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NEW DIRECTIONS FOR INTEGRATION POLICY: EXPLORING RACIAL AND INCOME SEGREGATION AT MULTIPLE GEOGRAPHIC SCALES IN LARGE U.S. SCHOOL DISTRICTS, 1990-2010

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Abstract

When considering the prospects for racial integration of schools, it is necessary to examine the underlying population patterns within school districts. Although some families exercise choice to opt out of traditional public schools, the large majority of students still attend the public school that their neighborhood is zoned for. Thus, the residential segregation and spatial proximity of racial and income groups that exist within school districts is important for the capacity for school integration within a district. Residential segregation within school districts is rarely studied, largely because census units do not align with school district boundaries. However, with the use of GIS, it is possible to estimate census geographies’ populations within school district boundaries, and estimate residential segregation within school districts. By linking together several data sources, including the School Attendance Boundary Survey (SABS) and census block and block group data, I study residential segregation in the largest school districts in the U.S. from 1990 to 2010 at multiple geographic scales. I explore racial and income groups’ spatial segregation within school districts in order to better understand conditions in school districts that may create or impede conditions supportive of integration.

From 1990 to 2010 in large school districts, macro segregation, or segregation occurring across large distances has been declining, with micro patterns of segregation relatively on the rise. Black/white segregation occurs at larger scales than Asian/white and Hispanic/white segregation, indicating that black and white residents not only experience a higher magnitude of segregation within districts, but are also more spatially segregated within school districts. I also explore the segregation of elementary school attendance zones, a geographic scale at which segregation is rarely studied, yet a policy tool over which school districts have relative autonomy. Slightly over half of racial residential segregation in large school districts in 2010 was due to residents living in neighborhoods in different elementary school attendance zones. Or in other words, attendance boundaries account for half of the racial residential segregation of school districts. School districts that were more racially diverse and had higher proportions of black residents had school zones that were more segregative, while countywide school systems had zones that were less segregative. In demonstrating the variation in residential segregation at different geographic scales within school districts, I aim to encourage new ways of thinking about the possibility of within-district integration based on existing residential patterns of school districts.
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Chapter 1

INTRODUCTION

Increasingly, school and housing segregation have been shown to be closely connected, with education policies shaping residential outcomes and neighborhood patterns of segregation leading to segregated schools (Frankenberg, 2009, 2013; Lareau & Goyette, 2014; Owens, 2017; Saporito & Sohoni, 2006). While previously the truism had been that segregated neighborhoods are the reason that schools are segregated, recently there has been a greater focus on how schools lead to segregated neighborhoods. For example, homebuyers will pay more money to live in a home further away from a diverse school (Dougherty, Harrelson, Maloney, Murphy, Smith, Snow, & Zannoni, 2009). Home prices also vary across school boundaries like school district lines, which delineate the link between residence and school district, (Frankenberg, 2009) and school attendance zone lines, which along with student assignment policies determine the school that students attend within a school district (Kane, Staiger, Riegg, & National Bureau of Economic Research, 2005). And metropolitan area populations are segregated by school district boundaries, more so than within these boundaries (Owens, 2017). Despite the links between schools and housing, few studies have examined the patterns of residential segregation within school districts. This is partly due to the fact that census geographies do not nest neatly within school districts, complicating the study of residential segregation of school districts. In this study, I make use of multiple federal datasets, including a new federal dataset, the School Attendance Boundary Survey (SABS), along with GIS, to study racial and income residential segregation at multiple geographic scales within the nation’s largest school districts. In doing so, I describe macro and micro racial and income segregation of large school districts over time to provide new knowledge about how school districts are residentially segregated. I also demonstrate the importance of one educational policy—the establishment of elementary school attendance zones—in shaping racial residential segregation in large U.S. school districts.

Causes and Consequences of Racially Segregated Neighborhoods and Schools

School and residential segregation have long been viewed as key sources of social inequality. In the 1968 Kerner Commission report on urban unrest, the report identified the segregation of metropolitan areas as a critical problem, and argued that schools should be provided funds to incentivize desegregation in order to provide more equal educational
opportunities for black students. The inequalities pointed to in this report remain persistent through present day, with schools isolated by race and poverty, and neighborhood segregation increasing for Asian and Hispanic residents, while remaining high for black residents (Logan & Stults, 2011; Orfield, Ee, Frankenberg & Siegel-Hawley, 2016). Where people live is connected to their ability to access spatially bound resources (Reardon, Farrell, Matthews, O’Sullivan, Bischoff & Firebaugh, 2009), and to opportunities in schools, employment, and social networks (Jargowsky, 1996). Residential segregation continues to drive racial differences in neighborhood quality and opportunity structures. Black and Hispanic residents of metropolitan areas, on average, live in neighborhoods where there are fewer residents with college degrees and lower income levels, and where there is higher exposure to poverty (Krysan, Crowder & Bader, 2014). This translates into material consequences in terms of racial disparities in wealth accumulation (Oliver & Shapiro, 2006), in terms of disparities associated with economic recessions (Rugh & Massey, 2010), and local institutions that lack stability (Neild & Balfanz, 2006).

Theoretically, schools are supposed to be an equalizer in society, providing students from disparate backgrounds with the opportunity for success. However, in so far as school segregation is closely linked with inequality, we find that schools are far from equalizers. Students are more segregated in schools than would be expected given patterns of residential segregation (Jargowsky, 2014), with white families opting out of the public school system, particularly in racially diverse settings (Renzulli & Evans, 2005; Sohoni & Saporito, 2009). While there was a period of time in the 1960s and 1970s when all three branches of the federal government pursued racial desegregation of schools (Frankenberg & Taylor, 2015), in more recent decades there has been a retrenchment in efforts to desegregate schools (Boger & Orfield, 2005), despite the harms of segregated education. In minority-segregated school contexts, teachers tend to be less qualified (Clotfelter, Ladd, Vigdor, & National Bureau of Economic Research, 2005) and teacher and school leader turnover is higher in schools that are concentrated with non-white students and students in poverty (Guin, 2004). Fewer Advanced Placement courses are offered in minority-segregated schools, which are critical in boosting high school students’ GPA (Oakes, Gamoran & Page, 1992). And the physical structures of minority segregated schools are on average inferior to schools in other contexts (Philips & Chin, 2004). In contrast, research has found that school desegregation significantly increased the achievement of black students, with no accompanying decrease in the achievement of white students (Johnson, 2001). Benefits of
desegregation even persist to the third generation for families, increasing math and reading test scores, high school graduation, and college attendance (Johnson, 2012).

Segregation and inequalities of schools and neighborhoods are closely connected. Schools often draw student populations from the areas nearest to the school (Saporito & Sohoni, 2006), and therefore patterns of residential segregation are impactful for school segregation. School districts, when designing student assignment policies, must contend with the residential patterns within school districts, and the proximity of different racial and income groups to each other. Yet little is known about the spatial segregation of racial and income groups within school districts, critical information for policymakers and district leaders when designing student assignment policies that are integrative. And while it has become axiomatic that schools are segregated because neighborhoods are segregated (Rothstein, 2017), more recent research has examined the role of schools in segregating residential spaces (Frankenberg, 2009; Owens, 2017).

Sample of School Districts

Many demographic studies where we have derived most of our knowledge of racial residential segregation come from research on the largest 100 metropolitan areas in the U.S. In this study, I am interested in residential segregation within school districts, and therefore take a similar approach, studying residential segregation in the largest 100 school districts in the U.S. These school districts include city, suburban, and countywide school systems, and represent 23 states. Compared to all U.S. school districts, the 100 largest districts have more racially diverse student enrollments and racially diverse residential populations. The smallest district in the study, Forsyth County School District in Georgia, had approximately 34,000 students in the school system, while the largest, Los Angeles Unified, had approximately 667,000 students. While many of the largest school districts in the nation were once under court-ordered desegregation, some have never been.

Overview of the Three Studies

In their guide for researchers, education scholars write, “the potential for description to inform policy, practice, and research is even more significant, given the recent availability of large and complex datasets that are relevant for understanding education issues” (Loeb, Dynarski, McFarland, Morris, Reardon, & Reber, 2017, v). Linking together several large federal
datasets, the main task of this dissertation is to describe residential racial and income segregation within school districts at multiple scales and over time. Descriptive research, or understanding “what is”, is critical for educational research to inform policies and practice. To identify what problems must be solved, it is necessary to first describe the landscape of a phenomena, something large scale descriptive studies are particularly well-suited to do (Loeb et al, 2017). In this study, I am interested in describing patterns of segregation for the population in large school districts, a description which can provide new knowledge about how school districts are residually segregated, and about how education polices are related to residential segregation. Residential segregation matters for schools because inequality in residential contexts is often reproduced in schools. And similarly, the education policy I explore in this dissertation, school attendance zones, also impact not only the segregation of schools, but also the segregation of neighborhoods. A deeper understanding of the residential patterns of segregation within school districts can inform our understanding of education policies like student assignment and choice, and, with the spatial measures used in this study, inform our understanding of how spatial proximity matters for school district segregation. Specifically, in the studies presented here, I explain the conditions where school attendance zones are most segregative for the total population and the under 18 population. I also describe how micro and macro racial and income segregation has changed over time in large school districts, highlighting differences between racial and income segregation and differences in segregation of racial dyads. With the availability of new federal data, this study centers on identifying undocumented phenomena, residential segregation within large school districts at multiple geographic scales, and identifying patterns that warrant policy intervention.

The primary goal of this dissertation is to describe residential racial and income segregation within large U.S. school districts, linking datasets together to provide new knowledge about how segregation exists within one of the most socially meaningful boundaries. Specifically, I explore the micro and macro segregation within school districts, and the segregation within and between elementary school attendance zones. The studies presented here draw on multiple datasets, including the School Attendance Boundary Survey (SABS), and census block group and block data. These data are well suited to investigate racial and income residential segregation at multiple geographic scales because they encompass socially meaningful boundaries—as in the case of elementary school zones—as well as units that can be
representative of residential segregation—in the case of census block groups and blocks. I also describe changes in racial and income segregation over time within school districts, providing a greater understanding of how residential populations of school districts have changed in recent decades.

In chapter 2, I determine to what extent large school districts in the U.S. are characterized by patterns of racial/income macro and micro segregation. Theoretically this study builds upon theoretical work that has emphasized the importance of proximity in the study of residential segregation (Lee, Firebaugh, Matthews, Reardon, Farrell, & O'Sullivan, 2008; Reardon, Farrell, Matthews, O'Sullivan, Bischoff, & Firebaugh, 2009) and has taken a multiscale approach to measuring segregation (Fowler, 2016; Fowler, Lee & Matthews, 2016; Lee et al., 2008; Lichter, Parisi & Taquino, 2015; Owens, 2017; Parisi, Lichter & Taquino, 2011). The main findings of this study are that in large U.S. school districts, racial and income residential segregation has become more micro scale from 1990 to 2010. But racial segregation persists at a more macro scale than income segregation, indicating an important difference between racial and income segregation within school districts. Additionally, black and white residents experience segregation across the largest geographic scale compared to other racial pairs, indicating that these groups are on average the most spatially isolated from each other within school districts. I argue that the scale at which segregation occurs within school districts, and the proximity of racial groups to one another, is a critical factor in the design of student assignment policies that seek to create less segregated school districts.

Chapters 3 and 4 describe the segregation of elementary school attendance zones, boundaries which school districts have a good deal of control over and adjust frequently, though not always with respect to implications for segregation. In Chapter 3, I determine the unique contribution of elementary school attendance zones to the racial residential segregation of large school districts, comparing the segregation within and between attendance zones for the total population and the under 18 population. This study builds on work that has examined the role of educational boundaries in residential segregation (Frankenberg, 2009; Owens, 2017; Saporito & Sohoni, 2006; Saporito & Hanley, 2014). I find that for the total population, more racial residential segregation occurs between elementary school zones than within them, indicating the importance of these zones in sorting the population in school districts. However, for the under 18 population, more segregation occurs within elementary catchment areas, indicating that children
in large school districts are segregated at a more micro scale by neighborhoods. Additionally, there are disparities in the extent to which school zones segregate the population, with these zones being most segregative for black and white residents and least segregative for Asian and white residents. And in Chapter 4, I compare the segregation of elementary school zones across school district characteristics, exploring in what contexts elementary school zones are most segregative. Drawing from research on racial residential preferences (Charles, 2000; 2006; Crowder & South, 2008; Emerson, Yancey & Chai, 2001; Harris, 2001; Krysan, 2002), and research on the behavior of white families in racially diverse settings (Rinzulli & Evans, 2005; Saporito 2003; 2009; Saporito & Hanley, 2014), I compare the segregation of school zones based on district racial composition. I also explore factors related to school district jurisdiction (Frankenberg, Lee & Orfield, 2003; Siegel-Hawley, 2016), the legacy of court orders (Boger & Orfield, 2005), along with district areal and population size (Brown & Knight, 2005). I find that elementary school zones are more segregative in racially diverse school districts, and with a high proportion of black residents. The most segregative school zones in the sample are for black and white residents in city school systems.

In a discussion of the three studies, I suggest the implications of these studies for policy and for future research. In demonstrating the variation in residential segregation at different geographic scales within school districts, I aim to encourage new ways of thinking about the possibility of within-district integration based on existing residential patterns of school districts. Education policies that promote racial and income integration, given the underlying residential patterns, are needed in order to address growing racial and income segregation of schools. These include approaches that are tailored to the spatial segregation that occurs within school districts. Additionally, I focus on one particular education policy, elementary school attendance zones, and their relationship to residential segregation. Based on my findings, I suggest that there is much more that school districts could do to draw these zones in less segregative ways. Ultimately, the research presented here provides a deeper understanding of the demographic patterns within school districts over time, provides evidence that school districts could potentially reduce residential and school segregation through attendance zone adjustments, and makes the case that education policies are related to not only school segregation but also to residential segregation.
Chapter 2

THE GEOGRAPHIC SCALE OF RACIAL AND INCOME SEGREGATION IN LARGE U.S. SCHOOL DISTRICTS 1990-2010

School segregation by race and income is a well-documented public policy concern that has a wide range of implications including impacts on academic achievement, on intergroup friendships and stereotypes, and on long-term outcomes related to integration like living in racially diverse neighborhoods (Hanushek, Kain, & Rivkin, 2009; Hawley, 2007; Pettigrew & Tropp, 2006; Sterns, 2010). Recently, the links between school segregation and residential segregation have been acknowledged, with research demonstrating that the relationship between residential segregation and school segregation is bidirectional (Frankenberg, 2013; Lareau & Goyette, 2014; Saporito & Sohoni, 2006). While the composition and segregation of school districts and neighborhoods impacts the segregation of schools, so too does the composition and segregation of schools impact the residential choices that families make, thus segregating residential spaces.

Spatial proximity plays a critical role in the education context in terms of segregation and desegregation, as school districts for the most part serve the populations only within their boundaries and schools within school districts often serve the populations most immediately surrounding the school. Richard Rothstein, a researcher who examines links between public policies and segregation, when discussing the state of school integration 62 years after the Brown v. Board of Education decision suggests, “We can do some desegregation on the margins, some magnet schools, we can adjust attendance boundaries at borderline areas. But the vast majority of children in this country who are segregated by race, are segregated because they live too far from neighborhoods where the other race lives to have meaningful integration” (2016). What is argued in this statement is that the geographic scale of residential segregation is so large, that there is no longer the possibility for school districts to desegregate on their own. Although spatial proximity alone does not determine integration and access to spatially-bound institutions like schools, spatial proximity can create or impede conditions that lead to integration (Reardon et al., 2009).

In this study, I explore the geographic scale of racial and income segregation in the nation’s largest school districts from 1990-2010 in order to understand to what extent conditions of spatial proximity exist that can create or impede racial and income integration. Specifically, I explore:
1. In large U.S. school districts, are patterns of racial and income segregation characterized by patterns of micro or macro segregation?

2. How has the geographic scale of racial and income segregation changed from 1990 to 2010 in large U.S. school districts?

3. In large U.S. school districts, does racial or income segregation occur across a more macro geographic scale?

The main contributions of this study are to forefront spatial measures of residential segregation within school districts so as to better understand residential segregation within school districts, a critical factor in the segregation of schools. Additionally, this research will provide a description of how spatial segregation has changed over time in school districts, and compare the geographic scale of segregation for racial and income segregation. Both of these findings are critical for school districts in the design of their student assignment policies.

**Multiscale Approaches to Understanding Segregation**

Studies that examine the link between residential and school segregation are inherently moving between different geographies or scales, either implicitly or explicitly. Residential segregation is often studied at the tract level (Crowder & Downey, 2010; Farrell, 2015; Jargowsky, 1997; Peterson & Krivo, 2009; Sharkey, 2012) while school segregation is most often studied at the school level or school district level (Frankenberg, 2009; Reardon & Rhodes, 2011; Stroub & Richards, 2013). Recent studies have explicitly taken a multiscale approach to examining racial residential segregation (Fowler, 2016; Fowler, Lee & Matthews, 2016; Lee et al., 2008; Lichter, Parisi & Taquino, 2015; Parisi, Lichter & Taquino, 2011; Reardon et al., 2008), but few have done so in the education context (for an exception see Owens, 2017). These studies that have examined segregation using multiple scales have brought a different perspective and understanding of segregation than studies that examine segregation at one scale alone (i.e. segregation at the scale of the tract only, or segregation at the scale of the school district alone). In the largest metropolitan areas in the U.S., there is a good deal of heterogeneity in the geographic scale of racial residential segregation (Reardon et al., 2008), and patterns of macro and micro segregation differ by region of the country (Lee et al, 2009). Increasingly, patterns of racial residential segregation are characterized by macro segregation patterns, and declining micro segregation, particularly for black residents (Lichter, Parisi & Taquini, 2015; Parisi,
Lichter & Taquino, 2011). And there has been a decrease in the impact of principal cities on metropolitan racial diversity and an increase in the impact of inner suburbs on metropolitan racial diversity (Fowler, Lee & Matthews, 2016). All of these trends are revealed by computing segregation at multiple scales within a unit (such as a metropolitan area) to better understand the segregation that exists at multiple geographies simultaneously.

Far fewer studies have examined income segregation at multiple geographic scales. Owens, Reardon & Jencks (2016) studied income segregation between schools and school districts and found that both between-district and between-school income segregation rose between 1990 and 2010. It should be emphasized that this study focused on students in schools and not residents in metropolitan areas. Saporito (2017) measures income segregation at the school attendance zone level and the residential level, using both rank-order H and a spatial variant of rank-order H to understand how the shape of attendance zones is related to their corresponding levels of income segregation. He finds that holding residential income segregation constant, attendance zones that are irregularly shaped have less income segregation than zones that are compact. And Reardon & Bischoff (2011) use a spatial version of rank-order H to measure the geographic scale of income segregation from 1980-2000 of households in metropolitan areas, finding that upper-income households are segregated to a greater extent at larger scales than low-income households.

These multiscale approaches to understanding segregation have offered numerous insights for researchers studying residential segregation, and can be applied to the education context to better understand segregation within the unit of the school district. Studies in the field of education have less often explicitly considered scale when studying segregation, and rarely has research in education studied segregation at multiple scales at once even though segregation is a multiscale phenomenon. This means that findings on school racial segregation are often only understood from the perspective of segregation as existing at one scale (i.e. the scale of the school or the scale of the school district). Such findings can decontextualize school segregation if little is known about segregation at other scales important to the school or school district’s context. These other scales include (but are not limited to) the residential setting, the school attendance boundary, the metropolitan area, even larger scales such as regions, and scales that are not bound to administrative units such as distance proximities or population densities. A handful of studies have examined school racial segregation at two scales through a
decomposition analysis (Owens, 2017; Owens, Reardon & Jencks, 2016; Reardon, Yun & Eitle, 2000; Stroub & Richards, 2013). In these studies segregation is examined by decomposing the within and between components of school and school district segregation in a metropolitan area, determining if more segregation occurs within or between school districts. These studies have provided the important insight that more school racial segregation today is due to between-district segregation rather than to between-school segregation.

**Aspatial Approaches**

Many of the previous studies that have used a multiscale approach to understanding residential segregation, and the few that have used two scales in a decomposition to understand school racial segregation, have used administrative units as their components of study and aspatial segregation measures such as Theil’s H. Administrative units in this case are census defined components such as block groups, tracts, or places to measure racial segregation, or school based administrative units such as schools or school districts to measure school segregation. However, there are a number of limitations associated with using administrative units to understand relationships between people and space as an established body of literature in sociology, demography and geography point out. Administrative boundaries may not relate well to individuals’ subjective understandings of place and neighborhood that give meaning to and structure their lives (Matthews, 2011). Indeed, many people may have no idea the census tract in which they reside, and should they know, that may have little bearing on the choices they make. This is in contrast to administrative boundaries like school districts which people are often highly aware of and can shape where they chose to live (Lareau & Goyette, 2014). People also typically interact with and transition through many administrative units within one day, and administrative-bound measures consider only “night time” populations and do not capture peoples’ transitions through administrative boundaries (Matthews, 2008; Shedd, 2015). Further, aggregation of data inevitably leads to loss of spatial information when data is grouped into units for analysis (Spielman & Logan, 2013). And the scale at which data is analyzed can produce different results; for example, when segregation is measured at a smaller administrative unit, such as census block, rather than a larger administrative unit, such as a census tract, segregation is usually higher.
Aspatial segregation measures typically used in research on residential and school segregation include the Theil’s H, rank-order H, the dissimilarity index, and the family of exposure (P*) indexes. These commonly used measures do not take account of the spatial relationships between populations (Reardon & O’Sullivan, 2004). In particular, these segregation measures that compute the evenness and exposure of populations within given administrative units are criticized for being unable to fully account for scale and proximity (Lee et al., 2008). When used to measure segregation among units, such as census tracts or school districts, the measures are sensitive to scale only by changing the unit of data aggregation (i.e. from school to school district). This limits comparisons across time and place as there is wide variation in the size of administrative units over time (both geographic size and population size). Further, it is not possible to determine trends at larger or smaller scales than the administrative boundary being used, which are often arbitrary in nature. Aspatial measures of segregation using administrative units also make problematic assumptions about proximity of populations within and between units. Namely, that all people within administrative units are equally proximate to each other within that unit and all people who do not share an administrative unit are equally not-proximate. In reality, people who share a census tract border but live on different sides of it are in closer proximity than people who live within the same census tract but on opposite ends.

**Spatial Approaches**

To address the limitations of using administrative boundaries and aspatial segregation measures when studying segregation, it is possible to measure segregation using environments that are distinct from administrative boundaries and segregation measures that account for the spatial distributions of populations within a given area of study. Such an approach is rarely used to examine residential segregation or school racial segregation, partly because of the complexity of computing spatial segregation (Lee et al., 2008). Reardon and colleagues use a proximity or distance based spatial version of the information theory index to measure segregation at a number of different radii including 500m, 1,000m, 2,000m, and 4,000m (2008). They chose these radii because they argued that these radii serve as approximations for different spatial markers in peoples’ everyday lives, from pedestrian neighborhoods to the largest areas in which people might shop or attend religious services. When there is little difference between the population composition of a person’s local environment and the overall composition of the study area, then there is low spatial segregation. And conversely, when the population composition of
an individual’s local environment is very different from the overall study areas composition, then there is high spatial segregation.

