectively. We single out four mutually exclusive groups for attention: non-Hispanic whites, non-Hispanic blacks, non-Hispanic Asians, and Hispanics of any race. All other groups, including persons who report two or more races, have been dropped at both time points. Combined, the four included groups make up over 97% of the total population in the 40 sample metro areas. Those areas in turn capture large shares of all metropolitan blacks (57%), Hispanics (68%), and Asians (74%) enumerated in the 2000 census. Given these substantial group representations, it is not surprising that 18 of the 40 areas rank among the 25 most diverse metropolises nationwide as of 2000, and 21 of the areas rank among the 25 most diverse in 2010 (Lee et al. 2014).

3.2 GIS Procedures

Race counts from the census summary files have been extracted for blocks (<http://www.geolytics.com/USCensus,Census-2000-Short-Form-Blocks,Products.asp>), which constitute the smallest spatial aggregations available. By spreading the count data across even smaller parcels with ArcGIS software (www.esri.com/arcgis/about-arcgis), we can approximate a description of the racial structure of individuals' local environments in both 1990 and 2000. The GIS procedures for constructing such environments are complex, so we only summarize them here (in-depth treatments appear in Reardon et al. 2008, 2009). As an initial step, a grid of 50m × 50m cells was superimposed on the census block map for a given metropolitan area. Next, we calculated race-specific population densities at the block level and used these densities to estimate racial group counts for every cell of each block, smoothing the cell grid with Tobler's (1979) pycnophylactic method. Pycnophylactic smoothing iteratively re-estimates group counts in each cell by assigning to that cell the average population of the cell and its eight neighboring (adjacent) cells. At the same time, cell counts are repeatedly adjusted to maintain the counts observed for the block as a whole. This method softens the sharp breaks in counts at boundaries between blocks yet preserves total and race-specific counts within blocks.⁷

We then computed the proximity-weighted racial composition of the local environment of each cell by taking weighted average population counts of the racial groups in surrounding cells. Note that a cell rather than a specific person technically serves as the focal point of a local environment, but weighting insures that different-sized cells represent different numbers of people, consistent with the 'egocentric' label for our approach. The particular function selected to estimate environmental composition, a two-dimensional biweight kernel function, incorporates the kind of distance-decay dynamic proposed by White (1983), assigning nearby cells more weight than far ones on the assumption that spatial proximity is

⁷Sensitivity tests reported in Reardon et al. (2008) indicate that our results appear robust to different assumptions about the smoothness of racial compositional patterns across boundaries between blocks.

correlated with interaction and influence among residents.⁸ The kernel function, which approximates a Gaussian (normal curve) shape, has the advantage of being bounded by a fixed radius that reduces computational time, with locations outside the specified radius given a weight of 0.⁹ Manipulation of the function's radius allows us to examine the racial make-up of local environments of varying size. As noted earlier, the four environments in Figure 1—with 500m, 1,000m, 2,000m, and 4,000m radii—have been chosen for this analysis because of their similarity to meaningful domains identified in previous urban research. However, they fall short of realism in a non-trivial respect. To keep computational tasks manageable, we treat all local environments as if they were free of physical or topographical features that might disrupt the proximity-weighted gradient of influence central to our approach.

3.3 Racial Structure Measures

The racial/ethnic structure of an egocentric neighborhood (or of any sociospatial unit, for that matter) is manifested as both overall diversity and detailed composition. To tap diversity, we have utilized a spatially refined version of the *entropy index* (or *E*). This index possesses several attractive properties, including a straightforward interpretation: it indicates the evenness with which members of a population are distributed across groups or categories on some variable of interest (Reardon and O'Sullivan 2004; White 1986). *E* can be formally defined as follows:

$$E_i = \sum_{g=1}^G Q_{gi} \ln \left(\frac{1}{Q_{gi}} \right)$$

where Q_{gi} refers to racial group g 's proximity-weighted proportion of the population in a local environment centered on cell i . We have standardized *E* to a 0–1 range, with 0 signifying complete homogeneity (only one racial group present) and 1 signifying maximum diversity (whites, blacks, Hispanics, and Asians present in equal proportions).¹⁰ *E*'s absolute criterion for diversity (equal group shares) facilitates cross-sectional and over-time comparisons of local environments. Such comparisons become more difficult when the diversity of these environments in a particular year is measured relative to the racial composition of a metropolitan area—or region or state—in which they are embedded. Simply put, our usage of *E* provides a consistent gauge of diversity magnitude regardless of spatial or temporal context.

