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GEOGRAPHICAL SCALE AS A FACTOR IN MEASURING RACIAL AND ETHNIC DIVERSITY IN CITIES

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***ABSTRACT*:** We propose that geographical scale be explicitly considered in studies evaluating racial and ethnic diversity to avoid obtaining misleading results. We tested six major U.S. cities for markers of racial and ethnic diversity at four scales: citywide; 3-4 city subunits; 1-mile radius circles (3.14 square miles); and census tracts. Observations at the citywide scale were contradicted at the neighborhood scale in several cities. At the city scale, Boston, San Diego, and San Francisco showed high racial and ethnic diversity whereas Pittsburgh and Cincinnati were much less diverse. At the neighborhood scale, however, Pittsburgh had far more racial and ethnic diversity than the citywide data suggested and Boston was far less racial and ethnically diverse. HUD public housing at the neighborhood scale showed Pittsburgh and Cincinnati, the two cities with the lowest citywide diversity scores, had the most dispersed public housing. Despite appearing racially and ethnically diverse citywide, San Francisco and San Diego had concentrated public housing at the neighborhood scale. We conclude that the extent to which HUD public housing is scattered is consistent with racial and ethnic diversity at the neighborhood scale but not the city scale. Database users need to be clear about the impact of geographic scale when advising communities, decision-makers, and potential investors about racial and ethnic diversity-related issues.

Keywords: *racial and ethnic diversity, geographical scale, population*

INTRODUCTION

This paper focuses on the importance of geographical scale in studies and reports related to population racial and ethnic diversity. Failure to explicitly report results that distinguish between geographic scales may lead to misleading interpretations of empirical results, deceptive marketing, and perhaps misinformed policies. The paper also focuses on the size and shape of the areas of study and the suitability of the data for the scales under examination.

Geographic scale is a long-standing challenge. Writing in 1965, British geographers Haggett, Chorley, and Stoddart (1965) were distressed by studies that ignored scale in analyses of physical environmental processes, indicating: "…at different scales different parameters become dominant, different levels of generalization may be attempted, and even different problems identified." (p. 45). Moore (2008) examined scale issues for human geographic studies, arguing that researchers should distinguish between individual decisions that shape place outcomes and political ones that can support or countermand community preferences. Failure to do so, he argued, leads to confusing and inconsistent results. Their astute questioning of the role of scale is central to this article.

We focus on two questions:

1. What is the interpretation of racial and ethnic diversity as the scale changes from (1) citywide, to (2) large subareas of cities, to (3) smaller areas of uniform shape and size, and (4) census tracts in these same cities?
2. Are HUD public housing sites (locally unwanted land uses or LULUs) spread out across cities, or are they clustered to increase racial, ethnic, and income-related segregation at the neighborhood scale?

Scale has long been part of teaching geography from elementary school through doctoral programs. Yet, experts in fields such as marketing and public policy often lack information about how geographic scale can influence their work. Philo's (2008) *Theory and Methods* includes a chapter about scale in geography by author Sallie Marston. After numerous debates about scale, Marston notes there is no consensus among geographers about its definition and operationalization. Critiquing the dominant hierarchical conceptualization of scale, Marston offers the alternative of flattening it so that stakeholders do not have the excuse of assigning responsibility for actions to one or two scales. While the idea is appealing, the approach needs to be tempered when scale-dependent data are not specifically acknowledged.

The major frustration that led to this paper stems from claims or inferences drawn about cities as good places to live because of racial and ethnic diversity when their neighborhoods are not racially and ethnically diverse. Indeed, a so-called "diverse" city may have more segregation within it than a city with less overall diversity. For example, one city may cluster its affordable housing for people of color, whereas another has chosen to disperse it citywide.

This paper does not break new ground in theory, yet it exemplifies the importance of considering scale when using diversity-related metrics. It also demonstrates the need to retain and use the hierarchy of places by showing how interpretations of results may be misleading when presented for citywide or major areas of cities rather than at the neighborhood scale. We begin by describing what we mean by racial and ethnic diversity.

