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Public Transit and School Choice in Philadelphia: Exploring Spatial Equity and Social Exclusion

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Abstract

This paper explores the importance of considering transportation mode when calculating commute time for a child's school choice options. While proponents of school choice argue that students can attend any school that will provide them the best education, several have argued that commute time is as important for families as a school's characteristics. However, research to date models commute time using either distance as a proxy or minutes driving. In Philadelphia, a context where most people use public transportation to work and school, the authors argue that commute time to school must be calculated using this mode of transit. Using geospatial network analyses, the authors create choice sets for each neighborhood public high school. They first calculate the commute time between each zoned public high school and each public high school choice in the city by driving and by using public transportation. These two sets of commute times are then evaluated for the differences. The authors then calculate choice sets based on the average commute time in the city based on both modes of transportation. Finally, they compare the choice sets for each service area for spatial equity of public school quality. Findings indicate that the commute times between driving and public transportation are statistically different. Furthermore, public school choice sets within Philadelphia are spatially equitable, although the overall school quality needs improvement. The paper concludes with policy implications and recommendations for future research.

Keywords

school choice sets; spatial equity; social exclusion; public transit; commute time; Philadelphia; GIS

This study is motivated by personal experience of one of the authors, who formerly served as a middle school teacher in Philadelphia:

At the end of each day, I would board the eastbound subway train towards my home. Along my journey, groups of students from schools throughout the city boarded the crowded train as well. For many students, if not a majority of them, the

city's public transportation system is how they got to school. It was also how I got to school as their teacher. When it came time for students to decide where to attend high school, my students' parents often sought my guidance on how to navigate this system. I would suggest options from which to consider, but the sticking point frequently was transportation. I recall one specific conversation that I had with a parent of a student who lived in one of the corners of Philadelphia. After each school that I would suggest, his mother would shake her head and say something along the lines of, "No, that's too far. He would have to take a subway and two buses. It would take almost an hour each way for him to get to and from school." This student had outstanding grades and top-tier test scores, and he was eligible to attend almost any school in the city he and his family would choose. However, in practical terms, many of the best schools in the city were not feasible options for his family.

Proponents of school choice argue that by allowing for schooling options that are not tied to where a student lives, students would be able to attend any high-quality school of their choosing (CREDO, 2015). However, research has shown that school characteristics are insufficient to choose a given school; home proximity is also an important facet of a family's decision (e.g., Bell, 2009b; Jabbar, 2016). As highlighted in the vignette above, even if students have access to any high-quality school, this may not be sufficient for a family to choose a particular school. The purpose of this study is two-fold: (1) to examine public transit commute time as a variable for understanding school choice sets, and (2) to explore the spatial equity of the public school choice sets derived based on that variable.

A free and accessible transportation system ensures that families are able to take advantage of school choice as designed (Marshall, 2017; Welner, 2013). Where this is not available, families who may be eligible to enroll their children in high quality schools of choice may not feasibly be able to get them to those schools (Frankenburg & Siegel-Hawley, 2012). Some governmental agencies recognize this need and have invested in absorbing the cost of public transportation for accommodating school choice policies. For example, the School District of Philadelphia (henceforth, SDP) has chosen to partner with the Southeastern Pennsylvania Transit Authority (SEPTA) to provide transportation to school for many of the students, instead of traditional school buses (Redfern, 2013). In fact, Redfern (2013) reports that 58,000 of the 134,000 Philadelphia students used the SEPTA Transpass program to get to school. Thus, this makes Philadelphia a unique case study to explore. Despite the removal of monetary burden on families seen in other cities with school choice programs, long commutes may produce additional burdens for the families. Indeed, commute time is shown to be inversely correlated to access to social capital (Besser, Marcus, & Frumkin, 2008). The research questions guiding this research study are: (1) Do the commute times for students in Philadelphia who travel by vehicle differ from students who travel by public transportation to schools of choice? (2) What are the public high school choice sets for those who travel using public transportation? (3) Do differences exist in school quality between the choice sets?