When *E* values are weighted by cell total population density and averaged across all local environments of a set radius, the result depicts the mean level of *racial diversity* to which a metropolitan resident in general is *exposed* within that distance (radius) from her or his home. (See Reardon and O'Sullivan [2004] for a more detailed explication of this and other

⁸ Several tract-based studies also incorporate distance-decay functions to assess the impact of proximity on social and residential processes (e.g., Crowder and South 2008; Sampson, Morenoff, and Earls 1999).

⁹ Potential 'edge effects'—distortions in the racial composition of local environments situated on or near the metropolitan periphery—could occur because the parts of these environments that extend beyond metro area boundaries are treated as having no population. However, additional analyses have shown such effects to be negligible (Reardon et al. 2008).

¹⁰ In the absence of standardization, the maximum value taken by *E* equals the natural log of the number of racial groups (1.386 in the case of four groups). Dividing computed values by this maximum produces *E* scores in the more familiar 0–1 range.

spatial analogs to the familiar P^* family of exposure measures.) Likewise, mean diversity exposure for members of a specific racial group can be estimated via weighting by the group's density in each cell. To capture racial change, one simply computes 1990–2000 differences for these general and group-specific entropy measures. The *diversity profile*, which is introduced in the next section, visually summarizes the differences, depicting diversity shifts over the decade in the four types of egocentric local environments.

Entropy measures, while conveying much information in a concise way, do not tell the entire story about neighborhood racial structure. Because local environments with the same E value may contain quite distinct racial mixes, more compositional detail is needed. To provide such detail, we unpacked each cell-based E score into its four proximity-weighted group proportions (i.e., white, black, Hispanic, and Asian). We then multiplied these proportions by a particular group's density in the cell and averaged across all local environments of a given radius. This procedure yields the mean proportions of whites, blacks, Hispanics, and Asians residing within 500m (or 1,000, 2,000, or 4,000m) of the typical member of the reference group.¹¹ In short, the proportions tap *compositional exposure*, paralleling our measures of diversity exposure. By comparing compositional exposure in 1990 and 2000, it becomes possible to describe racial changes occurring in the egocentric neighborhoods of different groups at a variety of scales.

4 Results

4.1 Changes in Diversity

The value of the proposed methodology is initially demonstrated via an analysis of metropolitan residents' exposure to racial and ethnic diversity in their egocentric neighborhoods. We address three questions: (1) How diverse are residents' local environments? (2) Does diversity vary by local environment size? (3) How did levels of diversity in such environments change during the 1990s? Although the third question focuses most directly on our main research objective, the first two also merit consideration. The answers to all three questions reflect a pair of dynamics that are difficult to disentangle, namely the shifting racial composition of metropolitan populations and the spatial rearrangement of racial groups within metro areas.

Table 1 captures racial diversity with proximity-weighted entropy scores, which have been averaged across the 40 sample metro areas. Examining the first two rows of the table, one sees that the mean 1990 and 2000 E s fall midway between the monoracial (single group) and multiracial (all-group proportional equality) extremes of the 0–1 range on the entropy index, implying a substantial degree of diversity. Cross-column inspection reveals another expected pattern: as local environments increase in size, racial diversity rises. Indeed, diversity within a 4,000m radius of the typical resident's home is at least one-fifth greater than within a 500m radius, according to the ratios in the far right column. Simply put, larger egocentric or

¹¹We do not calculate similar measures for a member of the metropolitan population at large because this person's exposure to specific racial groups will be nearly identical to the proportions of those groups in the population. If a metropolis is 20% Hispanic, for instance, then the average resident will live, by definition, in nested local environments that are all approximately 20% Hispanic.

person-centered neighborhoods encompass more heterogeneous populations, just as larger fixed units do (e.g., census tracts versus blocks; see Wong 2004).

