Student Mobility Networks in the Greater Houston Area
Elementary School Student Mobility Networks

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Houston Education Research Consortium

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The Houston Education Research Consortium (HERC), in collaboration with 10 public school districts in the Greater Houston area, set out to better understand the prevalence, patterns, and consequences of student mobility on Houston-area students and schools. This brief explores the informal networks of elementary school student mobility in the Greater Houston area across 27 independent school districts (ISDs), which include HERC's 10 school district partners involved in the Student Mobility and Continuous Enrollment project, their 17 neighboring districts, and non-district charter schools. Six mobility networks were identified in the Greater Houston area. These mobility networks crossed district boundaries, and differed in terms of their size, student demographics, and school characteristics. About 70 percent of student mobility that started from a campus in one of the six networks stayed within that same network.

Key Terms

Student mobility – when a student changed the school they attended. This may have involved students departing schools and/or entering schools (sometimes referred to as *school moves*).
Non-structural mobility – when a student changed the school they attended for a reason other than completing the terminal grade at that school (e.g., switching from one elementary school to another).
Mobility network – a cluster of campuses connected by the sharing and movement of students changing schools.
Swing schools – schools that did not belong to one of the six mobility networks.

Key Findings

There were six mobility networks in the Greater Houston area.

- The six networks were geographically clustered and identified as the Central, East, North, Southeast, Southwest, and West networks.

Mobile students tended to change schools within their mobility network.

- Approximately 70% of student mobility that started from a school in a mobility network ended at another school within that same mobility network.

Mobility networks differed in their size, school characteristics, and student demographics.

- On average, each network consisted of 102 schools, but network size ranged between 33 schools in the East network to 164 schools in the West network.
- The campus average proportion of economically disadvantaged students across networks was 63%, with a range of 38% in the North network to 79% in the East network

Background

Student mobility has many motivating factors (Welsh 2017) and been shown to disrupt learning (Gibbons & Telhai, 2011) with consequences for students' development (LeBoeuf & Fantuzzo, 2018) across the K-12 landscape (Anderson, 2017). Despite the diverse nature of student mobility, prior research has found evidence that mobility is patterned (Ingersoll et al., 1989; Kerbow, 1996; Welsh, 2017). In particular, research out of Chicago found student mobility tended to be contained to particular geographic spaces, such that clusters of schools exchanged a disproportionate number of mobile students (Kerbow, 1996). By identifying these informal networks of student mobility, researchers were able to highlight connections between campuses that were not otherwise established through feeder patterns or other formalized relationships, but which could be leveraged to better support and educate students as they moved through the educational system.

Research Purpose

Building on prior research about student mobility in the Greater Houston area, which highlighted the amount and type of mobility taking place within and between Houston area public school districts (Potter et al., 2020), this study explored the existence of informal mobility networks among elementary schools.

Data and Methods

To determine if informal mobility networks existed in the Greater Houston area, Public Education Information Management System (PEIMS) data from the 2011-12 to 2016-17 school years were used to measure and monitor student mobility between campuses in 27 public school districts. These districts included traditional public school districts and non-district charter schools.