This paper makes the case that mode of transportation matters for understanding one's commute to schools of choice in urban areas. Some research measures commute in terms of

miles (e.g., Hamlin, 2017), whereas others report drive time (e.g., Glazerman & Dotter, 2017). However, transportation scholars have indicated that parents choose different modes of transportation based on the type of school they attend and their ethnic background (Wilson, Marshall, Wilson & Krizek, 2010). Furthermore, although recent work documents that the average ninth grade student lives within ten minutes driving of a “high quality school”, the commute may take substantially longer if that child has to rely on public transportation (Blagg et al., 2018). Using Philadelphia as a case study, we explore whether and to what extent there is a difference in the high school options available between driving and using public transportation. Our hypothesis is that there is a difference, and therefore, urban education scholars should model commute by using travel time on the appropriate mode of transportation for the context. Secondly, we seek to understand if spatial inequity exists in the choice sets in Philadelphia. Specifically, are the choice sets as determined by public transit commute different from each other? We do this by using the quality score of each school assigned by SDP, which among many factors includes: (1) percent of students who attend at least 95% of the school days, (2) percent of students who never received an out-of-school suspension, (3) percent of students graduating high school within four years, and (4) percent of students passing the state standardized tests, among others (SDP, 2017a).

Conceptual Framework: Spatial Equity through School Choice and Commute Time

Inequality is typically examined by race, class, and gender (Lobao, Hooks, & Tickamyer, 2007). Recently, additional attention has been given to geographers and demographers who maintain that social inequality is also divided along spatial lines. In fact, Lobao et al. (2007) argue that the overarching question guiding the sociological study of stratification should be revised to read: “Who gets what where?” (p. 2). Recognizing that space plays as much of a role in the construction of opportunity, Gulson and Symes (2007) caution that excluding spatial analysis from studies of educational policy would, “at best, be a narrow [analysis], and, perhaps, at worst, a flawed one” (p. 13). However, these conversations of opportunity also debate whether the end goal is equality or equity. Espinoza (2007) offers a framework to delineate the differences between these two ideals, both used to explain the goal for distributive justice. While equality centers on equal access for every person, equity posits that access is equal for all people conditional on their needs. This study is framed in the tenets of spatial equity. In this section, we will first argue that spatial equity is an important consideration in the analysis of school choice. Then, we will explore commute time as a function of social capital. Finally, we will argue that commute time is an important mechanism for which to examine spatial equity in school choice contexts.

Theorizing and Debating School Choice: A Means for Social Inclusion or Exclusion?

Some research positions school choice as a social exclusionary mechanism. Madanipour (1998/2016) defines social exclusion as economic, political, and cultural mechanisms used to institutionally control access to places, resources, and information. As this relates to school choice, these policies may disrupt the school as, what Lipman (2009) argues, the

historically fundamental center of a community. Furthermore, opponents of school choice policies maintain that charter schools only serve the most elite students, either through market strategies that would establish guidelines to admit the best students from an entire area (metaphorically referred to as “skimming the cream”) or by “cropping off” services for students who would be costlier to educate (Lacireno-Paquet, Holyoke, Moser, & Henig, 2002). According to those opposing school choice policies, therefore, this further stratifies students by race, class, and space and reinforces segregation (Scott & Holme, 2016).

Outside of explicit school choice mechanisms through charter and voucher policies, school choice has always existed, and it has been a luxury for the most advantaged (Marshall, 2017). For example, Holme (2002) has documented how middle-class families choose to purchase homes partially based on the schools that serve a particular neighborhood. School choice advocates maintain that policies must be implemented to afford an equitable ability to choose a school to all families, particularly those who cannot readily move to a neighborhood with the best school for their child (Marshall, 2017; Pendergrass & Kern, 2017). The act of selecting a school outside of the neighborhood disrupts Lipman’s (2009) notion of the centrality of school to a community. Yet, school choice proponents suggest that this disruption is a net positive when it allows low-income families the ability to send their children to more desirable schools (Hentschke, 2017). Furthermore, some studies indicate that the effects of “cream-skimming” are only marginal in both charter schools and voucher programs (Altonji, Huang & Taber, 2015; Anderson, 2017). Regardless of the positive or negative effects, school choice proponents separate school and community from each other. However, in order to ensure equitable educational opportunity, analyzing school and urban policy systems in tandem is important (Holme & Finnigan, 2018).

Commute time: A negative relationship with social capital.

