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Examining Transit Accessibility to Choice Public High Schools in San Francisco, Denver,
and Indianapolis

By

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THESIS

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Abstract

Citywide school choice policies have been implemented across the U.S. with the goal of improving equitable access to high quality education for all public school students. However, a family's ability to choose what school to send their children to means little if they cannot conveniently reach it. This study examines who has convenient access to high, average, and low performing high schools within 30 minutes in San Francisco, Denver, and Indianapolis. These cities were selected for their population size, population density, and comparable school choice policies. School performance was measured using Math and English proficiency rates and standardized test scores. Results for each city were divided into terciles. 30-minute transit isochrones were generated for each school and census demographic data was overlaid using areal interpolation to calculate location quotients. Historical Home Owners' Loan Corporation (HOLC) redlining maps were also overlaid on tiered isochrones to examine whether transit access patterns reflect historical racial and economic segregation. Findings indicate that white, Asian, high-income, and highly educated populations consistently have the most access to high-performing schools, while Black, Hispanic, Native American, Pacific Islander, and low-income populations are consistently underrepresented in the catchment areas of high-performing schools. In San Francisco and Indianapolis, low-performing catchment areas are disproportionately overrepresented in areas graded D and underrepresented in areas graded A. None of the school districts provide adequate alternatives to school transportation aside from free transit fares for youth. This study suggests that the goal of improving equitable access to education cannot be reached solely through the implementation of school choice policies, but school districts must provide adequate student transportation if they want historically marginalized low-income students to have physical access to high-performing schools.

Introduction

Student transportation is a key issue to consider when evaluating equitable access to education in cities with citywide school choice policies. The specific type of school choice policy examined in this paper is open enrollment public high schools. If families are not able to find convenient transportation options that work with their busy schedules to send their students to high-performing schools, having the choice to send their children to those schools does not matter. Often having been implemented to eliminate segregation in school districts, citywide school choice policies were created in the hopes that all students would have the same opportunity to attend high-performing schools. Although it is true that these students can apply to attend any public school in their district, transportation burden continues to be cited as a driving force in depleting families' choice set of schools (Bell, 2009; Burdick-Will & Stein, 2025; Jochim et al. 2014; Lenhoff et al., 2022; Valant & Lincove, 2023). The underlying issue is that not every student has the same level of physical access to these high-performing schools. Students who come from more affluent families can afford to live closer to high-performing public schools, while historically marginalized low-income families often are not able to. This makes transportation more of an issue for some students than others.

This study examines the relationship between school transportation and Home Owners' Loan Corporation (HOLC) grades today because effects of historical redlining continue to prove to be long-lasting. Research shows that modern day school attendance zones closely mirror redlined communities of the past (Frohberg, 2023). Although this paper looks at school choice (and therefore not school districts where attendance zones are the main avenue of assigning students to schools), understanding the demographic composition of neighborhoods surrounding

schools is essential in assessing what demographics of people have the best access to what schools.

Prior research on the relationship between transportation and school choice examines how students get to school and what factors families consider when making their choice. This research contributes to the body of literature on this subject by examining who has physical access to high-performing high schools in three cities using public transit. The cities studied in this paper are San Francisco, Denver, and Indianapolis. This study generates 30-minute transit isochrones from each public high school and overlays these isochrones with census demographic data to examine what demographic groups have access to high, average, and low performing schools. These isochrones are then overlaid with historical redlining maps to examine the extent to which public transit accessibility to high schools in each city reflect historical patterns of racial and economic segregation.

This paper begins with a review of existing literature on the relationship between transportation and school choice, followed by a description of the methodology and data used to conduct the analysis. The results of the analysis are then presented and discussed. Finally, conclusions and limitations are outlined for this study, along with recommendations to improve student transportation in these cities.

This study aims to answer two research questions:

1. What demographics of students are able to reach high, average, and low performing high schools in San Francisco, Denver, and Indianapolis in 30 minutes by transit?
2. How might historical land use and zoning patterns reflect who has access to which tier of academically performing high schools in San Francisco, Denver, and Indianapolis today?

Literature Review

Student travel patterns

Studies have shown that school quality and geographic location (i.e. proximity to home) are important factors to parents when deciding which school to send their children to (He & Giuliano, 2018). How far students travel and how far they are willing to travel are tied to socioeconomic factors. White students who come from high-income families tend to travel the least amount of distance out of all students (Corcoran, 2018; He & Giuliano, 2018). For low-income students of color, prior research shows two complementary outcomes. There are some students whose choice set of schools is much smaller than their socioeconomically more advantaged peers, leading them to be more likely to attend their geographically closest schools (Cobb et al., 2026; He & Giuliano, 2018). Other studies show, however, that certain historically marginalized racial groups such as Black and Hispanic students tend to have the highest commute times compared to their white and Asian counterparts in order to reach high quality schools (Bierbaum et al., 2021; Cobb et al., 2026; Corcoran, 2018; Cowen et al., 2018; Denice & Gross, 2018; Weinstein et al., 2024).

In cities with citywide school choice policies, many students are driven to school. One study of travel patterns in eight cities finds that most Denver parents drive their children to school (Jochim et al., 2014). In a study looking at how public school students get to school in Detroit, researchers found that 75% of students in the city were driven to school by their parents (Lenhoff et al., 2023). In that same study, they found that although 21% of students were eligible for a public bus pass, only 4% of students reported using a public bus as their main commute mode, and only 10% of students reported ever having taken a public bus to school at all (Lenhoff

et al., 2023). In San Francisco, more than half of all students are dropped off at and picked up from school (56.5% and 52.1%) by being driven by a family member or caregiver (*Child Transportation Study* | SFCTA, 2016).

Effect of transportation on school choice

A lack of alternative transportation options other than being driven to school is a major reason as to why students' choice set of schools can be much smaller (Valant & Lincove, 2023). In several cities including New Orleans and Philadelphia, travel time to schools by public transit could be up to three times longer than by car (Bierbaum et al., 2021; Valant & Lincove, 2023). Families have been found to favor their geographically closest schools when public transit commutes are too long and inconvenient (Burdick-Will & Stein, 2025; Cobb et al., 2026; Trajkovski et al., 2021; Welsh et al., 2016). Studies found that public transit commutes that are longer than commutes by car and require multiple transfers were major reasons for families to avoid certain schools (Burdick-Will & Stein, 2025; Valant & Lincove, 2023). Students are more likely to enroll in schools where transportation options, like yellow school buses, are provided. Trajkovski et al. (2021) found that school bus eligibility increased the likelihood of a student enrolling in a school by up to 27%. Another study found that parents of color are more likely to enroll their children in schools that offer bus service and are closer to home (Lenhoff et al., 2022; Wilson et al., 2010).

Transportation generally plays a larger role in school choice for historically marginalized low-income families rather than their more socioeconomically advantaged peers. A study that examined the relationship between geography and school choice found that for parents who did not have to worry about figuring transportation options for their children, geography did not play a major factor in their school choice (Bell, 2009). More affluent families who can afford to live

close to high quality schools tend to not face transportation burdens to the extent that historically marginalized low-income families do (He & Giuliano, 2018).

Effect of Transportation and School Choice on Student Outcomes

The relationship between student transportation, school choice, and student outcomes goes to show why providing student transportation alternatives to driving is important to improve equitable access to education. Several studies have shown that students who attend choice schools and take a school bus as their main mode for school commuting tend to attend schools that are higher quality than students who attend their neighborhood schools (Cordes et al., 2022; Cordes & Schwartz, 2018; Denice & Gross, 2018). This shows not only the importance of being able to choose schools outside of their neighborhood and also shows that having good transportation options to get to those schools helps facilitate access to better education. Aside from attending higher quality schools, the availability of school bus service has also been linked to fewer absences and lower rates of chronic absenteeism overall (Gottfried, 2017).