CONTEXT

At the national scale, the U.S. Census Bureau (2021) rates every state and county for population diversity. It calculates the probability that two randomly chosen people will be from different racial and ethnic groups. A value of 1 means everyone has the same race/ethnicity and 100 means everyone has a different race/ethnicity. For example, assume cities A and B each have 100,000 people. Half are people of color (group 1) and half are non-Hispanic White (group 2). Both cities have diversity scores of 1, or a 50 percent chance of finding a person from group 1 and group 2. The interpretation may change, however, if we look more closely at the two hypothetical cities. For example, assume city A has a major river running north to south through its center. For multiple reasons, including ordinances and practices that legalized segregation of people and clusters of factories, 80 percent of the people of color live west of the river, and 20 percent live east of it.

In contrast, city B's population of non-Hispanic Whites and people of color are much more evenly distributed. Thus, while cities A and B have the same citywide diversity scores, city A's diversity is much less than city B's at the sub-municipal (neighborhood) scale. This leads us to question whether diversity measured at the municipal scale is misleading and requires more evaluation at the neighborhood scale.

The real estate industry rates metropolitan and city ethnic and racial diversity. McCann (2023a) rated diversity based on racial, ethnic, linguistic, and birthplace diversity. In a second study, McCann (2023b) integrated socioeconomic status, cultural, economic, household, and religious diversity scores. A few databases expand diversity to include economic assets, opportunities, and socioeconomic status. For instance, Niche, Inc. (2023) rates the quality of tens of thousands of places on a scale from F (worst) to A+ (best). Niche's definition of diversity includes age, ethnicity, race, income,13 additional quality-of-life indicators, and an overall rating. This provides a broad set of indicators for users at the municipal scale, yet we question whether such information reflects neighborhood realities.

Han (2023) used multiple methods to identify the 20 most racial and ethnically diverse places to live in the United States. Notably, seven were for neighborhoods in New York City and its New Jersey suburbs; five were in San Francisco and Oakland; and two were in Seattle. Han notes that these diverse neighborhoods are also among the most expensive places to live. That is, poor people are unable to afford to live in some of the most ethnically and racially diverse cities in the United States. Davis (2023) examined the ten most diverse cities in the United States, noting the importance of distinguishing between diversity and inclusiveness. In other words, diverse places measured by the proportions of people of different ethnicities and races may obscure intolerance for those groups.

While we have no objections to the diversity literature per se, we are concerned that labeling a city as diverse may lead people to believe diversity exists in neighborhoods where it does not and vice versa. For instance, Yonkers, New York, has a population of 210,000 and has the thirteenth highest diversity score (McCann, 2023a) of 149 mid-sized U.S. cities. While the city has been diverse since the mid-1950s, it is not at the neighborhood scale. It was the first U.S. city to be sued by the U.S. Department of Justice for segregated housing and schools (Cusaac-Smith 2019; Pastore 2007). While the schools were eventually desegregated by redefining their functions (students picked their area of interest and traveled outside their neighborhoods to find their specialty), recent analyses show that most people of color are located in the southwest part of the city (Greenberg 2021). Simply put, Yonkers' diversity index at the municipal level is not matched by its neighborhood realities.

New York City has the highest diversity score of any major U.S. city (McCann, 2023a). Yet, like Yonkers, racial and ethnic differences within its neighborhoods present a different on-the-ground reality. For example, the

central Bronx has 4,500 people living in a 0.04 square mile census tract (112,000 people per square mile), 98 percent of whom are people of color. About five miles to the northeast is a neighborhood south of the Pelham Parkway in the Bronx with 3,150 residents in 0.13 square mile census tract (24,000 per square mile). Here the population is 39 percent people of color. The central Bronx tract has a life expectancy of 70 years; that of Pelham Parkway in the Bronx is 86 years. While the city overall is diverse, it is also one of extremes in race and ethnicity, income, health, and other indicators. In other words, the diversity of New York City is overstated.