Reardon and colleagues further develop a scale-sensitive approach to understanding the segregation of metropolitan areas through the use of a segregation ratio, which allows for an understanding the relative extent of racial residential segregation patterns at different scales. It is critical to use multiple scales because segregation exists at multiple scales simultaneously. In their study of metropolitan areas, Reardon and colleagues examine the proportion of micro-segregation (500m radius local environments) that is due to patterns at the macro-scale (4,000m radius local environments) or larger. The macro/micro ratios are distinct dimensions of segregation, that is, they are not highly correlated with magnitudes of segregation derived from local environments or administrative units. By developing the macro/micro ratio, it is possible to capture a unique dimension of segregation and multiple scales of segregation at once; the geographic scale of segregation. The macro/micro ratio is used to characterize segregation patterns in a given study area and provides insight into not only the magnitude of segregation at a particular definition of local environment (i.e. 500m radius), but also the extent to which segregation at one scale is due to patterns of segregation at different geographic scales.

The approach outlined above—using the spatial variant of the information theory index along with distance-based local environments—overcomes a number of the critiques of the aspatial measure of segregation that is typically tied to administrative boundaries. First, in terms of scale, the use of distance-based local environments along with a spatial segregation measure overcomes the problem of administrative boundaries being unable to distinguish between areas where the population composition changes over short distances and where the population changes over large distances. The use of distance-based local environments also allows for consistency across regions and time, as administrative boundaries differ in area and population across the U.S. and change over the decades making it challenging to ascertain the “scale” of administrative units. In terms of proximity, the spatial version of the information theory index employs a distance-decay function which weights nearby locations more heavily than locations further away. In this way, the proximity of people can be taken more seriously than when an aspatial approach is used and administrative boundaries are considered “spatially autonomous” (Lee et al., 2008).
The Current Study

As noted previously, spatial proximity can create or impede conditions that lead to integration, and is particularly relevant to consider in the education setting as school segregation by race and poverty is increasing (Orfield et al., 2016). Understanding the proximity of populations and the patterns of racial and income segregation at multiple scales within school districts over time can provide important insights into the conditions that exist within school districts that support or impede school integration. Particularly, residential segregation within school districts has not been widely studied, due in large part to the complications arising from census units not nesting within school districts. But with the use of GIS it is possible to estimate populations within census units and school districts.

The purpose of this study is to describe the geographic scale of racial and income segregation within the largest school districts in the U.S. from 1990-2010. An understanding of patterns of micro and macro segregation over time will illustrate important trends in residential segregation at less often studied scales and will highlight differences between racial and income segregation. Additionally, I use the macro/micro ratio to explore how patterns of segregation differ among racial groups, over time, and between race and income. Finally, I discuss the findings in terms of implications for large school districts that are seeking to reduce racial and/or income segregation in their school district.

Methodology

This analysis uses a spatial measure of segregation in order to explore the geographic scale of racial and income segregation in 96 of the 100 largest school districts in the U.S.\(^1\) I examine a unique dimension of segregation within school districts, the trends over time in micro and macro segregation, and the extent to which micro-segregation is attributable to macro-segregation patterns.

Unit of Analysis and Sample

This analysis uses U.S. Census block group population counts from 1990, 2000 and 2010. Variables included are the four largest racial groups in the U.S.: non-Hispanic whites, non-

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\(^1\) The four largest New York City school districts were not included because of inconsistencies around the school district boundaries in the city across the years of study.
Hispanic blacks, Hispanics, and Asians, and income thresholds for households. School districts are the largest unit of geography used in this study in order to examine the residential segregation that occurs within school districts. Block groups do not always perfectly align with school district boundaries, and when a block group crosses a school district boundary, areal interpolation (Logan, Xu & Stults, 2014; Saporito, Chavers, Nixon, & McQuiddy, 2007) is used to weight the population of the block group by the proportion of the block group that falls within the school district boundary. Since school district boundaries are one of the most socially meaningful administrative boundaries, these boundaries were kept consistent in real time as opposed to consistent over time. Therefore in this study, 1990 school district boundaries reflect boundaries as they were in 1990, and so on.

The school districts in this study represent all regions of the country, different student body compositions, and diverging histories and current approaches to integration. The population in these districts includes approximately 60 million individuals, 45 percent of whom are white, 26 percent Hispanic, 20 percent black, and 6 percent Asian. In these large school districts, in comparison to the entire U.S. population, the study population has a lower percentage of white residents, a higher percentage of black and Hispanic residents, and about a comparable percentage of Asian residents.

**Measures**

*Spatial Information Theory Index.* Theil’s entropy index (H), or the information theory index, measures the evenness of racial groups’ distribution among given units. This measure can be used to determine the diversity of tracts to the diversity of a metropolitan area, schools to school districts, and so on. Values for H range between 0 and 1, with 1 representing maximum segregation (sub-units are very compositionally different from the larger unit) and 0 representing minimum segregation (sub-units mirror the composition of the larger unit). H can be interpreted as indicating the extent to which sub-unit diversity, on average, differs from the diversity of the larger study area. For example, a H value of 0.150 indicates that sub-units are, on average, 15

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2 This method (as well as other possible approaches) is imperfect precisely because of the topic under study; residential segregation means that populations are distributed unevenly within a block group, and weighting a population by areal proportion assumes an even population distribution. But this method of estimating block group populations when they do not align with school districts is preferable to other options that keep block groups whole like selecting by centroid because using areal interpolation does not systematically exclude block groups on the margin of school districts.
percent less diverse than the study area as a whole. Theil’s H is computed as:

\[ H = \sum_{i=1}^{n} \left[ t_i \left( E - E_i \right) / ET \right] \]  

(1)

Here \( t_i \) is the total population of a sub-component and \( T \) is the population of the entire area. The number of sub-components is \( n \), and \( E_i \) represents the sub-component \( i \)’s diversity and \( E \) represents the entire study area’s diversity. The spatial version of the information theory index (Reardon & O’Sullivan, 2004; Reardon et al., 2008) is used in this study to measure racial groups’ evenness among local environments. Spatial H is calculated using the following formula (Reardon et al., 2008):

\[ \tilde{H} = 1 - \frac{1}{TE} \int_{p=R} \tau_p \tilde{E}_p dp \]  

(2)

\( T \) is the total population and \( E \) is the overall area diversity in the area under study, or region \( R \). \( T_p \) is the total population count in cell \( p \), or the local environment.

**Spatial rank-order H.** Rank-order H is used to measure income segregation. There are a number of similarities between rank-order H and Theil’s H. They both measure the diversity within a sub-unit as compared to the entire study area. Rank-order H also ranges from 0 through 1.0, with 0 representing no segregation, or when the income distribution in the sub-units is the same as the entire region, and 1.0 representing complete segregation, or when there is no income variation within sub-units. However, rank-order H is used to measure segregation of a variable that is ordered and continuous in nature (in this case income). Rank-order H measures the ranking of household incomes within a school district, and thus it is independent of the income distribution which makes it easier to compare results across time and across school districts (Reardon & Bischoff, 2011). Rank-order H is computed by:

\[ H^R = 2 \ln(2) \int_0^1 E(p)H(p)dp \]  

(3)

Rank-order H is defined as a weighted average of the income segregation at each threshold point in the income distribution (\( p \) corresponds to thresholds of income that the census uses). \( E(p) \) denotes the diversity or entropy of the population between income thresholds and \( H(p) \) is the value of the segregation between those below the income threshold specified and those at/above the income threshold. In this study, rather than rank-order H being computed at a scale of an administrative boundary, a spatial variant of rank-order H is used with biweight kernel proximity
functions of 500m and 4,000m. This measure takes into account spatial proximity and is calculated as:

$$\tilde{H}^n = 2\ln2 \int_0^1 E(p)\tilde{H}(p)dp$$  \hspace{1cm} (4)$$

Spatial rank-order H is a spatially-weighted average of the income segregation at each threshold point in the income distribution. In spatial rank-order H, rather than people being located in an administrative unit (such as a tract), they are located in local environments. Income segregation is measured as evenness of the income distribution among these local environments, with nearby places being given greater weight.

**Local Environments.** In this study, scale is defined by radial distances which are comparable across place and time. Operationally, these are local environments in overlapping radiiuses of 500m and 4,000m. The local environments are derived from block group race and income threshold counts upon which a 50-by-50m cell grid is imposed. Population counts are estimated for each cell in the 50-by-50m grid using population densities of block groups and a smoothing technique which estimates counts in each cell by assigning the average population count of the cell and its eight neighbors (Reardon et al., 2008). Following the approach developed by Reardon and colleagues, I measure spatial segregation using a biweight kernel proximity function with radii of 500m and 4,000m. The biweight kernel function operates as a spatial lag, weighting near locations more heavily than farther locations and not considering locations that are outside of the local environments/radius.

Micro scale segregation is operationalized as segregation at the scale of a 500m radius and macro scale segregation is operationalized as segregation at the scale of a 4,000m radius. These local environments represent roughly the area of pedestrian neighborhoods where individuals might take a walk and visit neighbors (500m), and the largest scale at which people would consider community and engage in activities like shopping and attending school (4,000m) (Reardon et al., 2008). While micro and macro scale segregation is roughly correlated with

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3 It would be possible to define scale in a different way, besides radial distance. Common ways include using population sizes or travel times. For a recent example in the education context, see Saporito (2016; 2017) who uses population density. However, for this study, distance is the most appropriate way to understand scale and proximity because of the interest in understanding the unevenness across space of populations within school districts. In particular, proximity is especially relevant in order to understand the spatial dimension of segregation, and thus the capacity within school districts for integration.
segregation at different administrative units, the macro/micro ratio is a unique measure of segregation that is not highly correlated with segregation of administrative units like tracts.

**Analysis**

This study examines micro and macro residential segregation within school districts and the extent to which micro segregation is attributable to macro segregation patterns. Key to this analysis is determining not only the magnitude of segregation that occurs among particular local environments (i.e. 500m and 4,000m local environments), but also the extent to which segregation at the micro scale is due to racial patterns at the macro scale or larger. The *macro/micro segregation ratio* (Reardon et al., 2008) uses the spatial segregation values from 4,000m local environments (macro segregation) and the spatial segregation values from 500m local environments (micro segregation) in a given study area to determine the proportion of micro segregation that is due to patterns of macro segregation.

The analytic strategy follows three steps. First, for each of the school districts under study, the macro/micro segregation ratio is computed for racial segregation using the multiracial spatial information theory index, and income segregation is computed using the spatial rank-order information theory index from 1990-2010. The macro/micro ratio is derived from these measures of spatial segregation values at the 500m and 4,000m local environments for each school district.

Next, for each school district under study, the macro/micro racial segregation ratio is computed with racial dyads using the spatial information theory index for the years 1990-2010. The dyads analyzed include white/black, white/Hispanic and white/Asian. Considering not only multiracial H but also the racial dyads allows for an understanding of how the geographic scale of segregation differs across racial groups.

Finally, comparisons of the geographic scale of segregation will be made between racial and income segregation across time. The overlap (or lack thereof) of racial and income segregation in the education context is increasingly important, particularly as school districts turn to race-neutral and income-focused methods to achieve integration. Exploring similarities and differences in the geographic scale of racial and income segregation in school districts will provide a new dimension of understanding of the intersection of patterns between racial and income segregation.
Results

In large U.S. school districts, multiracial and black/white residential segregation has declined over time at micro and macro scales, but to a greater extent at macro scales. Hispanic/white and Asian/white segregation has increased, with the greatest increases occurring at the micro scale. And income segregation has declined, very modestly at the micro scale but more substantially at the macro scale. First, I describe patterns of micro and macro racial segregation, discussing the macro/micro ratio. Next I discuss patterns of income segregation over time, also exploring these patterns in terms of the macro/micro ratio. And finally, I compare patterns of racial and income residential segregation in large U.S. school districts and discuss implications for school district policy and future research.

Racial Segregation

Consistent with other studies on racial residential segregation (albeit at different scales than the school district), from 1990 to 2010 in large school districts, racial residential segregation has declined modestly for black and white residents while increasing for Hispanic and white, and Asian and white residents. Table 1.1 reports the average segregation from 1990 to 2010 for the largest school districts in the U.S. Racial segregation is measured at two different scales: 500m and 4,000m radii, and among racial dyads as well as multiracial segregation among the four largest racial groups. For all racial groups, as is expected, segregation is experienced at a higher magnitude at the 500m environment, and at a lower magnitude at the 4,000m environment. That would be expected, as larger areas usually encompass increasingly diverse populations. Figure 1.1 graphically illustrates the micro and macro segregation in large school districts over time by providing a spatial segregation profile (Reardon et al., 2008). The largest changes over this period of time were declines in macro multiracial segregation and macro black/white segregation, indicating that macro scale segregation for these groups within school districts was decreasing over time. And the largest increases in segregation over time were micro segregation for white and Hispanics and whites and Asians. It is worth reiterating however that despite increases in white/Hispanic and white/Asian segregation, black and white residents remain the most racially segregated groups within large school districts.

Table 1.1: Average racial segregation levels by geographic scale, 1990-2010
<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
<th>Change⁴</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiracial segregation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₅₀₀₀ₐₘᵦ</td>
<td>0.238</td>
<td>0.218</td>
<td>0.215</td>
<td>-0.023</td>
<td>-9.7</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘᵦ</td>
<td>0.142</td>
<td>0.140</td>
<td>0.120</td>
<td>-0.022</td>
<td>-15.5</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘ₅₀₀ₐₘᵦ</td>
<td>0.560</td>
<td>0.596</td>
<td>0.526</td>
<td>-0.034</td>
<td>-6.1</td>
</tr>
<tr>
<td><strong>Black-white segregation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₅₀₀₀ₐₘᵦ</td>
<td>0.323</td>
<td>0.291</td>
<td>0.291</td>
<td>-0.032</td>
<td>-9.9</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘᵦ</td>
<td>0.192</td>
<td>0.191</td>
<td>0.169</td>
<td>-0.023</td>
<td>-12.0</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘ₅₀₀ₐₘᵦ</td>
<td>0.563</td>
<td>0.597</td>
<td>0.528</td>
<td>-0.035</td>
<td>-6.2</td>
</tr>
<tr>
<td><strong>Hispanic-white segregation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₅₀₀₀ₐₘᵦ</td>
<td>0.141</td>
<td>0.186</td>
<td>0.207</td>
<td>0.066</td>
<td>46.8</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘᵦ</td>
<td>0.082</td>
<td>0.115</td>
<td>0.110</td>
<td>0.028</td>
<td>34.1</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘ₅₀₀ₐₘᵦ</td>
<td>0.515</td>
<td>0.563</td>
<td>0.507</td>
<td>-0.008</td>
<td>-1.6</td>
</tr>
<tr>
<td><strong>Asian-white segregation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₅₀₀₀ₐₘᵦ</td>
<td>0.104</td>
<td>0.121</td>
<td>0.174</td>
<td>0.070</td>
<td>65.4</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘᵦ</td>
<td>0.053</td>
<td>0.071</td>
<td>0.071</td>
<td>0.018</td>
<td>34.0</td>
</tr>
<tr>
<td>H₄₀₀₀ₐₘ₅₀₀ₐₘᵦ</td>
<td>0.481</td>
<td>0.550</td>
<td>0.389</td>
<td>-0.092</td>
<td>-19.1</td>
</tr>
</tbody>
</table>

Source: Census Tiger/LINE shapefiles of U.S. school districts 2010; ACS 2008-2012 5 year estimates of race population counts

*Figure 1.1: Average segregation by race and year in large U.S. school districts, 500m and 4,000m local environments*

Source: Census Tiger/LINE shapefiles of U.S. school districts 2010; ACS 2008-2012 5 year estimates of race population counts

⁴ Change from 1990 to 2010.
At the 500m and 4,000m scales, there are key differences in segregation patterns from 1990-2010 by racial group (see Table 1.1 and Figure 1.1). In the largest school districts in the U.S., average black/white segregation declined at both 500m and 4,000m environments. This finding is consistent with other studies that have examined patterns of racial residential segregation over time which have found declining—albeit still persistently high—black-white segregation (Logan & Stults, 2011). It is worth pointing out that despite decreasing black/white segregation at all scales in large U.S. school districts, black/white segregation is still experienced at the greatest magnitude compared to multiracial segregation or other dyads, which is also consistent with other research that has studied segregation at multiple scales (Owens, 2017; Parisi, Lichter & Taquino, 2011; Reardon et al., 2008). Like black/white segregation, multiracial segregation declined at 500m and 4,000m environments from 1990 to 2010. The largest decline was in macro scale, or 4,000m radii, segregation. Black/white segregation also declined most at the macro scale. Recent studies at the metropolitan level have identified the decreasing salience of small scale segregation and the rise of large scale segregation (Lichter, Parisi & Taquino, 2015; Reardon, Yun & Eitle, 2000; Stroub & Richards, 2013). While the decline of macro segregation may be true in this study from 1990 to 2000, when considering changes from 1990 to 2010, it is clear that micro segregation declined less than macro for black/white and multiracial segregation and increased more than macro segregation for Hispanic/white and Asian/white segregation. This finding underscores the importance of attention to scale when studying segregation, highlighting that segregation has changed differently over time at micro and macro scales. It also indicates that while neighborhood segregation is on the decline in the metropolitan context, it is still very much present in the school district context. School districts as units of study may be fundamentally different units from metropolitan areas or places—levels at which residential segregation is most often measured.

One benefit of using multiple scales simultaneously to study segregation is that while segregation may appear very similar at one scale, it may differ at another scale. This information is critical for school districts interested in designing student assignment policies that integrate students by race and socioeconomic status. For example, Baltimore City school district has high micro multiracial segregation, but low macro multiracial segregation, indicating that segregation in the school district is more characterized by enclave patterns of segregation. Measured at the 500m scale, segregation Baltimore City school district is the 14th highest of all the school
districts, comparable to segregation levels in other large city school districts. If segregation was only measured at this scale, Baltimore City school district would appear be one of the most segregated in the country. However, at the 4,000m scale, Baltimore City is the 50th most segregated, comparable to more countywide school systems. Thus choosing the scale at which segregation is measured will impact our understanding of the magnitude of segregation, and it is hard to say that one school district is more segregated than another because our understanding of segregation is bound to the scale at which it is measured. While many of the top 10 most segregated school districts at the micro scale are also in the top 10 at the macro scale, for other school districts their rank changes considerably depending on the scale at which segregation is measured.

The macro/micro ratio is one way to incorporate multiple scales into a single segregation index, overcoming some of the limitations of studying segregation at only one scale. The macro/micro ratio indicates the proportion of segregation at small scales (in this case, 500m radii) that is due to patterns of segregation at macro scales (4,000m radii) or larger (see Table 1.1). For example, in 2010 the average black/white macro/micro ratio in large school districts was 0.528. The interpretation of the macro/micro ratio is—in the example of a ratio of 0.528—that approximately 53 percent of black/white micro scale segregation is due to patterns of macro segregation. In other words, neighborhood segregation of black and white residents is influenced in good part by large scale patterns of black-white segregation in school districts. On average, black/white segregation has the highest macro/micro ratio, followed by multiracial segregation. Said another way, black/white segregation and multiracial segregation in large school districts are characterized by patterns of segregation over large distances as compared to Hispanic/white and Asian/white segregation. For example, in 2000 the average black/white macro/micro ratio was 0.597, which indicates that approximately 60 percent of racial segregation present at 500m environments was due to patterns at a 4,000m environment or larger. For all groups except the Asian/white dyad and for all years, macro/micro ratios were above 0.500. This means that for all groups except for Asian-white, and for all years, the proportion of micro segregation that is due to patterns at a macro scale was above 50 percent. Across the three decades under study, Asian-white segregation maintained the lowest macro/micro ratio, indicating that compared to the other groups, less of Asian/white micro segregation was due to large scale patterns of segregation. In sum, the macro/micro ratios indicate that black/white and multiracial segregation occur across
larger distances, followed by Hispanic/white segregation, whereas Asian/white segregation occurs at a more micro scale.

From 2000 to 2010 the macro/micro ratio declined for all racial groups, albeit by different amounts. This decline follows an increase in the macro/micro ratio which occurred between 1990 and 2000. Reardon and colleagues also found when studying the largest metropolitan areas from 1990 to 2000 that macro/micro segregation ratios increased; and thus that the proportion of micro segregation due to segregation patterns at macro scales was increasing (2009). However, their study did not include 2010 so it is unclear if segregation patterns in MSAs are similar to school districts from 2000 to 2010. The largest changes in the macro/micro ratio occurred for multiracial segregation and black/white segregation, declining by 6.1 percent and 6.2 percent respectively. Over this time period, segregation at the 4,000m scale declined by a greater percentage than segregation at the 500m scale for multiracial and black/white segregation, driving the decrease in macro segregation patterns. Hispanic/white and Asian/white segregation exhibited different trends from 1990 to 2010; both macro and micro segregation increased, and there was only a small decrease in the macro/micro ratio. While Hispanic/white and Asian/white dyads continued to have a lower magnitude of segregation at all scales than multiracial and black/white segregation, it is notable that segregation levels are increasing for these groups at micro and macro scales.

The average segregation of the largest school districts in the U.S. obscures the variation that exists across these school districts (Table 1.2). In Table 1.2, I rank school districts by highest macro/micro ratio. Black/white segregation consistently has the highest macro/micro ratios indicating that to a greater extent than other racial groups, black/white segregation was characterized by macro patterns. The school districts with the highest macro/micro ratios include both countywide and city school systems, and represent many different regions of the country. The scale of black/white segregation is particularly striking in the school districts with the highest macro/micro ratios. For example, the school districts in metropolitan Atlanta, Fulton County, DeKalb County, Forsyth County, and Atlanta Public Schools, all experience macro scale segregation among black and white residents, the largest two racial groups in the school districts. For example, in Fulton County school district in 2000, on average, for black and white residents, 4,000m environments were only 7 percent more racially diverse than their 500m environments. This means that black and white residents must travel relatively large distance to experience a
change in racial compositional in the school district. For all the school districts with the highest macro/micro ratios for black and white residents, 4,000m environments are at most 20 percent more diverse than 500m environments. This is in contrast to Asian/white segregation where in 2010, the districts with the most macro segregation had large scale environments in the school district that were least 32 percent more diverse than micro scale environments. And while the districts with the highest Asian-white and Hispanic-white segregation macro/micro ratios in 1990 had ratios similar to black-white segregation, by 2010 those ratios were lower than black-white ratios.

