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The Role of Noncontiguous Attendance Zones in Shaping School Populations: A Case Study of Tucson, Arizona and Fort Bend, Texas

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Abstract: Noncontiguous school attendance zone boundaries (AZBs) have a unique, relatively uncommon shape that assign two or more non-adjacent residential areas to the same school. Given their ability to shape school enrollments by taking advantage of

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residential sorting, noncontiguous AZBs have historically been linked to explicit efforts to both segregate and desegregate schools. In this paper, we use a novel, longitudinal dataset of AZBs and descriptive quantitative and geospatial methods to understand how the relationship between noncontiguous zones, school diversity, and neighborhood demographics changed from 1990-2020 in two southwestern school districts—Tucson Unified School District, Arizona and Fort Bend Independent School District, Texas. Each district has a unique legal history and demographic context that informs their use of noncontiguous AZBs. We find noncontiguous AZBs are more strongly associated with racially diverse schools and are more likely to bring together neighborhoods with different compositions in Tucson compared to Fort Bend. However, the association between Tucson's noncontiguous AZBs and racially diverse schools has waned since 1990, as the district has negotiated the end of its court-ordered desegregation plan. Our findings provide insight into when and how noncontiguous AZBs can effectively contribute to ethnoracially diverse schools.
Keywords: school attendance zones; school segregation; demographic change; case study

El papel de las zonas de asistencia no contiguas en la configuración de las poblaciones escolares: Un estudio de caso de Tucson, Arizona y Fort Bend, Texas
Resumen: Los límites de las zonas de asistencia escolar (AZB) no contiguas tienen una forma única y relativamente poco común que asigna dos o más áreas residenciales no adyacentes a la misma escuela. Dada su capacidad para dar forma a las inscripciones escolares aprovechando la clasificación residencial, las AZB no contiguas históricamente han estado vinculadas a esfuerzos explícitos tanto para segregar como para eliminar la segregación de las escuelas. En este artículo, utilizamos un nuevo conjunto de datos longitudinales de AZB y métodos cuantitativos y geoespaciales descriptivos para comprender cómo cambió la relación entre zonas no contiguas, la diversidad escolar y la demografía del vecindario entre 1990 y 2020 en dos distritos escolares del suroeste: el Distrito Escolar Unificado de Tucson, Arizona y el Distrito Escolar Independiente de Fort Bend, Texas. Cada distrito tiene una historia legal y un contexto demográfico únicos que informan su uso de AZB no contiguos. Encontramos que las AZB no contiguas están más fuertemente asociadas con escuelas racialmente diversas y es más probable que reúnan vecindarios con diferentes composiciones en Tucson en comparación con Fort Bend. Sin embargo, la asociación entre las AZB no contiguas de Tucson y las escuelas racialmente diversas ha disminuido desde 1990, a medida que el distrito negoció el fin de su plan de abolición de la segregación ordenado por la corte. Nuestros hallazgos brindan información sobre cuándo y cómo las AZB no contiguas pueden contribuir de manera efectiva a escuelas étnicamente diversas.
Palabras-clave: zonas de asistencia escolar; segregación escolar; cambio demográfico; caso de estudio

O papel das zonas de frequência não contíguas na formação das populações escolares: Um estudo de caso de Tucson, Arizona e Fort Bend, Texas
Resumo: Os limites das zonas de frequência escolar não contíguas (AZBs) têm uma forma única e relativamente incomum que atribui duas ou mais áreas residenciais não adjacentes à mesma escola. Dada a sua capacidade de moldar as matrículas escolares, tirando partido da triagem residencial, os AZBs não contíguos têm sido historicamente associados a esforços explícitos para segregar e dessegregar escolas. Neste artigo, usamos um novo conjunto de

dados longitudinais de AZBs e métodos quantitativos e geoespaciais descritivos para entender como a relação entre zonas não contíguas, diversidade escolar e demografia do bairro mudou de 1990 a 2020 em dois distritos escolares do sudoeste - Distrito Escolar Unificado de Tucson, Distrito escolar independente do Arizona e Fort Bend, Texas. Cada distrito tem um histórico jurídico e um contexto demográfico únicos que informam o uso de AZBs não contíguos. Descobrimos que os AZBs não contíguos estão mais fortemente associados a escolas racialmente diversas e são mais propensos a reunir bairros com composições diferentes em Tucson em comparação com Fort Bend. No entanto, a associação entre os AZBs não contíguos de Tucson e as escolas racialmente diversas diminuiu desde 1990, quando o distrito negociou o fim do seu plano de dessegregação ordenado pelo tribunal. Nossas descobertas fornecem informações sobre quando e como AZBs não contíguos podem efetivamente contribuir para escolas com diversidade étnico-racial.
Palavras-chave: zonas de frequência escolar; segregação escolar; mudança demográfica; estudo de caso

The Role of Noncontiguous Attendance Zones in Shaping School Populations: A Case Study of Tucson, Arizona and Fort Bend, Texas

Patterns of school and residential segregation are strongly linked, due in large part to the role school attendance zone boundaries (AZBs) play in determining where children attend school. Most school districts use AZBs as their primary student assignment policy, drawing lines to sort students into schools based on where they live. About 73% of students in the U.S. attend the public school to which they are zoned (National Center for Education Statistics, 2021). As the quality, resources, and opportunities of schools varies within and between districts, AZBs help shape students' access to educational opportunities and also affect residential patterns.

Noncontiguous AZBs are a unique type of AZB in which two or more non-adjacent residential areas are assigned to the same school. Historically, such zones have been used to mixed effect throughout the U.S. In some places, they have been used in court-ordered desegregation plans to assign students from neighborhoods with different ethnoracial compositions to the same school, working to overcome the role of residential segregation in shaping school enrollments (Douglas, 1995). In other places, they have been linked to explicit efforts to maintain segregated schools (Jacobs, 1998). It is unclear how school districts have maintained or altered their noncontiguous AZBs and how these AZBs have influenced school populations over time. Extant analyses of the relationship between the shape of AZBs and patterns of segregation have also produced mixed findings (Richards, 2014; Saporito & Van Riper, 2016; Siegel-Hawley, 2013). The current study addresses the gap in focus on noncontiguous AZBs by analyzing the relationship between noncontiguous AZBs, school diversity, and residential demographics over time.

This paper is a case study of two school districts in the Southwest: Tucson Unified School District (TUSD), Arizona and Fort Bend Independent School District (FBISD), Texas. A novel dataset—the Longitudinal School Attendance Boundary Survey—has 1990, 2000, 2010, and 2020 AZB shapefiles for both districts, allowing for analysis over time. We chose TUSD and FBISD because while both utilize noncontiguous AZBs, they do so for seemingly different reasons. TUSD began using noncontiguous AZBs in 1978 as part of its court-ordered desegregation plan. FBISD, on the other hand, does not have an explicit history of utilizing noncontiguous AZBs to achieve desegregation. Rather, it appears to use noncontiguous AZBs to help balance school capacities amidst rapidly growing enrollments.

We address two research questions. First, how does the use of noncontiguous AZBs relate to the ethnoracial diversity of schools over time? And second, to what extent do noncontiguous zones create ethnoracially diverse schools by bringing together students from ethnoracially different neighborhoods? Our findings provide insight into whether, when, and how noncontiguous AZBs are associated with ethnoracially diverse schools.

Literature Review

This study adds to existing literature on the way school AZBs link patterns of residential and school segregation. After briefly discussing this broad area of research, we turn to the limited studies to date that have focused more specifically on noncontiguous or other irregularly shaped AZBs. These studies have mixed conclusions: some have called out "gerrymandered" AZBs that serve to segregate students (Richards, 2014; Siegel-Hawley, 2013) while others claim irregularly shaped AZBs are more desegregative (Saporito & Van Riper, 2016). The current study speaks to this tension by exploring the contexts in which noncontiguous AZBs, often deemed highly irregular in both popular perception and mathematical indices, are associated with racially diverse schools.

The Importance of AZBs

Educational boundaries create a strong, mutually reinforced link between residential and school segregation (Denton, 1996). A school may be segregated if the surrounding residential area is segregated and its AZB captures a homogeneous area. Moreover, people are willing to move for access to specific schools, so parents—especially affluent and white parents—may purchase a home in a segregated residential area because they want access to what they perceive to be a high-quality school where children look like theirs (Holme, 2002; Lareau & Goyette, 2014; Pearce, 1980).