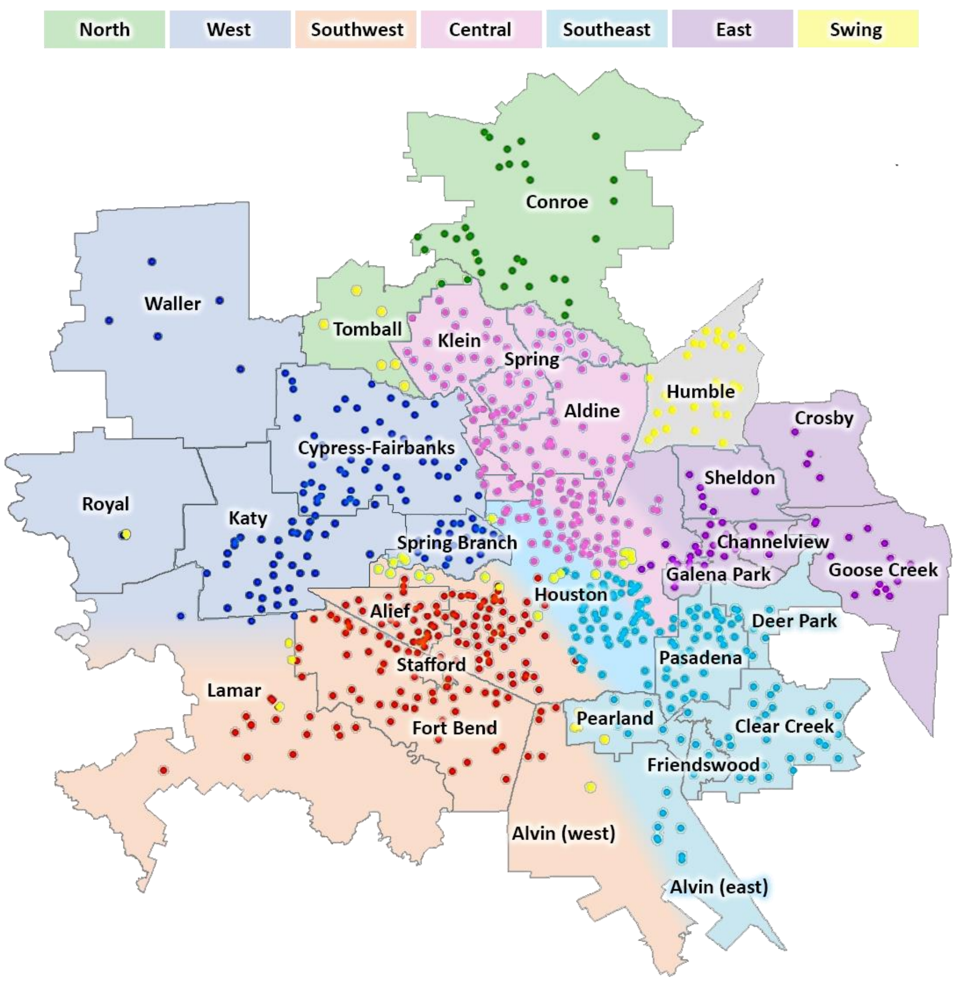
Detection of informal networks of student mobility was based exclusively on the number of students going between campuses. Geographic proximity, student body composition, and type of campus were <u>not</u> included in determining if or how many informal networks of student mobility existed in the Greater Houston area. For more detail on the data and methods used to identify student mobility networks, please see Appendix A.

Networks were identified separately for elementary, middle, and high schools. This report focuses on the results from the elementary school analyses; however, please see appendices for an overview of results from the network analyses of middle schools (Appendix B) and high schools (Appendix C).

1 There Were Six Mobility Networks in the Greater Houston Area

Six mobility networks were identified in the Greater Houston area. The mobility networks converged in central Houston, were geographically clustered, and were identified as the Central, East, North, Southeast, Southwest, and West networks. Figure 1 shows the coverage of the six elementary school mobility networks across the Greater Houston area. Most school districts were within a single mobility network, and each network consisted of multiple school districts. No school district was its own mobility network. Of note, Houston ISD spanned across multiple networks, with elementary school campuses belonging in the Central, East, Southeast, and Southwest networks. Of the 734 elementary schools in the Greater Houston area, 673 schools, more than 90% of the total, were included in the six mobility networks, while 61 schools, less than 10% of the total, were categorized as swing schools. Swing schools were mainly found along the borders between networks or concentrated in suburban districts, particularly in Humble and Tomball ISDs.