Irrespective of their size, egocentric neighborhoods did not remain racially stable during the decade of interest. The bottom row of Table 1 documents 16–20% gains in mean diversity from 1990 through 2000 for all types of local environments. These gains are greater than the mean increase in racial diversity experienced by the 40 metropolitan populations (15.5%), suggesting that what happens to local environments over time is not a perfect reflection of metropolitan-wide trends. For example, average 1990–2000 diversity changes among the largest (4,000m) local environments exceeded metro-level changes in 24 areas but fell short in the remaining 16. Similar local environment departures from metropolitan patterns occurred at other geographic scales.

Changes in diversity are inversely but weakly related to environmental scale. The biggest jump in diversity is apparent for micro-neighborhoods, i.e., local environments defined by a 500m radius. These environments became more like their 4,000m macro counterparts, a trend to which the 1990–2000 decline in diversity ratios attests (bottom of the fifth column). The same generalizations about change hold for the individual metropolises that underlie the means reported in the table. Of the 40 metropolitan areas in our sample, 31 exhibit their largest increases in diversity for micro-neighborhoods. And in 35 of the areas, the diversity gap between micro- and macro-neighborhoods has shrunk, albeit rarely by as much as 7%.

While the foregoing changes are prevalent, they still leave room for the emergence of metro-specific patterns. To facilitate the discovery of such patterns, we introduce the *diversity profile*, a curve that plots racial diversity (i.e., entropy scores) by egocentric neighborhood size in a given year.¹² Each point on the x axis identifies a local environment of a particular radius. The profile visually conveys both the magnitude of racial diversity in each type of environment (depicted by the height of the profile on the y axis) and the extent to which diversity varies with increases in environmental scale (depicted by the slope of the profile). When profiles from different years are presented together, their position in relation to each other indicates whether diversity within egocentric neighborhoods has increased, decreased, or held constant. Figure 2 illustrates these properties for selected metropolitan areas.

New York-White Plains-Wayne (hereafter shortened to New York) constitutes a useful place to start. As a longstanding immigrant gateway (Foner 2013), New York ranks among the most diverse metropolitan areas in the U.S., yet it is also among the most segregated for blacks, Hispanics, and Asians based on analyses of census tracts and blocks (Lee et al. 2014; Lichter et al. 2015). From the height of the 1990 and 2000 profiles, we learn—not surprisingly—that New Yorkers were exposed to very diverse local environments at the end of the twentieth century, just as they are today. Less anticipated is how sharply diversity climbs as the environmental radius expands, a fact apparent in the steep slopes of both profiles: average E values are at least 15 points greater in 4,000m than 500m environments. Most crucial for our purposes, the location of the 2000 profile above the 1990 profile reflects

¹²Elsewhere a parallel tool, the segregation profile, has been used to describe the extent to which patterns of racial residential segregation vary by spatial scale (Lee et al. 2008; Reardon et al. 2008, 2009).

increasing diversity in all types of egocentric neighborhoods over the course of the decade. The increases, though generally modest, are somewhat larger for 500m micro-neighborhoods, yielding a slightly flatter slope in 2000. In other words, during the 1990s the population immediately surrounding the typical New Yorker's home became a bit more similar in racial diversity to what that resident would encounter farther away.

The same cannot be said about a Los Angeles-Long Beach-Glendale (hereafter Los Angeles) resident's exposure to diversity. As the overlapping profiles in the Los Angeles panel of Figure 2 indicate, diversity levels stayed the same in 2000 as in 1990 for all types of local environments. This absence of egocentric neighborhood change is coupled with rather flat slopes in both years: E only increases by about 8 points when moving from a 500m environment to a 4,000m one. The flatness of the slopes attests to a macro-scale geography in Los Angeles that includes large swaths of both racial residential mixing and relative homogeneity, the latter in the form of Hispanic and Asian enclaves and primarily white coastal communities (Clark 1996; Lee et al. 2008). Other California metropolitan areas—Oakland-Fremont-Hayward, Riverside-San Bernardino-Ontario, Sacramento-Arden Arcade-Roseville, San Diego-Carlsbad-San Marcos, San Jose-Sunnyvale-Santa Clara, and Santa Ana-Anaheim-Irvine—exhibit a similar combination of high diversity (E values exceeding .50) and relatively horizontal profiles. However, their 2000 profiles lie above and parallel to those for 1990, reflecting non-trivial diversity increases in local environments that range from micro to macro in scale. During the decade, only San Franciscans (i.e., residents of San Francisco-San Mateo-Redwood City) experienced the same across-the-board stability in racial mix that Los Angelenos did, albeit with a smaller share of Hispanics and a larger share of Asians in their local environments.