Racial and ethnic diversity has been influenced by migration and policies. The Home Owners' Loan Corporation (HOLC) Act of the 1930s was passed to help local governments and financial institutions refinance home mortgages in default and to expand home-buying opportunities. Places classified as "A" were seen as good places to invest; those classified as "D" were perceived as hazardous and marked by the color red on maps. Almost a century after HOLC redlining, Aaronson et al. (2021) showed a strong association between the colors on those maps and diversity in race, ethnicity, and socioeconomic status. Poor people of color are disproportionately concentrated in redlined areas and Nardone et al. (2021) report strong relationships between those areas and poor health outcomes. Redlining is only one public policy that has impacted diversity. Public housing is a second, concentrating people by race, ethnicity, and income in some U.S. cities.

McDonald (2011) examined public housing built in U.S. cities from 1937 to 1967, a time when some local governments with large populations and inadequate housing stock strongly advocated for public housing resources. He found that the cities that built the most public housing had many low-income and minority residents. He then predicted the number of units needed and compared that number with the actual number of low-income units constructed. Cincinnati and San Francisco built fewer units than expected, whereas Boston, Chicago, and Pittsburgh built more. McDonald did not report whether the units were clustered or dispersed throughout the cities.

The original forms of HUD public housing (massive high-rise apartment complexes) are considered LULUs in most cities and are vehemently opposed by legacy residents. Some of the most aggressive opposition followed efforts to locate public housing occurred in Detroit, New York City, Yonkers, and other cities. These massive complexes have been strongly criticized, with some exceptions, and many have been torn down, and replaced by smaller units or vouchers designed to help close the gap between present and needed low-income units (Dagen Bloom 2009; Herriges 2023; Husock 2023; Pendall 2000; Seminary Co-op 2023). The National Low Income Housing Coalition (NLIHC 2020, 2023) monitors the presence of affordable rental units for every 100 extremely low-income renter households. It reports that only 33 affordable and available rental units exist for every 100 needy households. The United Way (2022) used that data to calculate affordable rentals for 50 U.S. cities. Cincinnati, Pittsburgh, and St. Louis had scores of 80 or more. Los Angeles, Miami, Orlando, and San Diego had scores of 24 to 26 rental units per 100 needed. NLIHC (2020, see also United Way, 2022) reports that a larger presence of HUD public housing has reduced stress on poor renters seeking a housing unit.

There are good reasons to expect HUD public housing projects would be segregated in census tracts with a large proportion of poor people of color, thereby decreasing racial, ethnic, and income diversity. Housing inequities persist through credit scoring systems, real estate practices, insurers, and banks, as well as lack of access to quality educational opportunities (Chicago Lawyers 2018; Massey and Denton, 1993; Rice and Swesnik 2012; Rothstein 2017; U.S. Department of Housing and Urban Development 2013). Rothstein (2017) makes a compelling case that segregation has historically been a part of U.S. public housing policy. Aladangady and Forder (2021) report that Latino and Black households earn about half the income of non-Hispanic Whites, making it infeasible for these groups to rent in expensive, gentrifying cities like Miami, San Francisco, and Washington, D.C. (U.S. Department of Housing and Urban Development, 2013). The construction of many HUD public housing projects in some cities, along with income differences, redlining, and various local formal and informal practices, have contributed to a lack of racial and ethnic diversity at the neighborhood scale. These differences are unlikely apparent at the cityside scale.

DATA AND METHODS

The U.S. Environmental Protection Agency (EPA) (2022, 2023), the Council on Environmental Quality (2023), the Agency for Toxic Substances and Disease Registry (2023), and the Centers for Disease Control and Prevention (2023) have developed publicly available databases that include information about health, land uses and public services at the scales required for this study. While the agencies carefully present their data sets, they do not explicitly warn readers that what results found at one scale may not be found at another.

We chose a small number of the 66 most populated U.S. cities identified by McCann (2023a) for multiple tests of scale. New York City and Yonkers were eliminated because they were already used for preliminary tests. From the remainder, we chose Boston, Chicago, San Diego, and San Francisco, four cities that have long been among the most expensive places to live in the United States. These four have housing under great pressure to gentrify, including displacement of public housing in the process (Bokat-Lindell, 2022; Durning, 2021; NLIHC, 2020, 2023). Pittsburgh and Cincinnati have also experienced significant gentrification, but not to the extent of the first four cities. These six provided sufficient size for testing at multiple geographic scales.