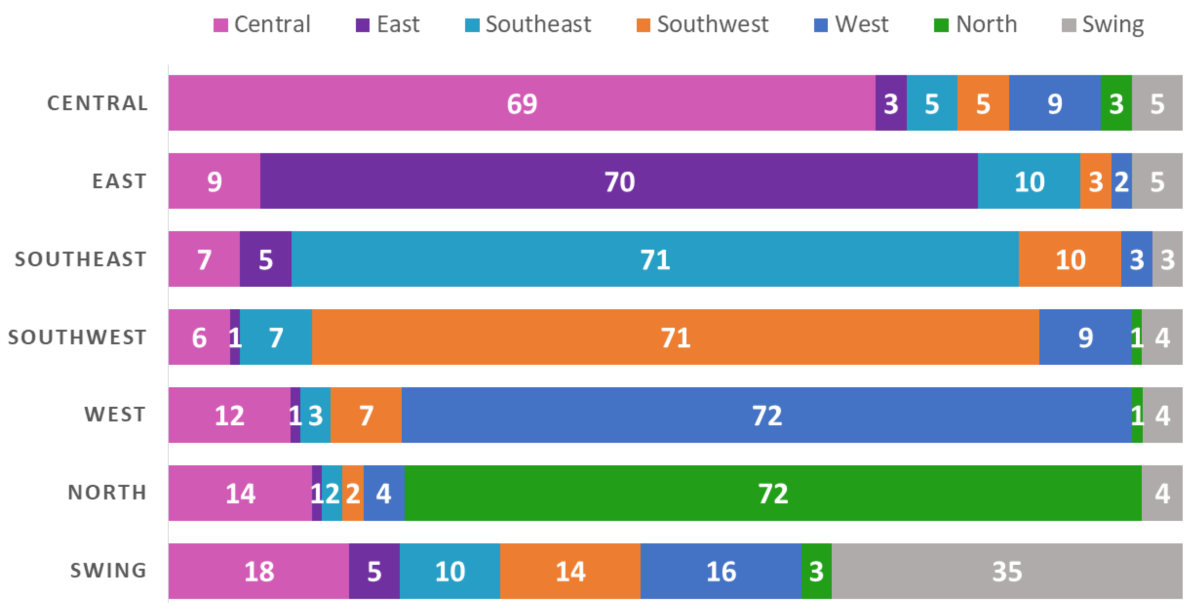
Figure 1. Six Elementary School Mobility Networks



2 About 70 Percent of Student Mobility Stayed Within Network

Student mobility that started from a campus in a mobility network tended to end at a campus in the same mobility network. This was a distinguishing feature of each mobility network, such that, on average, about 71% of student mobility remained within the same network (Figure 2). This self-contained nature of mobility networks can be contrasted with mobility taking place within a public school district. Public school districts, which have formalized relationships between campuses, only had about 40% of school year mobility and 40% of summer non-structural mobility stay within their boundaries (Potter et al., 2020). Formalizing connections between campuses within a student mobility network (including across district borders) would almost double the likelihood of being able to ensure a continuity to students' education when they change schools.

Figure 2. Mobile students tended to move between schools in the same network.



3 Mobility Networks Differed in Size, School Characteristics, and Student Demographics

Since only student mobility was used to develop the networks, the six resulting networks were compared across other factors beyond students changing schools to see how they differed. The six mobility networks differed in their size (i.e., number of campuses), school characteristics, and campus's student demographics. On average, each network consisted of 102 elementary school campuses, and as seen in Figure 3, networks ranged in size from 33 campuses in the East network to 164 campuses in the West network.

Figure 3. The East network was made up of the fewest campuses while the West network was made up of the most.