Transportation problems have been linked to absenteeism. Stein & Grigg (2019) found that school districts with school choice but that do not provide adequate transportation options see increases in absenteeism in high school students. One study reported that car troubles was a reason for their children's absences (Cobb et al., 2026). Another study found that bus rides that were considered to be "very long" negatively impacted student attendance and chronic absenteeism (Cordes et al., 2022). A study conducted in the Sacramento region found that transportation was the third leading reason for chronic absenteeism (Erbstein et al., 2017).

Transportation problems

One of the major reasons historically marginalized low-income families face much higher levels of transportation burden for school commutes has to do with their logistical constraints (Cobb et al., 2026). Some logistical constraints these families face include flexibility with work schedules, number of children that need to be transported to school, not owning a car, and car troubles, among others (Bell, 2009; Burdick-Will & Stein, 2025; He & Giuliano, 2018; Lenhoff et al., 2022). One study in Detroit found that parents who were facing car troubles had to find their own alternatives such as carpooling with neighbors to calling for a taxi because public transit was not an option for their children (Lenhoff et al., 2022). The same study found that support from their social networks (family, friends, neighbors) was key in figuring transportation options, especially when routines were disrupted (Lenhoff et al., 2022).

Historical Redlining and Educational Equity

Literature on the relationship between historical redlining and educational access largely focuses on the similarities between HOLC maps and school attendance zones (Frohberg, 2023; Powers & Ross, 2026). Studies have shown that the majority of neighborhoods that were graded D by the HOLC are considered low to moderate income neighborhoods today (Frohberg, 2023). One study conducted in Oakland, California found that patterns of student enrollment closely aligned with HOLC grades, as Black and Hispanic students were disproportionately found to be enrolled in schools located in C and D grade neighborhoods, while white students were mostly found to be enrolled in schools located in A and B grade neighborhoods (Powers & Ross, 2026). Although these studies were looking at places with school attendance zones, understanding how historical redlining might affect neighborhood demographics near schools today is important in understanding who has physical access to these schools.

Study Setting

The three cities in this study were chosen with three criteria in mind. **Table 1** displays geographic and demographic characteristics of each city. First, all three cities are of a similar population size, with Indianapolis having the largest population at 890,315 and Denver with the smallest population at 729,019. Second, they represent a range of population densities, with San Francisco being the most densely populated, Denver in the middle, and Indianapolis the least densely populated. Finally, all high schools in these three cities are open enrollment schools, which is just one type of school choice policy.

	San Francisco	Denver	Indianapolis
Land Area (sq mi)	46.7	153.1	361
Total Population	827,526	729,019	891,484
Pop. under 18 years old	~111,716	~131,223	~221,088
Population Density/sq mi	17,725.70	4,762.50	2,466.10
White %	36.3	53.3	47.4
Black %	4.7	8.9	26.6
Hispanic %	16.8	28.3	14.6
Asian %	35.1	3.7	4.1
Native American %	0.2	0.3	0.1
Pacific Islander %	0.3	0.2	0.2
Multiracial %	5.9	4.8	6.4
Median HH Income	\$139,801	\$92,504	\$66,900
College+ %	60.9	58.6	35.2
Poverty %	11.3	12.1	15.8

Source: U.S. Census Bureau

Table 1. Descriptive data of San Francisco, Denver, and Indianapolis

	San Francisco	Denver	Indianapolis
<i>Funding sources (2022-23)</i>			
Federal	\$97,501,000	\$217,971,000	\$144,557,000
State	\$572,066,000	\$395,110,000	\$332,328,000
Local	\$786,210,000	\$1,350,357,000	\$227,512,000
Total	\$1,455,777,000	\$1,963,438,000	\$704,397,000
Per-student spending	\$29,841	\$22,341	\$31,979
<i>School District Size</i>			
Number of high schools	17	53	12
# of students enrolled in school district (2024-25)	48,902	90,471	21,055

Source: National Center for Education Statistics

Table 2. School district funding sources and size.

The following section discusses why school choice policies were adopted in these cities, general characteristics of each city, and attempts to explore the ways in which student transportation is funded, although information on that is quite limited across all three cities.

San Francisco

San Francisco's current school choice policy is the result of decades of policies to eliminate racial segregation in schools within the district. The current model of school choice is the fifth policy implemented since 1971 with the goal of desegregating public schools. In 2011, San Francisco's current school choice policy was implemented. The school choice process is lottery-based. In one application, families rank schools by preference. There is no limit for how many schools families can rank.

As seen in **Table 2**, San Francisco has 17 high schools and 48,902 students enrolled in public schools (K-12), making it the middle in terms of school district size among the three case studies here. The majority of the San Francisco Unified School District's (SFUSD) funding comes at the local level. California's education funding is distributed using what is called the

Local Control Funding Formula (LCFF). The LCFF distributes 80% of state budget and local tax revenue funds to K-12 schools in the state. The remaining 20% is distributed for specific purposes such as special education programs (*California's Local Control Funding Formula*, 2025).

Despite having the most public school students in the country, California's lack of school bus offering is well-documented ("CSBA Makes School Transportation Funding a Top Priority in Sponsorship of AB 2933," 2022). Nationwide, 40% of students ride a school bus. In California, that number goes down to 8% (Schwartz, 2024). This discrepancy is due to the way that public schools are funded in the state. In 1978, California passed Proposition 13, which limited homeowners' property tax rate at only 1% of their property's assessed value (Schwartz, 2024). This limit caused a budget crisis, leading to a reduction in home-to-school transportation spending starting in 1982 and continued to 2022 (Schwartz, 2024). In 2022, Assembly Bill (AB) 181 was passed, which provides Local Education Agencies (LEA) with up to 60% reimbursements for home-to-school transportation expenditures for the prior year ("Supporting Unduplicated Students with Increased Transportation Funding," 2023). This reimbursement program does come with some limitations. LEAs must create annual transportation service plans and prioritize "students in transitional kindergarten, kindergarten, grades 1-6 and students from low-income backgrounds" ("Supporting Unduplicated Students with Increased Transportation Funding," 2023). Although this is a big win for student transportation in California, it does not meaningfully change the landscape of student transportation for high school students.

Denver

According to the Denver Public Schools, school choice was adopted in the city with equitable access to education as its intended goal. Denver's school choice process is called

SchoolChoice. It differs from San Francisco's in that it is not lottery-based. Like San Francisco, however, families rank schools based on preference and apply using only one application. In Denver, every student has a guaranteed seat at their local neighborhood school.

Denver has the largest school district in this study as it has 90,471 students enrolled in public schools and 53 public high schools. They also have the largest overall budget at \$1,963,438,000 but the lowest spending per student at \$22,341. The majority of Denver's public school funding comes from property taxes at the local level, with state funds coming in at second.

The majority of Colorado's student transportation funding comes from local tax revenue, although it is not clear how much of the local fund is used for transportation alone. Similar to California, Colorado has their own student transportation reimbursement program. Unlike California, however, only an estimated 20% of student transportation per school district is covered by state funding (Gamm & Gaulden, 2023).

Indianapolis

The decision to adopt school choice in Indianapolis, much like in San Francisco, came after a long history of attempts at desegregating the school district. Indianapolis' school choice program is run by a nonprofit organization called Enroll Indy. The process is called OneMatch and it is similar to San Francisco's process in that it is lottery-based but differs in that families can only apply to up to 10 schools with one application.

For the purposes of this study, Indianapolis has the least number of students enrolled in public schools at 21,055, the least number of public high schools at 12, and the smallest budget

of \$704,397,000. On the other hand, they spend the most per student, spending \$31,979. Unlike the other two cities in this study, most of the funding they receive comes from the state.