Table 1.2: Highest macro/micro ratio by year and racial group combination, large U.S. school districts

<table>
<thead>
<tr>
<th>Year</th>
<th>Racial Group</th>
<th>District Name, State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Multiracial</td>
<td>Fulton County, GA</td>
</tr>
<tr>
<td>0.887</td>
<td>Fort Bend ISD, TX</td>
<td></td>
</tr>
<tr>
<td>0.823</td>
<td>Cherry Creek 5, CO</td>
<td></td>
</tr>
<tr>
<td>0.801</td>
<td>Loudoun County, VA</td>
<td></td>
</tr>
<tr>
<td>0.797</td>
<td>Katy ISD, TX</td>
<td></td>
</tr>
<tr>
<td>0.794</td>
<td>Jeffco Public Schools, UT</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>Black/White</td>
<td>Fulton County, GA</td>
</tr>
<tr>
<td>0.890</td>
<td>Cherry Creek 5, CO</td>
<td></td>
</tr>
<tr>
<td>0.835</td>
<td>Gwinnet County, GA</td>
<td></td>
</tr>
<tr>
<td>0.834</td>
<td>Osceola County, FL</td>
<td></td>
</tr>
<tr>
<td>0.817</td>
<td>DeKalb County, GA</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Hispanic/White</td>
<td>Fulton County, GA</td>
</tr>
<tr>
<td>0.784</td>
<td>Cherry Creek 5, CO</td>
<td></td>
</tr>
<tr>
<td>0.747</td>
<td>DeKalb County, GA</td>
<td></td>
</tr>
<tr>
<td>0.736</td>
<td>Cleveland Metro, OH</td>
<td></td>
</tr>
<tr>
<td>0.732</td>
<td>LA Unified, CA</td>
<td></td>
</tr>
<tr>
<td>0.723</td>
<td>Dade County, FL</td>
<td></td>
</tr>
<tr>
<td>0.886</td>
<td>Forsyth County, GA</td>
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</tr>
<tr>
<td>0.851</td>
<td>DeKalb County, GA</td>
<td></td>
</tr>
<tr>
<td>0.831</td>
<td>LA Unified, CA</td>
<td></td>
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<tr>
<td>0.805</td>
<td>Chicago Public Schls, IL</td>
<td></td>
</tr>
<tr>
<td>0.864</td>
<td>DeKalb County, GA</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Asian/White</td>
<td>Fulton County, GA</td>
</tr>
<tr>
<td>0.896</td>
<td>Cherry Creek 5, CO</td>
<td></td>
</tr>
<tr>
<td>0.847</td>
<td>Osceola County, FL</td>
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</tr>
<tr>
<td>0.831</td>
<td>Gwinnet County, GA</td>
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</tr>
<tr>
<td>0.802</td>
<td>Aldine ISD, TX</td>
<td></td>
</tr>
<tr>
<td>0.846</td>
<td>Osceola County, FL</td>
<td></td>
</tr>
<tr>
<td>0.849</td>
<td>Katy ISD, TX</td>
<td></td>
</tr>
<tr>
<td>0.835</td>
<td>Prince William Cnty., VA</td>
<td></td>
</tr>
<tr>
<td>0.832</td>
<td>Fort Bend ISD, TX</td>
<td></td>
</tr>
<tr>
<td>Source: Census Tiger/LINE shapefiles of U.S. school districts 2010; ACS 2008-2012 5 year estimates of race population counts</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
San Antonio Independent School District and Baltimore City School District. It is instructive to consider particular school districts to illustrate what patterns of micro and macro segregation look like, and what the implications of these patterns are for school districts in terms of integration. Figures 1.2 and 1.3 illustrate two school districts which have differences in the spatial scale of segregation. San Antonio ISD and Baltimore City School District both have black/white segregation that is nearly identical at the micro scale (0.484 and 0.467 respectively) but quite different segregation at the macro scale (0.322 in San Antonio and 0.132 in Baltimore City). If segregation was only measured at the neighborhood scale, it would make sense to conclude that San Antonio ISD and Baltimore City school districts experience similar magnitudes of segregation. However, when segregation is measured at a larger scale it is clear that the segregation profile of these two school districts is quite different. In San Antonio ISD the black/white racial composition changes by about 33 percent from the micro scale to the macro scale, whereas in Baltimore it changes by about 72 percent. This means that although both districts experience very similar levels of neighborhood segregation, the compositional changes over the area of the school district are very different. While pedestrian neighborhoods in both city school districts are around 47 percent less diverse than the school district as a whole, in San Antonio 4,000m environments are 32 percent less diverse than the school district, and in Baltimore City 4,000m environments are only 13 percent less diverse than the school district. San Antonio’s black/white segregation occurs across a much larger scale than black/white segregation in Baltimore City.

On the San Antonio ISD map (Figure 1.2), the gray shading indicates the percentage of black residents in the local environment of a given point using a 500m radius. In the computation of segregation at 500m and 4,000m local environments, segregation is weighted by population density. This means that the areas with high population density contribute the most to the computation of segregation, while areas that are sparsely population contribute less in the computation of segregation. San Antonio ISD is characterized by a spatial concentration of the black population in the eastern part of the school district. The geographic scale of segregation in San Antonio ISD is relatively large, with black residents spatially isolated in one area of the school district; there is little black population outside of the eastern part of the school district. The black-white macro/micro ratio in San Antonio ISD in 2010 was 0.665, indicating that approximately 67 percent of segregation at the micro scale is due to variation in racial
composition across macro scales. Further, it means that large scale environments within the school district are about 33 percent more diverse than micro scale environments. While that is more substantial variation than exits in some of the most macro segregated districts, it means that, on average, black residents must travel a good distance to experience some degree of racial change.

*Figure 1.2: Spatially weighted percentage black, 500m radius biweight kernel, San Antonio Independent School District 2010*

In contrast to the more macro scale segregation patterns exhibited in San Antonio ISD, Baltimore City School District shows patterns of segregation that are characterized by pockets of areas with similar racial composition (Figure 1.3). In Figure 1.3, the gray shaded areas are the
percentage of white residents in the local environment of a given point using a 500m radius. The greatest concentration of white residents are around the inner harbor area and the outer edges of the school district, but the white population is dispersed throughout areas of the school district, and the distances that white residents have to travel to reach an area where the racial composition differs is not very far. This is in contrast to the large east/west divide seen in San Antonio ISD where black residents are spatially concentrated in one area of the school district. The macro/micro ratio in Baltimore City school district was 0.283. This means that the racial composition of white residents’ macro scale environment in the school district was very different than the racial composition of the micro scale environment—roughly 72 percent more diverse. It also means that in Baltimore City school district, white residents experience large changes in racial composition, suggesting that when one leaves their pedestrian neighborhood and travels a couple of kilometers there is a possibility for exposure to other racial groups.

*Figure 1.3: Spatially weighted percentage white, 500m radius, biweight kernel: Baltimore City School District 2010*
San Antonio ISD and Baltimore City school districts illustrate the differences in the scale of residential segregation within school districts. If measuring segregation at only the neighborhood scale in these school districts, we would conclude that they are similarly segregated. However, when measuring segregation at more than one scale, it is clear that these two school districts have distinct segregation profiles. By using spatial measures it is possible to understand not only differences in the magnitude of segregation, but also in the scale of segregation. In the cases of San Antonio ISD and Baltimore City school districts, we can distinguish between a school district where there is little racial compositional change across large distances, in the case of the black population in San Antonio ISD, and a school district where there is more substantial variation in racial composition across large distances, as was the case for white residents in Baltimore City School district. These differences in the geographic scale of segregation have important implications for school district integration policies that often employ student assignment to increase racial diversity.

**Summary of trends in racial segregation, 1990-2010.** Residentially, school districts are highly segregated by race at the micro scale, and moderately segregated at the macro scale. This diverges to some degree by race, with black residents experiencing the highest segregation from white residents at all scales, and Hispanics and Asians experiencing lower segregation from whites at all scales. Across the largest school districts in the U.S. there is a declining salience of macro racial segregation within school districts. This is evidenced by relatively large declines in macro scale racial segregation, and declining macro/micro ratios from 1990 to 2010. Despite declining macro segregation, on average, over half of segregation at micro scales in the largest school districts in the U.S. is due to patterns of segregation at large scales. While the proportion has decreased from 1990 to 2010, it is still a significant proportion. And in 2010, in nine school districts of the largest school districts in the U.S., the proportion of small scale segregation that is due to large scale patterns is over 75 percent. In this context, developing student assignment policies to produce racial integration in schools would be quite complex given the scale at which

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6 It is important to again emphasize that this study only examines segregation within school districts and not between them. School districts themselves are often smaller than places, and significantly smaller than metropolitan areas.

7 This is true for all racial groups except the Asian/white dyad where, on average, less than half of segregation at small scales is due to patterns at macro scales.
segregation occurs in the district. In these districts, there is little variation in racial composition across large distances within the school district, complicating racial integration of schools to the extent that it relies on spatial proximity.

**Income Segregation**

To measure income segregation, I use a spatial variant of rank-order H—that is, a measure that accounts for the proximity of households of different incomes and measures segregation among ranked income thresholds provided by the census. In this study, rank-order H compares the spatially weighted variation in household incomes in 500m environments and 4,000m environments to the variation in household incomes in the entire school district. Results indicate the sorting by household income at small scale environments and large scale environments within school districts. Rank-order H allows for a comparison in income across time because it is insensitive to inflation and changes in the shape of the income distribution because it only considers information about households rank in the income distribution (Reardon, 2009; Reardon & Bischoff, 2011).

From 1990 to 2010, income segregation within large U.S. school districts decreased (Table 1.3). Declining residential income segregation within school districts is in contrast to patterns of income segregation found in residential segregation at other scales. For example, at the metropolitan level, income residential segregation in the 100 largest metropolitan areas rose modestly between 1990 and 2010, with most of the increase occurring between 2000 and 2010 (Owens, 2016). In this study, I found that within school districts, while the change in micro segregation was quite small, decreasing by only about 5 percent from 1990 to 2010, the change in macro segregation was more significant, decreasing by about 28 percent from 1990 to 2010. Income segregation was moderate at micro scales, and low at macro scales for all years, which is expected as the magnitude of segregation declines as the geography of the unit of measurement gets larger. And income segregation persists at a lower magnitude than racial segregation.

Like with racial segregation, the macro/micro ratio indicates the proportion of income segregation of small scale environments that is due to macro scale patterns. From 1990 to 2010 in the largest school districts, macro/micro income segregation ratios declined by about 20 percent. In 1990, 57 percent of micro income segregation, on average, was due to large scale segregation, and 4,000m environments were about 43 percent more diverse than 500m
environments. By 2010, the average macro/micro ratio was 0.455, which means that only 46 percent of income segregation at small scales was due to large scale income segregation, and 4,000m environments were 54 percent more diverse than 500m environments. In sum, the changes in the macro/micro ratio from 1990 to 2010 in large school districts indicate that the geographic scale of income segregation was getting smaller, and residents could increasingly experience more income diversity when leaving their neighborhood environment.

Table 1.3: Average income segregation levels by geographic scale, 1990-2010

<table>
<thead>
<tr>
<th>Rank-Order H</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
<th>Change</th>
<th>%Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>H_{500m}</td>
<td>0.118</td>
<td>0.116</td>
<td>0.112</td>
<td>-0.006</td>
<td>-5.1</td>
</tr>
<tr>
<td>H_{4000m}</td>
<td>0.072</td>
<td>0.067</td>
<td>0.052</td>
<td>-0.020</td>
<td>-27.8</td>
</tr>
<tr>
<td>H_{4000m/500m}</td>
<td>0.568</td>
<td>0.545</td>
<td>0.455</td>
<td>-0.113</td>
<td>-19.9</td>
</tr>
</tbody>
</table>

Source: Census Tiger/LINE shapefiles of U.S. school districts 2010; ACS 2008-2012 5 year estimates of household income thresholds

There were relatively similar magnitudes of income segregation at the 500m scale across years, but at the 4,000m scale income segregation diverged more from 1990 to 2010. This indicates, as was pointed to before, more stability in the magnitude of income segregation at small scales, but greater change in the magnitude of macro segregation across years, with most of the change occurring between 2000 and 2010. As was the case with racial segregation, the averages discussed above don’t portray the variation that exits among the largest school districts in terms of the geographic scale of income segregation. In some school districts, income segregation is characterized by enclave patterns where households with similar income rankings are spatially concentrated at a small scale, but over larger areas in the school district there is greater household income diversity. On the other hand, in some school districts, households are spatially very distant from areas in the school district where the income composition differs from that of their pedestrian neighborhood environment. Table 1.4 shows the school districts with the highest macro/micro ratios for income segregation. Many of the school districts that have the highest macro/micro income ratios are different than those that have the highest macro/micro ratio for racial segregation. Mostly, these school districts are in countywide systems in the South, except for two from the West.

Table 1.4: Highest income macro/micro ratio by year, large U.S. school districts

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
</table>

8 Change from 1990 to 2010.
9 Appendix shows school districts with the lowest income macro/micro ratios.
Summary of income segregation trends, 1990-2010. Residential income segregation in large U.S. school districts persists at moderate levels at the neighborhood scale, and at low levels at larger scales. From 1990 to 2010, residential income segregation of school districts declined, with the greatest declines in macro income segregation and relatively small declines in micro segregation. While in 1990 over half of micro scale segregation—57 percent—was due to macro scale patterns, by 2010 this had decreased to 46 percent. On average, income segregation in large school districts became less characterized by patterns of segregation where there was little change in income composition over large distances. This is not to say that macro segregation did not continue to matter; it still played a substantial role in the income segregation of neighborhoods, just less so than in 1990. While the scale of racial and income segregation was very similar in 1990, by 2010 the scale of racial and income segregation had diverged (Table 1.5). For both forms of segregation in 1990, about 56 percent of segregation at small scales was due to large scale segregation patterns, but by 2010 than had decreased to 45 percent for income segregation without a similar decrease for racial segregation. In sum, these differences indicate that over time in large school districts, income segregation was occurring at increasingly smaller scales as compared to racial segregation.

Table 1.5: Multiracial and income segregation in the largest U.S. school districts, 1990-2010

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiracial Segregation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_{500m}$</td>
<td>0.238</td>
<td>0.218</td>
<td>0.215</td>
</tr>
<tr>
<td>$H_{4000m}$</td>
<td>0.142</td>
<td>0.140</td>
<td>0.120</td>
</tr>
<tr>
<td>$H_{4000m/500m}$</td>
<td>0.560</td>
<td>0.596</td>
<td>0.526</td>
</tr>
<tr>
<td><strong>Rank-Order Income Segregation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_{500m}$</td>
<td>0.118</td>
<td>0.116</td>
<td>0.112</td>
</tr>
<tr>
<td>$H_{4000m}$</td>
<td>0.072</td>
<td>0.067</td>
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</tr>
<tr>
<td>$H_{4000m/500m}$</td>
<td>0.568</td>
<td>0.545</td>
<td>0.455</td>
</tr>
</tbody>
</table>

Source: Census Tiger/LINE shapefiles of U.S. school districts 2010; ACS 2008-2012 5 year estimates of household income threshold

Discussion
Previous research has documented declining black/white residential segregation and increasing Hispanic/white and Asian/white residential segregation since the 1990s (Logan & Stults, 2011). At the same time, school racial and income segregation is rising (Orfield et al., 2016; Owens, Reardon & Jencks, 2014). Research that has examined residential racial segregation at multiple scales has also found the declining significance of segregation at small scales and a rise in segregation at large scales (Lichter, Parisi & Taquino, 2015; Reardon, Yun & Eitle, 2000; Reardon et al., 2009; Stroub & Richards, 2013). Previous studies of residential segregation have largely been done of metropolitan areas, geographic areas that are much more expansive than a school district. This study explored the geographic scale of segregation within individual school districts in order to better understand residential patterns over time in school districts. Additionally, school districts are units of analysis that are highly relevant for the study of residential racial segregation because of the relationship between residential and school segregation within school districts (Frankenberg 2009; 2013; Lareau & Goyette, 2014).

Understanding the spatial segregation that occurs within large, diverse, school districts is critical in the design of student assignment policies which often rely centrally on spatial proximity. The findings presented here provide insight into residential segregation within a less frequently studied unit, add some caveats to previous research on segregation at multiple scales, and provide a spatial lens for considering school district integration.

Findings presented here on the geographic scale of segregation in school districts are somewhat inconsistent with previous research on segregation at multiple scales to the extent that they indicate that micro segregation remains, and is increasingly, a salient feature of racial segregation in school districts and that the trend is not toward a macro segregation within school districts. Both micro and macro segregation declined in large school districts (multiracial segregation and rank-order income segregation), but the largest declines were in macro segregation. One possible explanation for why this study does not find the same patterns as related to the declining significance of micro segregation and the growth of macro segregation may have to do with the units of study. Residential patterns within school districts are rarely studied, partly because census geographies do not nest within school districts. School districts are relatively small units of study, covering a much smaller area than metropolitan areas—the most common unit within which residential segregation is studied. It is quite possible that because of the differing sizes, and corresponding compositional differences between school
districts and metropolitan areas, that segregation patterns are different within these units. Yet understanding patterns of segregation within school districts, distinct from metropolitan areas is important because of the critical role that school districts play in shaping educational opportunities, and in shaping both school and residential segregation (Ayscue, J. & Orfield, G, 2015; Lareau & Goyette, 2014; Owens, 2017).

In school districts that are interested in promoting school integration by race and/or income, knowledge of the patterns of residential segregation within school districts is particularly important. Some scholars have argued that in a legal context that complicates school districts’ efforts to promote racial integration (Parents Involved in Community Schools v. Seattle School District No.1, 2007), income integration should be pursued instead of racial integration. Kahlenberg argues that income segregation is harmful in and of itself, and that SES integration will prompt some degree of racial integration because of the correlation between race and income (2001; 2012). But other research has complicated this position, showing that SES integration policies in most circumstances will produce little racial integration (Reardon, Yun & Kurlaender, 2006). To promote integration, school districts often use student assignment policies, which rely on where households with children reside, to design plans that will produce school integration in a residentially segregated context. These policies include the use of school choice with civil rights protections, magnet schools, adjustments to school attendance zones, and assignments that consider student, family, and/or neighborhood characteristics. Design and use of these policies can benefit from information about the spatial segregation that exists within school districts.

The findings from this study demonstrate not only that racial and income residential segregation exist at different magnitudes within school districts, but also that the geographic scale of racial and income segregation differs within school districts. While previous research has documented the relatively greater segregation that is experienced by students and residents by race as compared to income (Owens, 2016; 2017; Owens, Reardon & Jencks, 2014; Stroub & Richard, 2013), this study compares the geographic scale of racial and income residential segregation. The geographic scale of racial and income segregation in the largest school districts was nearly the same in 1990, but in 2000 the gap between the two had grown, and by 2010 it had grown more, with racial segregation occurring at a larger scale than income segregation. Although the difference between the geographic scale of racial and income segregation in 2010
was not very large (the macro/micro ratio was 0.526 for racial segregation and 0.455 for income segregation), it is clear that within the largest school districts there are differences in the scale at which segregation occurs by race and income.

That the geographic scale of segregation differs for race and income, and that the gap between the two has grown in recent decades despite their similarity in 1990, has implications for school districts that are considering how to design student assignment policies that promote racial and income integration. Despite the correlation between race and income, the scale of segregation differs between the two, and that is another piece of evidence complicating the policy prescription of income integration to promote racial integration. In the context of growing race-neutrality in policy and politics, many school districts are pursuing socioeconomic integration rather than racial integration (Reardon & Rhodes, 2011). Because race and poverty are highly correlated, that has led some to believe that using socioeconomic status in lieu of race in student assignments can reduce racial segregation of schools by proxy (Kahlenberg, 2001; 2012). But research has shown that in most circumstances student assignment policies that use socioeconomic status to promote integration will produce little racial integration (Crosnoe, 2009; Reardon, Yun & Kurlaender, 2006). This study also provides evidence that complicate the argument that socioeconomic status can be used as a substitute for race to promote racial integration. Particularly in the most recent decade, given that racial segregation occurred across a larger scale than income segregation in school districts, if a student assignment policy is only considering income, it may be less effective in also addressing racial segregation because of the disparity in scale at which these forms of segregation occur. For example, attendance zone adjustments may be more effective in addressing segregation that exists at small scales within a school district, but less so at addressing large scale segregation where residents must travel larger distances from their proximate environment to experience changes in the population composition.

It may be seen as an advantage for school districts interested in promoting integration that macro scale segregation is on the decline. And certainly, student assignment policies that must deal with the proximity of students to schools and to each other may be easier to design in an environment where segregation is more small scale. But there are reasons to be skeptical of what these trends mean in a larger context. We know a greater deal of segregation occurs between school districts rather than within them, and that school district boundary lines are critical in the
sorting of students and residents across metropolitan areas (Owens, 2017; Owens, Reardon & Jencks, 2016; Reardon, Yun & Eitle, 2000; Stroub & Richards, 2013). Therefore the examination of residential segregation only within school districts is a limited picture of how residential segregation occurs. While macro segregation may be on the decline within school districts, this can co-exist with larger demographic patterns of macro segregation of metropolitan areas. And there are also residential patterns within school districts that indicate that despite declines in multiracial and income segregation at all scales, there is still large inequality residually within school districts. The disparities in the geographic scale of segregation among different racial groups show persistently high black/white segregation within school districts, and that while Hispanic/white and Asian/white segregation remains lower, it is increasing, particularly at micro scales. Indeed, findings suggest that black/white integration of schools may be the most challenging to promote within school districts given the relatively large scale at which segregation between these groups occurs. These residential inequalities have important implications in the context of school districts where students are most often assigned to school based on proximity of residence (Lareau, 2014).

As policymakers and school districts consider the ways in which to create school district policies that can effectively promote racial and income integration, understanding the spatial segregation that exists within a school district is critical. Segregation is indeed about spatial proximity, yet proximity is not often considered when measuring segregation. These finding underscore the importance of attention to scale when studying segregation, highlighting that racial and income segregation has changed differently over time at various scales.
Chapter 3

THE CONTRIBUTION OF ATTENDANCE BOUNDARY SEGREGATION TO SCHOOL DISTRICT RACIAL SEGREGATION IN LARGE U.S. SCHOOL DISTRICTS

The segregation of populations by political boundaries has been a well-documented part of the American experience, often aided by public policies in the housing and school sectors (Hirsch & Mohl, 1993; Lassiter & Crespino, 2010; Rothstein, 2014). Large metropolitan areas in the U.S. are fragmented by school districts lines and school attendance boundaries\(^{10}\) that demarcate distinct spheres of opportunity and create lasting public perceptions of neighborhoods, housing markets, and school systems (Ayscue & Orfield, 2015). It is clear that public policies have a crucial role in constructing educational boundaries and the resulting fragmentation of metropolitan areas. The administrative boundaries that separate public spaces in the U.S. become socially meaningful lines through both exclusion and recruitment, effectively segregating populations by race and class (Weiher, 1991). School attendance zones contain the population which are assigned to attend a particular school, and particularly for elementary attendance boundaries, these zones tend to be neighborhood-based (M. Orfield & Luce, 2009). Given that there are often moderate to high levels of racial residential segregation of metropolitan areas, drawing school zones based on neighborhoods can result in segregated school zones. The purpose of this paper is to determine to what extent elementary school attendance zones segregate the population residentially in large U.S. school districts, providing insight into how education policy matters for residential segregation.

The unique role of attendance zones in school district racial residential segregation has not been previously explored, despite the prevalence of school attendance zones and their potential as a policy tool for integration. NCES recently released the School Attendance Boundary Survey (SABS) which included attendance zones of approximately 350 large school districts in the U.S. I use this newly released federal dataset, along with census data, to describe the proportion of segregation that occurs within and between elementary catchment areas in large school districts. I also describe the magnitude of elementary school zone segregation through exposure and evenness measures of segregation. I find that on average, more segregation occurs between elementary school zones than within them, and that black and white residents are the most

\(^{10}\) The terms school attendance zones and school catchment areas are used interchangeably.
segregated by elementary school zones. Additionally, the average white, black, Hispanic, and Asian resident experiences very compositionally different school zones, with white residents being the most racially isolated in elementary zones. The main contributions of this research are to provide a greater understanding of the relationship between segregation and school attendance zones, and to provide greater insights into the link between school policy and residential segregation.

**Literature Review**

Racial segregation of schools has persisted and been difficult to remedy, even after the historic *Brown* and subsequent federal court decision, and a number of explanations suggest why this is so. The federal courts have historically played an active role in school desegregation, but since the 1990s many districts have been released from court supervision and the Supreme Court has dealt a number of rulings unfavorable towards school integration (*Freeman v. Pitts*, 1992; *Parents Involved in Community Schools v. Seattle School District No. 1*, 2007; Reardon & Owens, 2014). Racial segregation of schools increased after districts were released from court order, particularly in elementary schools and in the South, suggesting the importance of the courts in maintaining the desegregated character of districts (Reardon et al., 2012). And relatedly, desegregation of schools occurred to the greatest extent in response to legal mandate (Logan, Zhang & Oakley, 2017). With little federal enforcement of school desegregation through the courts, and new limits on how school district may use race in voluntary integration policies, schools have resegregated across the county (Orfield et al., 2016).