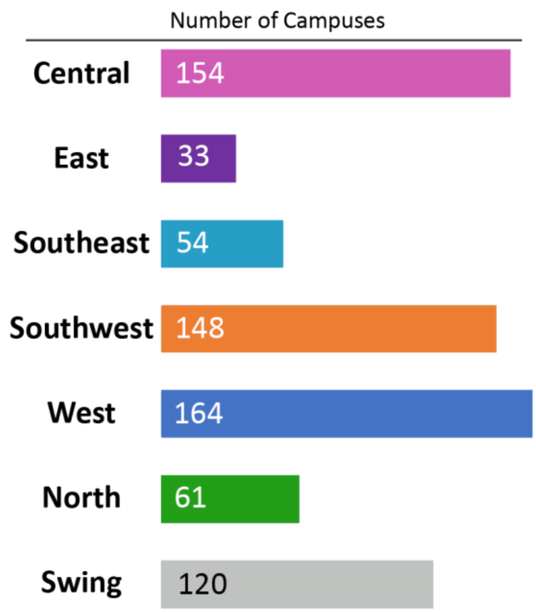
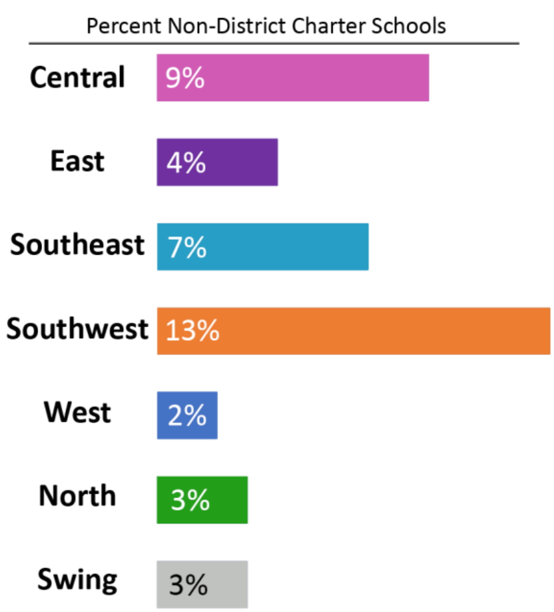


Figure 4. The West network had the smallest percent of non-district charter schools.

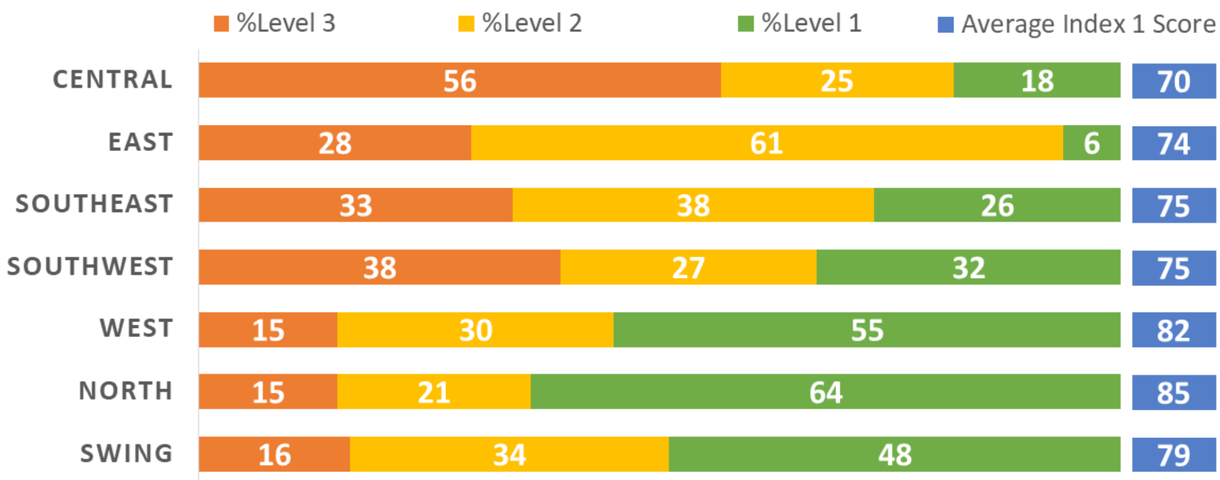


Mobility networks also differed by their schools' characteristics, particularly the percent of non-district charter schools making up a network. The Southwest network had the highest percent of non-district charter schools, as 13% of its elementary schools were charter schools. In contrast, the West network had the lowest percent of non-district charter schools: only 2% of its elementary schools were charters (Figure 4).

Key Findings

Networks also differed in their campuses' average STAAR performance (Figure 5). For example, the average Index 1 score for campuses in the North network was 85, compared to an average Index 1 score of about 70 for campuses in the Central network. In addition, mobility networks differed in their percent of Level 1, Level 2, and Level 3 campuses[1]. In the East network, about 6% of campuses were in level 1 compared to over 50% of campuses in the West and North networks.

