The Provision of Information and Incentives in School Assignment Mechanisms*

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Abstract

Research on centralized school assignment mechanisms often focuses on whether parents who participate in specific mechanisms are likely to truthfully report their preferences or engage in various costly strategic behaviors. However, a growing literature suggests that parents make not know enough about the school options available to them to form preference rankings. We develop a simple model that explains why it is not surprising that many participants in school assignment mechanisms possess limited information about the schools available to them. We then discuss policies that could improve both the information that participants bring to school assignment mechanisms and the quality of the schools in their choice sets.

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Introduction

For roughly a quarter of a century, economists have been publishing papers on centralized school assignment mechanisms. Much of this work has focused on the technical properties of competing mechanisms. Some mechanisms are strategy proof. If a mechanism is strategy proof, students find it optimal to report their true preference rankings over possible schools. Some mechanisms avoid justified envy. If a given mechanism produces school assignments that eliminate justified envy, then when any student assigned to school A prefers school B, the stated priorities of school B give this student weakly lower priority in school B than all students the mechanism assigned to school B. Some mechanisms are Pareto efficient with regard to student preferences. Efficient mechanisms produce assignments of students to schools such that there is no way to swap assignments among students and make some students better off while harming no students.[1]

Many education policy makers would gladly implement an efficient, strategy-proof mechanism that eliminates justified envy, but Abdulkadiroğlu et al. (2009) stress that no single mechanism can satisfy all three criteria. Thus, a portion of the assignment literature explores welfare comparisons among mechanisms that possess different properties. For example, some papers compare Deferred Acceptance (DA) to Top Trading Cycles (TTC). Both are strategy proof, but DA avoids justified envy while TTC produces assignments that are efficient with respect to student preferences. An even larger set of papers compares DA to a system know as the Boston mechanism (BOS). BOS is not strategy proof, and because it induces strategic play, it produces allocations that are not efficient with respect to student preferences. Further, it does not avoid justified envy. However, while both DA and TTC induce students to truthfully report how they rank different schools, the strategic play that BOS invites provides a channel for students to communicate the intensity of their preferences. As a result, one can create examples in which the set of assignments that BOS generates compares favorably to the assignments produced by DA.[2]

Pathak (2016) departs from much of the literature. Based on his experience as an advisor to numerous US school districts that have implemented various centralized mechanisms as well as documented accounts of similar efforts in other countries, Pathak concludes that

> *Transparency is paramount... While hard to formalize, the idea that a mechanism is transparent and simple to understand plays as important a role in choosing mechanisms as the algorithmic properties of the mechanisms.*

In large measure, Pathak's call for transparency is a plea to establish common knowledge that, ex ante, families need only report their true preferences to the mechanism, and that ex post, families should expect to receive a single, final assignment that does not create justified envy or raise concerns that the mechanism ignores the stated priorities of the school system in order to favor some families over others. Mechanisms that invite strategic behavior or involve chaotic after markets impose costs on families and may erode trust. Further, Pathak and Sönmez (2008) note that because resource-rich families may enjoy competitive advantages when interacting with mechanisms that involve strategic play or complicated after-market procedures, transparency likely promotes equity.

Pathak (2016) also discusses how transparent assignment systems built around DA may be useful tools for promoting competition among all schools that receive public funds, in part, because these

[1] See Pathak (2016), Agarwal and Somaini (2020*a*) and Ergin and Sönmez (2006).