School choice has also emerged as a powerful force in education, and as an explanation for school segregation and resegregation. Critics of school choice argue that in practice it allows those with resources to exacerbate inequality, and trends have shown that choice without civil rights protections can further segregation (Orfield & Frankenberg, 2013; Siegel-Hawley & Frankenberg, 2013). Indeed, many popular school choice policies like charters, vouchers, and open enrollment have historically been used in a way that furthers segregation (Orfield, 2013). The use of school choice has not been equal, with white students disproportionately opting out of the public school system, suggesting that white families may live in relatively racially diverse school districts or catchment areas, but may not be willing to send their children to racially diverse schools (Saporito, 2003; Saporito & Sohoni, 2007). Yet precisely for school choice’s
ability to decouple residence with school assignment, enabling students to attend schools outside of their neighborhood of residence, in certain contexts school choice may further integration. One example of a diverse and segregated school district that is operating controlled choice to further integration is Berkeley Unified. Using a mix of choice, zone priorities, and characteristics of individual students, Berkeley Unified has managed to implement choice with civil rights protections (Frankenberg, 2013).

The segregation of schools has also been explained as rooted in the segregation of neighborhoods. The relationship between school and residential segregation is usually understood as residential trends impacting school composition because schools draw their student populations from nearby residences (Frankenberg, 2013). Some scholars argue that as long as there is residential segregation, there will be persistent school segregation (Rothstein, 2017). At the same time, a growing body of research has focused on how the links between residential and school segregation have created mutually reinforcing mechanisms that exacerbate both forms of segregation. School and neighborhood composition signal important cues that become determining factors in the choices families make (Frankenberg, 2013; Lareau & Goyette, 2014). And school districts boundaries segregate not only students by race, but also the population in metropolitan areas by race (Owens, 2017). Further, one study found that residential segregation declined in metropolitan areas that had far-reaching school desegregation policies (Siegel-Hawley, 2011). In sum, research has shown that residential segregation does impact school segregation, but a more recent body of work demonstrates that schools are also critical in shaping residential choices and segregation.

Another explanation for the persistence of school segregation lies with school boundaries—both district and attendance zone. Boundaries can both deepen the effects of residential segregation in the school context when they are drawn in such a way that maximizes racial and income inequalities (Richards, 2014), and conversely they can be constructed in a way that contributes to the integration of populations in the school context (Saporito & Riper, 2015; Swann v. Charlotte-Mecklenburg Board of Education, 1971). Some scholars have even argued that school segregation is so intractable because of school district boundary lines, and without dramatically changing school district boundaries to include both cities and suburbs, there is little potential for meaningful integration of many large urban school districts. Attendance zones within school districts have received relatively less attention, but are associated with racial
residential and school segregation within school districts (Saporito & Sohoni, 2006; Saporito & Riper, 2015). Unlike school district boundaries however, school attendance zone boundaries are a policy tool that can be used to promote racial integration, insofar as they are educational boundaries that school districts control. A number of school districts across the country use attendance zone adjustments explicitly to increase integration (Reardon & Rhodes, 2011), although it is unclear to what extent these adjustments result in meaningful changes in levels of segregation. What is clearer is that large school districts frequently adjust school attendance zones, and most changes will be integrative or segregative, regardless of the intent of the school district.

While nearly all large school districts draw school attendance zone boundaries, which delineate the neighborhoods that are zoned for particular schools, these boundaries remain understudied. These boundaries along with student assignment policies determine not only the schools that children will attend, but also have the potential to shape patterns of residential segregation. This is because residential choices can be impacted by the schools in the area which serve as signals, based on school composition, of the character and quality of neighborhoods (Lareau & Goyette, 2014; Pearce, 1981). I explicitly address the question of the extent to which these school zones shape patterns of racial residential segregation, determining what proportion of residential segregation in school districts is due to elementary school zones. School zone boundaries are important to examine both for their role in structuring school and residential segregation, and because school zones are a policy tool which some school districts already use (Reardon & Rhodes, 2011), and others could potentially use, to make more integrative policy choices.

Segregation and Educational Boundaries

Since the Brown decision over half a century ago, trends in school segregation have fluctuated from a period of desegregation in the late-1960s and 1970s, to a retrenchment in the 1990s, and resegregation through present day (Orfield, 1996; Orfield, Siegel-Hawley & Kucsera, 2014). And many districts across the county never made progress on integration because they were considered “de facto” segregated (Frankenberg & Taylor, 2015). Judges and policymakers

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11 States do retain control of school district boundaries and could technically alter them. However, political backlash surrounding changes to school district boundaries complicates changes to these boundaries.
devised remedies and enforced desegregation in the de jure segregated states of the South, but classified the non-South as segregated not through official action, but through private choices. This distinction turned out to be critical in the extent to which racial integration in schools occurred, and since the 1970s the South has been the most integrated region for students (Orfield, 2009).

When heterogeneous areas are divided into smaller units, the result is often less diverse sub-components and the consequence for schools is often disparate quality and opportunities between boundaries (Bischoff, 2008). The two most important boundaries in the education context are school district boundaries and school attendance zone boundaries. Regions across the country differ widely in terms of the level of fragmentation of school district boundaries, with states in the Northeast and Midwest tending to have highly fragmented school districts and states in the South and West having school districts that are larger and tend to follow county lines (Bischoff, 2008). Less is known about within-district segregation by school attendance zones, partly due to a lack of data on school attendance boundaries. From studies that examine school level data, we know that in recent years a greater proportion of school segregation is attributed to segregation between school districts rather than within school districts (Reardon, Yun & Eitle, 2000; Stroub & Richards, 2013). Stroub & Richards find that over 60% of racial segregation of schools is due to between-district segregation while the rest is due to within-district (2013). But this was not always the case; particularly in the South when segregation was de jure, school segregation used to be characterized more by segregation between schools within the same district (Frankenberg, 2009). A recent study examined the contribution of school districts to metropolitan racial residential segregation, and found that about 45 percent of segregation for adults and 53 percent of segregation for children occurs between school districts in metropolitan areas (Owens, 2017). In sum, these studies have indicated that school district boundaries are important for structuring not only school segregation, but also residential segregation. Yet the same techniques that have been used to uncover that more segregation occurs between school districts than within them has not been applied to the study of the other major educational boundary; school attendance zones boundaries.12

12 As mentioned previously, this may be due in large part to the lack of data available on school attendance zone boundaries. NCES only recently released SABS which makes large-scale study of school zones possible.
Although more school segregation is due to between-district rather than within-district segregation, there are good reasons to focus on within-district segregation. Legal and policy constraints mean that it is easier to impact within-district segregation as opposed to between-district segregation (Reardon & Owens, 2014). The policy levers available to impact integration most often exist at the school district level, and the burden of proof required to initiate legal action that would require inter-district integration is prohibitive (Milliken v. Bradley, 1974). Some school districts have undertaken inter-district integration programs voluntarily, while others have done so under federal or state court order (Finnigan, Holme, Orfield, Luce, Diem, Mattheis, & Hylton, 2015). School attendance zone boundaries are one policy within school districts that the Supreme Court has upheld as a way to promote racial integration of schools (Parents Involved, 2007). School attendance zones are important in helping to determine the racial composition of schools within a district, though due to differential use of public schools, not the sole factor (Saporito & Sohoni, 2009). They are also an important boundary to study because not only are they zones that districts have relative autonomy over and re-draw frequently (unlike school district boundaries), but they are also closely connected to residential segregation, and can deepen our understanding of the link between school segregation, educational boundaries, and residential segregation (Saporito & Sohoni, 2006). In this study, I seek to address the gap that exists in the literature around the role of school zones in segregating populations within school districts. Through applying the method used to determine if more segregation occurs within or between school districts, which has contributed to our fundamental understanding of the role of school districts in contributing to inequality, I determine if more segregation occurs within or between school zones.

The Courts and School Boundaries

State governments have the power to develop school district boundary lines and local school boards have the power to establish school catchment areas, barring a violation of the Constitution or federal law. School catchment areas may be drawn in such a way as to increase segregation, but similarly, they may be developed in a way that can produce integration (Richards, 2014). For example, an attendance zone could be drawn to split a homogeneous population and incorporate a more diverse population. Conversely, an attendance zone could pack a homogenous population into a zone, maintaining a boundary around that population. There is historical precedent for school boundaries that both segregate and integrate. School
boards have often drawn lines to purposefully preserve racially isolated schools such as in Kalamazoo, Chicago, San Francisco, and in many other school districts (Oliver v. Kalamazoo Board of Education, 1972; Lawlor v. Board of Education of Chicago, 1972; Johnson v. San Francisco Unified School Dist., 1971). This occurred across the country, and was a practice not limited to the South. For example, a court in San Francisco found that the school board sited new schools in a discriminatory manor (Johnson v. San Francisco Unified School Dist., 1971). And the Seventh Circuit found unlawful discrimination by the Cook County school board including site selection of schools, the drawing of attendance zones, and student assignment (United States v. School Dist. of Cook County, 1970). In Minneapolis, the school board used a range of actions such as adding portable classrooms to heavily black schools and building small schools in white neighborhoods in an effort to manipulate the racial composition and segregation of schools in the district (Booker v. Special School Dist., 1972). There is evidence that still today some districts engage in policies that use school attendance zone boundaries to racially isolate populations (M. Orfield & Luce, 2009). At the same time, there is evidence that gerrymandered attendance zones in recent years are associated with less segregation (Saporito & Riper, 2016), suggesting that irregularly drawn zones are one way to achieve integration, much like suggested in the landmark Supreme Court case Swann v. Charlotte-Mecklenburg (1971).

In the Swann v. Charlotte-Mecklenburg decision in 1971, the unanimous Supreme Court ruled that drawing irregular attendance zone boundaries in a race-conscious manner was one way to overcome the effects of a dual school system. In that same decision, the Court also recognized that schools and their zoning matters in structuring the residential patterns of a metropolitan area, arguing, “The location of schools may thus influence the patterns of residential development of a metropolitan area and have an important impact on the composition of inner-city neighborhoods” (Swann, 1971, p.20-21). And more recently in the 2007 Parents Involved Supreme Court decision which ruled against the use of individuous race-conscious measures to achieve diversity, Justice Kennedy argued that school boards “may pursue the goal of bringing together students of diverse backgrounds and races through other means, including…drawing attendance zones with general recognition of the demographics of neighborhoods… These mechanisms are race conscious but do not lead to different treatment based on a classification that tells each student he or she is to be defined by race, so it is unlikely any of them would demand strict scrutiny to be found permissible.” (p. 8-9).
The courts have wrestled with the issue of school district intent when it comes to school boundaries and segregation. In the 1972 Supreme Court decision, *Wright v. Council of City of Emporia*, a divided Court reversed a lower court decision that would have allowed a newly incorporated city in Virginia to create a new school district within a larger county school district. While much judicial debate ensued around if and how the intent of policies and laws should supersede the effect of laws, in *Emporia*, the Court ruled that in determining violations of the Constitution the courts should be guided not by the intent of school boards and officials, but by the effects of their actions. The majority opinion argued that determining intent poses challenges, and thus courts must focus on what can be determined: the effect that school officials and boards have on dismantling or maintaining a dual system. This decision was extraordinary for ruling that the intention behind school policies, such as school district boundaries, were not the critical factor in evaluating if a policy impeded desegregation, and rather it was the effect of these policies.

Yet the Supreme Court dealt a unanimous decision in 1992 that marks the beginning of a period when the courts largely retreated from school desegregation. In *Freeman v. Pitts*, the Court reversed many of the arguments made in the historic *Swann* decision around the links between residential segregation and housing segregation. The majority opinion attributed the demographic shifts in DeKalb County Georgia to private actions, and claimed that the school district was not responsible for the existing residential segregation. This is in contrast to the *Swann* decision when the Court established a link between school and housing segregation, and argued that schools can and do impact residential segregation. In their ruling, the Court’s majority relied on assumptions that minimized the role of public officials in housing segregation, including assuming that time remedied the effects of past discrimination, and that natural preferences caused segregation (Orfield, 1996). While studies have allowed us to definitely say that school district boundaries are critical in shaping segregation, contributing to a great extent to the segregation of students and populations in metropolitan areas, the same cannot be said for school attendance zone boundaries. This study will provide evidence of the contribution that elementary school zones have contemporaneously to school district segregation, providing a greater insight into how educational boundaries segregate populations.

**Policies and Politics of Attendance Zones**
Case studies of school districts that have re-drawn their attendance zones, some with the intent to promote racial integration, have provided insight into how politically fraught the practice can be. School attendance zone boundaries have been used historically to maintain the racial character of schools, at times in response to racial change occurring (Clark, 1987). As noted before, attendance boundaries can be used to further integration, often based on the intent of the school board or supervising court. In one example that drew national attention, Eden Prairie School District, a suburb of Minneapolis that experienced racial change in recent years, faced opposition from parents when the district made adjustments to school zones to reduce segregation. The new attendance zones that Eden Prairie put forth, developed by a community group and based on socioeconomic status and not race, resulted in parents organizing a group against the changes and hiring a lawyer to represent them (Eaton, 2012). Eaton found that district leaders were very reticent to utilize race at all given the Supreme Court’s *Parents Involved* decision, even though there are circumstances when it is permissible to use race (U.S. DOE & DOJ, 2011). In another example of a school district in a racially changing suburb, when Henrico County Public Schools in Virginia rezoned its high schools, school officials preserved pockets of white isolation and solidified racial segregation rather than reduced it with the new school boundaries (Siegel-Hawley, 2013). And in another study of two countywide school systems in the South with histories of school desegregation, researchers found that politically engaged parents challenged the student assignment systems in order to achieve the best results for their children, with the outcome that advantaged families could altogether avoid racial integration (Diem & Frankenberg, 2013). With school districts that have historically used integration policies stepping back from these efforts (Parcel & Taylor, 2015) and the courts receding from enforcement of desegregation, the political and policy context for school districts seeking to make their schools more racially integrated is uncertain.

In larger scale studies of school zones using the School Attendance Boundary Survey (SABS) as well as its earlier iteration, SABINS\(^1\), researchers have examined gerrymandered school zones to understand how attendance boundaries relate to racial segregation or integration. Compact, rectangular or square attendance zones are not considered gerrymandered, whereas

\(^{13}\) SABINS (the School Attendance Boundary Information System) is a collaboration between the College of William and Mary and the Minnesota Population Center that provides, free of charge, aggregate census data and GIS-compatible boundary files for school attendance areas, or school catchment areas, for selected areas in the United States for the 2009-10, 2010-11 and 2011-12 school years.
irregularly shaped zones that draw populations from non-contiguous neighborhoods would be considered gerrymandered (Saporito & Riper, 2016). Given patterns of racial residential segregation, sometimes the only way in which schools can achieve racial diversity is to gerrymander zones. Indeed, a typical example of a gerrymandered attendance zone would be the “finger plan” where a multipart zone, reaching out like fingers on a hand, is created for elementary schools (Douglas, 1995). Richards, when examining the gerrymandering of school attendance boundaries, finds that in districts under court ordered desegregation, gerrymandered lines can serve to further integration (2014). Similarly, Saporito & Riper found that school attendance zones which are irregularly shaped—while the majority of boundaries are compact and square—are more diverse and contribute to racial integration within school districts (2016).

Yet studies that have examined school enrollment along with school catchment areas reveal ways in which families opt out of the public school system in segregative ways. Racial segregation in public schools is higher than racial segregation across school attendance zones, resulting from white students leaving the public school system at higher rates than other racial groups, a pattern that is particularly acute in racially balanced attendance zones (Sohoni & Saporito, 2009). Similar results were found when examining poverty, with more affluent families withdrawing from the public schools leaving diverging rates of poverty in catchment areas and their corresponding schools (Saporito & Sohoni, 2007). Prior research on attendance areas demonstrates both their salience in structuring racial segregation within school districts (Richards, 2014; Saporito & Riper, 2016), but also that they are boundaries which can be subverted by families with the opportunity to opt out of schools that they are zoned to attend (Sohoni & Saporito, 2009; Saporito & Sohoni, 2007).

The Current Study

A growing body of research has recognized that schools and education policy matter for residential segregation. For example, school district boundary lines segregate the population residually (Owens, 2017), real estate agents steer clients not only to particular neighborhoods but also to particular school zones (Dougherty, 2010), and homebuyers seek homes that are proximate to less racially diverse schools (Dougherty et al, 2009). While a good deal of research and policy attention has been given to particular policy areas, such as the role of school district boundaries in segregation and the role of charter schools, less attention has been payed to the
role of school attendance zones in residential segregation. These zones are important to study because they are a legally permissible policy lever that school districts have autonomy over to design in ways that foster integration. They are also critical to understand as a nexus between schools and housing, because they are critical in the assignment of students to schools, but also in the home selection process, positing them at the intersection of what is now recognized as a bidirectional link between school and housing segregation. In this study, I examine:

1) What is the composition of elementary school attendance zones for the average white, black, Hispanic, and Asian resident of large U.S. school districts?
2) What is the magnitude of racial residential segregation of elementary school zones for the total and under 18 population in large U.S. school districts?
3) Is a greater proportion of racial residential segregation for the total population and the under 18 population in large U.S. school districts due to segregation within or between elementary catchment areas?

Methodology

Data

School Attendance Boundary Survey (SABS). This study draws on data from a recently released federal dataset, the School Attendance Boundary Survey. The U.S. Department of Education’s National Center for Education Statistics (NCES) launched SABS in 2013 and conducted surveys biennially. SABS is a voluntary survey that is designed to collect data on school attendance boundaries for all schools in the U.S., although coverage for the current SABS release is not complete and is biased towards large school districts. However, this issue is mitigated by the fact that the largest school districts have the most school attendance zones and most complex student assignment policies. Indeed, there are many small school districts in the U.S. where the study of attendance zones is less relevant because they coincide with school district boundaries; that is, there is only one elementary school for the entire school district. In order for a school’s boundaries to be included in the SABS survey it must meet a number of criteria including: 1) currently open; 2) not a charter school; 3) not a magnet school; and 4) defined as a regular school by the SY 2013-2014 CCD14 (Phan, 2015). The SABS data used in

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14 Charter schools and magnet schools typically do not have attendance boundaries and operate outside of the public school attendance boundary system. Regular schools include those locally governed agencies that are responsible for
this study includes SY 2009-10 boundaries and custom tabulations of ACS 2006-2010. Unfortunately SABS currently does not have data available from previous decades which could make it possible to study changes in segregation of attendance zones over time.

**Census data.** In order to measure the contribution of school attendance boundaries to school district racial segregation, it is necessary to measure both the segregation within school attendance zones, and the segregation between school attendance zones in school districts. I use block level data from the U.S. Census for the year 2010\textsuperscript{15} and race counts from Summary File 1, including both the total population and the under 18 population.\textsuperscript{16} The race counts that are included are non-Hispanic whites, non-Hispanic blacks, Hispanics, and Asians.\textsuperscript{17}

Blocks do not align perfectly with school attendance zones, and in cases when a block crosses a school attendance zone boundary, areal interpolation is used to obtain population counts for the block. Areal interpolation always introduces the potential for error because it assumes that populations are evenly distributed across a unit, and if a population is skewed to one portion of the unit’s area then the likeliness of error will be higher (Logan, Xu & Stults, 2014). However, blocks are less susceptible to this problem as they are very small census units which are often delineated with population patterns in mind (i.e. empty areas are their own blocks—whereas block groups or tracts include these empty population areas along with populated areas).

**Sample**

Included in this study are 90 of the 100 largest school districts in the U.S. by student population size that have SABS coverage and utilize school attendance zone boundaries in the assignment of students to schools.\textsuperscript{18} These school districts represent all regions of the country, providing free public education and include independent school districts and those that are a dependent segment of a local government such as a city or county.

\textsuperscript{15} Data available in SABS does not include units within school attendance areas (which would make it possible to measure segregation within attendance zones), and so for an analysis of within and between catchment segregation I do not use the custom tabulations of ACS data provided by SABS.

\textsuperscript{16} I derive population counts for the under-18 population by subtracting the race counts for the total population by the race counts for the over-18 population. The under-18 population includes any individual from 0-17.

\textsuperscript{17} I include only the largest four racial groups in the U.S. in this study since including an “other” category when using the entropy measure Theil’s H (the main segregation measure used in this study) can have an outsize effect on segregation outcomes.

\textsuperscript{18} SABS has coverage for approximately 350 large school districts. Not included from the largest 100 school districts in this study are the New York City school districts because the school district boundaries changed frequently, complicating an analysis of school zones. Also not included are the school districts where the district
different student body compositions, and diverging histories and current approaches to integration. The population in these districts includes approximately 60 million individuals, 45 percent of whom are white, 26 percent Hispanic, 20 percent black, and 6 percent Asian. In these large school districts, in comparison to the entire U.S. population, the population has a lower percentage of white residents, a higher percentage of black and Hispanic residents, and about a comparable percentage of Asian residents.

Analysis

Different segregation indices measure the various dimensions of segregation (Massey & Denton, 1988). Two segregation indices are used in this study in order to understand the segregation of school attendance zones and the contribution of attendance zone segregation to school district racial segregation. First, the exposure dimension is measured with the interaction and isolation $P^*$ indices. These indices seek to capture the experience of segregation by examining the extent to which the population resides in areas (neighborhoods, catchment areas, schools, etc.) with residents of different and same racial groups. When measuring interaction and isolation of elementary school zones, I use the custom tabulations of 2006-2010 ACS data provided by SABS.$^{19}$ And second, I use Theil’s $H$ (Theil, 1972), a multiracial segregation measure that captures the evenness dimension and is decomposable across units. To measure the segregation within and between elementary school zones in large school districts, I use census block data merged with SABS shapefiles

Exposure ($P^*$). Scholars have made the argument that some indices are particularly suited to measuring school segregation because they are attentive to the potential for interracial contact which is at the core of school desegregation efforts (Orfield, Siegel-Hawley & Kucsera, 2014). The interaction and isolation $P^*$ indices, which tap exposure, are often used for this purpose, and in this study I use them to illustrate interracial contact of populations at the school catchment level. The exposure index overcomes one limitation of Theil’s $H$ because it is sensitive to the populations’ racial composition, and how that is related to interracial contact (Orfield et al, 2014; Owens, 2017). For example, if a school district is 80 percent Hispanic, as

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$^{19}$ Although I do not use the SABS tabulations to compute $H$, I do use them to compute the interaction index. This is because when computing interaction I do not measure segregation at a scale smaller than the school attendance zone boundary.
long as the schools in those districts are roughly each 80 percent Hispanic, using Theil’s H the school district will appear to be integrated, because the population is distributed evenly. However, if using the exposure index in that same scenario, it will reveal that Hispanic students are racially isolated in that school district, showing a pattern of segregation rather than integration. Therefore it is useful to consider both H and exposure simultaneously to capture the multiple dimensions of segregation. One of the exposure measures of residential segregation is the interaction index, which calculates the extent to which members of racial groups are exposed to members of different racial groups. Interaction is calculated using the following equation:

\[ s P_x^* = \sum_{i=1}^{n} \left[ \frac{x_i}{X} \right] \left[ \frac{y_i}{t_i} \right] \]  

(4)

Here \( x_i \), \( y_i \) and \( t_i \) are the counts of members of different racial groups and comprise the total population of unit \( i \). \( X \) represents the total population of group \( x \) in the entire study area (i.e. number of Hispanics in the school district). The isolation index that I use alongside the interaction index shows to what extent racial groups are only exposed to one another and is calculated as:

\[ s P_x^* = \sum_{i=1}^{n} \left[ \frac{x_i}{X} \right] \left[ \frac{t_i}{y_i} \right] \]  

(5)

The exposure index allows for an understanding of the level of racial interaction that could potentially occur within a catchment area, describing the composition of the zones within a school district for a typical resident. For example, the interaction and isolation indices will indicate that the typical white person resides in an attendance zone that is 65 percent white, 10 percent black, 20 percent Hispanic, and 5 percent Asian. Interaction and isolation are influenced by demographic changes and the overall demographics of the study area, allowing for an understanding of how the composition of the population is related to segregation. Combining the exposure index with H allows for a more complete picture of segregation of catchment areas within school districts, as both measures have strengths and weaknesses.