Given their power to shape school and residential communities, AZBs have been used both to segregate and desegregate schools. In the north, where de jure segregation did not typically exist, districts maintained de facto segregated schools by drawing AZBs to separate white and Black residential populations (Clark, 1987; Leigh, 1997). Even after such practices were deemed unconstitutional (*Keyes v. Denver School District No. 1*, 1973), many school districts continued to draw segregative AZBs, but described their student assignment policies as "neighborhood schools" (Clark, 1987; Orfield & Eaton, 1996). On the other hand, AZBs can also be intentionally drawn to pull together ethnoracially diverse students into the same schools (Gordon, 1994; Taylor et al., 2019).

Today, school AZBs often reinforce existing patterns of residential segregation, but there are also places where they serve to create particularly segregated or desegregated schools (Monarrez, 2023; Monarrez & Chien, 2021). AZBs can be especially segregative in areas where populations are rapidly diversifying (Richards, 2014). In other places, court-ordered or voluntary desegregation efforts have led to more desegregative AZBs (Taylor et al., 2019).

While legal and political commitment to enforcing desegregation and related student assignment plans has waned in recent decades, redrawing AZBs remains a powerful, legally permissible mechanism for addressing racial segregation within school districts. In particular, the portion of within-district segregation has risen in recent decades (Owens et al., 2022). The pursuit of diverse, integrated schools remains a critical one; decades of research have demonstrated the harms of segregated schools and the benefits of integrated ones for all students, and especially students of color (Johnson, 2019; Mickelson & Nkomo, 2012).

Noncontiguous AZBs

Noncontiguous AZBs are a particularly interesting subset of AZBs due to their relative rarity, irregular shape, and mixed history. They are relatively uncommon in the U.S. due to the perception that they split up neighborhoods and assign students to schools further from home, actions that contradict traditional American preferences for nearby schools with strong neighborhood ties (Bell, 2007; Goldring et al., 2006).

While Americans' desire for neighborhood schools is evident, such rhetoric is ultimately inseparable from racism and the avoidance of school desegregation (Delmont, 2016). Neighborhoods are also socially constructed, and their conceptions can differ within a community (Suttles, 1972). Historically, resistance to court-ordered desegregation came from white parents who did not want their children bused to integrated schools far away from home, and the preference for "neighborhood schools" was loudly voiced during this era (Delmont, 2016). Similarly, resistance to noncontiguous AZBs was particularly strong when they were utilized in court-ordered desegregation plans (Douglas, 1995).

One of the best-known examples of noncontiguous AZBs as a desegregation tool is in Charlotte-Mecklenburg Schools (CMS), North Carolina. The Supreme Court's *Swann v. Charlotte-Mecklenburg Board of Education* ruling in 1971 required CMS to redraw AZBs to desegregate schools. In response, the district created some noncontiguous AZBs, or "satellite zones." The zones helped create more racially desegregated schools until the district underwent large-scale rezoning in 2001 when released from court oversight. Levels of segregation were markedly higher after CMS eliminated noncontiguous AZBs (Billings et al., 2014). Similarly, Jefferson County Public Schools in Kentucky used noncontiguous AZBs to bring together predominantly Black neighborhoods from the city of Louisville with predominantly white neighborhoods in the county (McDermott et al., 2015). The district later moved away from using noncontiguous AZBs after its first voluntary integration plan was struck down by the courts, but it has since reincorporated noncontiguous AZBs as contiguous ones were associated with higher levels of segregation (Frankenberg & Diem, 2013).

On the other hand, there are other places where noncontiguous AZBs have been used by school districts to maintain racially segregated schools. In Columbus, Ohio, the school district used noncontiguous AZBs to maintain a dual system throughout the 1970s (Jacobs, 1998). A district court described these noncontiguous zones as "skipping about as capriciously as a young child at play" (*Penick v. Columbus Board of Education*, 1977, p. 236). In a Minnesota school district, researchers found home parks and public housing units containing large numbers of children of color were zoned to schools located across the district, rather than to the nearest schools which were mostly white (M. Orfield & Luce, 2010, p. 134).

More recently, the U.S. Department of Justice (DOJ) raised questions about a proposed noncontiguous AZB in Prince William County Schools, Virginia that would segregate minoritized students at one school (Balingit, 2014). The DOJ warned the AZB could violate the Equal Educational Opportunities Act (EEOA) of 1974, which prohibits "the assignment… of a student to a school, other than the one closest to his or her place of residence within the school district in which he or she resides, if the assignment results in a greater degree of segregation of students… than would result if such student were assigned to the school closest to his or her place of residence" (20 U.S.C. § 1703). Noncontiguous AZBs are legal if they do not serve to segregate, even if students attend schools further from their home.

Although literature specifically on noncontiguous AZBs is limited, researchers have analyzed the impacts of different AZB shapes on levels of school diversity and segregation. This research has relatively mixed conclusions (Monarrez, 2023; Richards, 2014). Some find that irregularly shaped AZBs—or zones with lots of nooks and crannies rather than smooth, even

edges—create racially homogenous schools if district leaders gerrymander the lines to group students of similar races (Richards, 2014; Siegel-Hawley, 2013). Others find highly irregular AZBs are correlated with increased racial diversity as they can combine students from demographically different residential areas in the same school (e.g., Saporito & Van Riper, 2016). Both of these scenarios are evident in different places. A recent study showed how it would be possible to redraw AZBs to achieve substantial decreases in school segregation. Notably, the authors found the potential for desegregation increased when they dropped constraints around contiguous AZBs from their optimization model (Gillani et al., 2023).

The current study contributes to the literature by analyzing the relationship between noncontiguous AZBs and the racial composition of schools over time. Though the legal landscape around school desegregation has changed dramatically in recent decades, noncontiguous AZBs theoretically remain an option for creating diverse schools. However, it is unclear how districts have maintained or altered their noncontiguous AZBs, and how these AZBs relate to school segregation over time.

Research Methods

Case Selection

In the process of collecting AZB maps from districts across the country for a larger project, the Longitudinal School Attendance Boundary Survey (LSABS), our research team initially noticed Tucson USD's high number of noncontiguous AZBs. Given persistent residential segregation, we wished to study how districts have used these particular kinds of zones over time. We decided to take a comparative case study approach to compare those in TUSD to those in another district (Merriam, 1998). Based on prior research described above, we prioritized districts with differing histories around implementing noncontiguous AZBs, while keeping region constant (Gerring, 2009). These criteria led us to Fort Bend ISD, another district in the Southwest with some use of noncontiguous zones, though unlike TUSD, it did not implement noncontiguous zones as part of its desegregation efforts. We present additional details on each district below. Importantly, both districts have school AZB maps available for 1990, 2000, 2010, and 2020, making longitudinal analysis possible.

Data

We use digitized school AZB maps from LSABS depicting elementary, middle, and high school AZBs in each district in the 1989-90, 1999-00, 2009-10, and 2019-20 school years. For this paper, we visually inspected AZB polygons and flagged the noncontiguous ones.

We combine AZB shapefiles with school enrollment data by race/ethnicity from the National Center for Education Statistics (NCES) for our four decile years of study. We also use census population counts to study residential populations in each district. We use block level data from the 1990, 2000, and 2010 decennial censuses and tract level data in 2020.[1] We calculate population counts for children under 18 by race and Hispanic ethnicity.[2]

Because census units do not line up with AZBs, we interpolate population counts within each AZB. We use binary dasymetric interpolation to evenly assign population counts to 30m^2 raster

[1] We use tract level data in 2020 because the U.S. Census Bureau used new differential privacy techniques to inject more random noise into population counts at small units like the block level (U.S. Census Bureau, 2021).
[2] Exact counts of Hispanic populations by race and age were not available in the 1990 Census. To not double count Hispanic individuals in those years, we used the proportion of all-aged Hispanic individuals by race in each unit to approximate the number of under 18 Hispanic individuals by race.

cells; data from the National Land Cover Database allow us to exclude undeveloped land, such as forests or water bodies (Eicher & Brewer, 2001). Dasymetric interpolation is a significant improvement upon commonly used methods of simple areal weighting which assume that population is uniformly distributed among source zones (Comber & Zeng, 2019; Eicher & Brewer, 2001; Schroeder, 2017). We use binary dasymetric interpolation because studies show little difference in its accuracy compared to multi-class approaches that require subjective calibration decisions (Schroeder, 2017). We aggregate raster cells up to the AZB level for analysis.

Methods

We use descriptive methods to answer our research questions. Descriptive research is crucial to understanding understudied phenomena such as noncontiguous AZBs (Loeb et al., 2017). There is very limited research to date that specifically explores the relationship between noncontiguous AZBs and school enrollments; our descriptive methods provide an initial understanding of this relationship over the last few decades and lay the groundwork for future inquiry. With our focus on two school districts, we are able to explore contextual factors at play and generate hypotheses that may help explain that relationship (Loeb et al., 2017; Seawright & Gerring, 2008).