Student transportation is paid for through the school district's operation budget, and can amount to 75% of the district's operations budget (Beck, 2025). In 2024, Indiana published a report outlining potential options and recommendations for a new transportation pilot program. Shared vehicle options outlined in this report include yellow school buses, smaller special purpose buses, and partnerships with local transit agencies. Implementation of this pilot program will begin in the 2026-27 school year (*Charter, Private Schools to Collaborate on Transportation and Building Solutions*, 2025). There is not much information on how this differs from the way that school transportation is currently provided.

School Transportation Policies and Programs

San Francisco

General education transportation services, commonly known as yellow school buses, are only available to students of 43 schools in the district, none of which are high schools. To put this in perspective, there are 112 schools in the district. 30 elementary schools, 7 K-8 schools, and 6 middle schools are served by yellow school buses. It was found that only 7.6% of students are dropped off and 6.8% are picked up by yellow school buses in the city (*Child Transportation Study | SFCTA*, 2016).

The city and school district run a few programs that are meant to help those not served by yellow school buses. All youth 18 and younger have access to Muni bus and rail service for free. There is no need to register for a pass, all they have to do is hop on a bus or a train, although they recommend that youth aged 16 or older bring some form of identification in case they are asked

to provide proof of age. Currently, every high school is served by at least two Muni routes. The San Francisco Municipal Transportation Agency (SFMTA) previously offered a pass called the Lifeline Pass to adults that would provide them with unlimited access to all Muni services at half the price of a standard adult monthly pass. As of May 1st, 2026, however, SFMTA stopped taking applications for the Lifeline program, and the program is now a part of the Clipper START program. Current Lifeline customers will still be able to get their discounted Muni monthly passes until July 2026. After that, all Lifeline customers will be a part of Clipper START, which offers 50% off single ride fares for all transit agencies in the Bay Area that take Clipper.

SFMTA also runs the Safe Routes to School (SRTS) program. The program was created to make taking active transportation modes to schools safer and to encourage more students to take active transportation, public transit, or to carpool more often. According to a study conducted by the San Francisco County Transportation Authority, only 14% of students are dropped off and 26.7% are picked up using public transit, 7.8% are dropped off and 10.6% are picked up by walking, and 3.3% are dropped off and 0.7% are picked up by bike (*Child Transportation Study* | SFCTA, 2016).

Denver

Most Denver high school students are not eligible for the yellow school bus program in the city. To be eligible for a district-provided public bus pass, students grade 9-12 must be attending a boundary/home school and must reside more than 2.5 miles from said school.

Denver Public Schools (DPS) offers a shuttle service called the Success Express. They have two shuttles: the Far Northeast Shuttle which, as the name suggests, serves students who attend school in the Northeast section of the city, and the Central Shuttle which serves students

who attend schools closer to the central core of the city. Only six out of the fifty-three high schools in this study are served by the Success Express.

Like in San Francisco, the Regional Transportation District (RTD), the major transportation agency in Denver, runs a program called Zero Fare for Youth, where youths aged 19 or under can ride any RTD bus for free by showing their “current school ID, valid government-issued ID, alien registration/permanent resident card, Military ID/dependent card with DOB, RTD-issued youth special discount card” (*Zero Fare for Youth*, n.d.).

Indianapolis

In Indianapolis, students who attend a school outside of their home school zone are not eligible for district-provided transportation services unless approved by the district. There are four school zones, and these zones determine whether a student is eligible for busing. If they do not attend a school that is in the same zone as their home, then the family is responsible for the students’ transportation to and from school.

IPS provides special transportation options specifically for before and after school care, but those services are only for students K-8 and have many stipulations for who is eligible for said service. They also provide special service for special education students who have transportation as part of their Individual Education Plans (IEP), which includes modifying stop locations to be more convenient for the student.

The only other transportation option provided is through IndyGo, the major bus transit agency in the city. High school students are eligible for IndyGo bus passes if there are no required transfers on their route to school, if they do not have to walk more than 1 mile in their

entire trip, and if their total journey time is 50 minutes or less. High school students can ride IndyGo free of charge with a school provided bus pass.

Methodology

In order to answer the question of who has access to high, average, and low performing high schools by public transit in these cities, and to examine whether that access reflects historical patterns of racial and economic segregation, four linked variables are required: a measure of school performance to categorize schools; 30-minute transit isochrones to define each school's catchment area; the demographic composition of each school's catchment areas; and historical redlining maps and grades. This section describes how each variable was constructed.

School Performance Metric

I created a school performance metric by calculating average Math and English proficiency rates from standardized test score results for San Francisco, Indianapolis, and Denver Alternative Education Campuses (AEC), and average standardized test scores for non-AEC schools in Denver. Denver AECs are described as schools that use non-traditional teaching methods.

Math and English Language Arts proficiency data for San Francisco was obtained from each school's School Accountability Report Card for the school year of 2024-25, published by the SFUSD annually.

For non-AEC schools in Denver, raw average SAT Reading and Writing and Math scores were obtained from each school's School Performance Framework for the year 2025, published annually by the Colorado Department of Education. For AEC schools in Denver, not every

school reported raw average SAT scores, so Math and English Language proficiency rates in the form of average Reading and Math results from the Northwest Evaluation Association's Measures of Academic Progress (NWEA MAP), a standardized assessment meant to measure student achievement and academic growth, were used instead. This data was obtained from AEC-specific School Performance Frameworks for each school.

School performance data for Indianapolis was all obtained from the Indiana Federal Report Card website published by the Indiana Department of Education. Percent of students proficient in Math and English/Language Arts Assessments was collected.

Z-scores were then calculated to rank schools within each respective city and divide schools into tiers. The top third of schools were categorized as high-performing schools, the middle third were categorized as average-performing schools, and the bottom third were categorized as low-performing schools.

School lists for each city were manually created by selecting only public high schools serving grades 9-12. This list was compiled from information obtained from each school district's website.

Transit Accessibility Analysis

Isochrones were created to capture demographic catchment areas for each school. All school locations needed to be geocoded. School addresses were obtained from the NCES Public School Directory. These addresses were then geocoded to latitude/longitude coordinates using the U.S. Census Bureau geocoder. GTFS data for San Francisco, Denver, and Indianapolis were obtained from Transitland. OpenStreetMap street network data was obtained as .pbk files from Geofabrik, a database for geospatial resources, to create the walking and cycling segments of the

network. The isochrones were then created using the *r5r* package in R. 30-minute transit isochrones were created with each school point as the origin. The isochrones were created using schedule data from the first available weekday in each dataset. The departure times were set for arrival at the school 15 minutes before school start times. The departure time for San Francisco was set for 7:55 AM (8:40 AM start time), Denver was set for 7:35 AM (8:20 AM start time), and Indianapolis was set for 6:35 AM (7:20 AM start time). The output showed the geographic area reachable within 30 minutes by transit.

Demographic Catchment Area Analysis

ACS 5-year estimate data on race/ethnicity (B02001, B03003), median household income (B19013), educational attainment (B15003), and total population (B01003) were obtained at the block group level. Data on poverty rate (B17001) was obtained at the census tract level because block group level data was not available. This data was accessed through the *tidycensus* package in R. The racial and ethnic variables for the entire population that were downloaded were as follows: white, Black, Hispanic, Asian, Native American, Pacific Islander, and Multiracial. Data on educational attainment measures the percentage of residents 25 years and older who have a bachelor's degree or higher in each block group.

Isochrones were intersected with census block groups. Since the isochrones did not match perfectly with census block group boundaries, an areal interpolation technique was implemented. This was done for every block group that intersected with an isochrone. For each isochrone, the weighted populations across all block groups within the boundaries were summed to create the estimated population that could reach that school within 30 minutes by transit.