**Evenness (Theil’s H).** H, or the Information Theory Index, is an evenness measure, which examines the random distribution of all racial groups among units within a study area. This measure is used most often to determine the diversity of the sub-unit under study (school, neighborhood, etc.) as compared to the diversity of the entire study unit (school district,
metropolitan area, etc.). H relies on calculating the entropy (or diversity) of the school district, and the average deviation of each catchment area from the school district’s entropy.

H is estimated using the following equation (Fowler, Lee, & Matthews, 2016; Parisi, Lichter, & Taquino, 2011):

\[ H = \frac{1}{TE} \sum_{j=1}^{J} t_j (E - E_j) \]  

(1)

Here T and \( t_j \) reference the population of the entire area of study \( J \), and its subcomponent \( j \). \( E \) and \( E_j \) represent the entropy of area \( J \) and its subcomponent \( j \).

The H index is reported using a 0 to 1 scale, with 0 representing complete evenness of groups across units, and 1 representing complete segregation of groups across units. The most intuitive interpretation of H is to convert it into a percentage that indicates how much less diverse on average sub-units are from the entire area of study. For example, a H value of .250 in this study could indicate that elementary catchment areas in a school district are on average 25 percent less diverse than the school district as a whole. One of the greatest advantages of H is that it measures all racial groups simultaneously, an increasingly important attribute as racial diversity in the U.S. increases. Most importantly however for this study, is that H has the advantage of being decomposable across geographies in order to understand the relative contribution of segregation from various units (Reardon & Firebaugh, 2002). I build the H decomposition based on the work of Fowler, Lee & Matthews (2016) who use the following notation:

\[ H_{JK} = \frac{1}{TE} \sum_{k=1}^{K} \sum_{j=1}^{J \text{in } k} t_j (E_k - E_j) \]  

(2)

This equation allows for the observation of individual contributions of subunits k to the overall \( H_{JK} \). In the decomposition, if the observations are elementary catchments within the school district, then \( H_{ECU} \) would be equal to \( H \) in equation (2).

\[ H_{SD} = H_{ECS} + H_{BEC} \]  

(3)

The above decomposition indicates \( H_{SD} \) (total segregation of the school district) equals the sum of differences between elementary catchment areas \( EC \) within the school district plus the sum of differences between blocks \( B \) within those elementary catchments. In this study, I use an H decomposition to ascertain the proportion of racial residential segregation for the total population.
and the under 18 population that occurs within school attendance zones as compared to between school attendance zones.

**Results**

First, I present findings from the exposure index at the elementary catchment zone level, describing the interaction and isolation that the average resident experiences in an elementary attendance zone. Next, I show the magnitude of multiracial segregation of elementary school catchment areas for the total population and the under 18 population. These findings are discussed for both residential segregation of school districts between elementary school zones, and within them. And finally, I describe the proportion of school district residential segregation that is due to segregation within and between elementary school catchment areas for the total population and the under 18 population.

**Racial Interaction and Isolation in Elementary Catchment Zones**

The results of the exposure index indicate that the interaction that the average white, black, Hispanic, and Asian individual has with other racial groups in elementary catchment zones varies, with racial groups residing in catchments that are compositionally distinct. The interaction index shows the extent of interracial contact the average resident of an elementary catchment zone has with other racial groups, and the isolation index indicates the exposure that the average resident has with members of their own racial group. I present the average elementary school catchment composition for the largest school districts in the U.S in Figure 2.1 and Table 2.1. The most racially isolated racial group at the elementary zone scale was white residents; that is, they were the group that has the highest exposure to residents of the same race and the lowest exposure to residents of different races. This is similar to what is found in public school enrollments, that white students are the most isolated racial group (Orfield, Kucsera & Siegel-Hawley, 2012). In elementary catchment areas across the largest school districts, the average white resident lived in a catchment that was 64 percent white, 12 percent black, 16 percent Hispanic, and 6 percent Asian. These figures are also consistent with what the literature on racial residential preferences show; that is, white residents tend to prefer neighborhoods that are composed of a greater share of white residents (Charles, 2006) and as the size of the non-white population increases in a neighborhood, it is increasingly likely that white residents will leave that neighborhood (Crowder & South, 2008).
Across elementary school catchment areas, black residents and Hispanic residents were exposed to whites the least, while Asians had relatively greater exposure to white residents. The average black individual lived in a catchment area that was 26 percent white, 53 percent black, 15 percent Hispanic, and 4 percent Asian. And the average Hispanic resident’s catchment was quite similar in terms of exposure to Asian and white residents. Similarly, whites had relatively low exposure to black and Hispanic residents, and relatively higher exposure to Asian residents. These compositional differences for attendance zones by race group indicate that the residential experiences across elementary school attendance zones in large school districts vary depending on race.

*Figure 2.1: Average elementary catchment racial composition, 2010*

Source: SABS SY 2009-10 school attendance boundaries merged with ACS 2006-10 estimates

In 2010, while white individuals were the most racially isolated group across elementary catchment areas, Asians were the least racially isolated (this is due to their relatively small population size; see Table 2.2).\(^{20}\) Black and Hispanic residents had nearly the same level of racial isolation at the elementary attendance zones scale, with black residents on average residing in zones that were 53 percent black and Hispanic individuals residing in zones that were 52 percent Hispanic (isolation levels not too far behind those of whites). Isolation is an important

\(^{20}\) That Asians are the least racially isolated is not surprising given that they represent a small proportion of the total population and thus they are exposed to a greater extent to other racial groups which make up a larger share of the population.
measure to consider when examining segregation in the education context because it gets at the heart of the goals of racial desegregation in education, which was to reduce the occurrence of racially isolated schools—particularly for black students (Orfield et al, 2014). What the patterns of elementary catchment isolation show is that there were high levels of isolation for whites, blacks, and Hispanics, the groups for which desegregation was most meant to affect exposure. These results also indicate the salience of school attendance zones in structuring residential patterns.

Table 2.1: Average elementary catchment racial composition, 2010

<table>
<thead>
<tr>
<th></th>
<th>Average White Resident</th>
<th>Average Black Resident</th>
<th>Average Hispanic Resident</th>
<th>Average Asian Resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>%White</td>
<td>63.92</td>
<td>25.90</td>
<td>28.61</td>
<td>44.73</td>
</tr>
<tr>
<td>%Black</td>
<td>11.60</td>
<td>53.01</td>
<td>12.08</td>
<td>12.88</td>
</tr>
<tr>
<td>%Hispanic</td>
<td>16.29</td>
<td>15.34</td>
<td>52.05</td>
<td>23.54</td>
</tr>
<tr>
<td>%Asian</td>
<td>5.68</td>
<td>3.65</td>
<td>5.25</td>
<td>15.93</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with ACS 2006-10 estimates

Table 2.2: Racial composition of large U.S. school districts, 2010

<table>
<thead>
<tr>
<th>% White</th>
<th>% Black</th>
<th>% Hispanic</th>
<th>% Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>45.54</td>
<td>20.41</td>
<td>25.92</td>
<td>5.78</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with ACS 2006-10 estimates

Racial Segregation within and between School Attendance Zones

The magnitude of elementary school zone segregation. As many other studies have found, whites and blacks are the most residentially segregated groups, and this remains true when residential segregation is studied at the scale of the elementary school zone. For black and white residents, on average, elementary school attendance zones were about 20 percent less diverse than the school district as a whole (Table 2.3). And the segregation of neighborhoods within catchment areas was also moderate for black and white residents, with blocks in catchment areas about 18 percent less diverse than the school district as a whole.

The segregation of white and Hispanic residents aligns closely with the levels of multiracial segregation; lower than black-white segregation but higher than Asian-white segregation. Hispanic and white residents lived in catchment areas on average that were about 14 percent less diverse than their school district as a whole. Interestingly, white and black residents
experienced nearly the same magnitude of segregation within school attendance zones as white and Asian residents, a racial dyad that tends to experience lower magnitudes of segregation. While the segregation of Asian and white residents between attendance zones is low, the more micro-scale or within catchment segregation is quite high-greater than that of multiracial or white-Hispanic segregation, and almost as high as white-black segregation. Asian and white residents live in neighborhoods within catchment areas that are about 18 percent less diverse than the school district as a whole.

Table 2.3: Racial evenness of neighborhoods between and within elementary school catchment areas in large U.S. school districts, 2010

<table>
<thead>
<tr>
<th></th>
<th>Total School District Segregation</th>
<th>Between Catchment</th>
<th>Within Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiracial</td>
<td>0.297</td>
<td>0.153</td>
<td>0.144</td>
</tr>
<tr>
<td>White-Black</td>
<td>0.384</td>
<td>0.202</td>
<td>0.183</td>
</tr>
<tr>
<td>White-Hispanic</td>
<td>0.285</td>
<td>0.144</td>
<td>0.140</td>
</tr>
<tr>
<td>White-Asian</td>
<td>0.269</td>
<td>0.089</td>
<td>0.179</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

Children may be more unevenly sorted by race across neighborhoods and catchment areas than adults because of the particular salience of school identity, and the links between residence and schools for this population (Owens, 2017). Research has shown that schooling options shape residential decisions, and especially do so in a racially diverse context (Saporito, 2003; Saporito & Sohoni, 2007). It is for this reason that I examine the under 18 population in the largest, and some of the most diverse, school districts separately to understand if and how children are sorted distinctly from the total population.

The magnitude of segregation experienced by the under 18 population was higher than that experienced by the total population (Table 2.4). The segregation by catchment areas of all four racial groups for the under 18 population shows that catchments were about 18 percent less diverse than the school district as a whole. The neighborhoods within those catchments were only slightly less diverse; on average about 19 percent less diverse than the school district as a whole. But for under 18 black and white residents, segregation was much higher. On average, catchment areas were about 25 percent less diverse for black and white children than the school district in which they live. Catchment areas that are 25 percent less diverse than the entire school district represents high segregation for black and white children at a scale which is very socially
meaningful, determining the school where those children are assigned by their school district to attend school. And for black and white children, neighborhoods within the catchment areas were also about 25 percent less diverse than the school district as a whole, representing high segregation within an already segregated elementary school zone. To compare, for the total black/white population, elementary catchment areas were approximately 20 percent less diverse than the school district in which residents lived, and neighborhoods within catchment areas were approximately 18 percent less diverse, indicating that for children segregation is indeed higher.

Table 2.4: Racial evenness of neighborhoods between and within elementary school catchment areas, under 18 population in large U.S. school districts, 2010

<table>
<thead>
<tr>
<th>Total School District Segregation</th>
<th>Between Catchment</th>
<th>Within Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiracial</td>
<td>0.373</td>
<td>0.179</td>
</tr>
<tr>
<td>White-Black</td>
<td>0.499</td>
<td>0.246</td>
</tr>
<tr>
<td>White-Hispanic</td>
<td>0.375</td>
<td>0.176</td>
</tr>
<tr>
<td>White-Asian</td>
<td>0.401</td>
<td>0.120</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

The relative contribution of attendance zones. Because H can be decomposed across geographic units, it is possible to estimate the proportion of residential segregation in school districts that is due to segregation between elementary catchment areas, and the proportion of segregation in school districts that is due to segregation within elementary catchment areas. The decomposable properties of Theil’s H allows for the partition of total segregation into additive components. In this case, census blocks and elementary attendance zones comprise the segregation of the entire school district. The proportion of segregation due to segregation of elementary attendance zones is the amount by which total segregation of the school district would be reduced if segregation of elementary zones was eliminated by relocating individuals across zones, but leaving neighborhood segregation unchanged. Conversely, the proportion of segregation due to the segregation of neighborhoods within elementary zones is the amount by which total segregation of the school district would be reduced if segregation of neighborhoods in zones was eliminated by redistributing individuals across neighborhoods, but leaving catchment segregation unchanged (Reardon & Firebaugh, 2002). Here, the block segregation of the entire school district is equal to the segregation of components elementary school attendance zones and blocks.
I explore the contribution of the components, elementary catchment areas and blocks, to school district segregation in large school districts. Specifically I examine the evenness with which racial groups are spread between elementary school attendance zones, and the evenness with which racial groups are spread within elementary attendance zones. If racial groups are spread more unevenly between attendance zones than within them that indicates that groups are more segregated by attendance zones. In contrast, if racial groups are spread more unevenly within attendance zones, it indicates that groups are more segregated by residences within those zones. In this section, I present the average results for the 100 largest school districts in the U.S., examining multiracial segregation between the four largest racial groups, as well as dyad segregation. Results are discussed for both the total population and for the under 18 population.

Table 2.5 shows estimates of segregation between and within elementary school attendance zones for the total population. About 52 percent of multiracial residential segregation, between white, black, Hispanic, and Asian residents, occurred between elementary catchment areas in 2010. In other words, a little over half of racial residential segregation in school districts is due to residents living in neighborhoods in different school zones. For white-black and white-Hispanic dyads, segregation is also almost evenly split within and between elementary school attendance zones. It is only for white and Asian segregation that a different pattern exists, with only one-third of racial residential segregation of the school district due to segregation between catchment areas. In the case of Asian-white segregation, these groups are more evenly distributed between catchment areas, but within them are more unevenly distributed. These findings indicate that for Asian and white residents, elementary school zones are less segregative than for all other groups.

Table 2.5: Proportion of residential segregation occurring between and within elementary school catchment areas in large U.S. school districts, 2010

<table>
<thead>
<tr>
<th></th>
<th>Between Catchment</th>
<th>Within Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiracial</td>
<td>51.6</td>
<td>48.4</td>
</tr>
<tr>
<td>White-Black</td>
<td>52.5</td>
<td>47.5</td>
</tr>
<tr>
<td>White-Hispanic</td>
<td>50.4</td>
<td>49.6</td>
</tr>
<tr>
<td>White-Asian</td>
<td>33.2</td>
<td>66.8</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

In 2010, about 48 percent of multiracial segregation of the under 18 population occurred between elementary school attendance zones, and segregation between neighborhoods in those
zones accounted for the rest (Table 2.6). This proportion is slightly less than the proportion that occurred for the total population, showing that the population as a whole was more unevenly sorted among elementary school attendance zones than the under 18 population is. The most sorting between elementary school attendance zones occurred between black and white children, with approximately half of segregation occurring between these zones. And the least sorting between elementary school zones occurred between Asian and white children, with less than a third of segregation attributable to between catchment segregation.

The proportion of segregation due to segregation of neighborhoods within catchment areas is greatest for white and Asian children, and to a lesser extent, white and Hispanic children. Approximately 70 percent of segregation of school districts for white and Asian children was due to the more micro scale segregation within attendance zones. The least sorting within catchments occurred between black and white children under 18. This suggests that inequality is greatest for white and Asian children within catchment areas, where they were sorted by residences within catchments. In contrast inequality is greatest for black and white children between catchment areas, where they were sorted unevenly between elementary school zones. Both forms of inequity are consequential, but being sorted unevenly between school zones has the very material consequence of the assignment to attend different schools.

Table 2.6: Proportion of residential segregation occurring between and within elementary school catchment areas in large U.S. school districts, under 18 population, 2010

<table>
<thead>
<tr>
<th></th>
<th>Between Catchment</th>
<th>Within Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiracial</td>
<td>47.96</td>
<td>52.03</td>
</tr>
<tr>
<td>White-Black</td>
<td>49.32</td>
<td>50.47</td>
</tr>
<tr>
<td>White-Hispanic</td>
<td>46.84</td>
<td>53.20</td>
</tr>
<tr>
<td>White-Asian</td>
<td>29.97</td>
<td>69.83</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

Differences between total population and under 18 population. Most of the disparity between the segregation of the total population and the under 18 population was due to higher segregation of the under 18 population within catchment areas, rather than segregation between catchment areas (Table 2.7). For all racial dyads as well as multiracial segregation, there was a larger increase in within-catchment segregation. For example, white/black segregation was about 12 points higher for the under 18 population as compared to the total population. Between catchment segregation was four points higher, while within catchment segregation was seven
points higher. And the largest disparity between the total population and the under 18 population was for white/Asian segregation. It was 13 points higher at the school district level, and that was largely due to the 10 point increase in within-catchment segregation.

It is somewhat surprising that the under 18 population was more segregated within catchment areas, rather than between them. It would be expected that elementary school attendance zones would matter more to households that have children under 18 because that is directly linked to what school that child is assigned to attend. On the other hand, what is clear is that the under 18 population within school districts was segregated more so on a micro scale within elementary zones than between those attendance zones. Or, said another way, this population was segregated more by neighborhoods within elementary zones, than between zones.

Table 2.7: Difference between segregation of total population and under 18 population between and within elementary catchment areas, 2010

<table>
<thead>
<tr>
<th></th>
<th>Total School District Segregation</th>
<th>Between Catchment</th>
<th>Within Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiracial</td>
<td>0.076</td>
<td>0.026</td>
<td>0.050</td>
</tr>
<tr>
<td>White-Black</td>
<td>0.115</td>
<td>0.044</td>
<td>0.069</td>
</tr>
<tr>
<td>White-Hispanic</td>
<td>0.090</td>
<td>0.032</td>
<td>0.060</td>
</tr>
<tr>
<td>White-Asian</td>
<td>0.132</td>
<td>0.031</td>
<td>0.101</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

Summary of decomposition findings. Slightly over half of racial residential segregation of the total population in 2010 was due to residents living in neighborhoods in different elementary school attendance zones. This means that for the total population, attendance zones account for a substantial proportion of school district racial residential segregation. That a large proportion of the total population is segregated by school attendance zones highlights the importance of these boundaries in residential choices, and school zones’ relationship to other municipal services that may be closely linked to race and place. School attendance zone boundaries play the greatest role in segregation outcomes for black and white residents, both relatively and absolutely. This is not surprising given the large body of research that documents high magnitudes of segregation for black and white individuals (i.e. Logan & Stults, 2011), a long history of housing discrimination towards black households (De Souza Briggs, 2005; Rothstein, 2014; Shapiro, 2004), and residential preferences among households of different racial backgrounds to avoid black neighbors (Emerson, Yancey & Chai, 2001; Harris, 2001; Krysan & Bader, 2007).
What is also clear from the decomposition analysis is that the magnitude of segregation within school districts is higher for the under 18 population. But this is due more to the segregation between blocks within elementary schools zones, than due to the segregation between elementary school zones themselves. In particular, white/black and white/Asian residents under 18 experienced high levels of segregation as compared to the total population. And the difference between the total population and the under 18 population for white and Asian segregation was mostly due to the high segregation of blocks within elementary school attendance zones. In sum, a comparison of the under 18 population with the total population decomposition shows that on average, elementary school attendance zones contribute slightly less to segregation of the under 18 population. The under 18 population, and particularly Asian children, are segregated more within elementary school zones.

Discussion

Research has documented that neighborhood segregation is related to school segregation, with some scholars arguing that the problem of school segregation is so intractable because of the degree to which neighborhoods are segregated. Other work has documented the ways in which school segregation leads to residential segregation, and this growing body of work has confirmed that the link between residential segregation and school segregation is bidirectional (Frankenberg, 2009; Lareau & Goyette, 2014; Owens, 2017). The research discussed here extends upon the line of research that has explored how school boundaries are related to residential segregation. I examined elementary school attendance zones and their relationship to racial residential segregation in school districts, finding that these educational boundaries play a role in segregating the population within school districts.

Elementary school zones in large and racially diverse school districts are boundaries that contribute to the racial residential segregation of school district populations, and scales at which residents experience varied exposure to their own racial group and to other racial groups. Exposure to different racial groups in schools is associated with a number of positive short and long term outcomes, including higher academic achievement for black and Hispanic students with no corresponding decline for white students (Hanushek et al., 2009), an enhanced ability to make friends across racial groups and a reduction in racial stereotypes (Hawley, 2007; Pettigrew & Tropp, 2006), and a greater likelihood to live in racially diverse neighborhoods in the future.
than those who attended segregated schools (Sterns, 2010). Additionally, exposure shapes outcomes through neighborhood effects on local municipal resources, social networks and support, and socialization with other racial groups (Owens, 2017). White residents are the most racially isolated group in attendance zones, on average, living in elementary catchment areas that are majority white. Hispanic and black residents are also racially isolated in these zones, living in zones that are majority Hispanic and majority black respectively. Households within elementary zones are assigned to attend schools within those zones, and the patterns of exposure and isolation would indicate—and previous research has confirmed—that schools in large school districts are racially isolated (Orfield et al., 2016). That whites are the most racially isolated group suggests that attendance zones, which are closely coupled with the valuable resource of schools and educational opportunity, may serve as a geographic unit that concentrates advantage.

The results at the catchment level are worth contrasting with previous research of interaction at the census tract level. An elementary catchment area is quite a different unit than a census tract because it is directly related to the school that a resident in that zone is assigned to attend. Because residents within catchment areas and school districts are zoned for particular schools, there are strong incentives to sort across these boundaries, as compared to census tracts (Weiher, 1991). Previous research studying tract level exposure of metropolitan areas found that in 2010, the average white resident lived in a tract that was 88 percent white, while the average black resident lived in a tract that was 45 percent black, and the average Hispanic resident lived in a tract that was 46 percent Hispanic (Logan & Stults, 2011). When examining elementary catchment areas in large school districts, I found that the average white individual lived in a catchment that was 64 percent white, the average black individual lived in a catchment that was 53 percent black, and the average Hispanic individual lived in a catchment that was 52 percent Hispanic. Although the samples compared here are different, there are some useful comparisons to cautiously point to.21 While there is a large difference in white isolation at the tract level as compared to the elementary catchment level, with white isolation in catchments much lower, black and Hispanic isolation is actually higher at the elementary catchment level as compared to the tract level. This suggests that elementary catchments as they are drawn are related to lower racial isolation for whites as compared to neighborhood (tract) level isolation, yet these same

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21 In a study examining segregation at the school, elementary zone, and tract levels simultaneously, similar results were found (Taylor & Frankenberg, 2017).
zones increased racial isolation for blacks and Hispanics compared to neighborhood (tract) isolation. Studying segregation at multiple scales has provided important insights into processes and consequences of segregation (i.e. Fowler, 2016; Fowler, Lee & Matthews, 2016; Reardon et al., 2008), and the area of educational boundaries would benefit from for future research that examines multiple scales simultaneously, such as school attendance zones, schools, and tracts. It would be especially important for research to examine how interracial exposure differs at these scales to better understand educational inequity.