The highly diverse egocentric neighborhoods common to New York and Los Angeles are far from universal, even among the largest metropolises. Chicago-Naperville-Joliet, the third most populous metro area, has diversity scores that approximate the means for our sample as a whole, with E s in the .30s and .40s (see Table 1). According to the gap between the two profiles, Chicagoans' local environments of all radii were one-fifth to one-fourth more diverse in 2000 than 10 years earlier, consistent with a pattern of expanding clusters of 'global' (multi-ethnic) neighborhoods fueled by Hispanic and Asian growth and white decline (Zhang and Logan 2017). Much greater change can be seen in the Figure 2 panel for Fort Lauderdale-Pompano Beach-Deerfield Beach, where exposure to diversity jumped from Chicago to Los Angeles levels between the two censuses in response to dramatic minority population gains. In Pittsburgh and Minneapolis-St. Paul-Bloomington, by contrast, racial homogeneity prevailed both close to and far from the typical resident's home, as revealed in the low, gently sloping profiles. The difference here lies in the magnitude of change: while Pittsburgh's local environments remained stable, those in Minneapolis registered diversity increases of roughly 50%.

Beyond its utility for capturing metropolitan-specific patterns, the profile methodology can tell us about trends in the local environments occupied by members of particular racial groups. Figure 3 displays group-specific, proximity-weighted entropy scores that have been averaged across the 40 metro areas in our sample. Thus, each panel in the figure depicts how exposed to diversity a group member was who lived in the metropolitan core of the U.S.

during the study period. Whites were clearly the least exposed at both time points. Although the gap between the 1990 and 2000 profiles indicates substantial diversity increases in local environments of every size, the typical white resident still inhabited far more homogeneous egocentric neighborhoods than did his or her black, Hispanic, and Asian counterparts. Indeed, E scores tend to be 15–20 points lower for whites than for any of the three minority groups.

These minority groups diverge from each other in significant ways. The profiles of African Americans, for example, stand out because of their steepness. Especially in 1990, the mean diversity experienced by a black person within 500m of home fell well short of that within a 4,000m radius. Yet by 2000, blacks' micro-neighborhoods had gained ground on their macro-neighborhoods in terms of racial diversity, resulting in a somewhat flatter slope. This change was driven in part by decreasing black-white segregation in the smallest (500m) local environments (Reardon et al. 2009). Compared to blacks, Asians' exposure to diversity was less sensitive to scale: the nearly horizontal profiles for both census years show that all four types of local environments were about equally diverse. All four environments in turn show larger diversity increases in the Asian than the black panel of the figure. Finally, Hispanics represent an intermediate case between Asians and blacks, both in the slope of their diversity profiles and the magnitude of their diversity gains during the 1990–2000 period.

4.2 Changes in Composition

The entropy measures featured thus far offer a convenient snapshot of the overall diversity changes occurring in the egocentric local environments of metropolitan dwellers. Nevertheless, the fact that quite distinct racial mixes can produce identical entropy scores suggests the need for more fine-grained measures of composition. As described in the methodology section, we use the proximity-weighted group proportions incorporated in E to calculate the mean percentages of whites, blacks, Hispanics, and Asians to which the typical member of each racial group was exposed within different-sized local environments. Table 2 presents findings on compositional exposure in micro- and macro-environments, which have radii of 500m and 4,000m respectively; racial reference groups are identified in the left margin.¹³ By way of orientation, the first four cells in the top row tell us that the average micro-environment occupied by a white person in 1990 was 83.3% white and 8.2% Hispanic, with smaller shares of black and Asian neighbors.