Location quotients were calculated to determine whether a certain demographic was under-or-over-represented within the context of each city. The formula for calculating these location quotients is as follows: percentage of group within catchment area/percentage of group citywide. For example, if a school's catchment area is 10% Black and San Francisco is 5% Black citywide, then the school's location quotient for the Black population would be 2 ($10/5$). A location quotient of 1 means that group is proportionately represented within the catchment area, a location quotient over 1 means the group is overrepresented, and a location quotient under 1 means the group is underrepresented.

The location quotients for median household income were calculated slightly differently because that data is not in percentages, but instead in average dollar amounts. An areal interpolation technique was also implemented, meaning each block group has one median household income value. The formula for these location quotients are as follows: catchment area weighted average median household income/citywide average median household income.

Statistical Analysis

Access inequality metrics were created by calculating the access ratios of high-tier schools to low-tier schools for each demographic group in each city. The formula for this metric is as follows: average location quotient in high tier/average location quotient in low tier. A ratio higher than 1 means that demographic group has better access to high tier schools than low tier schools, while a ratio lower than 1 means that demographic group has better access to low tier schools than high tier schools.

Historical Redlining Overlap Analysis

This analysis was conducted in R. HOLC maps were downloaded for each city as GeoJSON files from the Mapping Inequality Project by the University of Richmond Digital Scholarship Lab. The data was filtered to only include formally graded districts (A, B, C, and D). Ungraded polygons (polygons with N/A values) were excluded from all calculations. Tier-separated isochrones were loaded into R, Denver AEC and non-AEC schools were combined into a single dataset.

In order to control for the difference in size of each HOLC grade across the three cities, a baseline distribution of redlined areas was calculated. This distribution was calculated by calculating the area in square miles of each HOLC grade polygon. The total area for each grade was summed in each city. Finally, the percentage of the total redlined area for each grade was calculated.

All individual school isochrones were dissolved into a single unified polygon for each tier of school. The area of each intersection in square miles was calculated. N/A grade intersections were filtered out to only include isochrones that intersect with grade polygons. The results were aggregated by city, tier, and HOLC grade, creating redlined catchment areas for each tier.

For each city and performance tier, the percentage of how much each tier's redlined catchment area falls within each HOLC grade polygon was calculated. The formula is as follows:

$$\text{Tier \%} = \frac{\text{the area of tier overlapping with an HOLC grade}}{\text{the total area of tier overlapping any grade}} * 100$$

For example, in Denver the area of high tiered schools that overlap with A grade sections of the city is 2.22 square miles. The total area of high tiered isochrones that overlaps with all of the HOLC grade polygons is 17.29 square miles. The percentage of high tiered schools that overlap with A grade sections of the city is 12.82%.

Location quotients were then calculated to display over or under representation of each tier's isochrone within each HOLC grade. The location quotients were calculated by dividing the tier % with the baseline % calculated earlier. As with the location quotients calculated for the demographic catchment area analysis above, a location quotient 1 means proportional representation, over 1 means that tier is overrepresented, and less than 1 means that tier is underrepresented.

Findings

Location Quotient Analysis

The average location quotient for every demographic group by school performance tier and city can be seen in **Table 3** below. Beginning with the high tier of schools in each city, the demographics who are consistently well-represented within these schools' catchment areas are white, Asian, high-income, and higher educated populations. Hispanic, Native American, Pacific Islander, and multiracial populations were consistently underrepresented in these catchment areas as none of them have a location quotient of 1 or higher in any of the cities. Looking at **Figure 1** specifically, high-performing schools in San Francisco are located where there are consistently higher percentages of white and Asian residents, as well as where median household income is consistently higher.

For average tier schools, catchment areas most consistently skew toward higher concentrations of Black residents and households below the poverty line. Black residents have a location quotient of greater than 1 in three of the cities, with the only location quotient being lower than 1 being in Denver's non-AEC schools. In these non-AEC schools, the location quotient for the Black population is 0.93, which is relatively close to the 1 benchmark. In San Francisco, Black residents have a location quotient of 2.27, which is the highest value calculated, and only one of two location quotients over 2. Households living below the poverty line have higher location quotients in all three cities, including both AEC and non-AEC schools in Denver. **Figure 2** provides an interesting visualization of this finding. Looking at the far northeast section of Denver, where there are some of the highest percentages of Black residents in the city, that region is overrepresented by average and low performing schools. Not a single high-performing school falls within that area.

For low tier schools, catchment areas most consistently skew toward higher concentrations of Black, Hispanic, Native American, Pacific Islander residents and households below the poverty line. All of these populations have location quotients greater than 1 in each of the three cities (including both AECs and non-AECs in Denver). High-income residents did not have a location quotient of 1 in any of the cities, while white residents and residents with a bachelor's degree or higher have location quotients of 1 or higher in only one city. Pacific Islander residents in the low tier catchment area in Indianapolis have the second highest location quotient and the only other location quotient over 2, with a location quotient of 2.01. There are five demographic groups with a location quotient of over 1 in this category (white residents have a location quotient of 1.01 in San Francisco), which is the most out of all the tiers. As seen in

Figure 1, San Francisco’s Hispanic population is generally concentrated in the eastern part of the city, where low and average performing schools are also acutely concentrated.

Access Inequality Metric Analysis

The access inequality metric is the ratio of access to high-performing schools to access to low-performing schools. Access inequality metrics for every demographic group in each city are presented in **Table 4** below. In all three cities (including both AEC and non-AEC schools in Denver), white and high-income residents as well as residents who have a bachelor’s degree or higher consistently have easier access to high tier school over low tier schools. Access inequality is most stark among traditional high schools in Denver. Residents who have a bachelor’s degree and higher, high-income residents, and white residents have the first, third, and fourth highest access inequality ratios across all demographic groups in each city. The only other demographic group that has easier access to high-performing schools than low-performing schools are Asian residents in San Francisco and Indianapolis. Although they have values of under 1 in Denver non-AEC and AEC schools, they have a value of 0.92 and 0.95 respectively, which are very close to 1. No other demographic group has an average access inequality metric over 1 in any city. The next demographic group that comes closest are residents living below the poverty line near Denver AECs with 0.96, followed by multiracial residents in Indianapolis with 0.90.

City	Tier	n	White	Black	Hispanic	Asian	Native American	Pacific Islander	Multiracial	Income	Education	Poverty
San Francisco	High	5	1.20	1.28	0.56	1.04	0.61	0.45	0.89	1.03	1.01	0.85
	Average	6	1.37	2.27	0.63	0.84	1.06	0.45	0.88	0.98	0.99	1.12
	Low	6	1.01	1.76	1.30	0.89	1.75	1.04	1.04	0.98	0.91	1.23
Denver	High	8	1.18	0.75	0.45	1.24	0.33	0.68	0.68	1.33	1.29	0.61
	Average	8	0.80	0.93	1.51	1.26	0.90	1.14	1.66	0.98	0.74	1.03
	Low	9	0.79	1.32	1.33	1.36	1.37	1.63	1.38	0.88	0.79	1.03
Denver AEC	High	4	1.09	0.53	0.98	1.00	0.94	0.82	0.94	0.97	1.06	1.19
	Average	5	0.96	1.44	0.94	1.28	0.72	1.20	0.99	0.89	0.96	1.30
	Low	5	0.85	0.90	1.50	1.04	1.59	1.49	1.48	0.86	0.74	1.24
Indianapolis	High	3	1.14	0.86	0.59	1.03	0.56	0.93	0.87	1.18	1.60	1.29
	Average	4	1.06	1.01	0.73	0.63	0.96	0.88	1.02	0.86	1.11	1.46
	Low	4	0.94	1.05	1.39	0.83	1.85	2.01	0.97	0.83	1.02	1.57