[2] For example, imagine a setting where every student participating in a centralized mechanism has an outside option that involves paying tuition to attend a private school. For any allocation produced by the mechanism, we can define the compensating variation, CV, associated with each assignment as the maximum amount that each student would pay to keep his assigned school rather than leave the system and attend her outside option. The sum of the CV associated with each assignment produced by a mechanism is a measure of the welfare generated by the mechanism. Given this welfare measure, it is straightforward to create examples such that BOS beats DA. See Calsamiglia et al. (2020), Abdulkadiroğlu et al. (2011), and Kapor et al. (2020).

systems generate useful information concerning how parents view the performance of different schools. Neal (2018) proposes a school choice system that illustrates this point. Imagine a system that funds authorized schools using a common funding formula. These schools may be traditional public schools, charter schools, or private schools, but they are all authorized in the sense that the public education authority deems them eligible to receive public funds. In the spring of each year, the school system would require each authorized school to post information about their school in an online portal maintained by the education authority. The information could include the educational philosophy of the school, testimonials from former students, schedules of student fees, descriptions of available transportation services, etc. On the information page for each school, the education authority would add academic performance metrics that describe academic outcomes for each school's recent students. During the month of May, each authorized school would hold open houses that give interested families an opportunity to visit the school and speak with faculty and staff. In June, each school would submit a seating capacity and a formula that determines priority rankings among students who apply to the school. In July, each student would either inform the education authority that she plans to remain in her current school or submit a rank-ordered list of N schools that she prefers to her current school. At the end of July, the education authority would assign students using DA, and then assigns funds to schools based on their enrollments. As we discuss more in section 3, Neal also notes that the following spring, the education authority could award performance bonuses to participating schools based on various measures of school performance, and the authority could also make decisions about whether, based on their entire performance history, particular schools remain eligible to receive public funds.

Such a choice system clearly promotes competition among schools. Yet, both Pathak (2016) and Neal (2018) note that this type of school choice system also generates valuable information for education authorities. Consider the following scenario. School A is a K-5 school in a neighborhood that contains 500 kids ages 5-10, and there are no other elementary schools in the neighborhood. While reviewing the data submitted to the mechanism this summer, the education authority learns that only five students ranked school A among their top three choices. The education authority should investigate school A closely before renewing its authorization. Further, as we discuss in section 4, it may be possible to use this information when determining performance bonuses for each school.

Yet, before we explore how education authorities should employ various information about schools and their performance, we dig deeper into a different information concern that has recently received considerable attention. To date, the starting place for the analysis of most centralized assignment mechanisms has been the assumption that families can rank N different schools, where N is either the total number of schools available to a given student or the total number of available schools that dominate the student's outside option. However, results from several recent papers raise concerns about the information families possess as well as their willingness to acquire information about schools.

In the next section, we review several papers in the recent literature on how parents choose schools for their children. We pay close attention to papers that employ data from centralized assignment mechanisms and highlight papers that study how families respond when education officials provide families with new information about schools or about how school assignment mechanisms work. We then develop a simple model that explains why many parents who participate in centralized assignment mechanisms may be *rationally uninformed*, and we also discuss possible connections between Pathak's claim that *transparency is paramount* in the design of school assignment mechanisms and Wilson (1985)'s conjecture that some trading systems survive as stable institutions because participants find that making bids and offers that reflect their true valuations is an approximately optimal strategy and that outcomes are efficient when participants bid their valuations. We close by discussing challenges faced by an education authority that must decide what information to provide to parents and what performance metrics should inform accountability systems, e.g. rules concerning the accreditation of schools or the allocation of performance bonuses to high-performing schools.

1 Parents and Information

Systems that give parents more control over where their children attend school also often allow them to influence the level of public funding that specific schools receive. As a result, researchers and policy makers are keen to understand how parents choose schools for their children given different choice mechanisms. The literature on how parents choose schools largely addresses two questions: what do parents prefer, and what do parents know? Parents often make choices that reveal they place little or no weight on certain school attributes, but researchers find it difficult to discern whether parents do not value these attributes or simply posses no information about them. However, if choices reveal that parents place considerable weight on a particular school characteristic, it is often reasonable to conjecture that parents not only care about this characteristic but also understand it. We begin by reviewing results concerning one such school attribute.