The baseline for our spatial scale testing was the municipality. The second scale was created by dividing the city into three or four sub-areas based on natural (e.g., rivers, steep terrain) or human-made features (e.g., highways, business centers, shopping centers, landfills). The third scale used census tracts, although an option could have been zip codes The fourth scale used 1-mile radius circles as a standardized size and shape that can be applied everywhere in the United States.

Each scale has advantages and disadvantages and tells part of the story about a city. Cities are politically defined places that provide common services such as police and fire, public education, and others. Yet city-wide data can obscure intra-city differences in diversity, which was our expectation. Natural and manufactured features that divide a city into districts are also a way of examining its sub-sections. Defining sub-municipal groups this way may be arbitrary if the city lacks a sufficient number of such features.

Census tracts and zip codes are the standard for many diversity studies. However, the census tract is an imperfect measurement area. The U.S. Census Bureau tries to standardize by population size with an average of about 4,000 and a range of 1,000 to 8,000. The limitation is that this creates places that vary enormously in shape, size, and population density. Some census tracts have population densities of over 100,000 per square mile whereas others have less than 1,000 people per square mile.

Size and shape are important features that influence the measurement of diversity. A standardized circle has the advantage of being the same size and shape so that the distance from the center to the edge is consistent. A disadvantage is the boundary problem. A circle will not match the shape of a winding river. Also, when the circles touch, they leave empty spaces. Hence, the user has to decide what to do with the data at the boundaries. While a hexagonal lattice leaves no spaces, it is not currently available for the databases that are publicly accessible. EPA's EJScreen (2024) database can create polygons, but not a consistent hexagonal lattice. Thus, we used EPA's software to develop one-mile radius circles (3.14 square mile areas each) across the six study cities. We started in the northwest corner of each city and headed east. We then dropped down and headed west, and so on to create a standardized pattern.

We used three indicators to measure diversity. The first was the U.S. Census Bureau's diversity index based only on race and ethnicity variables [Hispanic or Latino; non-Hispanic (NH) White; NH Black or African-American; NH American Indian and Alaska Native; NH Asian; Native Hawaiian and Other Pacific Islander; NH Other Race; NH Multiracial]. In 2020, that diversity index for the United States was 61.1 percent, meaning the chance that two randomly chosen people would be from different racial or ethnic groups. The index lists results for the state and county scales, and the Census Bureau has developed a tool that allows calculations at the census tract scale. However, our tests yielded several extreme values based on small numbers in areas with small population sizes. Hence, we did not use the census tract information below the city scale.

The second indicator we used was McCann's diversity index (2023b) which includes racial, ethnic, linguistic, and birthplace diversity variables. While not identical to the Census Bureau's diversity index, we assumed the two would be correlated.

Our third indicator, people of color, was available at multiple geographic scales. We assumed that the two diversity indices would be correlated and they would both be correlated with people of color. At the state scale, the Spearman rank correlation between persons of color and the Census diversity index was 0.92. Using McCann's diversity scale (2023b) it was 0.96. At the county scale, the correlation between persons of color and the Census Bureau's diversity index for New Jersey's 21 counties was 0.96.

At the sub-municipal scale, we used EPA's EJScreen data set (2023) to obtain persons of color at the four scales. The EJScreen data is scaled to the United States or host state, which makes the numbers easier to understand.

For this study the EJScreen numbers are compared to all places in the United States The national percentile tells you what percent of the U.S. population has an equal or lower value, meaning according to EPA less potential for exposure/ risk/ proximity to certain facilities, or a lower percent minority. In other words, the percentiles for the areas are not the raw percentage, they are controlled for the national population. Overall, we used three related indicators that are different ways of measuring racial and ethnic diversity.