Table 3. Location quotients by school performance tier and city

City	White	Black	Hispanic	Asian	Native American	Pacific Islander	Multiracial	Income	Education	Poverty
San Francisco	1.19	0.73	0.43	1.18	0.35	0.43	0.85	1.06	1.11	0.69
Denver	1.50	0.57	0.34	0.92	0.24	0.42	0.50	1.51	1.63	0.60
Denver AECs	1.27	0.59	0.65	0.95	0.59	0.55	0.63	1.13	1.43	0.96
Indianapolis	1.22	0.82	0.42	1.24	0.30	0.46	0.90	1.42	1.57	0.82

Table 4. Access inequality ratios

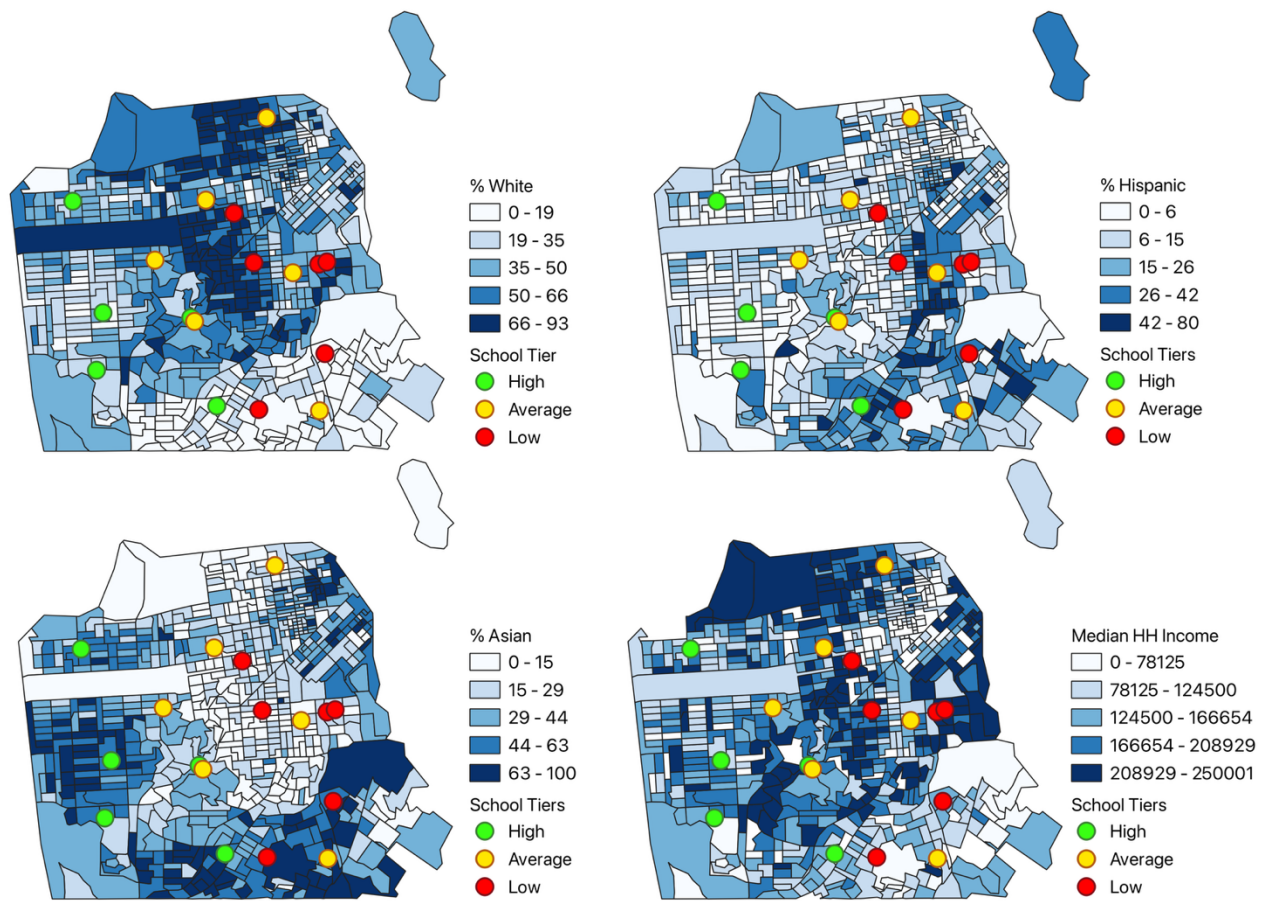


Figure 1. Tiered school locations on % of white, Hispanic, and Asian residents and median household income at the block group level in San Francisco

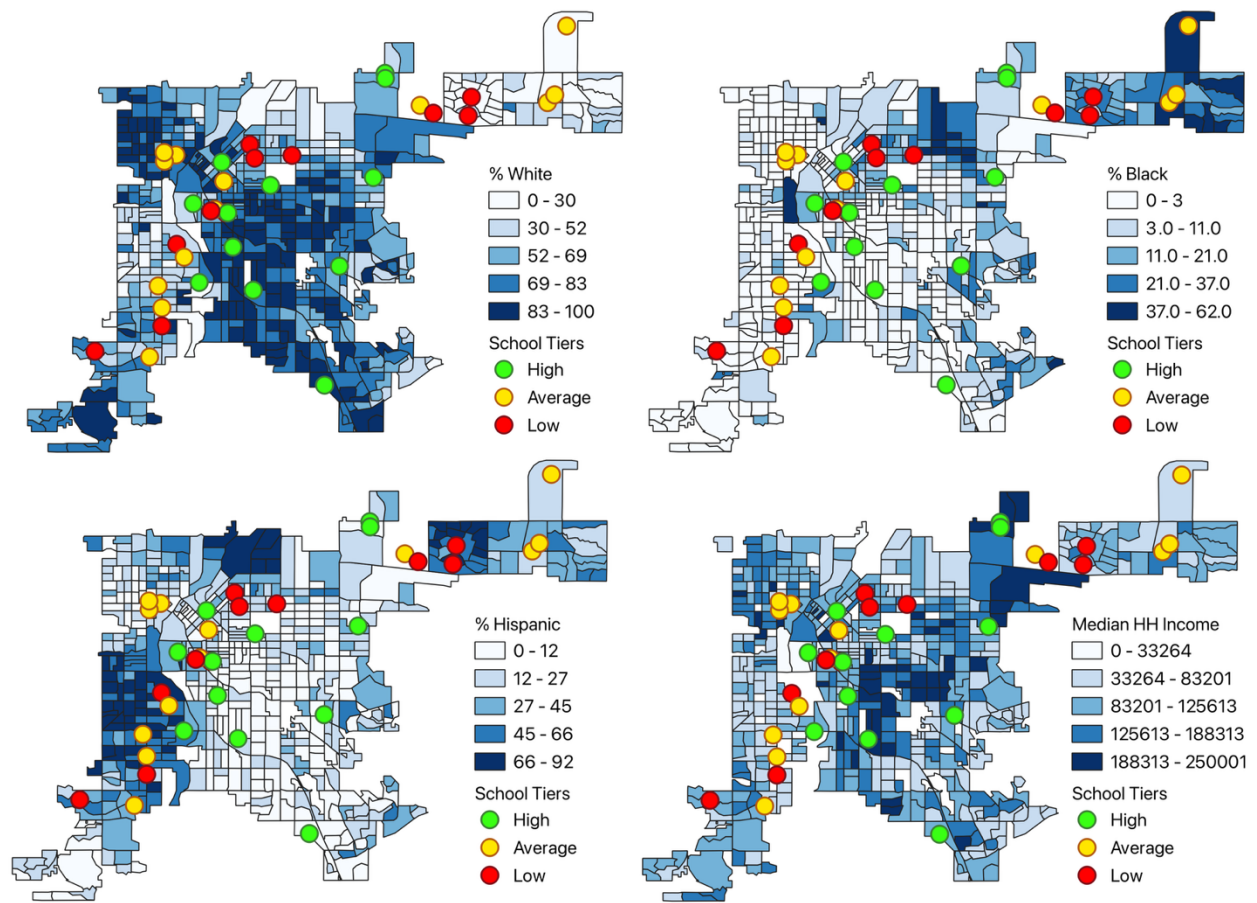


Figure 2. Tiered school locations on % of white, Black, and Hispanic residents and median household income at the block group level in Denver