Urban and community planning scholars have explored the role of commute and its impact on social capital. Broadly defined as the extent to which one is networked in a community, social capital has been shown to have important impacts on one’s life course outcomes, including health and labor (Lynch, Due, Muntaner, & Smith, 2000). Besser, Marcus, and Frumpkin (2008) posit that those people who travel further distances face reduced access to social capital. Lucas (2011) further argues that transportation systems are inherently inequitable, leading to a process of transportation-related social exclusion. She further claims that exclusion from transportation limits access to other amenities required for improved social capital. Even in large cities, not all people are networked to the public transportation system, especially when living away from the center city. This notion of social exclusion due to public transportation access is amplified when understanding capital related to one’s access to the workplace. The odds of taking sick leave significantly increase for those people who have long commutes, even when balancing for potential covariates, including their health (Goerke & Lorenz, 2017). This suggests that the distance of the commute may explain one taking leave, rather than actual sickness. For this study, we maintain that if students do not have equitable access to the public transportation network, then they will not have access to the wide array of options that Philadelphia claims it offers to all of the city’s children.

Commute time as a means to explore spatial equity.

Spatial equity methodology refers to examining both the formal access to a given amenity and the community perception of the equity of its access (Talen & Anselin, 1998). Even if a community has a high number of amenities, the perception of access to these amenities could be low. Thus, the notion of access is insufficient without a deeper examination of the community's needs and beliefs. In the school choice literature, travel time and mode of transportation are considered to be important factors for parents when they contemplate which school to send their children (He & Giuliano, 2018; Wilson et al., 2010). Through data collected in Oregon, Yang, Abbott, and Schlossberg (2012) report that parents whose children attend schools of choice are more likely to drive their children to school. However, a negative correlation exists between those living in poverty and vehicle access (Welch, 2013). Therefore, lacking a vehicle may limit access to school choice options, particularly affecting those for whom equity through school choice is most needed. Indeed, the American Community Survey [ACS] 2012–2016 five-year estimates estimate that a total of 26% of workers who reside in the City of Philadelphia take public transportation to work. This proportion increases for those living in poverty: 36% of workers who live below the poverty line commute to work using public transportation. Given these statistics, vehicle access may be less important to attending a school of choice in Philadelphia, but rather the transportation network is what is important for families choosing what school to attend.

Scholars have previously explored the geography of school choice through analyses that include distance as a control variable (see e.g., Burgess & Briggs, 2010; Glazerman & Dotter, 2017), but they do not capture the cost (time or money) required for commuting to school. Bell (2009a) conducted an analysis of choice sets as defined by parents in a survey, which does inherently capture commute, but the focus is on parental knowledge rather than capturing all schools that exist in the area. As researchers seek to expand parental knowledge of all the choices they have (e.g., Corcoran, Jennings, Cohodes, & Sattin-Bajaj, 2018), constructing choice sets by commute time provides data for a more equitably-focused analysis that could also be used for providing parents additional information about all their children's options. We then explore the spatial equity of these choice sets by comparing the school quality of the schools in each service area. Given that not all students will have applications accepted at selective admission schools, we also separate these schools from the open enrollment options in a final analysis.

Context

This study focuses on schools located within Philadelphia, Pennsylvania. As the eighth largest school district in the country (SDP, 2016a), it educates a diverse group of students from all races and socioeconomic statuses, while envisioning, "For all children, a great school, close to where they live." The city has also experienced a proliferation of school choice options district-wide. In addition to private schools, many public school options exist for Philadelphia students, including traditional neighborhood schools, school district-operated open enrollment schools, school district-operated selective admission schools, public charter schools which are open enrollment, and neighborhood schools operated by a charter. The various high school types and their distribution are described in Table 1 and are

visually depicted in Figure 1. Given the quantity of available options, the Commonwealth of Pennsylvania is committed to ensuring safe transportation for all students to their schools. To comply with this commitment, SDP has determined that all high school students who do not live on a school bus route or live over a mile and a half from their school are entitled to free public transportation during the weekdays (SDP, 2016b). Therefore, this alleviates the concern regarding bus transportation to schools that Wilson et al. (2010) report is important, especially for nonwhite parents.

Although students can attend any school within the city, not all schools are of equal quality. For example, while the median four-year graduation rate for zoned, neighborhood high schools in Philadelphia was 58% in 2016, the public school with the lowest graduation rate saw only 41% of its students graduate on time (Pennsylvania Department of Education [PDOE], 2016). Not all neighborhood schools are operated by the School District. Beginning with the 2010–11 school year, one strategy that was employed to turn around struggling district-run neighborhood schools, known as the Renaissance School Initiative, allowed those schools to be operated by organizations outside of the district as charter schools (SDP, 2017b). Furthermore, not all schools are open enrollment. Some schools are magnet schools that enroll based on an application-based admissions process through test scores, essays, auditions, or recommendation letters (Saporito & Sohoni, 2007). The magnet schools in Philadelphia are all operated by SDP. As a result, students may have to travel great distances to arrive at a quality school to which they have access. Given SDP's vision of a school close to each child's home, and the need for many students to be close to home to help with familial obligations or other personal reasons, the spatial equity of the choice sets in Philadelphia should be examined by the extent to which this vision is being fulfilled. Before this can be determined, these commute-sensitive choice sets must be described.