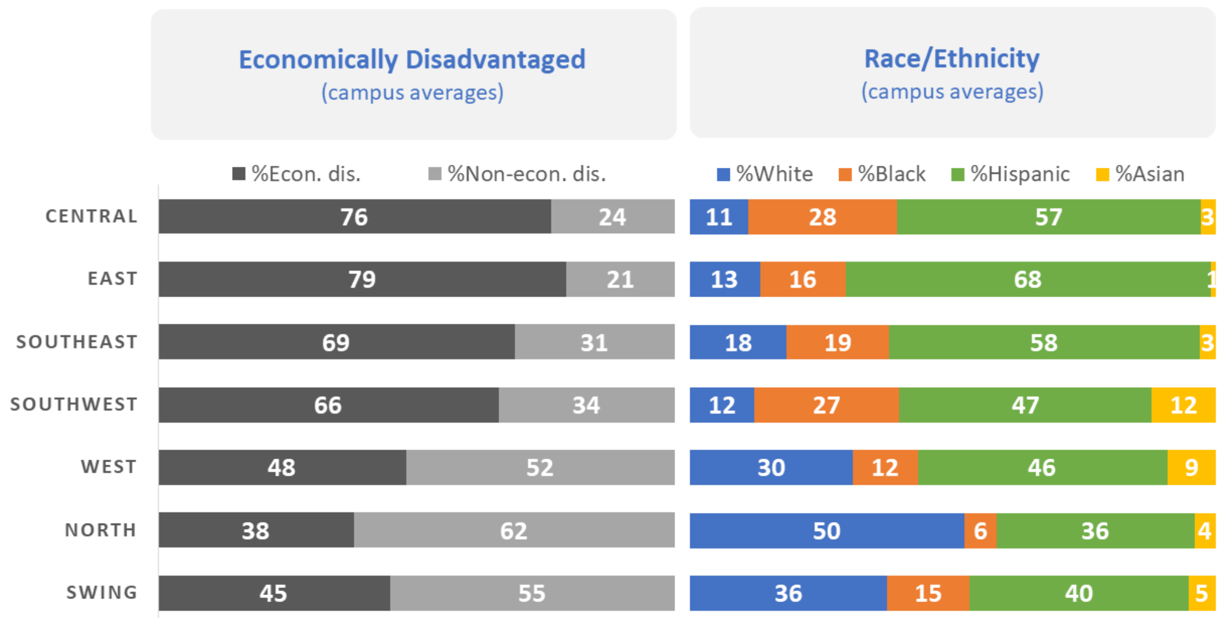
Figure 5. Mobility networks differed in their schools' average STAAR performance and percent of campuses in scoring levels.



[1]Level was defined by a campus's STAAR Index 1 score. Campuses that scored in the top one-third of campuses in the Greater Houston area on STAAR Index 1 were labeled Level 1, campuses that scored in the middle third on STAAR Index 1 were labeled Level 2, and campuses that scores in the lower third on STAAR Index 1 were labeled Level 3.

Networks also differed in their campus's student demographics (Figure 6). Economically disadvantaged students made up the majority of students at campuses in the Central, East, Southeast, and Southwest mobility networks. In the Central and East networks, campuses were composed, on average, of nearly 80% economically disadvantaged students. In the Southeast and Southwest networks, campuses were composed on average of nearly 70% economically disadvantaged students. In the North and West networks, on average, campuses were made up of less than 50% economically disadvantaged students.

Figure 6. Student race/ethnicity and economically disadvantaged status across networks.



Hispanic students were the largest race/ethnicity group in five of the six mobility networks. About 68% of students at campuses in the East network were Hispanic – the highest proportion across the networks – compared to around 34% of students at campuses in the North network – the lowest proportion across the networks.

Implications

The six mobility networks presented in this brief provide a novel and unprecedented view of student mobility in the Greater Houston area. Each network includes multiple districts and provides an informal map of schools connected by student mobility. They also offer a new underlying map of student mobility districts can use to better understand where their students are going to and coming from when they change schools. While school districts provide a formal organization of campuses, they do not correspond to where students are changing schools. This is particularly important because student mobility in the Greater Houston area has been shown to not stay within a single district's borders (Potter et al., 2020).