Numerous studies find that, all else equal, parents want their children to attend schools that are closer to their homes. While no one should be shocked that parents would rather avoid having their kids spend extra time commuting to school, the strength of the evidence that travel distance matters for family preferences over potential school options is noteworthy. In fact, Agarwal and Somaini (2020*b*) note that the standard choice model in this literature employs quasi-linear preferences that express how parents compare two schooling options in terms of the additional distance a family would be willing to travel to secure the more preferred school.

In recent work on the New York City (NYC) high school assignment mechanism, Coraradini and Idoux (2023) also report that parents care about the racial composition of the schools their children attend. All else equal, parents rank schools higher if that have higher fractions of students who share their race or ethnicity. This result is also less than shocking. However, Coraradini and Idoux (2023) also conclude that self-sorting on racial preferences contributes to academic inequality since schools with large fractions of Black and Hispanic students tend to be less effective in terms of value-added performance measures.

Abdulkadiroğlu et al. (2020) examine the preference rankings that parents submit to the DA mechanism that assigns students to NYC high schools. They find that parents prefer schools that have historically enrolled high-achieving students, and these schools are more likely to excel at raising student test scores in the future and promoting future educational attainment. However, the authors find no evidence that, conditional on the quality of peers in a school, parents rank schools at the margin based on how effective schools are at promoting future achievement or attainment. Once again, there are multiple ways to interpret these results. It is possible that parents in NYC have considerable information about the levels of historical achievement at various high schools but lack precise information about the effectiveness of various schools in producing various short or long-run outcomes.[3]

A number of papers document scenarios where parents choose schools that are not effective in promoting achievement growth. Abdulkadiroğlu et al. (2018) study parents who participated in the Louisiana Scholarship Program (LSP), a voucher program that targeted economically disadvantaged families enrolled in under-performing public schools. These parents used vouchers to find private schools for their children, and they reported high levels of satisfaction with these new schools. However, these voucher schools were not effective in fostering achievement growth, especially in math. Attending

[3] During part of the sample period, the NYC schools provide parents with no measures of effectiveness. Further, the system never provided parents with the granular measures of school performance that Abdulkadiroğlu et al. (2020) create. Hastings and Weinstein (2008) conducted an experiment in Charlotte, NC. where they randomly assigned information on the average test score performance of students by school. They found that treated parents were more likely to select higher-scoring schools as preferred schools for their children.

LSP voucher schools reduced math achievement by roughly .4 standard deviations. LSP did not provide voucher parents with value-added performance measures by school before parents selected LSP schools for their children, so parents may not have realized that the schools they chose were harming their kids academically. Or, parents may have been willing to accept lower achievement growth to find schools where they felt their children were safer and happier.

Abdulkadiroğlu et al. (2018) also note that the design of LSP likely contributed to these negative outcomes. Low funding levels combined with significant administrative burdens attracted many private schools with declining enrollment, and the LSP accountability practices did not screen schools on value-added or some other metric of achievement growth. While the LSP system did give new schooling options to disadvantaged students enrolled in failing public schools, the architects of LSP did not design the system to guarantee that these new options would be effective schools. Rather, they designed LSP to make sure that these new options would be cheap, and it appears they got what they paid for.[4] We return to this topic in section 4. Yet, for now we note that design choices greatly influence the degree to which systems that expand parental choice generate reductions or increases in the inequality of academic outcomes.

Walters (2017) studies charter schools in Boston, MA. Many charter schools in Boston follow the No Excuses Model, which has a strong record of improving student achievement in disadvantaged urban areas.[5] Walters models application decisions, attendance decisions conditional on admission lottery outcomes, and the academic impacts of charter school attendance. He concludes that disadvantaged public school families who choose not to apply to any charter school would likely gain more academically from charter attendance than the students who do apply to charters and matriculate. Walters cannot rule out the possibility that disadvantaged parents who choose not to apply to urban charters are simply less motivated to secure better schools for their children, but he notes that disadvantaged families may fail to apply to these schools simply because they do not know that these charters are much more effective than local public schools.