Data Sources

The demographic, enrollment, and student achievement data were all obtained from the publicly accessible SDP website. At the original construction of this study, the SDP website included individual school report cards with each school's data in a separate file. Furthermore, charter school data was only accessible through a different website. The website has recently been updated with a portal that provides all of the school data in a single location, which includes both SDP managed schools and the charter schools that serve inside of the city. The portal includes information regarding student enrollment by neighborhood school. The public accessibility of these data allows Philadelphia to highlight their portfolio of school options, including the city's charter schools. Neighborhood characteristics were obtained from the ACS. Transit data and commute times were obtained from both Google Maps API and the Pennsylvania Spatial Data portal, which is described in more detail below.

Methods

To first understand the landscape of the city, we wanted to better understand the spatial variation of poverty in the city. We applied a similar technique as the one utilized by Wodtke, Harding, and Elwert (2011). Using the ACS, we calculated a poverty factor score

for each census tract through a principal components analysis (PCA). As with all statistical analyses in this study, we utilized Stata 15.1 to conduct this analysis. The PCA creates a composite score on seven characteristics: “poverty, unemployment, welfare-receipt, female-headed households, education (i.e., percent of residents age 25 years or older without a high school diploma; percent of residents age 25 or older with a college degree), and occupational structure (i.e., percent of residents age 25 older in managerial or professional occupations)” (p. 720). The PCA results suggest that one factor captured the seven variables ($p = 0.709$). The census tract poverty scores are illustrated in Figure 2, and the factor loadings of the PCA are presented in Table 2. The ACS originated from, and later replaced, the “long form” decennial census. It examines the national demographic, including questions about housing, labor, and social welfare (U.S. Census Bureau, 2016).

We also calculate the travel time it takes for one to travel between a zoned neighborhood high school and every public school serving students in grades 9–12 in Philadelphia. We utilize Google Maps API through the Stata INSHEETJSON module (Lindsley, 2014) to calculate these times using public transit at four departure intervals: 7:00 A.M., 7:15 A.M., 7:30 A.M., and 7:45 A.M. Given that many high schools start at 8:00 A.M., this captures when many students will be leaving for school and allows for variations in transit arrival times. The mean commute times for these four departure time points are taken to estimate the amount of time it takes to travel between the two schools. The same process is conducted again to capture the amount of time it would take if driving, estimating the time as if traffic were heavy. Given that we do not have access to individual student addresses, we cannot construct individual choice sets. Therefore, we made the decision to utilize neighborhood school boundaries as the unit of analysis to make comparisons, given that neighborhood schools were historically considered the center of the community (Lipman, 2009). Also, 51% of the Philadelphia population living at or below the poverty line either take either a mean of public transportation or walk to work (U.S. Census Bureau, 2016),¹ and at least 43% of the Philadelphia students were reported to have used SEPTA in 2013 (Redfern, 2013). Given that our study exclusively explores school-choice decision-making at the high school level, it is reasonable to believe that this number is much higher for secondary students since SDP only provides SEPTA access for students starting in the seventh grade. Thus, commute time by public transportation more accurately represents commute to school for Philadelphia students. We then conduct a paired samples *t*-test of the two commute times to examine the extent of the difference in travel time between the two transportation modes.

This study then relies on geospatial analysis in ESRI ArcGIS 10.3. We first construct the Philadelphia transit network through publicly available data (SEPTA, 2016), which provides bus and train stops, service lines, and schedules. This allows ArcGIS to conduct a variety of analyses on transportation-focused issues. We then conduct a multimodal service area analysis of each of the zoned high schools in Philadelphia. A multimodal service area analysis uses the transportation data, as well as street data, to calculate the area within which one can travel up to a set time frame (Gutiérrez & García-Palomares, 2008; Morang, 2017; O’Neill, Ramsey, & Chou, 1992). We utilize the transportation network to set the service