Additionally, the existence of these networks poses new questions for educational leaders and policymakers to consider when it comes to the continuity of students' education and care. These questions include, but are not limited to, consideration of a real-time shared student information system, porous campus attendance boundaries, and potentially even open enrollment.

Recommendations

School District Collaboration

A primary recommendation from this study is for school districts to use the six mobility networks to create partnerships aimed at alleviating issues that arise from student mobility. These partnerships could be cross-district or cross-campus, and could engage in targeted data sharing for mobile students or sharing of course/curriculum progression guides. By taking measures to enhance their collaboration, school districts can better ensure continuity in students' education and learning.

Cooperate with Community Organizations

School districts could also cooperate with community-based organizations that serve students and bridge across district boundaries. These organizations may be in a position to serve as an intermediary for connecting students' information and records between districts in lieu of a formalized records sharing system being established.

Limited Open Enrollment

With an understanding of existing mobility networks, school districts could consider limited, within-network open enrollment options for mobile students. In doing so, at the parents' discretion, mobile students could have the option to complete their academic year at their original campus with support from districts for transportation, as long as it was in the same network.

References

Anderson, S. (2017). School mobility among middle school students: When and for whom does it matter?. *Psychology in the Schools*, *54*(5), 487-503.

Blondel, V. D., Guillaume, J. L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *Journal of statistical mechanics: theory and experiment*, *2008*(10), P10008.

Dauter, L., & Fuller, B. (2016). Student movement in social context: The influence of time, peers, and place. *American Educational Research Journal*, *53*(1), 33-70.

Gibbons, S., & Telhaj, S. (2011). Pupil mobility and school disruption. *Journal of Public Economics*, *95*(9-10), 1156-1167.

Ingersoll, G. M., Scamman, J. P., & Eckerling, W. D. (1989). Geographic mobility and student achievement in an urban setting. *Educational evaluation and policy analysis*, *11*(2), 143-149.

Kerbow, D. (1996). Patterns of urban student mobility and local school reform. *Journal of Education for Students Placed at Risk, 1*, 147–169. doi:10.1207/ s15327671espr0102_5.

LeBoeuf, W. A., & Fantuzzo, J. W. (2018). Effects of intradistrict school mobility and high student turnover rates on early reading achievement. *Applied Developmental Science, 22*(1), 43-57.

Potter, D., Alvear, S., Bao, K., Kennedy, C., & Min, J. (2020). *Changing Schools, Part 3: Student Mobility Within and Between Districts in Texas and the Houston Area*. Houston, TX: Houston Education Research Consortium, Kinder Institute for Urban Research, Rice University.

Texas Education Agency. (2017). *2017 Accountability Manual for Texas Public School Districts and Campuses*. Retrieved from https://tea.texas.gov/sites/default/files/2017AccountabilityManual_accessible.pdf

Welsh, R. O. (2017). School hopscotch: A comprehensive review of K–12 student mobility in the United States. *Review of Educational Research, 87*(3), 475-511.

Appendix

Appendix A. Data and Method

Data

The network analysis examined campus-to-campus mobility patterns in the Greater Houston Area. Campus-to-campus mobility, also referred to as flows, was calculated as the total number of students whose enrollment status went between two schools during the school year (i.e., while school was in session) or over the summer (intentionally excluding structural mobility, which are school moves that take place following the completion of a terminal grade at a school, to avoid having networks overly influenced by districts' feeder patterns).

Student mobility flows were calculated between every campus in the Greater Houston area. The Greater Houston area consists of 27 traditional public school districts and non-district charter schools located in and around the Houston region.

For the network analysis, the size of the flow of students between campuses over a 5-year period was the unit of analysis. Five years of data were created using the summer before and school year of the 2012-13, 2013-14, 2014-15, 2015-16, and 2016-17 school years. For demonstration purposes, the following description uses the elementary school network analysis to explain the process and method, and identical procedures were subsequently performed for the network analyzes of middle schools and high schools.