Measuring School Diversity

Our first research question concerns the relationship between noncontiguous AZBs and school racial diversity. We use school enrollment data to calculate several measures of diversity and segregation for each school district overall and disaggregate for schools with noncontiguous and contiguous AZBs.

First, we use scaled entropy, a measure of multiracial diversity that describes the extent to which various groups are present in each unit (e.g., a school or school district). We measure entropy with respect to American Indian/Alaska Native, Asian, Black, Hispanic, and white students.[3]

The scaled entropy score of a unit i, E_i, is defined as

$$E_i = \frac{\sum_{r=1}^{r} (\Pi_{ri}) \ln\left(\frac{1}{\Pi_{ri}}\right)}{\ln(r)}$$

where Π_{ri} refers to the proportion of a particular ethnoracial group r within unit i's enrollment (Theil, 1972). Scaled entropy ranges from 0 to 1, where 1 indicates maximum diversity. For example, when calculations include five ethnoracial groups, an entropy of 1 indicates each group comprises 20% of the population. We use Welch's unequal variance t-tests to test whether mean school entropy levels differ among schools with and without noncontiguous AZBs.

We next calculate exposure indices to understand potential contact between groups of students. This measure describes the weighted average school composition a student of group x experiences. Districtwide exposure, P^*, is calculated as

$$P^* = \sum_{i=1}^{n} \left(\frac{x_i}{X} * \frac{y_i}{t_i}\right)$$

[3] American Indian/Alaska Native is typically a small group that may bias the results of entropy analyses, but we include them because they comprise at least 3-4% of TUSD. Though they are less than 1% of FBISD's population, including them in FBISD's calculations does not alter reported trends.

where n is the number of schools in the district, x_i is the number of students from school i in group x, X is the total number of students from group x in the district, y_i is the number students from school i in group y, and t_i is the total number of students in the school i. A white-Hispanic exposure index of 0.35 indicates the average white student attends a school with 35% Hispanic students.

Lastly, we identify how many students attend racially concentrated or identifiable schools. We define concentrated schools as those with greater than or equal to 70% of its student body belonging to the same group; identifiable schools are those with compositions that differ by more than +/- 25 percentage points from the district's overall composition.[4]

Together, these measures provide a holistic view of racial diversity in schools with different kinds of AZBs. Entropy measures the multiracial diversity of individual schools. Exposure indices speak to the average student's lived experience by describing who she has the potential to interact with in her school. Flagging concentrated and identifiable schools allows us to see whether noncontiguous AZBs are associated with outlier schools. We note these measures are descriptive and cannot speak to any causal relationship between AZB shape and school diversity.

Comparing Residential Populations

Our second research question seeks to understand the extent to which noncontiguous AZBs combine neighborhoods with different ethnoracial compositions. To answer it, we compare the demographics of populations living in each part of noncontiguous AZBs. We use the term "main zone" to refer to the part of a noncontiguous AZB that houses the school building and "annex zone(s)" to refer to the other, non-adjacent parts of the AZB.

We use census data to measure residential segregation in each district under two scenarios: first, using noncontiguous zones as they actually exist, and second, assuming all units (all main and annex zones) act as single-part, contiguous zones. We refer to the former as multi-part polygons, where each AZB is potentially comprised of multiple noncontiguous pieces, and the latter as single-part polygons, where each piece constitutes its own AZB. The single-part scenario is likely not what would exist in the absence of noncontiguous zones; noncontiguous annexes would not have their own schools and act as standalone AZBs. However, the comparison demonstrates the extent to which the use of noncontiguous AZBs is associated with higher or lower districtwide residential segregation. Higher segregation under the second scenario compared to the first would indicate noncontiguous AZBs capture neighborhoods with different ethnoracial compositions.[5]

For each scenario, we measure districtwide segregation using Theil's H, a measure of evenness that calculates the weighted average deviation of each unit's (e.g., AZB) racial composition from a larger unit's (e.g., district) composition. H speaks to how evenly an overall population is sorted across units. The formal definition is,

[4] These definitions are informed by those in TUSD's court-ordered desegregation plan, further described below.

[5] These values should be interpreted with care, as the smaller population sizes of the single-part polygons increase the likelihood of stochastic variation that can systematically bias segregation measurement, but the relative magnitude and trend of segregation between the two scenarios is instructive (Carrington & Troske, 1997; Jones et al., 2018).

$$H = \frac{1}{TE}\sum_{i=1}^{j} t_i\,(E - E_i)$$

where T refers to the population of the district, and t_i refers to the total enrollment of each school i. E is the entropy of the overall district and E_i is the entropy of each school.

Next, we descriptively compare the racial composition of residential populations living within each separate piece of a noncontiguous AZB. Because some children do not attend their zoned school, residential demographics do not perfectly align with school enrollments. But the comparison helps describe the extent to which noncontiguous AZBs combine residential areas with different ethnoracial compositions.

Lastly, we more deeply analyze four individual schools with noncontiguous AZBs. While the previous analyses speak to the average outcomes associated with noncontiguous AZBs, this analysis focuses on the range of possible outcomes of noncontiguous zones. We select two schools from each district; one with the largest difference in the white share of residents in the main and annex zones and one with the smallest difference, in any year of our study. In other words, these are the noncontiguous zones that combined residential areas with the most and least extreme variations in racial compositions. We analyze outlier schools because values at the extreme can help reveal mechanisms that may make noncontiguous zones particularly desegregative or not (Stake, 2000). In our case, the outliers are one elementary and one middle school in each district. We compare the racial compositions of each school's main zone, annex zone(s), and school enrollments. We explore the extent to which any differences in the composition of main and annex zones may have contributed to the composition of the school. These school examples illuminate some of the factors that may affect the relationship between AZB and school compositions, such as school choice.

Case Study Contexts

Based on prior research, our case selection criteria prioritized districts with differing histories of implementing noncontiguous AZBs, school desegregation, and community demographics (Gerring, 2009). TUSD first created noncontiguous AZBs as part of its court-ordered desegregation plan. FBISD has not used such zones as part of any formal desegregation effort, providing a useful contrast.[6] Although FBISD does not have many schools with noncontiguous AZBs, we believe its limited use of noncontiguous AZBs is likely representative of how most districts would voluntarily use them, if they use them at all.

In this section, we describe changes in each district's enrollment patterns and policies around student assignment, including desegregation efforts and school choice policies. We also describe a few rezoning decisions in each district to illustrate how leaders have discussed AZBs over the years.

[6] FBISD does not appear on any lists of school districts with court-ordered desegregation plans (Logan, 2005; Reardon et al., 2012). It did submit a desegregation plan to HEW, as described below, which was the alternative option for districts in the era of desegregation enforcement. FBISD's "voluntary" desegregation is a sharp contrast to the kind of sustained court oversight that took place in districts like TUSD: HEW lacked meaningful enforcement mechanisms of voluntary plans (Frankenberg & Taylor, 2015), and voluntary efforts could be easily abandoned, as demonstrated in places like Wake County Public Schools, North Carolina (Parcel & Taylor, 2015).

Tucson Unified School District

Tucson Unified School District (TUSD) is the third largest district in Arizona. As of 2019-20, its enrollment was nearly two-thirds Hispanic (see table 1), although it has not always been majority Hispanic.

In 1951, three years prior to the Supreme Court's ruling in *Brown v. Board of Education*, TUSD became the first district in Arizona to repeal mandatory school segregation (Cooper, 1967). However, by 1973, the U.S. Department of Health, Education and Welfare (HEW) determined TUSD had still not achieved racial balance or equal educational opportunities within its schools. In 1974, the National Association for the Advancement of Colored People and Black plaintiffs filed a class-action lawsuit alleging the district did not provide equal educational opportunities for Black students, and soon after, Latino plaintiffs filed a similar suit. In 1975, the two cases merged into *Fisher-Mendoza v. TUSD*.

Following a 1978 settlement agreement, TUSD began to implement a desegregation plan which modified AZBs to further desegregate schools, including first implementation of several noncontiguous AZBs, which it referred to as "annex zones." By 1990, 15 schools had noncontiguous AZBs: nine elementary, four middle, and two high schools.