Every panel of the table provides insights about changes in racial structure that enrich our E -based diversity results. For whites (top panel), the 1990–2000 differences show that increases in egocentric neighborhood diversity were due to declining white dominance accompanied by minor to moderate gains in the proportional representation of each minority group. This pattern holds for micro- and macro-local environments, although in both types of settings whites remained surrounded primarily by members of their own race as of 2000, consistent with an aversion to people of color expressed in whites' racial preferences and

¹³The decision to limit our attention to 500m and 4,000m local environments is motivated by (1) the need to conserve space and (2) the sharper contrasts apparent between these two types of settings. The 1,000m and 2,000m local environments tend to exhibit patterns that fall in an intermediate range.

residential mobility decisions (Crowder et al. 2011; Havekes et al. 2016; Lewis et al. 2011). Among blacks (second panel), diversity increases were a function of declining black and white shares coupled with growing shares of Asians and especially Hispanics. Interestingly, black declines exceeded those for whites in the 500m local environment of the typical African American, but the opposite was true within a 4,000m radius.

What stands out in the third and fourth panels is Hispanics' and Asians' markedly diminished exposure to whites. Between 1990 and 2000, the mean presence of whites in the egocentric environments of these groups dropped by 8 to 9 percentage points. In the Hispanic case, a significant substitution of Hispanic for white neighbors appeared to be underway, with more modest (less than 2-point) increases in black and Asian representation also evident. Asians experienced substantial increases in the Hispanic and Asian composition of their micro- and macro-environments. However, whites still constituted a much larger portion of an Asian resident's neighbors (roughly 3 out of 5 in 2000) than did Hispanics or other Asians.

The means in Table 2, while informative, may obscure variation in compositional changes across metropolitan areas. Return, for a moment, to the cases of Pittsburgh and Fort Lauderdale (see Figure 2). In the former, whites occupied very homogeneous micro-environments (95.1% white, on average, in 1990) that remained stable over the subsequent decade, in keeping with Pittsburgh's stagnant population (which underwent a 1.5% decline) and persistent single-group racial structure (which hovered around nine-tenths white). In the latter, more diverse metropolis, the representation of Hispanics in the typical white's micro-environment jumped from 8.4% in 1990 to 15.8% in 2000, and black and Asian shares rose as well, by 3.8 and 1.1 percentage points. Fort Lauderdale's transformation resulted from the substantial growth of its Hispanic (156.9%), Asian (130.5%), and black (71.9%) populations during the 1990s.

One obvious implication here, as noted previously, is that the composition of egocentric neighborhoods does not change in a vacuum; the racial mix of the larger metropolitan context can exert a non-trivial influence. To demonstrate this in an efficient manner, we have rank-ordered our sample metropolises by metro-wide diversity levels (entropy scores) as of 2000. Figures 4 and 5 summarize changes in group-specific micro- and macro-environments for metro areas falling in the top and bottom thirds of the diversity distribution. (The last column of the appendix reports metro diversity scores, denoting top-third areas with a 't' in parentheses after their scores and bottom-third areas with a 'b').

Contrasts between high- and low-diversity metro contexts are apparent at a glance. Local environments in the upper (high diversity) panel for each reference group tend to be much more multiracial, on average, than their counterparts in the lower (low diversity) panel, irrespective of group, year, or environment size. Yet the exact composition of local environments clearly depends upon the reference group in question. On the one hand, whites were more likely to have a greater share of same-race neighbors in 1990–2000 when they lived in low-diversity metropolitan areas (Figure 4). So were African Americans, but only within a 500m radius of home; the representation of black neighbors within 4,000m differed little by metro-wide diversity. (Observe the similar lengths of the black segments in the

4,000m bars for corresponding years in the upper and lower black panels.) For Hispanics and Asians, on the other hand, exposure to own-group neighbors was more prevalent in high-diversity than low-diversity contexts (Figure 5).