The under 18 population experienced higher levels of neighborhood and catchment segregation within school districts, and thus faces greater inequality residentially. Children lived in neighborhoods within catchment areas that were less diverse, and in catchment areas that were themselves less diverse. However, more segregation of the under 18 population within school districts was due to segregation within elementary school zones, rather than between them. There are a number of possibilities for why the under 18 population was segregated to a greater extent by neighborhoods within elementary attendance zones. Relative to the total population, households with children under 18 may be more sensitive to making housing choices that result in neighbors of the same race. Research has documented thresholds of tolerance for other racial groups in residential settings, and that residents of all races are particularly adverse to black neighbors (Adelman, 2005; Charles, 2005; Emerson, Yancey & Chai, 2001; Harris, 2001). And in the case of this study, ‘neighbors’ in a very immediate or micro sense of the term. Rarely is residential segregation within school districts studied, and school districts are much smaller scales themselves than metropolitan areas or counties, more common areas within which residential segregation is analyzed. Interestingly, while previous research has shown that school district boundaries sort children more unequely than adults within metropolitan areas (Owens, 2017), this research, at a much smaller scale, complicates our understanding of how school boundaries are related to segregation for children. I find that about half of the total population’s racial residential segregation occurs between elementary school attendance zone boundaries, but slightly less than half of the under 18 population’s segregation occurs between these boundaries. In other words, more of children’s segregation occurs within elementary catchment areas boundaries than between them. Segregation of the under 18 population within school districts also occurs at a high magnitude, particularly for black and white children both between and within school zones.
Designing effective policies to address racial segregation of school districts requires understanding the extent to which neighborhood residence and segregation is related to school segregation. School zones are one clear way in which residential patterns can be replicated in schools, and school zones are closely connected to choices households make about where to live. Elementary school zones are also one important policy tool available to school districts that may reduce not only school segregation, but also residential segregation. This study shows that these boundaries play an important role in segregating the total population within school districts, and differentially depending on the racial groups.
Chapter 4

SCHOOL DISTRICT CHARACTERISTICS RELATED TO ELEMENTARY SCHOOL ATTENDANCE ZONE SEGREGATION IN LARGE U.S. SCHOOL DISTRICTS

While many scholars have pointed out the myriad of ways that housing policies and real estate practices have shaped the historical and contemporary patterns of residential segregation in the U.S., less often are non-housing policies considered for how they may contribute to creating or maintaining residential segregation. Virtually every large school district designs school attendance zone boundaries which, alongside student assignment policies, determine what school students will attend. These zones are one of the clearest links between residential and school segregation, directly connecting residence to schools. Additionally, school attendance zones may be critical in shaping residential decisions that families make, as educational boundaries and the composition of neighborhood school have been shown to impact residential outcomes (Lareau & Goyette, 2014; Owens, 2017; Saporito, 2009; Saporito & Sohoni, 2006). In this study, I examine school district characteristics that are associated with elementary school attendance zones that segregate the residential school district population, exploring in what cases these zones matter the most in terms of contributing to school district residential segregation. Through the use of a new federal dataset, the School Attendance Boundary Survey (SABS) alongside census data, I determine the unique contribution of elementary school attendance zones to the racial residential segregation of school districts. An understanding of the school district characteristics associated with segregative school zones can provide greater insight into the processes and consequences of educational policies in shaping residential segregation.

Scholars trace the roots of contemporary residential segregation to the legacy of federal, state and local policies, including zoning rules, racial covenants, segregated housing projects, exclusionary federal subsidies, the drawing of segregated municipal boundary lines, urban renewal plans, and interstate freeway construction, among others, to explain racial residential segregation (Hirsch & Mohl, 1993; Hirsch, 2000; Orfield, 1996; Ross & Turner, 2005; Rothstein, 2014). The same policies that have been used to make it possible for so many Americans to become homeowners have also been used to maintain racial segregation (Shapiro, 2004). Recently, contemporary education policies have been examined for their impact on residential segregation, expanding our understanding of how non-housing policies are related to racial residential segregation. Municipalities are seceding from large countywide school systems,
forming their own separate school districts, leading to residential disparities across district lines in race, home prices, income, and educational attainment among the population (Frankenberg, 2009). And residents of metropolitan areas are more segregated between school district boundaries than within them, indicating that school districts are important factors in structuring racial residential segregation of metropolitan areas (Owens, 2017). Yet education policies can also be used to further residential desegregation, with metropolitan-wide school desegregation policies supporting more integrated housing (Orfield, 2001; Pearce, 1981). School attendance zones are one educational policy that has received relatively less attention, but is at the nexus of education and housing policy. These zones structure school attendance based on residence, and have been shown to impact households’ choices about housing based on school zones for the total population, regardless of if a household has children. That the attendance zones matter in household decisions and residential segregation of the total population (Dougherty, 2010; Saporito & Sohoni, 2006; Saporito & Riper, 2016) underscores that these boundaries are socially meaningful beyond just the function they fulfill as a factor in student assignment to school.

The purpose of this paper is to explore the school district characteristics that are associated with the magnitude of elementary attendance zone segregation, and with the relative contribution of elementary school zones to the racial residential segregation of school districts. I use Theil’s H to measure the racial residential segregation occurring within and between elementary school attendance zones, decomposing Theil’s H to understand what proportion of segregation occurring within the school district is due to elementary attendance zones. Specifically, I examine:

1) What school district characteristics are associated with elementary school catchment areas that contribute the most to racial residential segregation of school districts?

2) What school district characteristics are associated with elementary school catchment areas that are highly segregated by race?

3) Are there any differences between the total population and the under 18 population in terms of the extent to which school district characteristics are related to the segregation of elementary catchment zones?

   a) If so, how is this apparent in the relative contribution of elementary school catchment areas to school district racial segregation?
b) If so, how is this apparent in the absolute segregation levels of elementary school catchment areas?

The main contributions of this research are to describe in what school district contexts elementary attendance zones are highly segregated, and contribute to the most to the racial segregation of school districts. Understanding in what types of school districts attendance zones are most segregative will deepen our understanding of the relationship between segregation and educational boundaries, and provide additional evidence of the role of educational policies in residential segregation.

Literature Review

In this study, I examine how six school district characteristics are related to the segregation of elementary school attendance zones in large U.S. school districts. In order to determine what characteristics are most salient for analysis, I draw from a large body of literature in education and sociology. From research on racial residential and school preferences, I elect to consider how school districts demographic diversity and racial composition is related to the segregation of elementary school zones. And from research in the area of school desegregation, I examine the relationship between elementary zone segregation, school district jurisdiction, and history of court ordered desegregation. And finally, from a very small body of work that has examined the mechanics of how school districts design school attendance zones, I consider the relationship between school district population and areal size and the segregation of elementary zones. Below, I review the literature that informed my choice of these six school district characteristics to analyze.

Racial Residential and School Preferences

In this study, I consider how the racial composition of a school district and the racial diversity (or entropy) of a district is related to the segregation of elementary school attendance zones. A large body of research in the area of racial residential preferences and the link between school and housing segregation suggests that the population’s racial composition may be an important arbiter in families’ decision-making processes. Specifically, I seek to understand if in school districts where the largest racial groups are black and white, there are different levels of attendance zone segregation than in districts where the largest racial groups are Hispanic and white. This comparison builds on work that has found that residents avoid shared residential
areas with groups that are most marginalized in the U.S. racial hierarchy (Feagin, 1994; Harris, 2001; Zubrinsky & Bobo, 1996) and that white families make segregative choices in racially diverse settings (Sohoni & Saporito, 2009; Saporito & Hanley, 2014).

Racial residential segregation has been linked to a number of negative consequences including disparate economic opportunities (Turner, 2008); large differences in the accumulation of wealth between racial groups (Shapiro, 2004), exposure to crime (Krivo, Peterson & Kuhl, 2009), and exposure to environmental threats (Crowder & Downey, 2010). Although racial residential segregation has declined in recent decades (Logan & Stults, 2011), segregation still remains a defining feature of metropolitan areas. And although predominantly white neighborhoods are becoming more diverse, this is mostly due to the growth of Asian, Hispanic, and other race residents, while at the same time predominantly black neighborhoods have remained compositionally relatively stable (Krysan, Crowder & Bader, 2014).

Studies have shown that residential preferences are one important factor in the perpetuation of racial residential segregation (Charles, 2000; 2006; Crowder & South, 2008; Emerson, Yancey & Chai, 2001; Krysan, 2002). Residents that are white tend to rate neighborhoods that are composed of racial minorities as less desirable than white neighborhoods, and especially avoid black neighborhoods (Charles, 2006). And as the size of a minority population increases in a neighborhood, it is increasingly likely that white residents of that neighborhood will move out (Crowder & South, 2008). Individual’s racial prejudice and avoidance of shared residential spaces with racial groups that are marginalized within the U.S. hierarchy contribute to patterns of residential segregation (Feagin, 1994; Zubrinski & Bobo, 1996).

Residential and school segregation are closely linked together because in most large diverse school districts, attendance zone boundaries are drawn around the neighborhoods surrounding a school (Sohoni & Saporito, 2009). Having school-age children may be particularly influential in the residential sorting process, as families choose where to live in part based on concerns about reproducing social status for their children, which is closely connected to schools (Lareau, 2011; Owens 2016; 2017). School composition often serves as a proxy for school quality when families are searching for homes and schools (Holme, 2002). When boundaries are highly fragmented, choices between different school districts and school attendance zones
become even clearer (Bischoff, 2008). School attendance zone boundaries factor into residential choices that families make by sending signals to families about the schools and neighborhoods they are making choices about (Weiher, 1991). There is also evidence that real estate agents respond to information about school attendance zones, steering families not only into particular neighborhoods but also into particular school zones (Dougherty, 2010). Dougherty, in fact, likens the dynamics between school zones and racial transition to blockbusting, terming school-busting the process by which scare tactics are used by real estate agents to facilitate racial turnover in previously white neighborhoods (2010). Research conducted in Charlotte, NC found that housing prices varied significantly on different sides of school attendance zone boundaries (Kane et al., 2005) and similarly, a study in Connecticut found that homebuyers were willing to pay over $7,000 more for a home in order to live closer to a less diverse school (Dougherty et al, 2009).

In the context of racially diverse metropolitan areas, there is evidence that white families do not participate in the public school system at the same rate as black and Hispanic residents. White and advantaged families often tap into informal networks to learn about desirable schools, and the demographic character of schools is often a more critical factor in perceptions of school quality than actual indicators of school quality (Holme, 2002). As the proportion of black children in their community increases, white families tend to increasingly opt out of the public school system (Saporito 2003; 2009). When examining patterns of private school enrollment between 1970 and 2010, Saporito and Hanley found that race was a critical factor in predicting private school enrollment, even when accounting for socioeconomic characteristics, suggesting that race was paramount (2014). And Renzulli & Evans found that in school districts that are more racially integrated, white students are more likely to attend charter schools (2005). Studies have also demonstrated that residential segregation is higher for students in schools than for children in residences (Jargowsky, 2014; Saporito, 2003; 2009), underscoring the role of education policies in segregating students by race.

It is important to note however that individual preferences for living with same-race neighbors can change, especially when racial groups gain exposure to each other (Mickelson, 2011; Wells & Crain, 1994). Public polies have a role in facilitating exposure among different racial groups, as indeed they have had a role in facilitating the segregation of racial groups (Rothstein, 2017). School attendance zones are one such policy that can be leveraged to increase exposure among different racial groups, if designed in a race-conscious manner.
School District Desegregation

Large school systems vary in their jurisdiction, with countywide, suburban, and city school districts comprising the largest school districts in the U.S. Drawing school attendance zones in these different types of school systems will theoretically vary, due to their size, composition, and legal and demographic history. In this study, I explore how the jurisdiction of a school district and the desegregation history of a school district are related to the segregation of elementary school attendance zones. Countywide school systems have historically had a jurisdictional advantage when it comes to school desegregation because they often encompass both a central city and surrounding suburbs, allowing for racial integration of populations from these disparate areas of the school district if student assignment policies support desegregation (Orfield & Boger, 2005). I explore the role of attendance zones in segregation in school districts of different jurisdictional types to understand if there is a relationship between the two. Additionally, there have been a number of studies showing the importance of the federal intervention into desegregation, indicating that the South became the most integrated region of the country for students following a number of historic U.S. Supreme Court decisions (Orfield et al, 2014). Therefore I seek to understand if the legal history of a school district is related to attendance zones in those districts being less segregative.

As the federal government stepped up enforcement through the passage of the Civil Rights Act and ESEA, a string of U.S. Supreme Court decisions, and through enforcement by the Department of Health, Education and Welfare, the reality of dual school systems was being forcefully challenged (Frankenberg & Taylor, 2015). At the height of these desegregation efforts in the 1960s and 1970s, suburbs were often seen as areas of metropolitan areas where families could move to avoid school desegregation (Delmont, 2016). A U.S. Supreme Court decision in the mid-1970s cemented this option, effectively walling off the suburbs from metropolitan desegregation. In *Milliken v. Bradley*, the Court ruled against a metropolitan desegregation plan for Detroit and in doing so established a very high bar for an interdistrict remedy to segregation (1974). Plaintiffs would have to prove that there was intentional discrimination by suburban jurisdictions in order for desegregation between cities and suburbs to be ordered, a prohibitively high standard. The result of *Milliken* was that the school district lines between cities and suburbs in metropolitan areas were solidified (Siegel-Hawley, 2013). But suburban school districts have changed substantially post-*Milliken*, with suburban school districts in recent years growing
increasingly racially diverse (Diem, Welton, Frankenberg, & Holme, 2014), changing the historic city/suburb demographic divide. Suburbs of metropolitan areas are no longer white enclaves, with over half of all non-white residents in metropolitan areas residing in suburbs (Frey, 2011). The changing demographics of the suburbs presents both opportunities and challenges for suburban school districts, including the growth of low-income residents in suburbs (Kneebone & Garr, 2010), the increase in racially integrated suburbs (M. Orfield & Lucs, 2012), and the design of new school zone boundaries to encompass new population growth (Siegel-Hawley, 2013b).

Countywide school systems have a rich history of school desegregation. Some states, particularly in the South, utilize county boundaries for school district boundaries, following the principle of one county, one school system (Siegel-Hawley, 2011). These school systems can encompass entire metropolitan areas and have had the most stable and long lasting desegregation (Orfield, 2001). However, a number of contemporary trends are undermining the jurisdictional advantage that countywide school systems have. Municipalities that are disproportionately white within countywide systems are seceding, leading to a loss of white and more affluent students in the original countywide school district (EdBuilds, 2016; Frankenberg, 2009). And other countywide school systems are abandoning student assignment policies that have traditionally fostered racially integrated schools, returning to a neighborhood school policy (Parcel & Taylor, 2015). Countywide school districts are in contrast to city school systems that often align with census place boundaries, following city lines. City school districts at the height of desegregation were at times ordered to desegregate with surrounding suburban areas in metropolitan-wide desegregation plans (Siegel-Hawley, 2016). These arrangements are few and far between today, and are now interdistrict transfer programs, much weaker arrangements than metropolitan-wide desegregation programs (Stuart Wells, Warner, & Grzesikowski, 2013). Interdistrict desegregation plans were most famously ended by the Milliken v. Bradley decision in Detroit and its surrounding suburbs, but there were many other metropolitan-wide desegregation programs that were ended, such as in Richmond VA where a federal judge had ordered a metropolitan-wide desegregation plan (Siegel-Hawley, 2016).

School systems of all types were taken to court at the height of federal desegregation enforcement in the 1960s and 1970s (i.e. see Swann v. Charlotte-Mecklenburg Board of Education, Johnson v. San Francisco Unified School District, Oliver v. Kalamazoo Board of
The most school desegregation occurred in the 1970s, a time when the federal judiciary was particularly active in issuing court ordered desegregation, and school desegregation was greatest in response to a court order (Logan, Zhang & Oakley, 2017). Court orders were effective during this moment in time because the U.S. Supreme Court had legitimated them through a number of rulings including *Brown, Swann, Green*, and *Wright*, and all three branches of the federal government was committed to a policy shift on school desegregation, buoyed by public mobilization on civil rights issues (Frankenberg & Taylor, 2015; Rosenberg, 1991). In metropolitan areas, there was a 40 percent decline in levels of black-white segregation between 1968-71 and 1990 (Logan, Oakley & Stowell, 2008). But since the mid-1980s research has documented the resegregation of schools (Boger & Orfield, 2005; GAO, 2016; Orfield & Frankenberg, 2014). The 1990s marked a turning point in the U.S. Supreme Court’s active role in enforcing school desegregation. In a 1991 decision, the Supreme Court ruled that school desegregation plans were not meant to be permanent (*Board of Education of Oklahoma v. Dowell*). The next year, the Supreme Court allowed for an incremental approach to school desegregation, ruling that a district could be released from court order partially as it meets criteria piecemeal to achieve unitary status (*Freeman v. Pitts*, 1992) Over half of the districts under court ordered desegregation in 1990 were released from these plans by 2010 (Reardon et al, 2012) and studies have shown increases in segregation following release from court orders (Clotfelter et al, 2006; Lutz, 2011).

**Population and Geographic Dimensions of Attendance Zones**

A growing student population, particularly in the suburbs, can strain the capacities of existing schools and require school districts to build new schools and draw new attendance zone boundaries, in the context of increasing racial diversity (Siegel-Hawley, 2013b). When drawing new zones to address population changes, large school districts often work with demographic consultants who devise and present different boundary options, and compromise is almost always necessary in the boundary design process (Brown & Knight, 2005). School attendance zones are coupled with districts’ student assignment policies to determine where a student will attend school. Housing segregation remains closely linked to school segregation because many student assignment policies are based on attendance zones that spatially link neighborhoods and schools (Siegel-Hawley, 2013a). Plans that seek to decouple residence and school in order to further integration—for example through the use of metropolitan wide desegregation programs—
can actually weaken the link between school and housing choices because residents know that where they live is not directly related to where their child will be assigned to attend school (Holme, 2002).

School attendance zones have been historically used to promote integration, as well as to maintain dual school systems, and remain one of the legally permissible means to use race in plans to integrate schools. Federal court records document the ways in which school boards zoned schools in order to maintain racially identifiable schools (Oliver v. Kalamazoo Board of Education, 1972; Lawlor v. Board of Education of Chicago, 1972; Johnson v. San Francisco Unified School Dist., 1971). But recent quantitative studies of school attendance zones have shown that contemporaneously, irregularly drawn zones are related to more racial integration, suggesting that school boards which gerrymander school zones may be doing so in order to promote integration (Saporito & Riper, 2016). Gerrymandered zones to further integration would be consistent with what the U.S. Supreme Court put forth in its 1971 ruling when the Court suggested that school zones may be constructed in a way that supports racial integration (Swann v. Charlotte-Mecklenburg Board of Education, 1971). School attendance zones were more recently affirmed by the court as a way in which race may be used by school boards in order to further integration in schools; that is, school boards may draw attendance zones with the racial composition of neighborhoods in mind so as to increase integration at the school level (Parents Involved in Community Schools v. Seattle School District No. 1, 2007).

The drawing of school attendance zone boundaries can be a political minefield for districts, especially when large changes are necessary to support population growth (Brown & Knight, 2005). School districts must balance many factors when drawing school attendance zones, including population size and density, contemporary and historical population trends, natural boundaries and barriers, feeder patterns, and costs, among other things (Brown & Knight, 2005; Hanover Research, 2015). And this is not assuming that the school district is also interested in drawing zones that would further racial and/or socioeconomic integration, which would add to the considerations the district would be making. When racial and/or income integration is a factor, a school district must also consider how to draw populations from different areas of the school district that will result in diverse schools (Siegel-Hawley, 2013b). The extent to which educational boundaries segregate students and residents varies across contexts. For example, school district lines in the Northeast and Midwest are more highly
fragmented than those in the South and West (Bischoff, 2008). In this study, I am interested in exploring how the segregation of elementary school zones is related to two key factors that school districts must consider when designing elementary school zones; the population size of the school district and the areal size of the school district. Particularly, I am interested in exploring if there are disparities in the segregation of school zones based on either the population size or areal size of school districts.

The Current Study

Federal, state, and local housing policies have been shown to be deeply linked to residential segregation, but less often are non-housing policies considered for how they may contribute to creating or maintaining residential segregation. In this study, one particular non-housing policy is explored for its role in segregating residential spaces. School attendance zone boundaries are examined for how they relate to particular school district characteristics that have been shown to matter for school and residential segregation. The main purpose of this study is to better understand in what contexts attendance zones are most segregative, providing new insights into how, and under what conditions education policies structure residential segregation.

Methodology

This study combines multiple federal datasets along with the use of GIS to better understand the residential segregation that occurs within school districts. I explore how the unique contribution of elementary school attendance zones and the magnitude of attendance zone segregation are related to various school district characteristics. Specifically, I examine the contribution of elementary school zones to racial residential segregation and the magnitude of elementary school zone segregation as related to the 1) racial composition of a school’s district; 2) entropy of a school district; 3) jurisdiction of a school district; 4) legal history of a school district; 5) population size of a school district; and 6) areal size of a school district. These six characteristics were chosen based on a review of literature in education and sociology that suggest what school district characteristics may be most salient in the racial residential segregation of school zones.

Data
**School Attendance Boundary Survey (SABS).** The School Attendance Boundary Survey or SABS collected spatial data on elementary, middle, and high school zones for the 2009-2010 school year. This federal dataset grew out of SABINS, a collection of school attendance boundaries started by researchers at William & Mary College and the University of Minnesota. Provided in this dataset are shapefiles of elementary school attendance zones for approximately 350 large school districts. For the purposes of this study, I measure segregation both between and within elementary school zones, using shapefiles of school year 2009-10 boundaries from SABS. In order to measure segregation within school zones, it is necessary to utilize smaller units that are within school zones. Census blocks are used for this purpose.

**Census.** I use block-level population data to estimate the total population and under 18 population race counts within and between school attendance zones. The four largest race groups are included in this study; non-Hispanic whites, non-Hispanic blacks, Hispanics, and Asians. In order to determine population counts for blocks within and between elementary school attendance zones, it is necessary to use GIS and areal interpolation since blocks do not nest within attendance zone boundaries. I calculate the area of intersection between a block and school attendance zone, and weight the population of the block by the area that the two intersect. One key assumption of areal interpolation is that populations are evenly distributed across a unit, but if a population is distributed unevenly across a unit (i.e. a block) then the likeliness of error is higher (Logan, Xu & Stults, 2014; Saporito et al, 2007). However, blocks are preferable to use for areal interpolation because they are very small census units which are often delineated with population patterns in mind.

**Sample**

Included in this study are 90 of the largest school districts in the U.S. by student population size that have SABS coverage and utilize school attendance zone boundaries in the assignment of students to schools. From the 100 largest school districts, 90 have both SABS coverage and utilize attendance zones\(^{22}\), leading to an analytical sample of 90. These school districts represent all regions of the country, different student body compositions, and diverging

\(^{22}\) Some school districts, including Lee, Boston, Garland, and San Francisco school districts which are in the 100 largest school districts, use open enrollment instead of attendance zones. Students in these districts are not zoned to a particular school based on residence but instead attend school based on different student assignment policies like school choice.
histories and current approaches to integration. The population within these districts includes approximately 60 million individuals, 45 percent of whom are white, 26 percent Hispanic, 20 percent black, and 6 percent Asian. In these large school districts, the population is disproportionately lower in white percentage, higher in black and Hispanic percentage, and about comparable Asian percentage, compared to the entire U.S. population.

Analytic Strategy

First I use Theil’s H to measure the unique components of racial residential segregation within the largest school districts in the U.S., determining the within and between components of elementary school attendance zone segregation. I do this for both the total population and for the under 18 population. Next, I compare the means of both the magnitude of between catchment segregation and the proportion of racial residential segregation in large school districts due to catchment area segregation to six different school district characteristics to understand in what context elementary zones are most segregative.

Segregation analysis. Theil’s H (also known as the information theory index) is an evenness measure, which examines the distribution of all racial groups among units within a study area. In this study, I use H to examine the evenness of populations among blocks within catchment areas, and the evenness of populations among catchment areas within school districts. H relies on calculating the entropy (or diversity) of the school district, and the average deviation of each catchment area from the school district’s entropy, and the average deviation of each block from the catchment area’s entropy. The most intuitive interpretation of H is to convert it into a percentage that indicates how much less diverse a sub-unit is from the larger study area. For example, a H value of 0.270 for catchment areas within a school district indicates that catchment areas are, on average, 27 percent less diverse than the school district as a whole, making these zones highly segregated. Theil’s H is reported using a 0 to 1 scale, with 0 representing complete evenness of groups across units, and 1 representing complete segregation of groups across units.