First, the sample of elementary schools in the Greater Houston area was filtered to include only those who were opened during all five years under consideration in the study. The decision to limit to only campuses open for the entirety of the study period was to avoid having the analyses overly influenced by flows of students between an existing school and a newly opened school. After limiting the sample to only schools opened for the entirety of the study period, a flow was calculated for every dyad of elementary schools in the Greater Houston area. Any flow equal to 0 was then dropped. A total of 734 schools were included in the analysis; 89 schools were excluded because[2] of the aforementioned criteria.

Method

The network analysis used the Louvain algorithm proposed by Blondel et al. (2008). It is a heuristic method based on modularity optimization. The algorithm starts with small groups by optimizing on specific randomized nodes and then iterates the process to combine nodes into larger groups. Modularity is the extent to which a network is divided into more groups than would appear if the connections were established at random. The maximum value of the modularity index is 1. The higher the modularity value (i.e., closer to 1), the more distinct the patterns in the network are; whereas when it is low (i.e., closer to 0), it means the network does not have clear patterns and differences are more likely to be at random. For instance, a modularity value of 0.8 from the analysis indicates the presence of a rather clear and separate network; the connection between nodes within modules are dense but connections between

[2] Other restrictions used in the mobility study also apply, such as alternative education campuses, virtual campuses, and special education campus/programs.

nodes in different modules are sparse. In comparison, a modularity value of 0.1 suggests the connections between nodes in the analysis are weak or random and hence there may not be a clear pattern of network. A result value of 0.4 or greater is generally considered meaningful.

We conducted the analysis in Gephi-0.9.1 using default resolution[3] at 1 and the number of school changes among schools as a weight. We chose the randomize function in the modularity settings to produce a better decomposition. That is, the starting point for the optimization was randomly selected each time the modularity command was run. This resulted in different optimized solutions to the network when the divisions between clusters were not clear-cut. For example, School A and School B exchanged 50 students over the summer while the total mobile students into/out of School A and B were 100 and 500, respectively. This means school changes with School B accounted for 50% of School A's total mobility, yet school changes with School A accounted for only 10% of School B's total mobility. Hence, when School A was the starting point, School B was pulled into School A's network due to its importance to School A. However, when School B was the starting point, School A might not be counted as part of School B's network due to its relative importance to School B in comparison to other schools, which have larger flows of students exchanged with School B.

Over a dozen runs were tested to investigate the strength of the network and its delineation. A modularity value of approximately 0.43 was reported. Despite minor differences in the optimized solutions, general spatial patterns emerged from the network analysis, which showed robust geographic clusters. Schools near the edge of the networks' geographic clusters tended to be assigned to different networks over multiple runs of the analysis because of their relative importance to other schools in the neighboring networks and the sequencing of the randomization process. These schools were eventually termed "swing" campuses because of their tendency to swing between networks across the multiple runs of the analysis.

To better interpret and understand the networks, we used geospatial tools to identify schools that are always in the network and those that swing between neighboring networks. The former are defined as fixed network, whereas the latter are defined as swing schools. Using the center point of each network as the anchor point, the network attribute (i.e., East, Central, and West) was assigned to each campus over 10 rounds of optimized solutions. Then the results were combined to identify schools in fixed network (schools stayed in the same network in all 10 rounds) and swing schools (schools present in multiple networks). In the end, 673 schools, more than 90% of the total, were divided among the 6 networks; while 61 schools (less than 10%) were classified as swing schools, which did not belong to any specific network.