The district's desegregation plan required it to consider racial demographics when redrawing AZBs. Perhaps because it had to seek court approval for all boundary changes, the district has only rezoned intermittently since 1990; it last updated its AZBs in 2013. TUSD's other student assignment actions have focused mostly on magnet schools (*Fisher and Mendoza v. TUSD*, document 2123, 2018). TUSD was declared unitary with respect to student assignment in 2018, and in July 2022, it was declared unitary with respect to remaining factors. The case was closed following the approval of a post-unitary status plan, or USP (*Fisher-Mendoza v. TUSD*, document 2650, 2022).[7] Current TUSD policy notes racial, ethnic, and socioeconomic demographics of schools must still be considered when rezoning (Tucson Unified School District, 2023). In line with its USP, the district defines an integrated school as one in which "no racial or ethnic group exceeds 70% of total enrollment; and when no single racial or ethnic group varies from the district average for the school's grade level (Elementary, Middle, K-8, High) by more than +/- 25 percentage points" (*Fisher-Mendoza v. TUSD*, document 2615-1, p. 9, 2022).[8]

Alongside desegregation efforts, declining enrollment—specifically declining white enrollment—has been a prominent story in TUSD in recent decades (López, 2016). Since 1990, the district's enrollment has decreased from almost 56,000 students to about 45,000 (table 1). Reduced population growth, the draw of charter schools, and the ability for non-residents to enroll in other public school districts are all contributing factors (Saifer, 2019). Declining enrollments have necessitated several AZB changes, including the closure of tens of schools in the early 2010s (Tucson Unified School District, 2021). There have also been shifts in the ethnoracial makeup of TUSD. While the district enrolled 33,000 white students and almost 21,000 Hispanic students in 1990, there were fewer than 9,000 white students and almost 30,000 Hispanic students in 2020.

Overall charter school enrollment in the county housing TUSD (Pima) has grown from approximately 3,000 in 2000 to nearly 19,000 in 2019-20. In 2009-10, the percentage of white charter

[7] *Fisher* and *Mendoza* plaintiffs both objected, claiming the district remained noncompliant with certain obligations outlined in the USP (*Fisher-Mendoza v. TUSD*, document 2653, 2022; *Fisher-Mendoza v. TUSD*, document 2652, 2022); the 9th Circuit Court of Appeals affirmed the case's dismissal in 2023.

[8] A September 2018 court ruling granting partial unitary status defined an integrated school as one which did not differ from district averages by more than +/- 15% (*Fisher-Mendoza v. TUSD*, document 2123, 2018, p. 15). The new +/- 25% threshold in 2022 indicates a less robust definition of integration.

school students mirrored TUSD's percentage, but by 2019-20, Pima's charter enrollment had disproportionately higher white percentage (37%). These trends affect the potential for racial diversity within the district's zoned public schools. In particular, given TUSD's overall declines in white enrollment, the extent to which school choice further draws white students away from or into TUSD public schools affects the diversity of schools with and without noncontiguous AZBs.

Rezoning documentation suggest TUSD's use of noncontiguous AZBs for explicit desegregative purpose has diminished over time. Since 1990, TUSD has converted some previously noncontiguous AZBs back to contiguous ones, reflecting district leadership's preference for "neighborhood schools" (Tucson Unified School District, 2010). When deciding to eliminate some noncontiguous annex zones, district leaders discussed how the changes would balance school capacities and align feeder patterns. Unlike during the 1970s, racial diversity no longer seems to be a top priority, though it ostensibly remains part of district policy. For example, in 2010, when the district was considering eliminating a noncontiguous annex, a member of the Boundary Committee described the proposed change as "fairly neutral in terms of ethnicity," but that is all that was said in public discussion about ethnoracial diversity (Tucson Unified School District, 2010).

Since 1990, a few AZBs have also become newly noncontiguous. In most of these cases, district documents suggest noncontiguous annexes were created to incorporate pockets of students previously attending overcrowded schools or schools slated to close. For example, in 1998, TUSD worked to curb severe overcrowding at Grijalva Elementary by assigning small parts of its AZB to two nearby, though not neighboring, schools: Miller and Maldonado (Bustamante, 1998). The move turned Miller's and Maldonado's AZBs into noncontiguous ones. The change was meant to be temporary; the district promised to build new schools in the area that would "promote the neighborhood school concept,"—i.e., would have contiguous AZBs (Samuelson, 1998)—however, Miller's AZB remains noncontiguous today.

The role of school AZBs in TUSD is further complicated by an open enrollment policy. The statewide policy allows students to apply to attend a school other than the one to which they are zoned, within capacity limits (Brodesky, 2007).[9] One school board member suggested in 2010 that the policy was decreasing community resistance to proposed rezonings, since families knew they could likely avoid unfavorable AZB changes (Tucson Unified School District, 2010). The district's current Facilities Master Plan notes that as of 2013-14, nearly 40% of TUSD elementary students used open enrollment policies to attend a school other than the one to which they are zoned (Tucson Unified School District, 2016, p. 57). School board meeting minutes suggested families living in noncontiguous annex areas were especially likely to use open enrollment to attend a school closer to home (Tucson Unified School District, 2010).

Fort Bend Independent School District

Fort Bend Independent School District (FBISD), a suburban district south of Houston, formed in 1959 with just four schools. The suburb has grown steadily since then, and since the 1970s, the district has opened new schools almost every year.

The district voluntarily desegregated in the 1960s; in 1965, it submitted a desegregation plan to HEW that was approved and implemented. The district's plan required it "to redraw its school attendance zones each time a new school is constructed in order to maintain the necessary racial balance in its neighborhood schools" (*Fort Bend Ind. Sch. Dist. v. City of Stafford*, 1978, p. 382).

In 1982, the area in the north part of the district split away and established its own school district, Stafford Municipal School District (SMSD). When the City of Stafford held a referendum to approve the split in 1978, FBISD sued, alleging the breakaway plan would "impede [its] efforts to

[9] Such students do not receive transportation to their chosen school (Tucson Unified School District, 2012).

achieve and maintain a unitary school system" (*Fort Bend Ind. Sch. Dist. v. City of Stafford*, 1978, p. 380). The Fifth Circuit Court of Appeals ultimately disagreed, instead finding FBISD had already successfully desegregated, there was no racial motivation for the split, and the split would not substantially alter the racial composition of FBISD (*Fort Bend Ind. Sch. Dist. v. City of Stafford*, 1979).[10] Though never under court order, FBISD brought itself to court arguing it was not yet fully desegregated, as a means to try to retain part of its land.

Even after SMSD split away, FBISD continued to grow in the 1980s—opening at least one new school per year, if not more, meaning the district rezoned annually. Overall enrollment rose from roughly 33,600 students in 1989-90 to almost 78,000 in 2019-20 (table 1). The growing population also became increasingly racially diverse, particularly as the proportions of Hispanic and Asian students grew.

According to a 2022 demographic study, 87% of resident youth living in FBISD were enrolled in district schools, with approximately 5-6% of students attending private schools or charter schools, each (Population and Survey Analysts, 2022). Another 2% of students attended school in nearby districts, while 1% of district enrollment were transfers into the district. Prior to 2019-20, charter school enrollment was minimal. In 2019-20, in the entire county that contains FBISD, nearly 6,000 students were enrolled in 10 charter schools; the racial composition of these students had a slightly higher Black percentage but otherwise closely approximated FBISD's enrollment.[11]

Dulles Junior High and Dulles High School were the first FBISD schools to have noncontiguous AZBs, created as a byproduct of the SMSD secession. The land that became SMSD was originally part of the Dulles AZB, and when it seceded, the Dulles AZB became three noncontiguous pieces (see appendix figure A1).

Over the years, the district has slowly added a few additional noncontiguous AZBs. However, school board records indicate school building capacities and feeder patterns are the main considerations during rezoning, rather than any explicit efforts to increase ethnoracial diversity. For example, Oyster Creek Elementary became noncontiguous in 2011. District documents suggest the noncontiguous AZB was created to help balance capacity, rezone as few students as possible, and keep a neighborhood of cul-de-sacs together (Copeland, 2010). As another example, when the Windsor Estates neighborhood was assigned to Walker Station Elementary in 2017, it created a noncontiguous annex zone. To keep feeder patterns consistent, that neighborhood was also then assigned to Sartartia Middle School, creating a noncontiguous annex zone for Sartartia as well. A presentation at a school board meeting by Cooperative Strategies—a company FBISD hires to help coordinate rezoning—mentioned that changing the Walker Station AZB would change school demographics by "plus or minus five or six percent." However, there was no further discussion of which specific racial, economic, or other student group would change, nor the direction of the changes (Fort Bend Independent School District, 2017). Discussion around the creation of these noncontiguous AZBs suggest they were not specifically designed to increase school diversity, though we do not know for certain the intent.

FBISD policy currently does not include racial or economic diversity as a consideration during rezoning. Instead, the policy, last updated in 2020, lists other priorities for rezoning, a few of which suggest a desire to avoid noncontiguous AZBs. One priority is to "assign entire

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[10] At the time, FBISD's enrollment, including Stafford students, was 68% white, 19% Mexican-American, 12% Black. The students living in Stafford were 62% white, 35% Mexican-American, and 3% Black (*Fort Bend Ind. Sch. Dist. v. City of Stafford*, 1978, p. 380).