¹This contrasts the national average, where 18% of the national population at or below the poverty line either take either a mean of public transportation or walk to work

area's limit based on the number of minutes required to travel on the public transportation network. We considered the neighborhood schools as the center of a given service area, and schools within the median reported time a Philadelphia resident commutes to work according to the ACS 2016 five-year estimates, which is 31.5 minutes, were captured. This cut point was chosen as median commute time is a frequently employed variable in the urban planning research (e.g., Kneebone & Holmes, 2015). We conduct this step as a separate check against directly downloading the data from the Google Maps API, as we had done in comparing commute times by transportation mode. Given that the navigation tool uses the same data as the network map, we expected these two networks to reflect similar results, which they do. Recognizing the limitation of the study using the zoned school as the center of analysis, it is important to understand if all students in a given catchment area could arrive at their zoned high school within the median 31.5 minutes. Service areas were compared to each of the zoned high schools' boundaries, and a percent area outside of the radius is calculated. Census tracts in which no children lived were excluded from this calculation. Figure 3 illustrates the areas in which a child would have to commute more than 31.5 minutes to their neighborhood school. It is important to note that these census tracts are on the city's boundaries, and only reflect a small area of the city.

For each of the 21 catchment areas, we constructed a choice set based on the median commute time (31.5 minutes) from the neighborhood high school. Consider Universal Audenried Charter High School's choice set as an example. Audenried lies in South Philadelphia and is one of the three Renaissance schools that serve as neighborhood high schools in the city. Students who live in this catchment area have 18 additional options outside of their zoned school at Audenried. See Figure 4 for a map depicting this choice set. Four of the 18 options in the Audenried choice set are other neighborhood schools (Bartram, Furness, West Philadelphia, and South Philadelphia). Another six schools are special admission schools that may be exclusionary for those without the test scores or credentials to gain admittance. Eight open enrollment schools also exist within the choice set that service grades nine through 12, six of which are charter schools. Table 3 compares Audenried to the 12 other schools that are open enrollment in terms of the district-calculated school report score, four-year graduation rates, English/Language Arts Keystone Exam² proficiency rates, and Math Keystone Exam proficiency rates.

Overall, Audenried's performance on these three academic metrics is better than that of the other four neighborhood schools which lie within the choice set boundaries. However, the metrics of the SDP and charter school open enrollment schools within the choice set are better than those at Audenried.

As these methods were implemented to understand the school choice landscape in Philadelphia, additional questions emerged. One of the more prominent questions we asked was if the choice sets were equitable between each other. Therefore, we first conduct a series of analyses of variance, whereby the quality of each choice school is estimated against if the school is within the service area. The quality of school is a score ranging between 0 and 100 as determined by SDP using a variety of measures including achievement, progress, climate,

²The Keystone Exams are the standardized tests taken by public high school students in Pennsylvania.

and college/career readiness (SDP, 2017a). Because the high school scores are right-skewed ($\mu=34.80$; $\sigma=20$), we conducted a square root transformation on the quality score variable. This one-way ANOVA served to assess the *equality* of school choice sets, that every person has equal access to each school irrelevant of their needs of a policy that allows them to engage in choice (Espinoza, 2007). We performed a second analysis using the same dependent variables but including the catchment poverty score that was constructed using the poverty PCA as a covariate. This analysis was used to capture the *equity* of school choice sets, accounting for socioeconomic status of the neighborhood. Given that equity is operationalized as equal access conditional on one's needs (Espinoza, 2007), this serves to control for the needs of the community to engage in choice. Finally, we conducted the same two analyses again assessing only those schools that are open enrollment. That is, if the school requires an application process, it is not necessarily a viable option for all students, and thus we elected to eliminate these options for the purpose of this analysis. Postestimation diagnostics indicated that the assumptions for conducting analyses of variance hold.

Findings

Our first question considers if there is a statistically significant difference between the time it takes to travel to school by driving by car or by taking public transportation. We find that there is a significant difference between taking public transit ($\mu = 46.86$, $\sigma = 20.37$) and driving ($\mu = 24.82$, $\sigma = 11.05$); $t(1721) = 70.61$, $p < 0.001$. Thus, we can say with 95% confidence that the taking public transit to school is, on average, between 21.75 and 23 minutes longer than driving, even in traffic. We subsequently used ArcGIS to illustrate the schools in which one can commute 31.5 minutes via public transit and the additional schools to which one can commute 31.5 minutes when driving. The maps of three of the sets are illustrated in Figure 5. As a result of this analysis, we argue that mode of transportation must be considered. Given that students do not have direct costs associated with using public transportation to school and that most students in Philadelphia use public transportation, this is the most appropriate measure of distance.