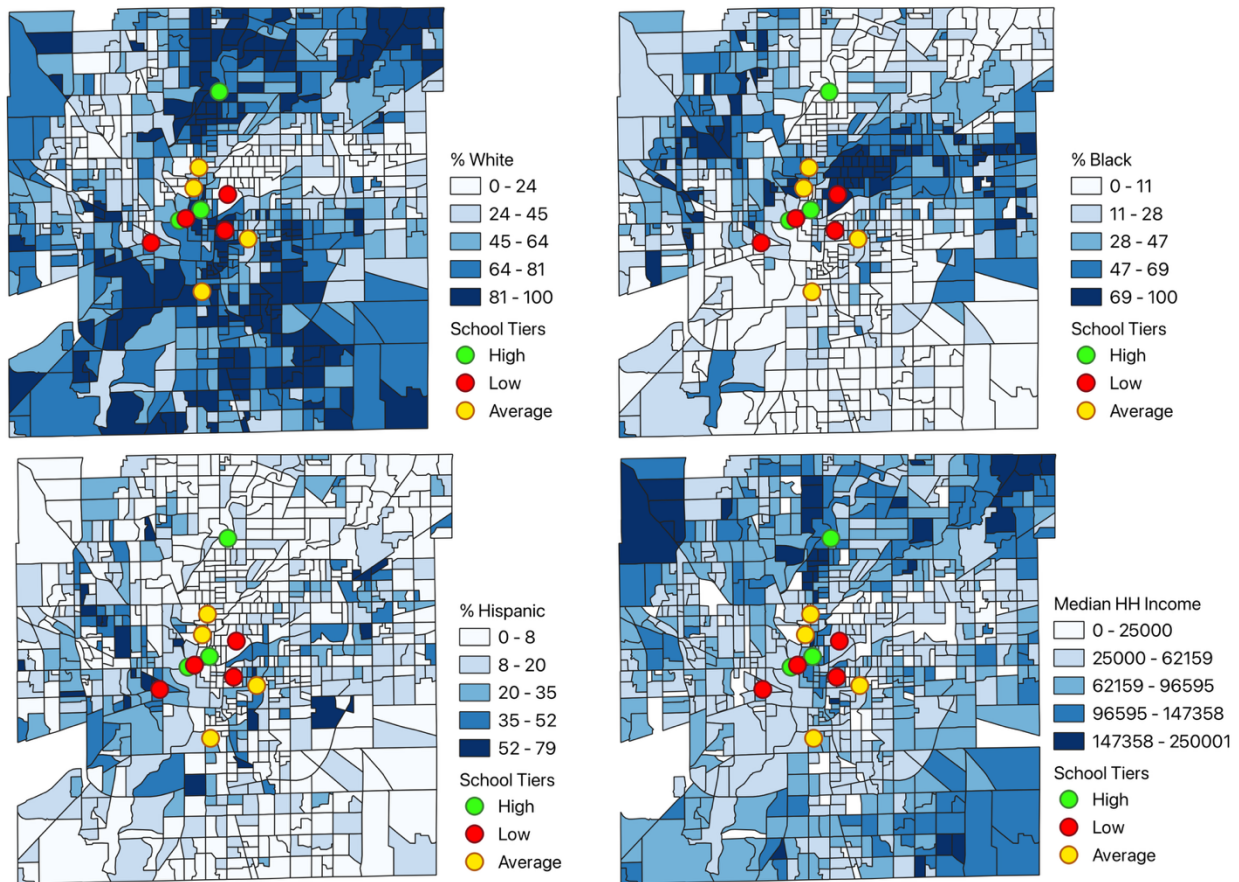


Figure 3. Tiered school locations on % of white, Black, and Hispanic residents and median household income at the block group level in Indianapolis

Isochrones Overlaid on Historical Redlining Maps

Table 5 displays location quotients for how much of each tier of isochrone in each city overlaps with the different HOLC district grades, A being the best grade an area could receive, while D areas were described as “hazardous” (*Mapping Inequality*, n.d.). As with the location quotients calculated above, 1 means the isochrones are proportionally represented within the HOLC grades, over 1 means the tier serves the grade more than expected, and below 1 means the tier serves the grade less than expected.

Looking at the results from San Francisco, there is clear discrepancy between where high and low tier schools are represented. High tier schools in the city have a location quotient of 1.19

in areas graded A and a 0.53 location quotient in areas graded D. Low tier schools have a location quotient of 0.52 in areas graded A and a location quotient of 1.55 in areas graded D.

Figure 4 shows this pattern clearly. Four of the five high-performing schools in the city are in the west side of the city and located within areas graded A or B. Nearly all average and low performing schools are located in the east side and located within areas graded C or D. Only one average performing school falls within an area graded B.

In Denver, however, the results are a little different. The discrepancy of representation in high-performing schools still exists. High-performing schools in Denver have a location quotient of 1.95 in areas graded A and a location quotient of 0.78 in areas graded D. The results are much more different when looking at the values for the low tier of schools. Low tier schools have a location quotient of 2.13 in areas graded A and a location quotient of only 0.98 in areas graded D. 2.13 in this case is the highest location quotient in the city. Looking at **Figure 5**, many of the high-performing schools are located within the city center. This may be due to the development patterns of Denver since these maps were created. There could have been high rates of gentrification or overall demographic changes within the city, although a conclusion of why this is the case cannot be made without looking more closely at the city's development patterns and patterns of demographic change over time.

In Indianapolis, the results are quite stark. The most interesting numbers to look at here are the overlap between high tier of schools and areas graded A and low tier of schools and areas graded D. High tier schools in the city have a location quotient of 2.69 in areas graded A, while low tier schools have a location quotient of 2.80 in areas graded D. These two values are the highest values between the three cities. The results for the low-performing schools show the most discrepancy. Low tier schools in areas graded A have a location quotient of only 0.02 and 0.04 in

areas graded B, the lowest values between the three cities. Looking at **Figure 6**, the majority of the city is comprised of areas graded C and D. The high location quotient for high-performing schools in areas graded A could be explained by the one school in the north side of the city that is located very near to the largest section of areas graded A and B. The high location quotient for low-performing schools in areas graded D could be explained by how nearly all of these schools are located in these areas. Not a single low-performing school is particularly close to areas graded A or B.