[11] We do not know if these charter schools included FBISD within the designated "geographic boundaries" that they serve. For example, a few are located in Katy, TX, which is not part of FBISD. FBISD's estimate of its resident charter population was 1,000 fewer than the countywide sum.

neighborhoods to the same school(s)"; another is to "support the neighborhood school concept by combining geographically proximate neighborhoods or developments into school attendance boundaries" (Fort Bend Independent School District, 2020). Notably, older versions of this policy did include diversity. The 2006 version listed "draw zones which reflect the diversity of the district, as much as possible" as the last of ten guiding principles (Fort Bend Independent School District, 2006).[12]

Like in many districts, rezoning decisions in FBISD can be quite contentious. However, it is not clear that noncontiguous AZB proposals receive any extra resistance from stakeholders. Noncontiguous annexes within FBISD are often located very close to their assigned schools, and do not lead to cross-town busing like they have in TUSD. FBISD policy also allows students affected by rezoning to request to stay at their current school for another year, and it allows those with special circumstances to request to attend a school other than their zoned school (Fort Bend Independent School District, 2023). These factors may help diffuse opposition to noncontiguous AZBs.

Findings

We present findings by research question. For the first question, we present all school diversity findings first for TUSD and then for FBISD. For the second, we discuss our findings in the districts together.

The Relationship Between Noncontiguous AZBs and School Diversity

TUSD

In TUSD, the number of schools with noncontiguous AZBs increased from 15 in 1990 to 17 in 2000, and has since decreased to 11 (see table 1). In each year, schools with noncontiguous AZBs enrolled around 14-18% of the district's students. Districtwide, multiracial entropy decreased from 0.65 in 1990 to 0.60 in 2020, reflecting the shrinking proportion of white students and the growing Hispanic majority.

The overall composition of TUSD's schools with noncontiguous AZBs is relatively similar to the overall composition of schools with contiguous AZBs. In 1990, schools with noncontiguous AZBs had a higher percentage of white students and lower percentage of Hispanic students, but since then, the overall demographics of contiguous and non-contiguous AZB schools have largely converged (see table 1). We do find the median entropy score is higher for schools with noncontiguous AZBs compared to those with contiguous AZBs in all four years we study, demonstrating greater diversity in schools with noncontiguous AZBs.[13] However, over time, the range of entropy scores for schools with noncontiguous AZBs has grown larger and more similar to schools with contiguous AZBs (see appendix figure A2). In 1990, the middle 50% of TUSD's schools with noncontiguous AZBs had entropy values between 0.53 and 0.62. By comparison, the middle 50% of schools with contiguous AZBs were between 0.39 and 0.63, a range that included more schools with comparatively low diversity. By 2020, the middle 50% of noncontiguous schools had entropy values between 0.45 and 0.65, while contiguous schools fell between 0.38 and 0.65. This suggests the median diversity of schools with noncontiguous AZBs has declined over time and become more similar to the median diversity of schools with contiguous AZBs.

[12] It is unclear exactly when FBISD eliminated this consideration from its policy, but as recently as 2017, a representative from Cooperative Strategies mentioned "maintain a diverse population" as a rezoning consideration during a school board meeting (Fort Bend Independent School District, 2017).

[13] Interpret patterns with caution given there are fewer noncontiguous AZBs than contiguous ones.

Table 1

Student Enrollments and Number of Schools, by Year

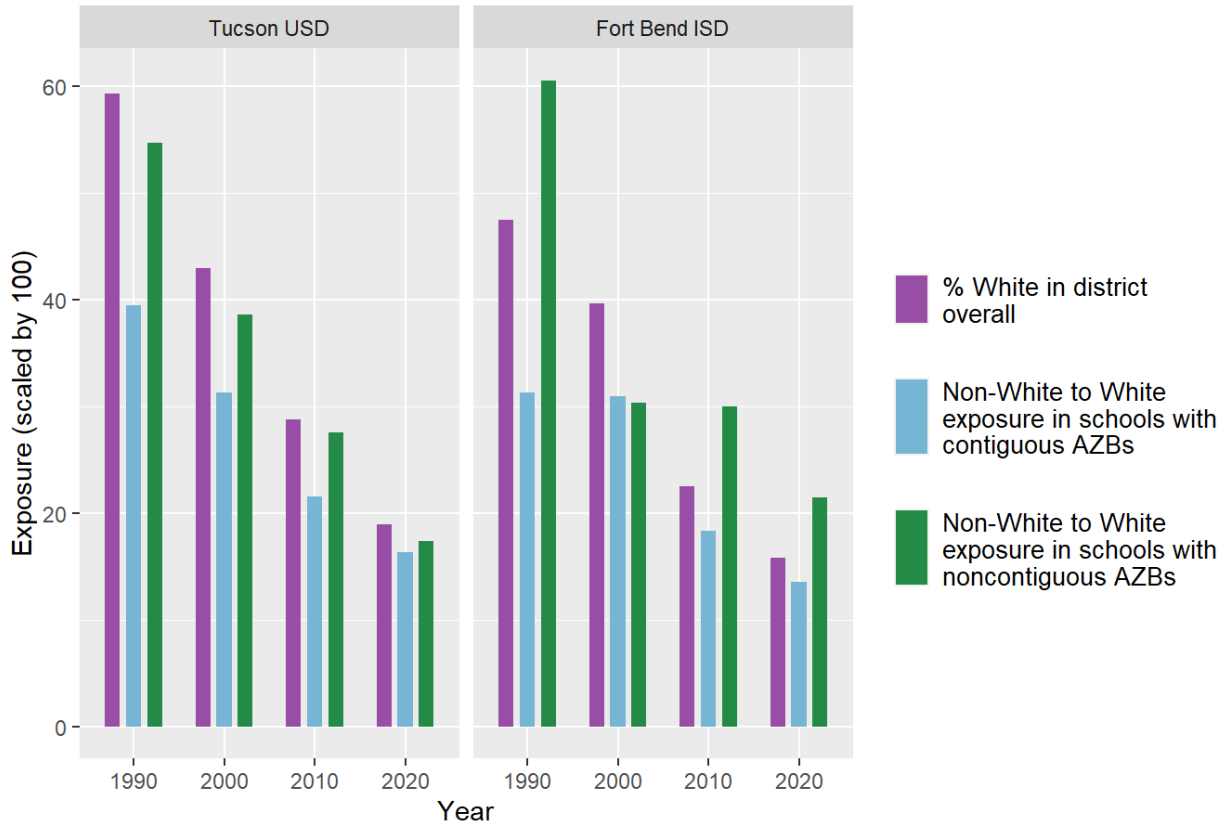
	% American Indian/AL Native	% Asian	% Black	% Hispanic	% White	% 2 or more races	% Free-reduced lunch	Schools (n)	Enrollment (n)	Enrollment (%)
					Tucson USD					
1989-1990										
Contiguous	3.5	2.1	6.1	38.6	58.0	—	—	79	45,512	81.7
Noncontiguous	1.7	2.9	6.7	30.3	66.2	—	—	15	8,704	15.6
Overall	3.2	2.3	6.1	37.2	59.3	—	—	104	55,737	100.0
1999-2000										
Contiguous	4.2	2.4	6.7	43.6	43.2	—	—	80	48,515	77.6
Noncontiguous	2.8	2.7	7.1	45.2	42.2	—	—	17	11,166	17.9
Overall	3.9	2.5	6.7	43.9	43.0	—	—	119	62,548	100.0
2009-2010										
Contiguous	4.8	2.4	7.0	57.2	28.6	—	55.3	81	42,814	77.3
Noncontiguous	3.1	3.2	10.5	53.6	29.6	—	58.5	16	9,283	16.8
Overall	4.5	2.7	7.5	56.2	29.1	—	54.9	121	55,386	100.0
2019-2020										
Contiguous	3.5	1.3	6.1	65.4	19.1	4.0	62.7	68	36,040	80.0
Noncontiguous	2.8	1.7	8.3	62.6	19.6	4.4	58.9	11	6,262	13.9
Overall	3.4	1.6	6.3	64.2	19.9	4.2	60.0	89	45,036	100.0
					Fort Bend ISD					
1989-1990										
Contiguous	0.1	9.2	30.9	13.9	45.9	—	—	30	30,041	89.3
Noncontiguous	0.1	10.7	12.3	16.0	60.9	—	—	2	3,606	10.7
Overall	0.1	9.4	28.9	14.2	47.5	—	—	32	33,647	100.0
1999-2000										
Contiguous	0.1	14.5	27.9	17.3	40.2	—	20.5	46	48,401	91.8
Noncontiguous	0.1	22.9	25.4	18.0	33.6	—	17.5	3	4,168	7.9
Overall	0.1	15.1	27.8	17.4	39.6	—	20.2	51	52,704	100.0
2009-2010										
Contiguous	0.2	21.4	31.7	24.7	22.0	—	35.6	64	65,008	93.7
Noncontiguous	0.3	28.7	24.6	16.1	30.3	—	21.9	3	4,245	6.1
Overall	0.2	21.8	31.4	24.1	22.4	—	34.8	69	69,374	100.0
2019-2020										
Contiguous	0.4	25.4	28.1	27.2	15.3	3.4	44.6	72	70,777	91.0
Noncontiguous	0.5	40.9	15.9	17.7	21.5	3.5	27.4	5	6,351	8.2
Overall	0.4	26.5	27.2	26.6	15.7	3.4	43.5	81	77,756	100.0

Note: Overall district enrollments include non-zoned schools.
Source: National Center for Education Statistics, Common Core of Data
—NCES does not provide data for these categories in these years.