Differences in Choice Sets

The final question research question asks if there is spatial equality and/or equity between school choice sets. To do this, a series of analyses of variance were estimated to explore if there are differences between the groups, which are the 21 zoned choice sets. To test for spatial equality, the null hypothesis is that there is no statistical difference in the quality of schools between catchment service areas. As a second analysis, to test for equity, the null hypothesis is that there is no statistical difference in the quality of schools between catchment service areas, controlling for catchment poverty. Therefore, the analysis of variance for the equality models is replicated while adding the poverty factor score as a covariate. We perform these analyses for all schools in a service area and again for all open enrollment schools. For each of the four models, we fail to reject the null hypothesis. A summary of these four analyses is provided in Table 4. The variance explained by each of these models is quite low; however, these models are not seeking to explain why a school receives a certain outcome. Rather, this study explores the extent to which the service areas

are spatially equitable, in terms of neighborhood poverty, for the students of Philadelphia, and these analyses suggest they are.

Discussion

The School District of Philadelphia's mission, "For all children, a great school, close to where they live," clearly is one of spatial equity. This mission provides a worthy context in which to explore the spatial equity of the school choice contexts. As a result, this study considers two points. First, it explores the extent to which a public transit data variable is different from previously utilized variables. In a context where a sizable proportion of the population uses public transit, using a variable of driving time may not capture the magnitude that commuting may play in choosing which school one's child will attend. Secondly, we employ this variable to construct choice sets for each high school catchment area to understand the extent to which these areas are spatially equitable. Findings indicate that even though the catchment areas provide equitable access in terms of school quality when controlling for neighborhood poverty in the Philadelphia context, the average quality of the schools is quite low (27.5 over a possible 100). In fact, the district indicates the schools that receive a score below 49 should be watched, and those that receive a score below 24 require intervention (SDP, 2017a). This raises further concerns about the potential implications of social exclusion in the city at large.

Students on the boundaries of the city have reduced access to the public transportation system, and thus have fewer schools from which they can choose within the 31.5-minute commute time radius. This would indicate potential social exclusion (Lucas, 2011; Madanipour, 1998/2016). However, given that the zones in which students are further than 31.5 minutes from their zoned high school tend to have less mean poverty and greater access to cars, this suggests that other potential choice outcomes, including choosing to attend private schools or homeschooling, may be at play. Additionally, each catchment area provides an equitable set of schools based on school quality from other catchment areas. However, as stated above, the larger concern illustrated in these findings is the overall quality of the open-enrollment schools.

"Cream-skimming" of the best students (Lacireno-Paquet et al., 2002) does not appear to come from a particular service area or even from the charter schools. These findings that charter schools do not "cream skim" agree with those of Lacireno-Paquet et al. (2002). Although they instead suggest that charter schools instead "crop off" by excluding access to students who are costlier to educate, this analysis is outside of the scope of this paper, which examines the spatial equity of the choice sets as a whole. The application process to attend selective admit schools differs from the other schools in the city whereby test scores are one criterion for admission. This may function as its own mechanism of social exclusion, which is different from being able to access the school from a transportation lens. However, the vignette at the beginning of this article highlights that for even those students who do have the credentials to attend a selective admit school, they may still be socially excluded due to transportation, as Lucas (2011) describes. Thus, there are two mechanisms at work for a student to be able to attend a selective admit school: they must have the credentials to attend, and they must be able to get there in a reasonable amount of time.

This discussion signals a limitation that should also be explicitly noted. Specifically, the descriptions in commute time are related to the zoned high school. Given that we do not have access to student-level data, we made the decision to focus on the zoned high school as the center of the community, following historical and philosophical interpretations of a school (Lipman, 2009). While this does not accurately represent the reality for all students, the approximation still does indicate important trends in understanding spatial equity in school choice in Philadelphia.

Using GIS and commute times to assess distance from schools are important tools to better understand the school choice landscape. Access to schools when relying on public transportation may be limited by the transit network itself. For example, students in the northeastern sector of the city must travel around an airport. Thus, distance between two schools on either side of the airport should not be measured in geodesic length because traveling to that school would require traveling around the airport, as one cannot traverse it.