H is estimated using the following equation (Fowler, Lee, & Matthews, 2016; Parisi, Lichter, & Taquino, 2011):

$$H = \frac{1}{TE} \sum_{j=1}^{J} t_j (E - E_j)$$

(1)
Here $T$ and $t_j$ reference the population of the entire area of study $J$, and its subcomponent $j$. $E$ and $E_j$ represent the entropy of area $J$ and its subcomponent $j$.

One of the advantages of $H$ is that it can measure all racial groups simultaneously, an increasingly important attribute as racial diversity in the U.S. increases. Most importantly however for this study, is that $H$ has the advantage of being decomposable across geographies in order to understand the relative contribution of segregation from various units (Reardon & Firebaugh, 2002). I build the $H$ decomposition based on the work of Fowler et al. (2016) who use the following notation:

$$H_{JK} = \frac{1}{TE} \sum_{k=1}^{K} \sum_{j=1}^{J_{in\cdot k}} t_j (E_k - E_j)$$

(2)

This equation allows for the observation of individual contributions of subunits $k$ to the overall $H_{JK}$. In the decomposition, if the observations are elementary catchments within the school district, then $H_{ECU}$ would be equal to $H$ in equation (2).

$$H_{SD} = H_{ECSd} + H_{BEC}$$

(3)

The above decomposition indicates $H_{SD}$ (total segregation of the school district) equals the sum of differences between elementary catchment areas $EC$ within the school district plus the sum of differences between blocks $B$ within those elementary catchments. In this study, I use an $H$ decomposition to ascertain the proportion of racial residential segregation for the total population and the under 18 population that occurs within school attendance zones as compared to between school attendance zones.

**School District Characteristics**

Most of the previous research on school attendance zones have focused on either the relationship between attendance zone gerrymandering and segregation, or disparities between attendance zone populations and their corresponding student enrollments (i.e. see Saporito, 2003; Saporito & Sohoni, 2006; Saporito & Riper, 2016). In this study I explore something different, measuring the unique contribution of elementary school attendance zones to racial segregation, and examining in what school district contexts elementary school zones are most segregative. The characteristics chosen for analysis were based on a review of the literature which suggest what residential and school factors have been shown to matter for segregation outcomes. While these characteristics have been explored in the context of metropolitan racial segregation, or
school segregation, they have not been previously explored in terms of school attendance zone segregation within school districts. Exploring the H decomposition results through varying school district characteristics can provide better insights into in what contexts elementary attendance zones are related to inequality.

Population composition and entropy. Research in the area of racial residential preferences has shown that residents are particularly averse to black neighbors (Harris, 2001). I explore if elementary school attendance zones are more segregative in school districts that are composed primarily of white and black residents, as compared to composed primarily of white and Hispanic residents. Further, white families may make particularly segregative choices in more racially diverse contexts (Renzulli & Evans, 2005; Saporito 2003; 2009). Therefore, I also examine how a school district’s entropy is related to the segregation of elementary school zones. School district entropy is simply the racial diversity within the district, with a maximum diversity for two groups being a 50-50 division, and for four groups 25-25-25-25, etc. (Massey & Denton, 1988). An entropy value of 1.0 represents a school district where the four racial groups in my study are the same proportion of the population (.25-.25-.25-.25), and a score of 0 indicates complete homogeneity, or no racial diversity. A score closer to 0 indicates that one or two racial groups of the four may be particularly large in comparison with the other groups. For the school districts in my sample, the median entropy value was 0.725, and I examine the differences in elementary attendance zone segregation in districts above and below the median.

Jurisdiction. Previous research has identified countywide school systems as particularly suited for desegregation, and indeed the largest of these school systems have had more extensive and long lasting school integration (Frankenberg, Lee & Orfield, 2003; Siegel-Hawley, 2016). In contrast, city and suburban school districts typically have more racially isolated schools, although changing demographics challenge previous trends (Diem et al, 2014; Frankenberg, Lee & Orfield, 2003; Frey, 2011). Each school district is categorized by district type: city, countywide, or suburban based on the categories as used in Frankenberg, Lee & Orfield (2003).

Legal history. To categorize school districts by their desegregation history, I use the Center for Education Policy Analysis (CEPA) district court order data and Pro Publica’s national survey of school desegregation orders which document medium and large school districts under court ordered desegregation plans. This data includes school districts dismissal status with the
year of dismissal. However, the data does not include information on districts that have desegregated voluntarily or that were required to desegregate by the Department of Health, Education, and Welfare (Reardon, Grewal, Kalogrides, & Greenberg, 2012). Only 52 of the 90 school districts in my study were included in these datasets, so I complete the analysis with legal history for only that subset of school districts. I compare school districts that were released from court order before 1990 and after 1991, as the 1990s were a period when the courts retreated from school desegregation (Boger & Orfield, 2005). Additionally I consider districts that still have an open court order. Of the 52 districts with their status determined, 15 were released from court order prior to 1990, 31 were released after 1991, and 6 were still under court order.

Population and areal size. School districts must contend with population and geographic size of their district when drawing school attendance zones, and I compare attendance zone segregation in school districts that have a population and areal size that are above and below the median of my sample. The median population size in 2010 was 383,835, and the median areal size of the school districts was 316 square miles. I explore if smaller/larger school districts by population and area have segregative elementary school attendance zones.

Results

In the 90 school districts under study, slightly over half of total population racial residential segregation of school districts was due to between elementary school attendance zone segregation. In contrast, for the under 18 population, less than half of racial residential segregation of school districts was due to elementary school zones. There were important differences among racial dyads in terms of the segregative impacts of elementary school zones, with black and white residents being most segregated between these zones, and Asian and white residents being least segregated. In the following sections, I explore differences in the relative contribution of school zones to school district segregation, and the magnitude of school zone segregation, based on six school district characteristics. While the previous chapter outlined the findings for the sample of large school districts, this chapter explores variation in the sample’s segregation results.

Attendance Zone Segregation and School District Composition

In large school districts where the color line is primarily black/white, elementary school attendance zones contribute to a greater extent to the racial residential segregation of the total
population and the under 18 population in the school district. In 2010, for school districts that were primarily composed of black and white residents, elementary school attendance zones accounted for 56 percent of the multiracial segregation in those districts (Table 3.1). And elementary school attendance zones account for over 60 percent of the racial residential segregation of the black and white population. In contrast, in school districts that were primarily Hispanic/white, elementary school attendance zones contributed, on average, 47 percent to the multiracial segregation of the school district, and 54 percent to Hispanic and white segregation. These differences indicate that the segregative impacts of elementary school attendance zones are greater in school districts where the black residents account for a larger portion of the population. It is also clear that white residents are most segregated by elementary school zones in relation to the largest non-white racial group. That is, in school districts with a large proportion of Hispanic residents, in those districts white residents are more segregated by elementary school zones from Hispanic residents, rather than from black residents.

Table 3.1: Average proportion of racial residential segregation due to elementary school attendance zones by school district racial composition, 2010

<table>
<thead>
<tr>
<th></th>
<th>Largest racial groups: White and Black</th>
<th>Largest racial groups: White and Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>55.81</td>
<td>46.58</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>61.19</td>
<td>43.51</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>45.89</td>
<td>53.71</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>33.78</td>
<td>32.91</td>
</tr>
<tr>
<td><strong>Under 18 Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>52.86</td>
<td>42.69</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>59.93</td>
<td>40.03</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>43.11</td>
<td>50.26</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>31.00</td>
<td>29.37</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>36</td>
<td>51</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data
*Three school districts were not included here because the two largest racial groups were not white and either black or Hispanic; all other school districts fit into this categorization.

In addition to elementary school zones being more segregative in school districts where the largest population groups are black and white—that is, elementary zones have a higher relative contribution to residential segregation as compared to the segregation within attendance zones—the magnitude of segregation in these districts is also higher than in districts where the largest racial groups are white and Hispanic (Figure 3.1). In school districts where the largest
racial groups are black and white residents’ elementary school zones are, on average, 21 percent less racially diverse than the school district, whereas in Hispanic/white school districts elementary school zones are, on average, 12 percent less diverse than the school district. This disparity is more pronounced when examining black/white dyad segregation; elementary school zones are 28 percent less diverse than the school district for the black and white residents in school districts where the population is primarily black and white. In contrast, for Hispanic and white residents, elementary zones are, on average, 14 percent less diverse than the school district in districts that are majority white and Hispanic. Not only did attendance zones contribute a relatively greater extent to residential segregation in districts with a large portion of black residents, but there was also a higher magnitude of segregation of elementary school zones within these districts.

**Figure 3.1:** Average magnitude of racial residential segregation between and within elementary school attendance zones for the total population by school district composition, 2010

![Theil's H](chart.png)

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

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I focus on the between component in this study, or the segregation that occurs between elementary school zones—both absolute (the magnitude of segregation) and relative (the proportion of segregation of school districts that can be attributed to segregation between elementary school zones). I focus on the between component, as opposed to the within component because of the interest in exploring educational boundary lines and their relationship to racial residential segregation.
Attendance Zone Segregation and School District Entropy

Previous research has indicated that neighbors respond in segregative ways in non-white residential contexts, as do families respond in segregative ways in non-white school contexts. Additionally, there is a long history documented in court cases of school districts making decisions, including school siting and zoning, in a way to maintain racial isolation of schools. Therefore, I am interested in examining how elementary school zone segregation is related to the racial diversity (entropy) in school districts. In school districts that had higher entropy values than the median in my sample (meaning that they were more racially diverse), elementary school attendance zones were more segregative for the total population and under 18 population than in school districts that were more homogenous (i.e. had lower entropy values). School districts with entropy values above the median of 0.725 were closer to having the four racial groups in this study as equal proportions of the population, whereas school districts with entropy values below the median had population compositions where the four racial groups made up more uneven proportions of the population. For example, Alpine ISD in Utah had an entropy score of 0.301, one of the lowest in the sample. In Alpine, 77 percent of the population was white, while the other three racial groups make up small percentages of the district population, indicating relatively low racial diversity in Alpine. In contrast, Cypress Fairbanks ISD in Texas was one of the most racially diverse districts in the sample, with no racial group as a majority and an entropy value of 0.878. The school district was 35 percent white, 16 percent black, and 39 percent Hispanic, with other racial groups comprising the rest of the district.

The greatest differences in school zone segregation between school districts that were more and less diverse were between the white and black children and white and Hispanic children (Table 3.2). For black and white children in the most diverse school districts in this study, attendance zones accounted for 57 percent of school district racial residential segregation, while in the least diverse school districts, attendance zones accounted for 41 percent of black and white children’s school district segregation. And for Hispanic and white children, there was a 20 percent difference, with attendance zones in more diverse districts contributing 56 percent to racial residential segregation and 36 percent in less diverse districts. These findings are consistent with previous research that has documented the importance of educational boundaries in structuring segregation, and research that has identified racial diversity as being related to segregating choices. Families, when making home buying decisions, will pay more to live away
from a racially diverse school (Dougherty, 2010), and white residents are more likely to move out of a neighborhood as the size of a minority population increases (Crowder & South, 2008). Additionally, white families tend to opt out of the public school system in more racially diverse educational and residential contexts (Renzulli & Evans, 2005; Saporito 2003; 2009). It is not surprising therefore to see that in school districts that are more racially diverse, elementary school zones which are at the nexus of residential and school choices, are more segregative.

Table 3.2: Average proportion of racial residential segregation due to elementary school attendance zones by school district entropy, 2010

<table>
<thead>
<tr>
<th></th>
<th>Below median</th>
<th>Above median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>46.58</td>
<td>56.91</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>44.79</td>
<td>60.05</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>40.94</td>
<td>58.69</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>26.73</td>
<td>39.88</td>
</tr>
<tr>
<td><strong>Under 18 Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>43.22</td>
<td>53.02</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>41.10</td>
<td>57.40</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>36.39</td>
<td>56.23</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>23.43</td>
<td>36.93</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data
*Median entropy value for the 90 districts under study was 0.725

Even though racial residential segregation of school districts was similar in magnitude in school districts that were more and less diverse, the level of catchment segregation in these districts differed (Figure 3.2). For districts that had entropy values below the median—indicating less racial diversity—the under 18 population was more segregated within catchment areas for all groups. In contrast, in the most diverse school districts, children were more segregated by elementary attendance zones than within them (for all groups except for Asian and white children). For black and white children in the most diverse school districts, elementary attendance zones were 30 percent less diverse than the school district as a whole. But for black and white children in less racially diverse school districts, elementary school attendance zones were 20 percent less diverse than the school district. A similar disparity existed for white and Hispanic children. In sum, elementary school zones contributed to a greater extent to racial residential segregation in school districts that were more racially diverse, and the magnitude of school zone segregation in diverse districts was much higher.
Figure 3.2: Average magnitude of racial residential segregation between and within elementary school attendance zones for the under 18 population by school district entropy, 2010

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

**Attendance Zone Segregation and School District Jurisdiction**

Countywide school systems have historically had a jurisdictional advantage when it comes to school desegregation, and in this study I find that countywide school systems had less segregative school zones as compared to suburban or city school districts (Table 3.3). City school systems had elementary school zones that contributed most to school district residential segregation, and were particularly segregative for black and Hispanic residents. For the under 18 population in countywide systems, on average, elementary school zones contributed to 40 percent of the racial residential segregation in school districts. The equivalent figures for suburban and city school systems were 45 percent and 58 percent respectively. The most segregative zones were found in city school systems for the black and white resident population, where elementary school zones, on average, accounted for 66 percent of the racial residential segregation of school districts. The least segregative zones were for Asian and white residents under 18 in countywide systems, where zones accounted for only 23 percent of segregation in districts.
Table 3.3: Average proportion of racial residential segregation due to elementary school attendance zones by school district jurisdiction, 2010

<table>
<thead>
<tr>
<th></th>
<th>Countywide</th>
<th>Suburban</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>41.85</td>
<td>47.86</td>
<td>64.20</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>43.80</td>
<td>47.00</td>
<td>65.74</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>38.30</td>
<td>48.90</td>
<td>63.25</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>26.75</td>
<td>35.29</td>
<td>37.73</td>
</tr>
<tr>
<td><strong>Under 18 Population</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>39.93</td>
<td>45.14</td>
<td>58.28</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>42.36</td>
<td>44.71</td>
<td>60.21</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>36.79</td>
<td>48.18</td>
<td>55.28</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>23.45</td>
<td>31.19</td>
<td>34.66</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>33</td>
<td>32</td>
<td>25</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

The magnitude of segregation between elementary attendance zones did not differ very much from countywide to suburban school districts, although there was a more substantial difference in their relative contribution to residential school district segregation—one reason why it is important to consider both relative and absolute values in a H decomposition (Figure 3.3). Countywide and suburban school systems look very similar in terms of the level of segregation experienced by the under 18 population; in both jurisdictions elementary catchments were, on average, 14 percent less diverse than the school district as a whole. In contrast, city school systems had much higher magnitudes of elementary zone segregation, with these zones, on average, 28 percent less diverse than the school district as a whole. The magnitude of segregation for black and white children between elementary school zones in cities is striking, with catchments, on average, 38 percent less diverse than the school district as a whole. Given that countywide school systems have historically been associated with school desegregation, and that city school systems have particular challenges related to their isolation from the populations in the suburbs (Orfield, 2001; Orfield & Boger, 2005), the findings presented here add another dimension along which differences in school district jurisdiction can be understood. In sum, these findings show that cities have elementary school zones that are the most segregative along with high magnitudes of segregation. Suburban and countywide school systems have similar magnitudes of elementary school zone segregation, but in countywide systems school zones contribute less to the racial residential segregation of school districts.
Figure 3.3: Average magnitude of racial residential segregation between elementary school attendance zones for the under 18 population by school district jurisdiction, 2010

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

Attendance Zone Segregation and History of Court Ordered Desegregation

I also compare the segregation of elementary school zones in districts with court ordered desegregation plans that ended before 1990 and those that ended after 1991. The 1990s marked a critical period in the courts retrenchment from school desegregation (Boger & Orfield, 2005), and thus I explored how school districts that were released from court order before this time point compare to those released after this time point. Additionally, I examined school districts with a court order still open. I find that in districts that were released from court order before the 1990s, elementary school attendance zones contributed less to racial residential segregation in school districts for children and the total population (Table 3.4). This is somewhat counter-intuitive; it would make sense that in school districts that have been under court order more recently that they have less segregative attendance zones because of their court supervision. But there are also reasons to think that school districts released from court order earlier would have less segregative zones. In the 1960s and 1970s the courts more vigorously enforced school desegregation with stringent guidelines for school districts to comply with desegregation orders.

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24 The frequency of school districts based on court order status is in Appendix C.
(Frankenberg & Taylor, 2015; Orfield, 1969; Read & McGough, 1978), but U.S. Supreme Court
decisions in the 1990s diminished what was required of school districts to be declared unitary
(Board of Education of Oklahoma v. Dowell, 1991; Freeman v. Pitts, 1992). Therefore one way
to interpret these findings is that school districts that met unitary status in earlier years did so
when requirements were more substantial (Green v. County School Board, 1968).

Table 3.4: Average proportion of racial residential segregation due to elementary school
attendance zones by school district legal history, 2010

<table>
<thead>
<tr>
<th></th>
<th>Court order dismissed before 1990*</th>
<th>Court order dismissed after 1991</th>
<th>Court order still open</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>49.15</td>
<td>59.23</td>
<td>53.65</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>51.41</td>
<td>62.23</td>
<td>55.98</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>42.56</td>
<td>56.40</td>
<td>46.98</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>28.94</td>
<td>34.90</td>
<td>35.75</td>
</tr>
<tr>
<td><strong>Under 18 Population</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>47.30</td>
<td>55.33</td>
<td>46.61</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>52.03</td>
<td>59.38</td>
<td>50.37</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>39.55</td>
<td>51.68</td>
<td>44.40</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>26.82</td>
<td>32.10</td>
<td>30.89</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>15</td>
<td>31</td>
<td>6</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data
*Legal history was determined for 52 of the 90 districts from Reardon and colleagues CEPA and Propublica’s school desegregation database

While the magnitude of racial residential segregation for the under 18 population in
school districts was similar for districts with court orders dismissed before and after 1990, there
are clear differences in the magnitude of segregation between elementary zones (Figure 3.4).
Particularly for black/white segregation of school zones, there was a large difference in the
magnitude of segregation in districts that had court orders dismissed before 1990 and those
dismissed after 1991. For black and white children in districts where court orders that were
dismissed after 1991, their elementary attendance zones were 35 percent less diverse than the
school district as a whole, indicating very high levels of segregation. But for black and white
children in school districts that had a court order dismissed prior to 1990, black and white
children resided in catchment areas that were, on average, 28 percent less diverse than the district
as a whole; still highly segregated, but less so. Hispanic and white children were also less
segregated by elementary school zones in districts that had a court order dismissed prior to 1990,
but there was no difference for Asian and white children. Court ordered desegregation does not focus on the integration of Asian and white children, so it makes sense that there would be little difference seen for Asia/white segregation.

*Figure 3.4: Average magnitude of racial residential segregation between and within elementary school attendance zones for the under 18 population by school district legal history, 2010*

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data

**Attendance Zone Segregation and School District Population and Geographic Size**

School districts consider the population size of a school district when designing school attendance zones, and here I examine if and how the population size of a district is related to the segregation of elementary school zones. Large school districts (both in terms of population and area) often have the most complex student assignment plans and the greatest number of school attendance zones. In school districts with populations larger than the sample median, elementary school zones contributed to a greater extent to multiracial and black/white segregation for the total population and the under 18 population (Table 3.5). But elementary school attendance zones contributed more to segregation of Hispanic and Asian residents in school districts with populations below the median. It should be emphasized however that the differences in mean contribution of zone segregation to school district residential segregation did not differ
substantially for districts below and above the median; for example, in school districts with populations above the median, school zones contributed to 53 percent of the total populations’ multiracial segregation, while for school districts with populations below the median, school zones contributed to 50 percent of the total populations’ multiracial segregation.

Table 3.5: Average proportion of racial residential segregation due to elementary school attendance zones by school district population size, 2010

<table>
<thead>
<tr>
<th></th>
<th>Below median</th>
<th>Above median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>50.07</td>
<td>52.88</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>50.79</td>
<td>53.93</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>51.60</td>
<td>49.28</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>34.61</td>
<td>31.83</td>
</tr>
<tr>
<td><strong>Under 18 Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>45.67</td>
<td>49.87</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>46.54</td>
<td>51.83</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>47.65</td>
<td>46.13</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>30.87</td>
<td>29.10</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data *Median population in the 90 districts under study was 383,835

While there was little difference in the relative contribution of elementary school zones to racial residential segregation based on if a districts’ population was above or below the sample’s median, there was a greater difference in the magnitude of segregation for districts with larger populations. In the school districts in the sample with the largest populations, the districts themselves were more segregated, and the catchments within those district were also more segregated (Figure 3.5). For example, in the largest districts for black and white residents, catchment areas were, on average, 22 percent less racially diverse than the school district, whereas in districts with smaller populations, catchment areas were, on average, 18 percent less diverse than school districts for black and white residents. While there was little difference in the contribution of elementary school zones to the segregation of school districts based on population, there was a slightly larger difference in terms of the magnitude of segregation. In both cases, segregation was slightly higher in districts that had larger populations. Little is known about how school district population size is related to the segregation of school zones. What this research shows is that while population size does not seem to matter in terms of the relative contribution of school zones to racial residential segregation, in districts with larger populations the magnitude of school zone segregation is higher.
School districts must also consider the geographic size of the district when designing school attendance zone boundaries, considering transportation time for students and district costs of transporting students. Larger school districts tend to be countywide school systems, which as noted above, on average, have less segregative elementary school zones. In larger school districts, catchment zones themselves are often larger and can be drawn in a way that captures different demographics (a prime example of this strategy of drawing zones is in the countywide school districts in Florida where zones are long and narrow, stretching from East to West).

However, theoretically large school districts also pose challenges in designing desegregative school zones, namely the issue of transporting students over large distances. In the 90 large school districts under study, the largest school districts did have elementary school zones that contributed less to the racial residential segregation for both the total population and the under 18 population (Table 3.6). For the under 18 population in school districts that had areas below the sample median, elementary school zones contributed 52 percent to multiracial segregation of the school district, whereas in districts above the median that figure was 43 percent. These patterns were consistent across racial dyads and for the total population.
### Table 3.6: Average of racial residential segregation due to elementary school attendance zones by school district areal size, 2010

<table>
<thead>
<tr>
<th></th>
<th>Below median*</th>
<th>Above median</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>56.52</td>
<td>46.45</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>55.85</td>
<td>49.12</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>55.37</td>
<td>45.00</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>37.47</td>
<td>28.14</td>
</tr>
<tr>
<td><strong>Under 18 Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiracial Segregation</td>
<td>52.39</td>
<td>43.29</td>
</tr>
<tr>
<td>Black/White Segregation</td>
<td>51.41</td>
<td>47.13</td>
</tr>
<tr>
<td>Hispanic/White Segregation</td>
<td>50.59</td>
<td>42.79</td>
</tr>
<tr>
<td>Asian/White Segregation</td>
<td>33.89</td>
<td>25.11</td>
</tr>
</tbody>
</table>

Source: SABS SY 2009-10 school attendance boundaries merged with 2010 Decennial Census data
*Median area in the 90 districts under study was 316mi²

School districts with the largest areas not only had school zones that contributed less to racial residential segregation, but they also had a lower magnitude of racial segregation. For black and white residents under 18 in small school districts, on average, elementary school zones were 26 percent less diverse than the entire school district, a highly segregated context (Figure 3.6). In school districts with a larger geographic area, black and white residents under 18 lived, on average, in catchment areas that were 23 percent less diverse than the school district. But the largest difference was for Asian and white residents under 18; whereas in large school districts these children resided in catchment areas that were 9 percent less diverse than the school district as a whole, in smaller school districts they resided in catchment areas that were 15 percent less diverse than the school district. These findings show that larger school districts do in fact have elementary school zones that are less segregative than smaller school districts, but this is likely related to the overlap between school district jurisdiction and geographic size, with city systems covering a small geographic area and countywide systems covering a larger geographic area.