Turning to exposure indices, students of all racial groups have had decreasing exposure to white students, as we would expect given declining white enrollment.[14] In 1990, 2000, and 2010, non-white students in TUSD schools with noncontiguous AZBs experienced higher exposure to white students than did their non-white peers in schools with contiguous AZBs, though that difference was smaller in more recent years. Exposure indices in schools with noncontiguous AZBs also more closely tracked the district's overall demographics. For example, in 1990, when the district was 59% white, the average non-white student in a noncontiguous AZB school attended school with 55% white students, while the average non-white student in a contiguous AZB school attended school with just 40% white students. By 2020, the average non-white student in both types of schools attended school with about 17% white students. Overall, the lower percentage of white students in TUSD limits exposure experienced by students of color. Specifically, students of color in schools with noncontiguous AZBs no longer have higher exposure to white students, as they did from 1990-2010.

Figure 1

Non-white to white exposure rates by district, AZB type, and year



[14] For purposes of comparability across both districts, we present non-white to white exposure indices for contiguous and noncontiguous AZBs in figure 1 panel a (all exposure indices are documented in appendix table A1).

For individual racial groups, in more recent years, there is a weaker association between noncontiguous AZBs and higher exposure to white students (appendix table A1). Both Hispanic and American Indian students have had more exposure to white students in schools with noncontiguous AZBs as compared to those with contiguous AZBs. The exposure differences between the two types of schools was greater in 1990 but is nearly equal in 2020. In 1990, Black and Asian students also each had higher exposure to white students in schools with noncontiguous AZBs. But the trend flipped in 2000, and since then, Black and Asian students have each had lower exposure to white students in schools with noncontiguous AZBs as compared to those with contiguous AZBs. While we cannot know for certain, the flip in the trend could be related to the fewer schools with noncontiguous zones and/or how AZBs combine areas with disparate ethnoracial compositions.

On the other hand, white students' exposure to non-white students in TUSD has increased since 1990. This is mainly driven by higher exposure to Hispanic students (appendix table A1). In particular, white students in schools with noncontiguous AZBs now have slightly higher exposure to non-white students than those in schools with contiguous AZBs. In 1990, the average white student in each type of school had similar racial compositions. By 2020, though, their school compositions diverged. The higher exposure to students of color for white students in schools with noncontiguous AZBs contrasts with exposure findings for non-white students, who comprise a growing majority of TUSD's enrollment.

Finally, we analyze the percentage of students attending racially concentrated and identifiable schools. In each year we study, fewer students in schools with noncontiguous AZBs are in concentrated or identifiable schools compared to students in schools with contiguous AZBs (see appendix table A2). The difference is especially large for white students and American Indian/Alaska Native students. For example, of the white students attending schools with contiguous AZBs in TUSD in 2000, 37% attended concentrated schools compared to 0% of white students attending schools with noncontiguous AZBs. We note one exception with respect to Hispanic students, who have become more concentrated in schools with noncontiguous AZBs over time, though Hispanic concentration in contiguous schools remains higher. In 2020, 46% and 55% of Hispanic students attend Hispanic concentrated schools, for noncontiguous and contiguous AZBs respectively. Overall, schools with noncontiguous AZBs are less likely than schools with contiguous AZBs to have especially non-diverse enrollments. However, this difference no longer exists for Hispanic students, the district's largest group.

We conclude that TUSD schools with noncontiguous AZBs remain more racially diverse than schools with contiguous AZBs, but their association with diversity is less in 2020 than in 1990. Students' intergroup exposure has decreased over time in schools with noncontiguous AZBs, and the number and percentage of concentrated Hispanic schools with noncontiguous AZBs is higher. This trend has taken place as the district has negotiated the end of its desegregation order, converted some noncontiguous AZBs back into contiguous ones, and lost white enrollment, becoming less diverse overall.

FBISD

Next, we turn to FBISD, where the number of noncontiguous AZBs increased from two in 1990 to five in 2020. FBISD has also become more ethnoracially diverse over time, particularly due to increasing Hispanic and Asian populations: as of 2020, the district's overall entropy score was 0.82, near the maximum possible value of 1.

Due to the low number of schools with noncontiguous AZBs in FBISD, there are no distinct patterns in their overall composition over time, as compared to the rest of the district (see table 1). However, the median entropy value of schools with noncontiguous AZBs is indeed higher

than that of schools with contiguous AZBs across all years (appendix figure A3).[15] In 2020, the median school with a noncontiguous AZB had an entropy value of 0.81, while the median school with a contiguous AZB had an entropy value of 0.73. Both types of schools have become more diverse over time.

In terms of interracial exposure, white students' exposure to Asian, Black, and Hispanic students has increased substantially since 1990, while students of color's exposure to white students have all decreased. These patterns align with the changing overall demographics of the district: the percentage of white students has decreased while percentages of non-white students increased.

Exposure indices disaggregated by AZB type indicate that interracial exposure in schools with noncontiguous zones is not consistently different than in schools with contiguous zones. Non-white students generally have higher exposure to white students in schools with noncontiguous AZBs compared to schools with contiguous AZBs, but the differences in exposure levels across each type of school vary quite a bit over time (figure 1 panel b). In 2000, white students had considerably higher exposure rates to non-white students in schools with noncontiguous AZBs (see appendix table A3 for exposure rates for all groups). But this difference was less in 2010 and 2020. By 2020, the average white student in a school with noncontiguous AZBs attended a school that was 78% non-white, while the average white student in a school with contiguous AZBs attended a school that was 75% non-white. Disaggregated by racial group, white students in 2020 had higher exposure to Asian students in schools with noncontiguous AZBs, but lower exposure to Black and Hispanic students, compared to those in schools with contiguous AZBs. We conclude that, relative to schools with contiguous AZBs, those with noncontiguous AZBs in FBISD do not consistently have greater interracial exposure over time nor for every group of students.

Finally, when measuring racial concentration and identifiability in FBISD schools, we find fewer schools with noncontiguous AZBs are extremely non-diverse. There is no racial concentration among schools with noncontiguous AZBs in FBISD, while schools with contiguous AZBs have previously been racially concentrated in terms of Black and Hispanic students (concentration has decreased among schools with contiguous AZBs over time). There is some identifiability for Black and Asian students in schools with noncontiguous AZBs in certain years, though it remains less than their identifiability in schools with contiguous AZBs (appendix table A4).

Based on the diversity measures we studied, we conclude schools in FBISD with noncontiguous AZBs are slightly more racially diverse than other schools, though results are inconsistent across time, measures, and racial groups.

Noncontiguous AZBs and Residential Populations

Our second research question focuses on the extent to which noncontiguous AZBs specifically combine neighborhoods with different ethnoracial compositions. While the measures above describe the diversity of school enrollments for schools with noncontiguous AZBs, they do not speak to the mechanisms by which enrollments may be more or less diverse. It is possible that schools with noncontiguous AZBs simply draw from two separate, but demographically similar residential areas. The following analyses use Census data on residential populations to further understand how noncontiguous AZBs operate.

[15] Again, differences in medians should be interpreted cautiously given there are many fewer noncontiguous AZBs than contiguous ones.

Districtwide, Residential Segregation

We begin by comparing residential racial segregation (Theil's *H*) in each district when measured between actual noncontiguous AZBs (multi-part polygons) and when each noncontiguous piece acts as a standalone AZB (single-part polygons). Generally, *H* values above 0.25 are considered high segregation, and values above 0.10 are considered moderate segregation. In TUSD, residential segregation is lower in the multi-part scenario; this is true across the elementary, middle, and high school levels (table 2). This indicates noncontiguous AZBs are, to some extent, combining neighborhoods with different ethnoracial compositions. However, segregation values under each scenario have converged over time, which may represent waning association between noncontiguous AZBs and desegregation. In FBISD, segregation values under the two different scenarios are much more similar than in TUSD, though the multi-part scenario still has slightly lower segregation.