Conclusion

The argument that children can choose to attend any school in Philadelphia might be true; however, this might not be feasible, especially for the most disadvantaged children. School location is just as important for families as the quality of the school when choosing where their child will be educated (Bell, 2009b; Theobald, 2005). Many students do not have the capacity to travel great lengths given family or work obligations. Furthermore, high quality options may also have long waitlists, but exploring the school choice admissions process is outside of the scope of this study. Thus, understanding what does feasibly exist for students is important. This study shows that transit time is a better measure of distance for the Philadelphia school choice context; yet, the context is important. Philadelphia has chosen to focus its school transportation program for most of its students on the use of public transit rather than on traditional school buses. Analyses of other cities might require including transit cost. The argument that quality choices exist for all students appears valid within this study's context, even controlling for the neighborhood poverty, but this depends on their ability to access those schools. As a result, qualitative research examining how families choose schools specifically with an eye toward commute and access would be helpful. This could then be juxtaposed with the spatial choice-making process of charter schools (Glomm, Harris, & Lo, 2005; Lee, 2018). Finally, additional research should be conducted to explore ways to improve the overall educational opportunity for all students in the Philadelphia public school system.

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Figure 1.
All Philadelphia high schools located within zoned high school boundaries.

Figure 2.
Philadelphia poverty factor scores by census tract.

Figure 3.
Percent of school boundary located within zoned school's service area.

Figure 4.
School choice options within public transit service areas for Universal Charter School at Audenried.

Figure 5.
Comparison of school choice options within 31.5-minute commute time by transportation mode.

Table 1

Number of Public High School Choice Options in Philadelphia by School Type

<u>School Type</u>	<u>Number of Schools</u>
SDP Operated Neighborhood Schools	18
SDP Operated Open Enrollment Schools	11
SDP Operated Selective Admission Schools	16
Renaissance Charter Schools	3
Open Enrollment Public Charter Schools	31
<i>Total</i>	<i>79</i>

Note. Data source: School District of Philadelphia (2017c). School profiles. Retrieved from: <https://dashboards.philasd.org/extensions/philadelphia/index.html>

Table 2

Factor loadings of principal components analysis for census tract poverty score

Variable	Component	Unexplained
Percent less than HS	0.377	0.296
Percent graduate degree	−0.390	0.244
Percent household income in poverty	0.350	0.391
Percent female heads of household	0.382	0.278
Percent receiving welfare	0.390	0.244
Percent unemployed	0.374	0.304
Percent in professional occupation	−0.381	0.280

Note. $\rho = 0.709$

Table 3

Open Enrollment Options in Audenried Choice Set

<u>School</u>	<u>Overall Score</u>	<u>Graduation Rate</u>	<u>ELA Keystone Proficiency</u>	<u>Math Keystone Proficiency</u>
Audenried *	22	76	20	6
<i><u>Neighborhood</u></i>				
Bartram	14	54	13	1
Furness	27	67	11	8
South Philadelphia	7	50	14	5
West Philadelphia	22	53	20	4
<i><u>Open Enrollment</u></i>				
Freire Charter *	53	68	43	36
Hardy Williams (Mastery) *	30	89	24	8
Mastery Charter-Thomas *	27	86	53	16
Phila. Electrical/Technical *	47	85	37	20
Phila. Performing Arts *	52	91	54	15
Prep Charter *	32	93	59	41
Robeson	41	96	35	7
The Workshop	32	89	13	2
<i>City Average</i>	<i>35</i>	<i>81</i>	<i>38</i>	<i>20</i>
<i>State Average</i>			<i>77</i>	<i>68</i>

Notes.

* Denotes charter school. ELA=English/Language Arts. Data sources: School District of Philadelphia (2017c). School profiles (2016–2017 Data). Retrieved from <https://dashboards.philasd.org/extensions/philadelphia/index.html>. State average data collected from Pennsylvania Department of Education. Retrieved from <http://www.education.pa.gov/Data-and-Statistics/Pages/Keystone-Exams-Results.aspx>.

Table 4

Results of Analyses of Variance

Analysis	Variable	df	F	p
Equality of All	Catchment groups	20	0.57	0.934
	Residual	355		
Equity of All	Poverty	1	0.14	0.713
	Catchment groups	19	0.54	0.943
	Residual	355		
Equality of Open	Catchment groups	20	0.31	0.998
	Residual	273		
Equity of Open	Poverty	1	0.22	0.639
	Catchment groups	19	0.33	0.997
	Residual	273		