City	Tier	A	B	C	D
San Francisco	High	1.19	1.37	1.05	0.53
	Average	1.16	0.94	1.03	0.99
	Low	0.52	0.37	1.19	1.55
Denver	High	1.95	1.52	0.84	0.78
	Average	0.28	0.66	1.04	1.26
	Low	2.13	1.47	0.70	0.98
Indianapolis	High	2.69	1.21	0.55	1.58
	Average	1.19	1.70	0.65	1.52
	Low	0.02	0.04	0.41	2.80

Table 5. Intersection of tiered isochrones and HOLC district grades

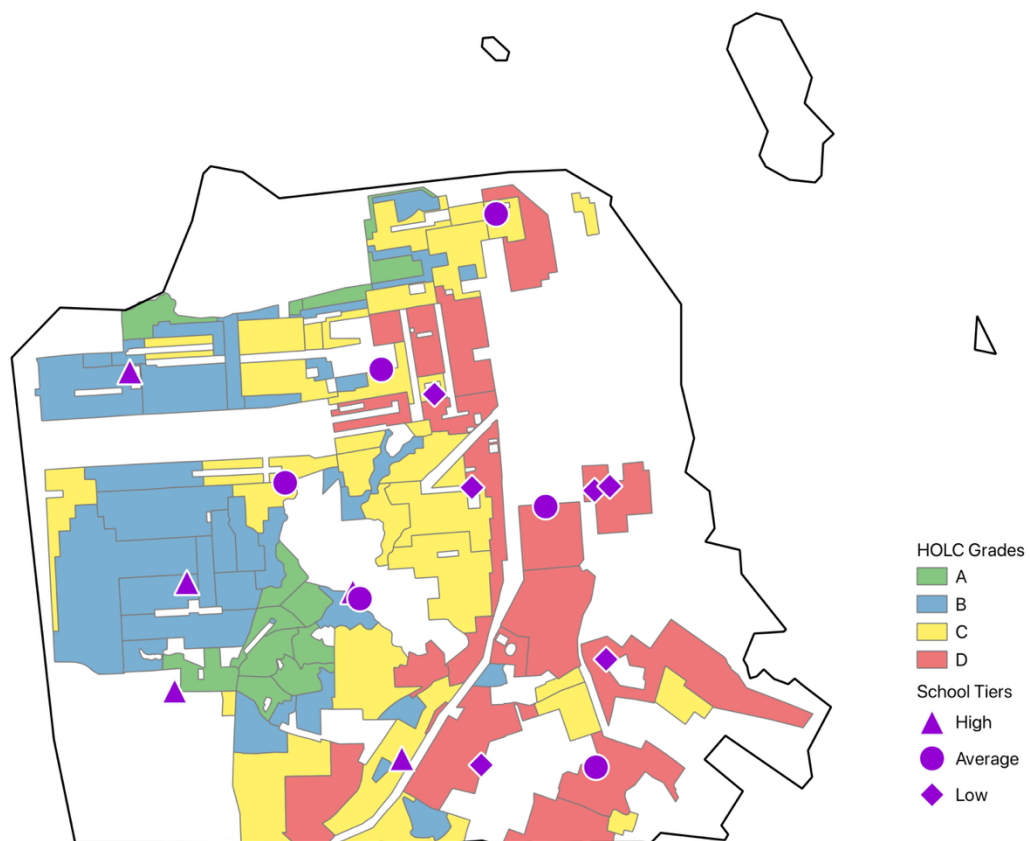


Figure 4. Tiered school locations on HOLC grade areas in San Francisco

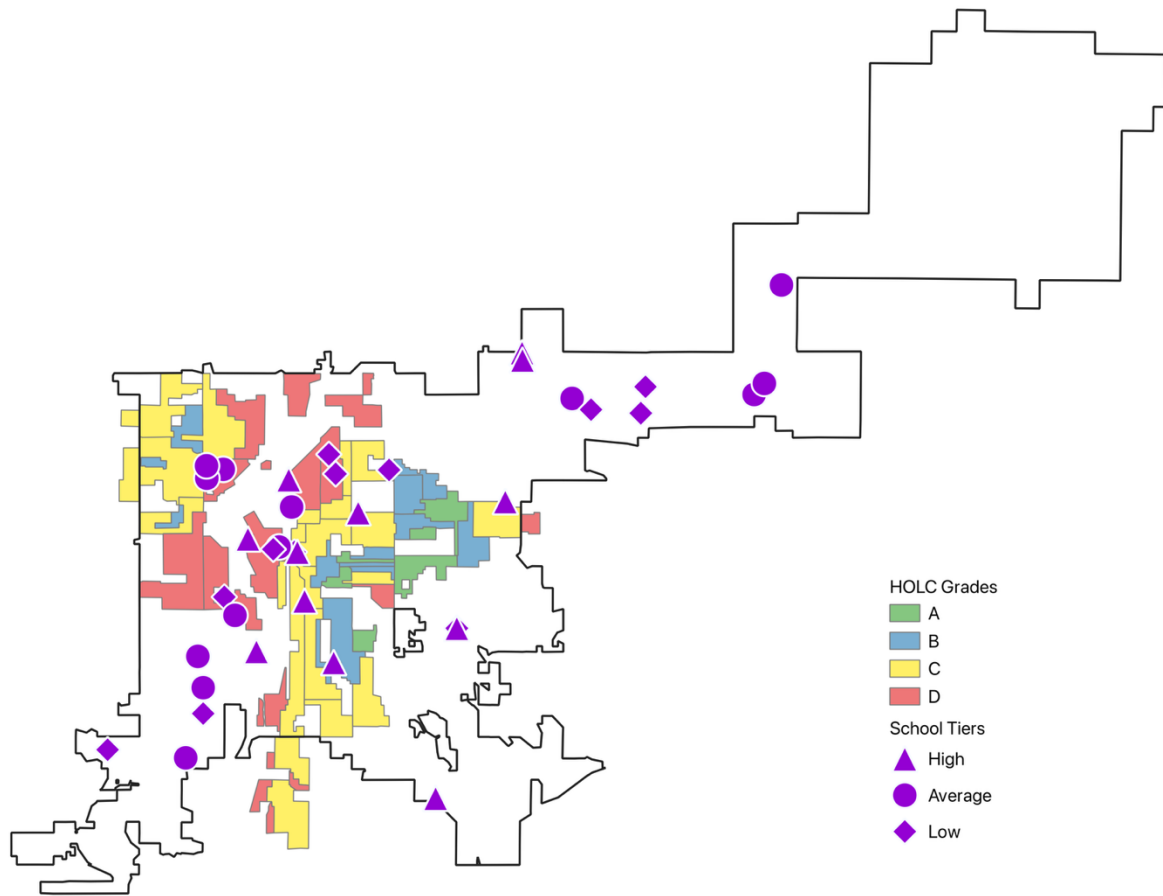


Figure 5. Tiered school locations on HOLC grade areas in Denver

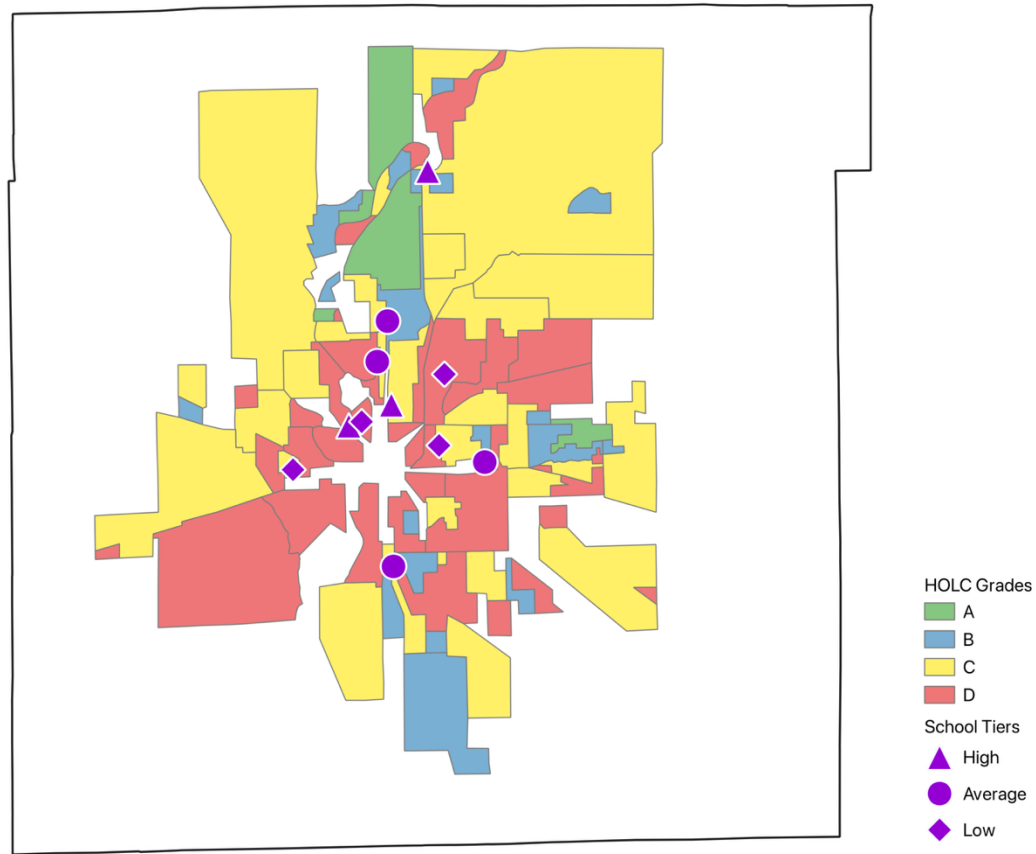


Figure 6. Tiered school locations on HOLC grade areas in Indianapolis

Discussion and Recommendations

By looking at the location quotients for access to schools by public transit, the picture of who has access to high quality schools is quite clear. In all three cities, white, Asian, high-income, and highly educated populations have the most access within 30 minutes by public transit to high-performing schools. The access inequality metric tells the same story. White, Asian, high-income, and highly educated groups were the only demographics with values of over 1, meaning they are the only groups that have easier access to high performing schools than they do low performing schools. What these findings show is that public transit is not currently an adequate solution to providing more students with equitable access to higher performing schools.

This is an issue as none of the three school districts in this study provide good transportation alternatives for all high school students. In all three cities, most high school students are not eligible for student transportation in the form of yellow school buses. In San Francisco, no public high schools are served by yellow school buses for general students. In both Denver and Indianapolis, no high school students are eligible to ride yellow school buses. Instead, the only alternative provided by these school districts is for students to take transit for free.

All three school districts work closely with transportation agencies in their city, SFMTA in San Francisco, RTD in Denver, and IndyGo in Indianapolis. In San Francisco and Denver, their local transit agencies are currently running a program where youth can ride their services for free, there is no need to receive a bus pass from the school district. IndyGo is not currently running a free program for youth. Instead, students are assigned to taking IndyGo by the school district and are given a free bus pass. Providing students with free or reduced fares is not enough to improve students' access to high performing schools. It does not matter if students can take transit for free if they are not able to get to their schools in a manner that is convenient and safe, and the results above show that historically marginalized low-income students do not have convenient access to high performing schools in their city in the first place. In San Francisco, transit users reported that they were the least satisfied with their school commutes compared to all other modes (*Child Transportation Study* | SFCTA, 2016). By looking at the results from overlaying the tiered isochrones with historical redlining maps, the transit systems in these cities are not built to provide equitable access to education. Studies have shown that 74% of neighborhoods that were graded D by the HOLC are low to moderate income neighborhoods today (Frohberg, 2023). In two of the three cities in this study, isochrones for low performing schools are consistently overrepresented in D grade areas.

San Francisco and Denver try to provide alternatives to driving and public transit. San Francisco has their SRTS program and Denver runs two routes of their Success Express shuttles. The issue with these two programs is that they only really work to serve specific communities. SRTS was created with the goal of promoting walking, cycling, taking public transit, and carpooling to school. Walking, cycling, and taking public transit are only viable options for students if they live close to their school. The Success Express is a program that has a lot of great potential but is currently only serving the Far Northeast and Central Denver communities. An expansion of the Success Express program, or any other shuttle program, could have great positive impact on student mobility. In San Francisco, more than half of the respondents in their study who stated they were interested in alternative school commute options listed “other buses” and shuttles as transportation options they were most interested in (*Child Transportation Study | SFCTA*, 2016). Interest in a shuttle service is high in San Francisco in particular, with parents reporting that they would be open to paying for a shuttle service (*Child Transportation Study | SFCTA*, 2016).

In their paper *Can Public Transportation Improve Students’ Access to Denver’s Best Schools of Choice?* Betheny Gross and Patrick Denice (2017) come to the conclusion that “public transit is unlikely to reduce neighborhood isolation” in Denver due to geographic factors such as the size of the city and its highway system, among other factors (Gross & Denice, 2017). In general, it would be hard for transit agencies to provide services and routes specifically to connect historically marginalized low-income students to high performing schools. Due to this constraint, it should be up to the school districts themselves to provide adequate student transportation, especially in the form of shuttle services. In the 2011-12 school year, it was found that running two Success Express routes in Denver cost a combined \$1,192,135 less than running