Together, the figures further underscore the key role played by Hispanic and Asian populations in driving egocentric neighborhood change. From 1990 to 2000, increases in the percentages of both groups were consistently greater in high-diversity metropolises, with magnitudes of increase (indicated by differences in segment lengths between census years) often double those observed in low-diversity areas. The fact that the Hispanic gains usually exceeded the Asian ones should come as no surprise, given the size and growth of the Hispanic population nationally. Among our subsample of high-diversity metropolitan areas, Hispanics enjoyed major demographic advantages over Asians during the study period in absolute numbers (15.2 million vs. 5.2 million in 2000), relative numbers (26.5% vs. 9.1% of pooled population), and absolute 1990–2000 growth (4.9 million vs. 1.7 million). Asians, however, exhibited a growth rate (47.2%) nearly equal to that for Hispanics (47.5%) during the 1990s.

In terms of reference group impact, Hispanic residents in high-diversity metro areas registered 7 to 8 percentage-point increases over the decade in the representation of Hispanic neighbors within their micro- and macro-environments. Black inhabitants of high-diversity areas also saw the composition of their egocentric neighborhoods substantially altered by the surge in Hispanics. For Asian inhabitants of high-diversity metropolises, the percentage of Asian neighbors increased more than that of Hispanics did, regardless of local environment size. Whites appear least affected by Hispanic and Asian growth; they remained disproportionately exposed to white neighbors, even when living in otherwise diverse metropolitan contexts. The greater ability of whites to act on their racial residential preferences—moving out of or avoiding diverse neighborhoods—likely played a role in their own-group exposure (Crowder et al. 2011; Lewis et al. 2011). So did their tendency to make stereotypic inferences about school quality, safety, and other features based on the perceived racial mix of a neighborhood (Ellen 2000). Still, the major message from Figures 4 and 5 is how all racial reference groups—whites included—experienced rising micro- and macro-environment exposure to Hispanics and Asians from 1990 through 2000, the extent of change contingent on the level of diversity in the surrounding metropolitan landscape.

5 Conclusion

Consistent with the tract-based scholarship reviewed earlier, we conclude that during the 1990s metropolitan residents—especially members of minority groups—lived in neighborhoods that were experiencing marked changes in racial structure fueled by Hispanic and Asian growth. The familiarity of this conclusion implies that census tracts, however crude they might be, do an acceptable job of describing basic neighborhood patterns. But our research goes beyond what can be learned from tracts alone, generating new insights.

One fundamental insight is the scalar nature of exposure to diversity, apparent in comparisons across local environments of distinct radii. We discover, for example, that diversity gains between 1990 and 2000 were larger in micro- than macro-environments, with

the most significant narrowing of the macro-micro gap evident for blacks. At the same time, living in a low-diversity metro area increased blacks' exposure to same-race neighbors, but only close to home (within 500m). These scale-specific results are reinforced by a replication using tracts (not shown), which reveals that the correspondence between 1990–2000 changes observed for tracts and for any of our standardized local environments varies by metropolis and racial group.¹⁴ Simply put, a census tract-based analysis cannot tell as nuanced a story as an egocentric multi-scalar study can about how neighborhood racial composition evolves over time.

This is not to deny the existence of 'real' neighborhoods that possess physical and symbolic identities (reflected in commonly recognized boundaries and place names). Rather, we propose that the treatment of neighborhood as a collective entity—either through Census Bureau definition or social construction—be balanced by more attention to how individuals perceive and engage the urban setting during their daily rounds. The concept of egocentric neighborhood redirects our focus from what happens in a single fixed unit to what happens within a series of concentric, person-anchored local environments. Why is the flexibility and precision provided by the local environment approach valuable? Because shifts in racial composition occur at different spatial scales and are relevant to different domains of activity. For the sake of illustration, consider racial change underway within 500m of one's home. This sort of change, which we find significant, can be expected to have greater effects on informal neighbor relations than would change spread over a 4,000m region, which might shape high school experiences or decisions about where to shop or attend religious services. More generally, by building multiple types of local environments into the study design, an investigator increases the odds of capturing racial trends at scales that are meaningful to residents but that research on tracts may obscure.