Table 2

Residential segregation (Theil's H) by district, school level, year, and AZB scenario

	Elementary		Middle		High	
	Multi-part	**Single-part**	**Multi-part**	**Single-part**	**Multi-part**	**Single-part**
			Tucson USD			
1989-1990	0.209	0.218	0.138	0.179	0.134	0.150
1999-2000	0.194	0.198	0.131	0.164	0.131	0.143
2009-2010	0.170	0.177	0.117	0.140	0.120	0.128
2019-2020	0.141	0.144	0.106	0.109	0.096	0.107
			Fort Bend ISD			
1989-1990	0.239	0.239	0.183	0.186	0.182	0.187
1999-2000	0.233	0.235	0.170	0.172	0.153	0.156
2009-2010	0.204	0.206	0.152	0.152	0.126	0.126
2019-2020	0.177	0.178	0.134	0.143	0.112	0.113

Comparing Main and Annex Zones

Next, we compare the percentage of white children living in each noncontiguous AZB's main zone and annex zone. Though we compare the demographics of main zones and annex zones in terms of all ethnoracial groups, differences in the white percentage are most informative, because while each district has different compositions of non-white populations, both have similarly sized, non-majority white populations that provide a useful comparison. Figures for other racial groups are presented in appendix figures A4-A6.

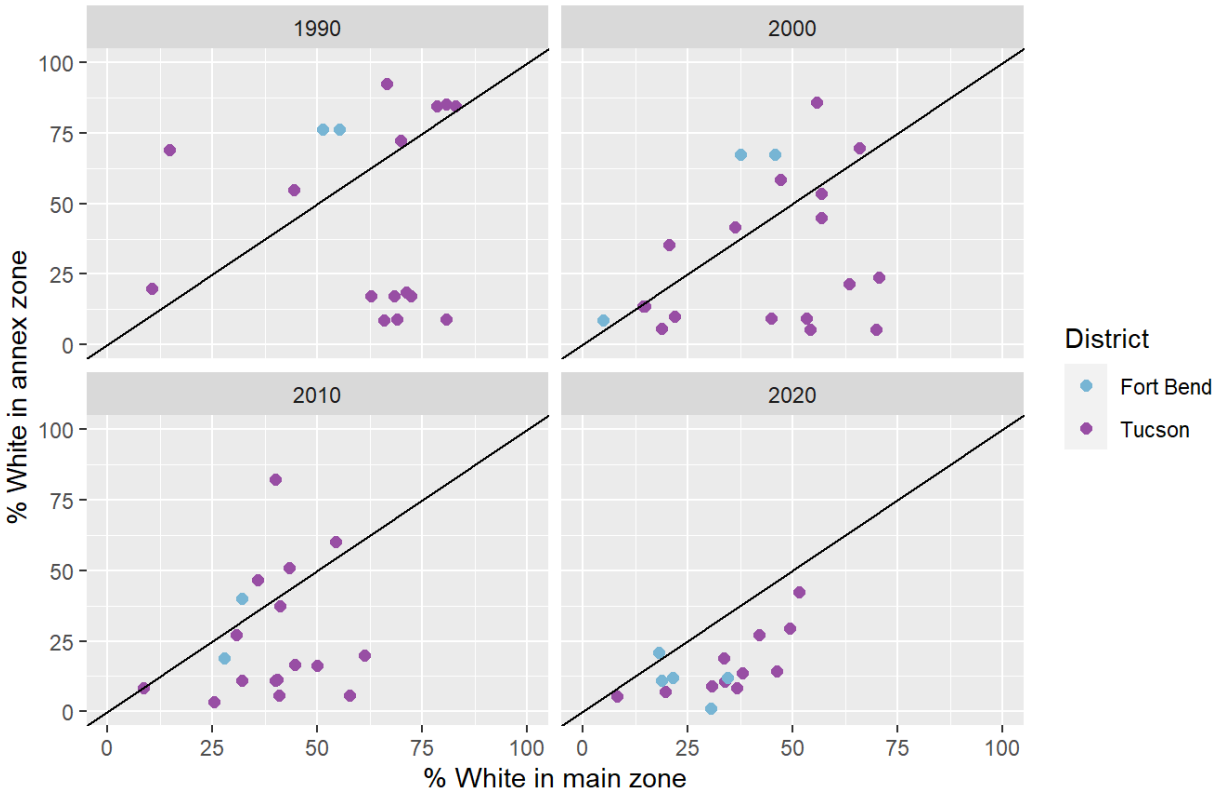
In TUSD, most schools with noncontiguous AZBs include main zones and annex zones with different percentages of white children (figure 2). In 1990 and 2000, about half of noncontiguous zones had higher percentages of white children in their main zone than in their annex zone, and half had the opposite. The variation in those years indicates both white and non-white neighborhoods were turned into annex zones and assigned to schools in demographically different neighborhoods. However, by 2020, all schools with noncontiguous AZBs had higher percentages of white residents in the main zone than in the annex. This indicates that recently, annex neighborhoods are predominantly non-white and are assigned to schools in neighborhoods with

higher proportions of white children. In each year, there are also a few TUSD schools with similar percentages of white children living in main and annex zones, depicted near the reference line.

On the other hand, FBISD's schools with noncontiguous AZBs are generally clustered closer to the reference line, indicating main and annex zones have more similar white compositions. We note these comparisons do not account for the different population sizes of main zones and annex zones, but we further explore that in the school examples below.

Figure 2

Percent of main and annex zone populations comprised of white youth, by district and year



Note: Some noncontiguous AZBs in TUSD have more than one annex zone. This figure includes the demographics of the annex zone with the largest population.

Overall, we conclude that FBISD's noncontiguous AZBs do not capture neighborhoods with different racial makeups to the same extent that TUSD's noncontiguous AZBs do. However, the small number of noncontiguous AZBs and the variation among them preclude further generalized claims. In the next section, we examine individual schools in each district to better understand the variation in noncontiguous AZBs.

Individual School Examples

We analyze two noncontiguous AZBs in each district; the one with the largest difference in the white share of residents in the main and annex zones, and the one with the smallest difference. Our findings suggest additional factors are associated with the relationship between noncontiguous AZBs and school compositions, such as the size of populations living within main and annex zones and the rationale behind the creation of a noncontiguous AZB.

In TUSD, the school with the largest difference in the proportion of white residents in its main and (one of) its annex zones is Utterback Middle School.[16] Utterback's AZB used to include a main zone and three annexes (figure 3). The school was located outside of all four zones, but we consider the main zone to be the northwest zone that is physically closest to the school building. As seen in figure 3, the AZB's western areas have a greater number and proportion of Hispanic children, while the eastern areas have more white children. In 1990, the difference in the white share between the main zone and the northeastern annex was 73 percentage points. While we cannot know for certain which in-zone and out-of-zone children actually attended this school, we do find the noncontiguous AZB was associated with a relatively diverse school in 1990. The school's enrollment was 51% white, 40% Hispanic, and 6% Black—more diverse than any of the AZB pieces alone (see appendix figure A7).

Figure 3

Composition of the youth population residing within Utterback Middle School AZB, 1990-2020

Note: Each dot represents four residents under age 18. Dots are placed randomly within developed parts of the main and annex zones and do not represent actual addresses. School location is denoted by the black triangle. In 1990, 2000, and 2010, we consider the northwest zone to be the main zone as it is located closest to the school. We label the southwest zone annex 1, the southeast zone annex 2, and the northeast zone annex 3. In 2020, there is only a main zone.

[16] Utterback became a magnet school in the 1980s under TUSD's desegregation order, though it maintained an AZB and automatically enrolled in-zone students; out-of-zone students applied for seats through a lottery (Tucson Unified School District, 2015). The school lost its magnet status (and the promise of associated funding) in 2016, when a judge determined it was not meeting its required integration goals (*Fisher-Mendoza v. TUSD*, document 1983, 2016).

Over time, Utterback's annex zones and school enrollment became less racially diverse (appendix figure A7). In particular, white residential shares in the eastern annex zones decreased over time, mirroring overall shifts in TUSD. By 2020, the AZB had been redrawn as one large contiguous zone with a predominantly Hispanic residential population. Similarly, the school's enrollment in 2020 was 79% Hispanic, 6% white, and 8% Black. Utterback's previous northeast and southeast annex zones were reassigned to nearby middle schools with comparably higher percentages of white students: the northeast zone was reassigned to Booth-Fickett Magnet Middle School, which was 18% white in 2020, while the southeast annex zone was rezoned to Secrist Middle School, which was 31% white. Notably, these AZB changes took place in a short window during which TUSD was not under court oversight (2010-12). During a May 2010 meeting, school board members discussed a desire to return to "neighborhood schools" and a concern that open enrollment policies rendered annex zones ineffective (Tucson Unified School District, 2010). While not stated explicitly, it is possible the district also wanted to reassign Utterback's eastern annexes to help maintain disproportionately white enclaves at other schools.