For the second question, HUD public housing data provided the number of units within each circle, as well as other information using EJScreen. In total, 254 circles of 3.14 square miles were created in the selected six cities. The data indicate that HUD public housing, under operation by approximately 3,300 public housing authorities, houses about 1.2 million people. The locations of the units are imperfect, and since the circles leave empty spaces between them, we assigned the units in empty spaces to their nearest circle.

Given the small number of sub-areas in the six cities, we used Spearman rank correlation (rho) to measure statistical associations among the variables at the different scales. We used a version of the Gini coefficient, a statistical indicator derived from the Lorenz curve to measure the extent to which the geographical distribution of HUD public housing was concentrated. The Gini index was developed over a half-century ago and variations have been developed to measure racial and economic segregation (Massey and Denton 1988; Taeuber and Taeuber 1965). If public housing is equitably located across each city relative to each city's equal-sized areas, the Gini value should be 0, indicating no segregation. At the other extreme, if public housing is completely located in a single part of a city, the Gini value would be 100. As part of question 2, we measured the extent to which HUD public housing units in each city would need to be relocated for the public housing projects to be equitably distributed in each city.

RESULTS

The results of the multi-scale analysis of racial and ethnic diversity in six of the most populous U.S. cities appear in Table 1. All of the cities have challenging histories around segregation and affordable housing (Acs et al. 2017; Bay Area Council 2016; Casey-Leininger 2018; Chicago Lawyers 2018; Chopra 2020; City of Boston 2021; Cook 2020; Costello 2021; White 2001). Before comparing them, we illustrate the data using Chicago, which has the highest diversity index and the highest percentage of persons of color in Table 1. Chicago's ethnic diversity score in McCann's study was 63.2, which ranked 16th among 66 U.S. cities. In other words, Chicago has more population diversity than most of the other cities in McCann's study and has a relatively higher percentage of persons of color compared to other U.S. cities.

Looking at all the data in the table, Chicago and Pittsburgh are the most different. Chicago's diversity index is the highest as is its percent persons of color. Pittsburgh's are the lowest. San Francisco, Boston, and San Diego are closer to Chicago than to Pittsburgh. Cincinnati is closer to Pittsburgh in McCann's measure, but not regarding the diversity index and persons of color. We caution the reader the results in Table 1 are at the citywide scale.

Table 1. Most Diverse U.S. Cities at the Municipal Scale

City	Ethnic diversity score (rank) of 66 U.S. cities*	Diversity Index**	%, Persons of color***
Boston	65.8 (6)	55.8	70
Chicago	63.2 (16)	67.3	78
Cincinnati	43.7 (57)	51.3	67
Pittsburgh	42.3 (60)	36.9	55
San Diego	65.4 (8)	58.5	71
San Francisco	66.6 (5)	61.7	73

Sources: *McCann, 2023a,b
**Calculated by the authors from U.S. Census Bureau Data
***EPA, 2023. The numbers in the last column are comparisons to the United States as a whole, with a potential range of 0 (lowest in the nation) and 100 (highest in the nation).

The second of the four spatial scaling steps was to divide each city into 3 or 4 subsections based on rivers and large changes in terrain (Table 2). The results offer some new information. San Diego, San Francisco, and Boston show relatively little variation in the percent population of color. Chicago, Cincinnati, and Pittsburgh – the three

Midwestern cities – have larger differences between the districts with the highest and lowest values. Given that there are only 3 to 4 districts, it is hard to read much into the observations at this scale.

The 1-mile radius circle scale provided some interesting insights about neighborhood diversity below the city scale. We examined the results at the 75th and 25th percentiles for persons of color. San Francisco had the least variation with differences of 19 for people of color followed by Pittsburgh with 22. Cincinnati, by far had the largest difference – 38. Boston, Chicago, and San Diego reported 26 or 27 percent differences.

The census tract scale results are similar to the 1-mile radius findings with an interesting difference. Cincinnati manifested the largest difference and San Francisco the smallest difference. Yet, Boston (37%) also has a high difference between the 75th and 25th percentile values.