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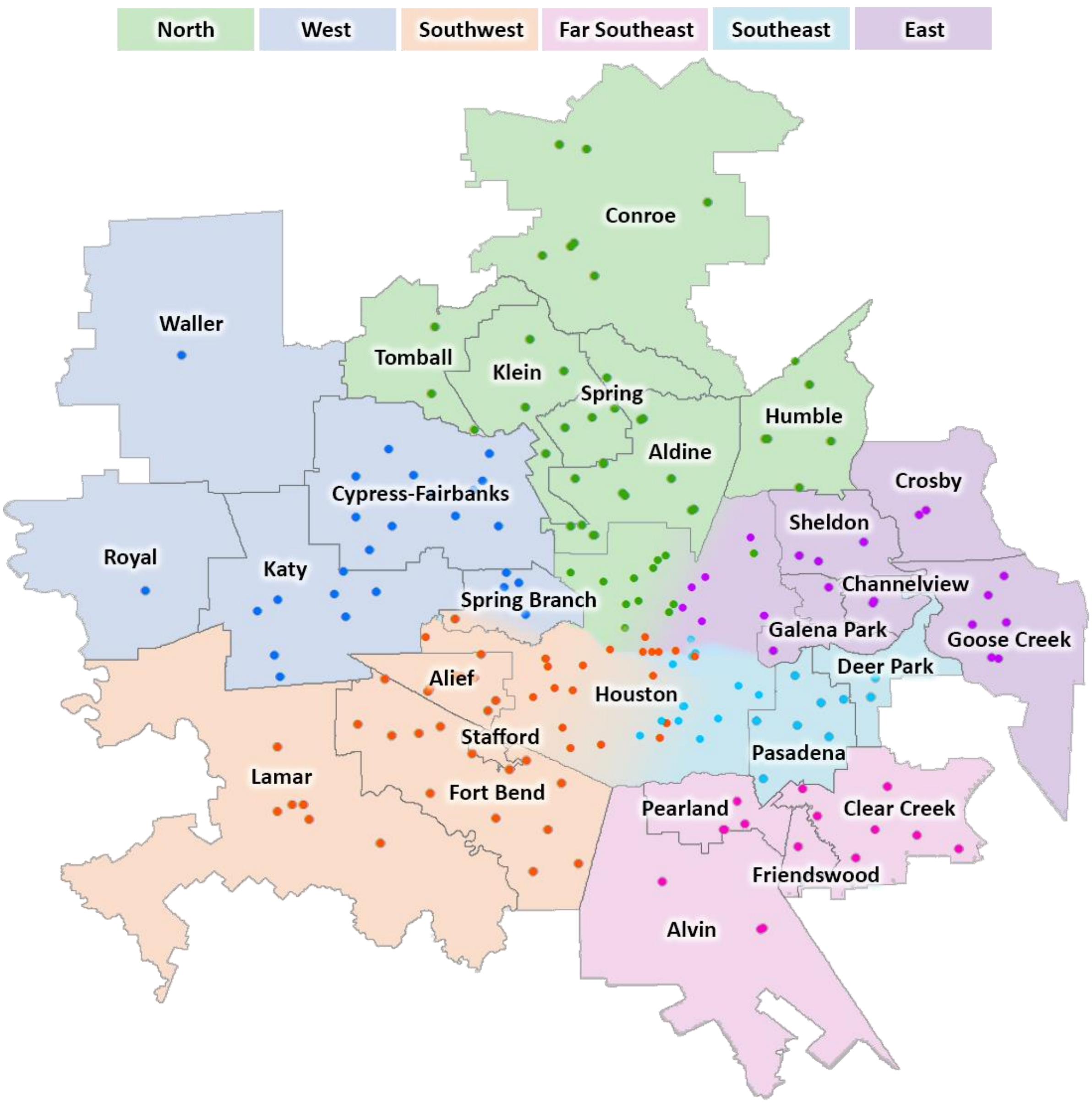
[3] Different resolutions (below and above 1) had been tested as well. Lower resolution gets more communities (smaller ones) and higher resolution gets fewer communities (bigger ones).

Appendix B. Middle School Student Mobility Networks

The mobility analysis for middle schools in the Greater Houston area consisted of 264 campuses and identified six mobility networks. The mobility networks were geographically clustered. Between 64% and 72% of mobility that started from a middle school ended at another middle school in the same mobility network.

Appendix C. High School Student Mobility Networks

The mobility analysis for high schools in the Greater Houston area consisted of 188 campuses, and identified six mobility networks. The mobility networks were also geographically clustered. Between 64% and 72% of mobility that started from a high school ended at another high school in the same mobility network.



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About HERC. Focusing on the most pressing challenges facing the region, the Houston Education Research Consortium (HERC) is a research-practice partnership between Rice University and 11 Houston-area school districts. HERC aims to improve the connection between education research and decision making for the purpose of equalizing outcomes by race, ethnicity, economic status, and other factors associated with inequitable educational opportunities.

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