Although the egocentric approach to neighborhood change has great potential, much work must be done before that potential is fully realized. At a minimum, we should develop a more refined, spatially explicit understanding of how racial change transpires in various types of local environments and what its consequences are in each. Technical improvements are needed to increase the realism of our approach. For example, efforts could be made to incorporate 'hard' barriers (highways, dead-end streets, railroads, etc.) that disrupt the continuity of racial residential patterns between locations (see Grannis 1998; Roberto and Hwang 2017). Similarly, innovative ways to measure social rather than Euclidian distance—as manifested by shifts in non-racial as well as racial characteristics across urban space—may prove useful in refining how local environments are bounded (Legewie and Schaeffer 2016; Spielman and Logan 2013). These improvements, while not impossible, remain computationally challenging.

¹⁴. We performed the replication with the GeoLytics Neighborhood Change Database (<http://www.geolytics.com/USCensus,Neighborhood-Change-Database-1970-000,Products.asp>) to insure constant tract boundaries at both time points. Mean 1990 and 2000 tract diversity (entropy) scores closely resemble the means for the 1,000m local environments shown in Table 1. But average tract-based diversity changes for the metropolitan areas and racial groups in Figures 2 and 3 do not consistently match those previously reported for local environments of a single size. Equally inconsistent patterns emerge when the compositional exposure measures summarized in Table 1 and Figure 4 are compared with their tract analogs (xP^*_x and xP^*_y). In short, it is unclear which spatial scale, if any, tracts can be said to capture.

Steps should also be taken to make the approach less abstract. Throughout the paper, exposure to racial change is documented for the average metropolitan inhabitant or the average member of a particular minority group. Yet more specific referents, such as the average white Pittsburgher or average Hispanic resident of a high-diversity metropolis, appear late in our analysis and hint at the payoff from race-by-place combinations. Ultimately, the egocentric neighborhood circumstances of actual individuals (instead of average ones) could be explored, assuming that a survey has been conducted that includes street addresses or comparable geocodes for its respondents. When merged with spatially reconfigured census summary file data, the survey information would permit inquiry into the personal characteristics associated with exposure to trajectories of change at distinct scales, not to mention the consequences of such exposure (for collective efficacy, child and adult well-being, and the like).

Keep in mind that extensions of the egocentric approach are not confined to research on neighborhood racial change. GIS methods akin to ours could be employed to measure exposure to income diversity and composition within local environments of varying radii, then differences in exposure levels computed between time points. In a similar vein, investigators may seek to determine how the age structure of the nested environments occupied by residents is changing; shifts in the tenure, nativity, and household type mix of one's neighbors could be of interest as well.¹⁵ Hopefully, application of the strategy outlined here to a range of dimensions will facilitate a broader, more scale-sensitive, and person-centered understanding of neighborhood change.

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Appendix

Appendix Sample Metropolitan Areas, 2000

Area	Population (000s)	Diversity
Atlanta-Sandy Springs-Marietta, GA	4,248	.681
Baltimore-Towson, MD	2,553	.576
Boston-Quincy, MA	1,813	.564
Chicago-Naperville-Joliet, IL	7,628	.786 (t)
Cincinnati-Middletown, OH-KY-IN	2,010	.347 (b)

¹⁵ Hall and Lee's (2010) suburban study computes entropy scores that reflect multiple-category income, age, tenure, nativity, and household type dimensions of diversity. Comparable measures could be created for egocentric neighborhoods by applying our GIS procedures to block group data.