Looking at all four scales, if we wanted to live in a city with the least differences in racial and ethnic diversity at the neighborhood scale we would look at San Francisco and Pittsburgh. If we wanted to live in a city with more separation of racial and ethnic groups, we would search in Cincinnati and Boston. The Cincinnati and San Francisco results are consistent with their ethnic diversity scores at the city scale. The neighborhood scale results for Pittsburgh and Boston are inconsistent with the citywide results.

Table 2. Percentile of Persons of Color as a Measure of Racial and Ethnic Diversity in Selected Cities Compared to the United States as a Whole by Geographic Scale

	Scale	Boston	Chicago	Cincinnati	Pittsburgh	San Diego	San Francisco
1	Entire city	70	78	67	55	71	73
2	Large areas (3-4)						
	Lowest value	61	65	48	45	67	67
	Highest value	74	88	75	64	76	79
	Highest-Lowest	13	23	27	19	9	12
3	1-mile radius circles						
	25th %ile	53	65	40	44	54	67
	Median	66	22	67	56	63	74
	75th %ile	80	91	78	66	80	88
	75th-25th %ile	27	26	38	22	26	19
4	Census tracts						
	25th %ile	46	68	37	35	49	67
	Median	69	83	69	47	61	75
	75th %ile	83	94	81	60	77	92
	75%-25%	37	26	44	25	28	25

Source of data: EPA (2023).
Note: Numbers represent percentile persons of color compared with the United States.

The results for the HUD public housing add a layer of information and complexity. The Gini index values for HUD public housing are in the first data column of Table 3. The results indicate a higher concentration of HUD public housing in San Diego and San Franciso than in Cincinnati and Pittsburgh. That is, much of the HUD public housing would need to be relocated for a more equitable distribution in San Diego and San Francisco. Some areas in San Diego had no HUD public housing and 76 percent of the circles containing no HUD public housing. In Pittsburgh and Cincinnati, we could not fit a 1-mile radius circle anywhere that did not contain at least one HUD public housing unit.

These findings are consistent with United Way's (2022, see also McDonald 2011) observation that Pittsburgh and Cincinnati have much more available affordable housing compared to San Diego and San Francisco (see the second column of Table 3). Indeed, the Spearman rank correlation between the city-scale Gini indices and affordability was rho=-0.89 ($P<.05$), that is, more clustered HUD public housing is correlated with less available affordable housing.

Stepping back from the relationship between public housing and racial/ethnic diversity, we examined the relationship with the location of low-income people. The data show that Pittsburgh and Cincinnati have larger proportions of low-income people than the other four cities. The Spearman rank correlation between the Gini Index in column 1 and low income in the last column is rho=-0.82. San Diego and San Franciso have relatively low proportions of poor people and more clustered HUD public housing. Pittsburgh and Cincinnati, the cities with the most spread out HUD public housing, have the lowest proportions of people of color and the lowest ethnic diversity scores.

These observations ignore the question of what land uses are near HUD public housing. We explored the location of HUD public compared to services using the one-mile radius circle data. HUD public housing tends to concentrate near people and public services. The Spearman rank correlations between the distribution of HUD public housing across the 254 circular areas of 3.14 square miles were as follows: population (rho=0.51), public schools (rho=0.69), places of worship (rho=0.64), and hospitals (rho=0.52; all P<.05). In short, the distribution of HUD public housing in the six cities was moderately statistically linked to the location of people and service facilities.

The results of this study reinforce the connections between HUD public housing, race/ethnicity, and income. For instance, Pittsburgh and Cincinnati were among the heaviest supporters of HUD public housing when the target population was the growing population of the poor, many of whom were non-Hispanic Whites. As that group moved to the suburbs, the public housing in those cities changed to providing support for persons of color. In contrast, San Diego and San Francisco, which did not invest heavily in HUD public housing and had a large proportion of persons of color, found relatively isolated locations for its limited portfolio of HUD public housing.