**Figure 3.6:** Average magnitude of racial residential segregation between elementary school attendance zones for the under 18 population by school district areal size, 2010
Discussion

In 2016, HUD, the Department of Education, and the Department of Transportation issued a joint statement on how these agencies should work together to promote racial integration, noting “we recognize that a growing body of research supports the benefits of socioeconomic and racial diversity in schools and communities, and that such diversity can help establish access points for opportunity and mobility” (1). This research has sought to contribute to ongoing research that views education and housing as inextricably linked. Specifically, this paper has shown how various school district characteristics are related to more segregative elementary school zones in the largest school districts in the U.S. School districts with a greater proportion of black residents and with high racial diversity have school attendance zones that segregate the total population and under 18 population to a greater extent. Additionally, countywide school systems and districts that were released from court order prior to 1990 had less segregative elementary zones. City based school districts had elementary zones that had the highest magnitude of segregation. And finally, school district population size did not seem to be clearly related to distinct patterns of school zone segregation, but school district areal size was, with larger school districts having less segregative elementary school zones. These findings have implications for how we understand the relationship between school and housing segregation,
and for our understanding of the ways in which education policies are related to residential outcomes.

I draw from literature in sociology and education to explore how educational boundaries are related to residential segregation, and in what contexts this relationship is most salient. Previous research has shown that residents are particularly averse to black neighbors (Harris, 2001), and that when selecting neighbors people will avoid those who they perceive as being lowest in the U.S. racial hierarchy (Feagin, 1994; Zubrinski & Bobo, 1996). Black residents and students have persistently been highly segregated in neighborhoods and schools (Logan & Stults, 2011; Orfield et al., 2016). Coupled with the close link between school and housing segregation, and the fact that families will use school racial composition as a proxy for school quality (Holme, 2002), there is good reason to suspect that patterns of school zone segregation will differ in school districts with large black populations. And indeed, I find that in large school districts where the largest groups are black and white residents, as compared to when the largest two groups are Hispanic and white residents, elementary school zones are more highly segregated and contribute more to the segregation of the school district. Additionally, in school districts that are more racially diverse, elementary school zones are more segregative. These findings suggest that attendance zones may be perceived as more high stakes in school districts that have a high proportion of black residents and are more racially diverse. This is in line with previous research showing that white families make more segregative school decisions in more racially diverse contexts (Renzulli & Evans, 2005; Saporito 2003; 2009; Saporito & Hanley, 2014).

When considering the full sample of school districts, the under 18 population is more segregated within attendance zones than between them. However, in the most diverse school districts, the under 18 population was more segregated between elementary zones than within them. This means that school district racial diversity is related to children being sorted unevenly between school zones, and that it is in the most diverse contexts that children are the most racially segregated by school zones. Other research has documented that families make more segregated school choices in the context of greater racial diversity in a school district, and the research presented here builds upon work along these lines. In the context of greater racial diversity, school attendance zones may have an even greater role in signaling the character of certain areas based on the population composition (Weiher, 1991). In other words, the stakes of
choices of attendance zones may be perceived as being higher in the context of racially diverse school districts.

Countywide school systems have historically been associated with school desegregation (Orfield, 2001), and this study shows that in countywide school systems elementary school attendance zones contribute less to the racial residential of the school district. Suburban school districts had zones that were somewhat more segregative than countywide districts, but city school systems had the most segregative elementary school zones. Although suburban school districts had zones that contributed relatively more to residential segregation than countywide systems, when examining the magnitude of segregation, there was relatively little difference between countywide and suburban systems. This suggests that while residential countywide segregation occurs to a lesser extent due to elementary school zones, the residential segregation of these districts, and the segregation both within and between catchment areas is still substantial. Yet cities were strikingly more segregated than either suburban or countywide systems. In sum, there seems to be a jurisdictional advantage that countywide school systems have, in so far as attendance zones are a smaller factor in the segregation of the entire school district. However, this advantage is belied by the magnitude of residential segregation in these districts, which is similar to suburban school districts.

The timing of release from court order was also related to segregation of elementary school zones. A critical turning point for the courts in school desegregation was the 1990s, when several court decisions limited the scope of school desegregation (Board of Education of Oklahoma v. Dowell, 1991; Freeman v. Pitts, 1992). In a study by Reardon and colleagues, they found that school districts that have been released from court order were not very different to those not released (2011). Districts that were released from court order and those that were not had similar racial compositions and magnitudes of segregation, but following release of court order, school districts do become more segregated. Logan and colleagues found that desegregation was greatest in response to court order, although desegregation did also occur in districts not under court order (Logan, Zhang, & Oakley, 2017). In this study, I find differences in elementary school zone segregation in the school districts that were released from court order before 1990 and those released after 1990. Theoretically, this could be related to the fact that prior to 1990, school districts had to meet a higher bar to achieve unitary status, whereas after 1990 being released from a court order was easier because of lower standards issued by U.S.
Supreme Court decisions. For example, court orders prior to 1990 required more of school districts, including re-zoning, while after a string of court decisions in the early 1990s, less was required of desegregation plans, and weaker measures like school choice were used. Further research with a larger sample would be needed to better understand the relationship between court orders and the segregation of attendance zones.

Finally, school districts must consider structural aspects of the school district, including population size and geographic size, when designing school attendance zone boundaries. I found little association between school district population size and the segregation of elementary school zones, with districts with large populations being slightly more segregated. However, the geographic size of the school district did seem to be related to the contribution of school zones to racial residential segregation, and the magnitude of school zone segregation. In school districts with larger geographic sizes, the magnitude of elementary catchment segregation was lower, and these zones contributed relatively less to the racial segregation of the district. Student assignment policies and school zones are complex in large school districts (Parcel & Taylor, 2015) and that school districts with large geographic areas have zones that are less segregative, despite the challenges around transportation and proximity, is notable. However, as mentioned previously, this is closely related to the fact that the school districts with the largest geographic areas are often countywide school systems, which have lower school zone segregation.

While this study has focused exclusively on residential segregation, it is important to remember that school attendance zones are also related to the segregation of students in schools. How these zones are drawn, and the population within them, are critical in how students are assigned to attend particular schools (Sohoni & Saporito, 2009). Therefore, the findings presented here on residential segregation of attendance zones also have implications for school segregation. Previous research has identified how demographics matter for how families make school choices that are segregative. School racial composition is a critical factor in families’ decision-making about schools, often more critical than indicators of school quality (Holme, 2002). And as the proportion of black students increase in a school system, white families increasingly opt out of the public school system (Saporito, 2003; 2009). The particular contexts identified here where attendance zones are most segregative are also contexts where the reinforcing mechanisms of school and housing segregation might be particularly vicious. Elementary zones were most segregative in diverse districts, city districts, and districts with a
large black population. It is in these contexts as well that, as other research has shown, white families are more likely to flee the public school system, increasing the racial isolation in public schools.

Elementary school attendance zones are one of the clearest links between residential and school segregation, shaping who goes to school where, while also impacting families’ home buying decisions. In this way, educational boundaries can become mutually reinforcing to educational and residential segregation. Yet these boundaries are not well understood, and in particular it is not well understood in what cases they produce the most unequal outcomes. In this study I sought to explore school district characteristics that are salient to segregation in order to better understand in what context these boundaries seem to be the most high stakes, where the population and children are sorted the most unevenly by race. Building on research that has identified the persistence of the black/white color line and the role of residential and educational racial preferences in segregation, I find that school zones are most unequal in school districts with large black populations, and where there are high levels of racial diversity. This contributes to our understanding of how individuals are sorted residually within school districts, and how the racial compositions of those districts may matter in that sorting. And in city school districts, school attendance zone boundaries are especially segregative. City school districts are some of the most large and racially diverse districts, offering the potential of truly multiracial education contexts. However it is in these districts where zones contribute the most to the racial residential segregation. It is important to remember that attendance zone boundaries are far more malleable than school district boundaries, and indeed large school districts like the ones in this study frequently re-draw zones to account for population changes. The results presented here suggest that in the majority of large school districts, elementary attendance zones could be designed in a way that contribute less to the racial residential segregation of school districts. Desegregative school attendance zones are a potential, if under recognized, policy lever for school districts to reduce segregation at the nexus of housing and schools.
Chapter 5

CONCLUSION

This dissertation provides new insights into the patterns of racial and income residential segregation in school districts over time. Making use of several federal datasets, I conduct analyses that show how schools districts are segregated by race and income at different geographic scales, from micro and macro segregation to school attendance zone segregation. I approach these studies with the conceptual underpinning that proximity is critical to consider when measuring segregation (Fowler, 2016; Fowler, Lee & Matthews, 2016; Lee et al., 2008; Lichter, Parisi & Taquino, 2015; Parisi, Lichter & Taquino, 2011; Reardon et al., 2008), and that the linkages between school and housing need to be more fully understood (Frankenberg, 2009; 2013; Lareau & Goyette, 2014; Saporito & Sohoni, 2006; Siegel-Hawley, 2016). Spatial proximity is critical to understand in the context of school district residential segregation because schools are spatially bound resources, and if school districts are interested in designing policies that promote integration of schools, they must contend with the residential patterns within the district. Additionally, there is a need to better understand the ways in which education policies are related to residential segregation, more fully capturing the bidirectional relationship between school and residential segregation.

Here, I highlight several key findings from the three chapters. First, I examined the macro and micro racial and income segregation that occurred within large school districts from 1990 to 2010. I found that racial segregation occurred at a more macro scale than income segregation, and that the gap between the geographic scale of racial and income segregation was largest in 2010. This means that the since 1990, racial and income segregation have occurred at increasingly different scales within large school districts. Further, I showed that different racial dyads experience segregation at different scales within school districts, with black and white residents segregated across the largest scales. In many of the major school districts in the U.S., black/white segregation and multiracial segregation occurred across large distances, with residents having to travel several kilometers to reach areas of the school district where the racial composition differs substantially from their immediate pedestrian neighborhood. This connects to earlier research that has examined metropolitan racial segregation over time using distance-based measures of segregation (Lee et al, 2008; Reardon et al, 2008). Additionally, it builds upon
research that has documented patterns of residential segregation within school districts (Owens, 2017; Siegel-Hawley, 2016; Saporito & Sohoni, 2006), taking seriously the need to examine the residential patterns within school districts on their own. There has been increasing interest in the use of socioeconomic status instead of race to produce both racial and income integration of schools. But the findings from this study add another caveat to those that have already been raised (Crosnoe, 2009; Reardon, Yun & Kurlaender, 2006), indicating that the geographic scale of racial and income segregation differ. Policies to address segregation at different scales likely have to take different approaches (for example attendance zone adjustments versus the use of magnet schools with transportation), complicating the use of socioeconomic status to promote racial integration.

A second key finding is that educational policies—in the form of school attendance zone boundaries—are critical in shaping residential segregation. In large school districts, over half of multiracial residential segregation occurred between elementary school zones, rather than within them. This indicates that these educational boundaries are important features in structuring the total population sorting within school districts. These boundaries were even more critical in the sorting of black and white residents, with elementary school zones being most segregative for the black and white resident population in school districts. Interestingly, the under 18 population was actually less segregated by elementary school zones than the total population. Children were more segregated across neighborhoods within zones than across elementary school zones. I suggest, based on literature in the area of racial residential preferences (Charles, 2000; 2006; Crowder & South, 2008; Emerson, Yancey & Chai, 2001; Feagin, 1994; Harris, 2001; Krysan, 2002; Zubrinski & Bobo, 1996), that this may be related to particular sensitivity that families with children have in living in close proximity to neighbors of different races. That the total population was segregated within school districts by elementary attendance zones, and that black and white residents had particularly high segregation, indicates that the education policy of school attendance zone boundaries is related to residential segregation. This finding adds to a growing body of literature that documents the ways in which school choices matter for residential outcomes. School attendance zone boundaries may be a particularly relevant education policy to target for reducing racial segregation of housing and schools because they are controlled by the school district and are adjusted frequently.
Finally, the segregative impact of school zones on residential patterns differs across contexts, with school districts that have a greater proportion of black residents and a higher degree of racial diversity experiencing greater segregation by school zone. These patterns may be related to the close links between the composition of schools and the perception of school quality (Holme, 2002), leading families to avoid zones where there are a high proportion of black families and high levels of racial diversity. Indeed, previous research has found that white families make segregative school decisions in diverse contexts, and that education contexts are more segregated than residential patterns would suggest (Jargowsky, 2014; Saporito 2003; 2009; Saporito & Hanley, 2014). Additionally, geographically large and countywide school systems had less segregative school zones. This finding demonstrated that school zones could be drawn in a less segregating manner despite challenges often raised around distance and transportation. It also shows that there may still be a jurisdictional advantage that countywide systems hold onto in terms of desegregation. The context where elementary school zones were most segregative was for black and white residents in a city school system, with 66 percent of racial segregation for black and white residents in this type of school district due to elementary school zones. This is indicative of school zones that are highly unequal. These findings provide a greater understanding of settings in which elementary school attendance zones are most segregative, and thus are suggestive of places where attendance zone adjustments may be most critical. Conversely, we see where school zones are the least segregative, notably in countywide school systems, and lessons can perhaps be learned from the approach taken in these districts.

This dissertation draws from a large body of research in the fields of sociology and education. I sought to emphasize the importance of proximity in studying segregation (Lee et al, 2008; Readon et al, 2008). In particular, I demonstrated how a spatial approach to measuring segregation can be used to better understand population patterns within school districts, and suggested why proximity may be particularly important in the education context. School districts often use student assignment plans where students attend the school closest to their home (Frankenberg, 2013; Saporito, 2009) and therefore the micro and macro segregation within school districts is an important feature in understanding the extent to which residential proximity may create or impede conditions conducive to school integration. I also sought to build upon research that has documented the ways that schools and housing are connected (Frankenberg, 2009, 2013; Lareau & Goyette, 2014; Owens, 2017; Saporito & Sohani, 2006; Saporito &
Hanley, 2014; Siegel-Hawley, 2013a). I did so by measuring the extent to which an education policy, school attendance zones, contributed to the racial residential segregation of school districts, finding that these boundaries were indeed important in segregating populations.

The research here presents broad descriptions of residential segregation in large school districts, and there are a number of areas for future research. In education, residential segregation is rarely studied within school districts, with school districts as the largest units of study (as compared to metropolitan areas or counties). In this dissertation, I demonstrated different ways in which residential segregation can be studied within school districts, utilizing different census units and GIS. Future research may consider other scales when measuring segregation of school districts, and going further back in time to have a better understanding of how residential segregation has changed in school districts over a longer period. This study also indicated important differences between the total population and the under 18 population in terms of their segregation within school districts, and future research should also consider how children are segregated distinctly. Finally, school attendance zones are just a small part of the myriad of ways in which segregation is experienced in society. But I argue that they are worth understanding because they are positioned at an important nexus of educational and residential segregation, and they are a potential policy lever that is legally permissible and embedded into school districts’ operations. Most large school district use attendance zones, and adjust them frequently when the populations within their districts change. These changes are necessarily segregative or integrative. There is also a need for future research that identifies the processes of how school attendance zones are designed, so that coupled with studies that have explored patterns of attendance zone segregation, more comprehensive policy recommendations can be made about how these zones can be designed to be less segregative.

This dissertation has implications for what is known about the link between education policies and residential segregation, and for our understanding of residential patterns within school districts. It also provides a rationale and approach to study segregation at multiple geographic scales in the education context, highlighting the benefits of new insights that such approaches can produce. And it has implications for policymakers and school district leaders that seek to design school attendance zones that promote racial integration. Adjustments to school attendance zones are one of the most common ways that school districts design policies to further integration of schools (Reardon & Rhodes, 2011). Yet building upon previous work
(Saporito & Sohoni, 2006; Sohoni & Saporito, 2009) this study also shows that school attendance zones are also related to residential segregation, and therefore school districts that design attendance zones to be more educationally integrative may also find them to be more residentially integrative.

Many different stakeholders have been engaged in the issue of how to reduce school and residential segregation, from civil rights lawyers, to policymakers, to school district administrators. In this dissertation, I aimed to encourage new ways of thinking about the link between school and residential segregation, and the possibilities for within-district integration. The findings might be especially useful for advocates that have been working in a context where the long-standing axiom has been that schools are segregated because neighborhoods are—and therefore there is little opportunity for education polices to make a difference. While previous research has documented the enormous potential for law and policy to transform schools (i.e. Orfield, 1969), the demographic research presented here offers insight into the potential that exists for school districts to integrate. While some of the largest and most diverse school district in the U.S. have population patterns that do greatly complicate school integration—that is, racial groups are spatial segregated, living relatively far distances from each other—in most large school districts there is a demographic capacity for school integration. That is, we cannot simply say that schools are segregated because neighborhoods are, in many large school districts education policies could be enacted within the existing neighborhood demographic context. Furthermore, education policies actually contribute to residential segregation. There is great potential for advocates and lawmakers to develop education policies, even given existing patterns of residential segregation, to reduce school segregation. And in doing so, there may be important ancillary benefits in the housing context.

In sum, this dissertation deepens existing perspectives on the link between school and residential segregation. School segregation is typically understood by studying students in schools, but an understanding of residential segregation within school districts offers potentially important insights into school segregation as well. Broadly, studies of residential patterns within school districts show what may be possible should more families opt into the public school system. For example, the macro and micro segregation of the population within school districts suggest what may be practical in terms of integration of schools, given limits related to spatial proximity and transportation. And studying residential segregation by school attendance zones
demonstrates how educational policies shape decisions that all people make about where to live. This dissertation also provides an approach to studying residential segregation within school districts, making use of multiple federal datasets and GIS, and making clear education and housing are closely connected. Going forward, scholars might benefit from exploring educational segregation at multiple scales, taking account of spatial proximity, and further delineating the relationship between school and residential segregation.
References


Hawley, W. (2007). Designing schools that use student diversity to enhance learning of all students. In *Lessons in integration: Realizing the promise of racial diversity in American
schools (E. Frankenberger & G. Orfield, Eds.), 31-56, Charlottesville: University of Virginia Press.


Lawlor v. Board of Education of Chicago, 458 F.2d 660 (7th Cir. 1972).


Siegel-Hawley, G. (2013a). City lines, county lines, color lines: The relationship between school and housing segregation in four southern metro areas. Teachers College Record, 115(6), 1.


the city of the angels. Social Science Research, 25(4), 335-374.
### Appendix A. Lowest racial macro/micro ratio by year, large U.S. school districts

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiracial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.247 Garden Grove, CA</td>
<td>0.274 Alpine, UT</td>
<td>0.240 Capistrano Unified, CA</td>
</tr>
<tr>
<td></td>
<td>0.299 Virginia Beach, VA</td>
<td>0.275 Garland ISD, TX</td>
<td>0.252 Davis, UT</td>
</tr>
<tr>
<td></td>
<td>0.299 Capistrano Unified, CA</td>
<td>0.307 Brownsville ISD, TX</td>
<td>0.292 Baltimore City, MD</td>
</tr>
<tr>
<td></td>
<td>0.306 Washoe County, NV</td>
<td>0.308 Capistrano Unified, CA</td>
<td>0.336 Fairfax County, VA</td>
</tr>
<tr>
<td></td>
<td>0.310 Baltimore City, MD</td>
<td>0.311 Baltimore City, MD</td>
<td>0.342 Cherry Creek 5, CO</td>
</tr>
<tr>
<td><strong>Black-white</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.033 Santa Ana Unified, CA</td>
<td>0.043 Garland ISD, TX</td>
<td>0.091 Santa Ana Unified, CA</td>
</tr>
<tr>
<td></td>
<td>0.127 Mesa Unified, AZ</td>
<td>0.083 Cherry Creek 5, CO</td>
<td>0.098 Garden Grove, CA</td>
</tr>
<tr>
<td></td>
<td>0.179 Plano, TX</td>
<td>0.128 Lewisville ISD, TX</td>
<td>0.138 Corona Norco Unified, CA</td>
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<tr>
<td></td>
<td>0.209 Virginia Beach, VA</td>
<td>0.287 Santa Ana Unified, CA</td>
<td>0.171 Davis, UT</td>
</tr>
<tr>
<td></td>
<td>0.241 Douglas County, CO</td>
<td>0.314 Baltimore City, MD</td>
<td>0.201 Alpine, UT</td>
</tr>
<tr>
<td><strong>Hispanic-white</strong></td>
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<td></td>
<td></td>
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<td>0.164 Howard County, MD</td>
<td>0.172 Capistrano Unified, CA</td>
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<td>0.269 Alpine, UT</td>
<td>0.238 Henrico County, VA</td>
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<td></td>
<td>0.217 Boston, MA</td>
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<td>0.253 Boston, MA</td>
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<tr>
<td><strong>Asian-white</strong></td>
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<td></td>
<td></td>
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<td>0.071 Seminole County, FL</td>
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<td>0.185 North East ISD, TX</td>
<td>0.286 Palm Beach, FL</td>
<td>0.136 Omaha, NE</td>
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<td></td>
<td>0.220 Brevard, FL</td>
<td>0.288 North East ISD, TX</td>
<td>0.138 Baltimore City, MD</td>
</tr>
<tr>
<td></td>
<td>0.224 Palm Beach County, FL</td>
<td>0.291 Austin ISD, TX</td>
<td>0.140 Tucson Unified, AZ</td>
</tr>
</tbody>
</table>

Source: Census Tiger/LINE shapefiles of U.S. school districts 2010; ACS 2008-2012 5 year estimates of race population counts
Appendix B. Lowest racial macro/micro ratio by year, large U.S. school districts

<table>
<thead>
<tr>
<th>Rank-Order H</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Santa Ana Unified, CA</td>
<td>0.175</td>
<td>Brownsville ISD, TX</td>
</tr>
<tr>
<td></td>
<td>Boston, MA</td>
<td>0.180</td>
<td>Long Beach Unified, CA</td>
</tr>
<tr>
<td></td>
<td>Guilford County, NC</td>
<td>0.204</td>
<td>San Francisco Unified</td>
</tr>
<tr>
<td></td>
<td>San Francisco Unified</td>
<td>0.212</td>
<td>Santa Ana Unified, CA</td>
</tr>
<tr>
<td></td>
<td>Garden Grove, CA</td>
<td>0.220</td>
<td>San Antonio ISD, TX</td>
</tr>
</tbody>
</table>

Source: Census Tiger/LINE shapefiles of U.S. school districts 2010; ACS 2008-2012 5 year estimates of household income threshold
Appendix C. School Districts with Court Ordered Desegregation Plans

<table>
<thead>
<tr>
<th>Number of School Districts</th>
<th>Released from Court Order before 1990</th>
<th>Released from Court Order after 1991</th>
<th>Still under Court Order(^{25})</th>
<th>Status not Determined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
<td>31</td>
<td>6</td>
<td>38</td>
</tr>
</tbody>
</table>

Sources: CEPA: District Court Order Data; Pro Publica: A National Survey of School Desegregation Orders

\(^{25}\) As of the year of the data under study, 2010.
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SELECTED PUBLICATIONS


SELECTED CONFERENCE PRESENTATIONS