traditional school transportation services in the same regions (Ely & Teske, 2014). This discrepancy in cost mainly stemmed from having to run less buses with the shuttle service than with the traditional yellow school bus service (Ely & Teske, 2014). Expanding the shuttle service in Denver and introducing shuttle services in San Francisco and Indianapolis could prove to be beneficial for historically marginalized low-income students who are currently not being adequately served by public transit systems.

Conclusion and Limitations

This study set out to examine who has convenient access to high, average, and low performing schools by public transit in San Francisco, Denver, and Indianapolis. These cities were selected due to being similar in population size, difference in population density, and similarities in school choice processes. The findings suggest that in all three cities studied white, Asian, high-income, and highly educated individuals have the most convenient access to high performing high schools. White, high-income and highly educated individuals also consistently have more convenient access to high performing schools than they do low performing schools across all three cities. Hispanic, Native American, Pacific Islander, and low-income populations were the most consistently underrepresented in the catchment area for high performing schools. None of these groups were found to have more convenient access to high performing schools than low performing schools in any of the cities. Low performing schools' isochrones are disproportionately concentrated in historically redlined neighborhoods graded D by the HOLC in San Francisco and Indianapolis. The results in Denver are more nuanced in that low performing schools' catchment areas were highly overrepresented in A grade neighborhoods. The reason for this is unknown, though worth noting.

All three school districts fail at providing high schools students with adequate transportation options. The yellow school bus services in all three cities do not serve general education high school students. The only other form of transportation provided to these students comes in the form of free transit fare programs, although these programs are not enough to advance educational access to high performing schools to those who need it most, as historically marginalized low-income communities are not the ones who have the worst access to said schools. This paper recommends an expansion of shuttle service in Denver and an introduction of shuttle services in San Francisco and Indianapolis. School districts must provide good transportation options to all of its students because public transit systems are not designed solely with student commutes in mind.

This study has several important limitations. First, this study only examines who has physical access not actual enrollment patterns. This study does not have data on where students of each school are commuting from. Without school-level data on where students are commuting from and how they are commuting, it is not possible to draw conclusions about how physical access through public transit translates to school choice decisions, attendance, or student success. Future research that combines the transit accessibility analysis with data on where students are travelling from could paint a more complete picture of how transit access might affect school choice. Additionally, the areal interpolation technique utilized to estimate demographics within each catchment area assumes a uniform distribution of population within block groups, which may not reflect reality. Furthermore, the three cities chosen for this study were selected on the ground that they have similar school choice policies, meaning these findings may not be generalizable to cities with different kinds of school choice policies. Finally, the way that schools are separated into terciles may not necessarily reflect the ways in which parents perceive these

schools. In reality, more or less than a third of schools may be considered high, average, and low performing. There are organizations like Great Schools that rank schools based on academic performance as well as other factors, which may better reflect parents' perceptions of what schools are considered high, average, and low performing.

Despite these limitations, this study makes an important contribution to the literature on school choice and equitable access to education. By combining transit accessibility analysis and historical redlining overlay in three cities, it provides a transportation-focused and geographic lens through which to evaluate whether citywide school choice policies, as they currently exist, are capable of meeting their goal of equitable access to education. The findings make clear that school choice without adequate access to transportation does not work to serve historically marginalized low-income communities. Addressing transportation barriers must be a central component of any serious effort to address the issue of access to high quality education for all students.

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