In contrast to Utterback Middle School, Miller Elementary School had the smallest difference in the white share of its main and annex zones of all TUSD's noncontiguous AZBs—less than one percentage point difference in 2010. Miller gained two noncontiguous annexes in the 1990s to alleviate overcrowding at a nearby school. One of those annexes was later rezoned away in 2010, but the other remained part of Miller's AZB as of 2020. Across these years, Miller's main and annex zones have been demographically similar and are not associated with a school population more diverse than either residential area. For example, in 2000, the school, main zone, and two annexes each had compositions between 75-80% Hispanic, 15-22% white, and 2-4% Black, demonstrating minimal variation (see appendix figures A8-A9). This noncontiguous annex was created to alleviate overcrowding, not to desegregate schools (Bustamante, 1998), and it illustrates how noncontiguous AZBs created without a specific desegregation goal may not lead to diverse schools, even in a district under a desegregation order.

Noncontiguous zones in FBISD are not consistently associated with diverse schools. Billy Baines Middle School is the school in FBISD with the largest difference in the white share across its main and annex zone—a 33 percentage point difference in 2020. The school opened in 2006 and its AZB became noncontiguous in 2018. While the main zone is very diverse (28% Asian, 24% Black, 15% Hispanic, 34% white in 2020), the annex zone is almost entirely comprised of Hispanic residents (97%). The school's enrollment in 2020 has a higher proportion of Hispanic students (28%) than the main zone has residents (15%), suggesting the annex may help make the school more diverse than it otherwise would be (see appendix figures A10-A11).

Nevertheless, Billy Baines's annex zone is not associated with as large of increases in school diversity as many of the annexes in TUSD. One important factor may be the relative sizes of Billy Baines's main and annex zones. While its main zone contained nearly 6,000 residential children in 2020, the annex contained fewer than 1,000. The relatively smaller size of the annex zone may prevent it from shifting the school's demographics. FBISD policy also allows students affected by rezoning to request to stay at their current school rather than move, so the effect of the 2018 annex zone creation may not yet fully be seen in 2020.

Finally, EA Jones Elementary School in FBISD is the noncontiguous AZB with the smallest difference in terms of white share (five percentage points). The EA Jones AZB became noncontiguous in the 1990s but was made contiguous again in the 2000s. While we do not know the rationale for these changes, most district documents indicate FBISD's rezoning decisions are driven by fast population growth, school capacity concerns, and a desire for contiguous boundaries wherever possible. It may be that EA Jones's annex was created to balance school capacities, and was later removed when capacities allowed.

While it existed, EA Jones's annex had a notably higher percentage of white, Asian, and Hispanic residents compared to the majority Black main zone (see appendix figures A12-A13). And while the annex zone's larger share of Hispanic residents was associated with a higher Hispanic share in the school, the same was not true of white or Asian students. In fact, in 2000, the school had a lower percentage of white and Asian students than either the annex zone or the main zone. One possible explanation is that white and Asian families may be opting out of EA Jones and instead enrolling in other FBISD schools or private schools.[17] This case demonstrates another possible limitation of noncontiguous AZBs: not every student will attend their zoned public school. The racial characteristics of schools, neighborhoods, and likely AZB design can play a role in such school choice decisions (Lareau & Goyette, 2014).

Discussion

The use of noncontiguous AZBs in TUSD and FBISD represent important variations in both the intentions and outcomes of these relatively uncommon AZB shapes. AZBs link residential and school populations, and given ethnoracial segregation and inequities often present in residential communities, AZBs can easily reproduce that segregation in schools. However, they can also be purposefully altered to achieve greater school diversity, among other goals. Noncontiguous AZBs, in particular, provide opportunities for school leaders to disrupt the residential-school segregation link by assigning demographically different neighborhoods to the same school. Our analysis offers lessons in when and how such AZBs may be associated with diverse schools.

While TUSD's noncontiguous AZBs were originally created to achieve desegregation and did appear to be successful at doing so, the positive association between noncontiguous zones and school diversity within TUSD has decreased over time. This is likely related to the overall decline in white enrollment and growth of school choice options, including an intradistrict open enrollment policy. But it may also be related to converting several noncontiguous AZBs to contiguous "neighborhood" schools and focusing on factors other than ethnoracial diversity when rezoning. TUSD has been unitary with respect to student assignment since 2018, and even before then, rezoning focused on capacity issues more than racial diversity.

FBISD, on the other hand, has never used noncontiguous AZBs for explicit desegregation purposes. There, too, rezoning efforts are driven almost entirely by school capacity, though caused by rapidly growing, rather than shrinking, enrollments. Additionally, ethnoracial diversity is not currently a stated consideration in the district's rezoning policy. This helps to explain why schools with noncontiguous AZBs in FBISD are associated with somewhat higher levels of ethnoracial diversity than schools with contiguous AZBs, but that noncontiguous AZBs in FBISD do not necessarily combine demographically distinct residential areas.

Findings also demonstrate that the racial diversity within a school district relates to the potential of noncontiguous zones to create diverse schools. For example, the diversity of TUSD schools, including those with noncontiguous AZBs, declined as the district lost white enrollment. AZBs are a policy tool that can help address within-district segregation, especially in large racially diverse districts, but they should also be paired with other remedies that address the segregation between school districts.

The four schools we analyze offer additional insight into factors that can influence the relationship between noncontiguous AZBs and school diversity. For example, if an annex zone's population is small compared to that of its main zone, as in the case of Billy Baines Middle School, it

[17] In 2000, there were no charter schools operating in Fort Bend County. There was one open by 2009-10, and its enrollment was 50% Asian.

isn't likely to shift a school's enrollment dramatically. School choice also complicates the relationship between residential and school compositions. While we do not know the exact school choice patterns in every school we study, in the case of EA Jones in FBISD, the school had lower proportions of Asian and white students than either its main or annex zone had residents, suggesting some residents opted out of the zoned school. The noncontiguous zone was associated with minimal increases in school diversity.

Noncontiguous AZBs can potentially foster diversity even absent an explicit intention to do so, as we see to some extent in FBISD's schools with noncontiguous AZBs. Billy Baines's enrollment, for example, is slightly more diverse than its main or annex attendance zones alone. However, the comparison to TUSD, with its explicit desegregation plan in earlier years of study, and specifically to Utterback Middle School, a noncontiguous zone created under the desegregation plan, suggests these zones are more likely to be associated with more substantial desegregation when they are intentionally designed to do so.

Our study adds to existing literature on the way AZBs link patterns of residential and school segregation. While some research has identified gerrymandered AZBs that segregate students (Richards, 2014; Siegel-Hawley, 2013), others have claimed irregular AZBs are more integrative (Saporito & Van Riper, 2016). This study demonstrates the need for more specificity when discussing AZB shape. Shape in and of itself does not matter so much as how AZBs capture or exclude residential populations. Noncontiguous AZBs, typically deemed highly irregular, can desegregate when drawn intentionally.

Our analyses are not without limitations. We focus on two districts, each with their own specific histories of desegregation and demographic change and with limited numbers of noncontiguous AZBs. Simultaneous changes in AZBs, ethnoracial demographics, and student assignment policies complicate the role of noncontiguous AZBs. Additional data from each district on how many residential children attend their zoned school vs. choice schools could help further disentangle the link between AZBs and school enrollments and inform the drawing of maximally desegregative AZBs. Future research should also investigate additional school districts with noncontiguous AZBs to help enhance our understanding of how these zones contribute to school diversity in different contexts.

Despite the limitations, our analyses clearly suggest that noncontiguous AZBs can combine ethnoracially different neighborhoods to help create ethnoracially diverse schools. This is especially likely when there is explicit consideration of ethnoracial demographics (Siegel-Hawley et al., 2021). School district leaders interested in using noncontiguous AZBs to help create more diverse schools should consider, and consistently review, the numbers and composition of students living in the neighborhoods defined by AZBs. Noncontiguous AZBs may become less desegregative as neighborhoods, enrollments, and school choice options change over time. Moreover, we recommend district leaders not currently using noncontiguous AZBs consider them. Existing literature and school district policies suggest many districts prefer not to use noncontiguous AZBs, as they disrupt the traditional notion of neighborhood schools (Gillani et al., 2023). However, when carefully implemented, they can help create diverse schools in the context of stark residential segregation.

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