Table 3. The concentration of HUD Public Housing in 1-Mile Radius Circles in Six U.S. Cities

City	Gini Index for circular Areas#	Affordable rental units per 100 low income renters*	Ethnic diversity score**	% Persons of color***	% Low income***
Pittsburgh	32	80	42.3	55	65
Cincinnati	45	84	43.7	67	75
Boston	47	59	65.8	70	57
Chicago	54	61	63.2	78	62
San Francisco	69	48	66.6	73	38
San Diego	86	26	65.4	71	47

Sources: *United Way, 2022; **McCann, 2023a,b; ***EPA 2023.
#Calculated by authors for each city from 1-mile radius circles.

Census tract results for public housing were consistent with the 1-mile radius area results. However, the issue of small census tracts obscuring results was apparent. Concentrations of HUD public housing tended to be located in separate census tracts whereas the 1-mile circular areas included both public housing and other land uses. This is not to say that census tract data should not be used. Rather, analysts need to scan 4-6 surrounding census tracts to avoid missing the on-the-ground reality.

DISCUSSION

Before summarizing the results, we point to three important limitations. We only studied six cities. We would be more confident in the findings if all 66 of the most populated U.S. cities had been studied. Alternatively, we would like to see a study of the approximately 8,200 census tracts in the United States that the U.S. Census Bureau has identified as “persistent” poverty areas (Benson et al., 2023). While these are primarily in rural areas, many are in the nation’s largest cities, mostly marked by poor people of color.

Second, the number of variables is limited. This is apparent in the public housing database. We used HUD public housing because the location information was considered more accurate than HUD-supported rental housing data. The latter frequently changes and some affordable housing does not get brought into the database. The HUD

public housing data is imperfect about location and number of units, but more certain than the other affordable housing datasets. Please note these last comments are not meant as a criticism of HUD or EPA, the agencies that posted the data. This database, despite its limitations, is systematic and includes many indicators. The imperfect solution to the omission of voucher rental housing is to work with states. Several states have good records of available voucher housing.

Third, the assertions made here need to be tested for environmental justice metrics, such as air pollution, factories, hazardous waste sites, highways, underground storage tanks, and issues of lack of access to attractions such as zoos, museums, and other attributes. While we have not tested those connections here, the historical and some recent literature suggests that the scale issue is there (Adamson, n.d.; Bullard et al., 2007; Mohai, et al., 2009; Montes, 2023; Greenberg, 2022; Wilson, 2010)

Regarding the major results, we began this essay by suggesting that it is important for analysts to explicitly acknowledge and explain how geographic scale is used in diversity studies. After providing theoretical grounds for our concerns, we selected six major U.S. cities and compared observations at the city scale with three sub-scales: 3-4 subareas, census tracts, and 3.14 square mile circles located in those cities. There are important differences between the city results and the finer scales. Indeed, citywide data obscured the reality within neighborhoods in several cities.

Using HUD public housing as an illustration of a locally unwanted land use (LULU), we found that cities with the most dispersed HUD public housing measured by the Gini index had a large proportion of poor people, many of whom were non-Hispanic White. When their public housing was built, the cities dispersed the housing across their cities to serve many non-Hispanic Whites. Pittsburgh and Cincinnati, the two cities with the lowest ethnic/racial city-wide diversity scores had the most dispersed HUD public housing. San Diego and San Francisco began their affordable housing programs with a large proportion of persons of color and relatively few poor people. Their need for HUD public housing was far less acute and complicated by the extremely high cost of housing in these cities fanned by gentrification. The limited amount of HUD public housing was clustered in a few areas in both cities, especially San Diego.

These database explorations show that a single measure of racial and ethnic diversity for a city obscures the complex set of circumstances that are more visible at the neighborhood scale. There have been politically charged debates for decades about diversity and affordable housing, and there will be more (Jacobs, 1999; Fiorina and Abrams, 2008; McLeay, 1984). Analysts can support the results of studies on diversity, as well as affordable housing and other socio-demographic issues, by evaluating and commenting on results at multiple geographic scales. We conclude that city-wide diversity measurements are misleading people about levels of racial and ethnic diversity in U.S. cities. The new databases allow users to take multi-scale snapshots of demographic realities and convey what they see. The problem of misleading information can be reduced by providing results at multiple geographic scales.

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