Area	Population (000s)	Diversity
Cleveland-Elyria-Mentor, OH	2,148	.508 (b)
Columbus, OH	1,613	.418 (b)
Dallas-Plano-Irving, TX	3,451	.781 (t)
Denver-Aurora, CO	2,158	.581
Detroit-Livonia-Dearborn, MI	2,061	.651
Edison, NJ	2,174	.575
Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	1,623	.738
Fort Worth-Arlington, TX	1,710	.674
Houston-Sugar Land-Baytown, TX	4,715	.834 (t)
Kansas City, MO-KS	1,836	.470 (b)
Los Angeles-Long Beach-Glendale, CA	9,519	.871 (t)
Miami-Miami Beach-Kendall, FL	2,253	.734
Minneapolis-St. Paul-Bloomington, MN-WI	2,969	.377 (b)
Nassau-Suffolk, NY	2,754	.545 (b)
New York-White Plains-Wayne, NY-NJ	11,296	.908 (t)
Newark-Union, NJ-PA	2,099	.742 (t)
Oakland-Fremont-Hayward, CA	2,393	.892 (t)
Orlando-Kissimmee, FL	1,645	.676
Philadelphia, PA	3,850	.611
Phoenix-Mesa-Scottsdale, AZ	3,252	.587
Pittsburgh, PA	2,431	.271 (b)
Portland-Vancouver-Beaverton, OR-WA	1,928	.418 (b)
Providence-New Bedford-Fall River, RI-MA	1,583	.360 (b)
Riverside-San Bernardino-Ontario, CA	3,255	.758 (t)
Sacramento--Arden-Arcade--Roseville, CA	1,797	.706
San Antonio, TX	1,712	.676
San Diego-Carlsbad-San Marcos, CA	2,814	.766 (t)
San Francisco-San Mateo-Redwood City, CA	1,731	.822 (t)
San Jose-Sunnyvale-Santa Clara, CA	1,736	.830 (t)
Santa Ana-Anaheim-Irvine, CA	2,846	.751 (t)
Seattle-Bellevue-Everett, WA	2,343	.515 (b)
St. Louis, MO-IL	2,699	.443 (b)
Tampa-St. Petersburg-Clearwater, FL	2,396	.534 (b)
Warren-Farmington Hills-Troy, MI	2,391	.332 (b)
Washington-Arlington-Alexandria, DC-VA-MD-WV	3,728	.781 (t)

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Fig. 1.
Local Environments in Relation to Census Tracts

Fig. 2.
Diversity Profiles for Selected Metropolitan Areas, 1990–2000

Fig. 3.
Diversity Profiles for Racial Groups, 1990–2000

Fig. 4.
Mean Composition of Micro- and Macro-Local Environments for Whites and Blacks by
Metropolitan Diversity, 1990–2000

Fig. 5.
Mean Composition of Micro- and Macro-Local Environments for Hispanics and Asians by
Metropolitan Diversity, 1990–2000

Table 1

Mean Diversity Levels and Changes by Local Environment Size, 1990–2000

Year	Local Environment Size				4000m/500m
	500m	1000m	2000m	4000m	
1990	.351	.370	.394	.426	1.24
2000	.419	.440	.465	.496	1.20
% change	19.4	18.9	18.0	16.4	−3.2

Table 2

Mean Composition of Micro- and Macro-Local Environments by Racial Group, 1990–2000

Reference/Year	500m Composition				4000m Composition			
	White	Black	Hispanic	Asian	White	Black	Hispanic	Asian
White								
1990	83.3	4.9	8.2	3.7	79.9	7.1	9.2	4.0
2000	78.2	5.6	11.1	5.1	74.4	7.6	12.6	5.4
Difference	−5.1	.7	2.9	1.4	−5.5	.5	3.4	1.4
Black								
1990	35.0	49.2	11.7	4.2	46.6	36.3	12.7	4.4
2000	33.5	44.0	16.7	5.8	41.9	34.4	17.7	6.0
Difference	−1.5	−5.2	5.0	1.6	−4.7	−1.9	5.0	1.6
Hispanic								
1990	58.0	11.9	25.8	4.3	62.3	13.3	20.1	4.3
2000	48.6	12.9	32.8	5.7	53.5	13.9	26.9	5.8
Difference	−9.4	1.0	7.0	1.4	−8.8	.6	6.8	1.5
Asian								
1990	68.9	9.3	11.1	10.7	70.9	10.9	11.4	6.8
2000	60.6	10.2	14.8	14.4	62.7	11.5	15.6	10.1
Difference	−8.3	.9	3.7	3.7	−8.2	.6	4.2	3.3