Overall, there is little evidence that parents are able to figure out on their own which schools excel at promoting achievement growth or future education attainment. However, the results in Beuermann et al. (2023) are an exception. Beuermann et al. (2023) examine data on parental preference orderings and school performance in Trinidad and Tobago. Trinidad and Tobago employ serial dictatorship, a special case of DA where all schools have the same priorities, to assign students leaving elementary school to secondary schools. The authors find that secondary schools here differ substantially in their impacts on achievement growth and future outcomes such as arrests, teen births, secondary school graduation, and future labor market participation. Further, they find evidence that many parents care about many of these dimensions of school performance when forming preference orderings over potential schools.[6] Compared to other collections of parents that researchers have studied, parents in Trinidad and Tobego appear to have a much better understanding of the relative effectiveness of different schools on different dimensions. Future work is needed to understand why this is so.

Parental Responses to Better Information

One possible explanation for the patterns we observe in the literature on parental preferences over schools is that most parents desire schools that generate positive causal impacts on achievement

[4]In section 4 of chapter 5, Neal (2018) notes that the results in Table 11 of Abdulkadiroğlu et al. (2018), which reports estimates of LSP effectiveness by the tuition level of LSP schools, shows that among students who attend LSP schools that charge tuition equal to at least 75 percent of public school funding per student, achievement did not decline and may have risen slightly. However, the average LSP school tuition was only 57 percent of per-pupil spending in public schools, and many LSP schools spent less than half as much per student as public schools.

[5]See Angrist et al. (2013), Fryer (2014), and Dobbie and Fryer (2015).

[6]The parents of high-achieving students appear to place more weight on the academic performance of schools.

growth, attainment, and post-secondary outcomes but few are able to discern which schools are most effective. This conjecture is an obvious place to start since most centralized choice mechanisms furnish parents with little information about school effectiveness.

Consistent with this conjecture, several studies find that parents respond when provided with additional information about the relative effectiveness of various schools. Ainsworth et al. (2023) examine parental preferences over high schools submitted to a serial dictatorship mechanisms that Romania uses to assign students to high schools. They run an information experiment that provides parents with value-added estimates of high school effectiveness and find that the children of treated parents end up in schools with value-added scores that are, on average, .2 standard deviations higher. The authors also conclude that parents care about school attributes other than value-added, but the size of the response that Ainsworth et al. (2023) document is consistent with the hypothesis that many parents would rank high value-added schools more favorably if they possessed better information about the relative effectiveness of different schools.

Corradini (2023) finds that the introduction of school report cards changed the way parents ranked high schools in NYC. The letter grades assigned to high schools served as coarse measures of school effectiveness. This change shifted parental preferences toward schools that promote achievement growth, and this shift was more prominent among Black and Hispanics students. Corradini (2023) concludes that these differential responses contributed to a narrowing of racial achievement gaps. These results, like many we have already discussed, support the ideas that parents have imperfect information about school effectiveness, and this lack of information may be particularly acute among disadvantaged parents.

Campos (2023) describes a similar information experiment in Los Angeles, CA. Students who live in Zones of Choice (ZOC) neighborhoods in Los Angeles participate in a centralized mechanism that assigns students to high schools. Campos (2023) treated randomly selected parents with information about both the historical achievement levels of entering students and rates of achievement growth for each high school in the ZOC. Campos (2023) concludes that treated parents are more willing to incur travel costs for placement in a school with higher achievement growth, but he also reports that this effect is driven by treated parents in middle schools with a high-fraction of treated parents. He also argues that much of the treatment impact he observes arises not because the treatment makes parents better informed but rather because the treatment makes achievement growth more salient for parents. However, this conclusion rests on strong modelling assumptions, and this pattern may not be present in other settings. The ZOC system is quite small, and even parents in the control group, who receive no information, appear to place more weight on expected achievement growth than expected peer achievement levels when ranking schools.[7]

As a whole, the literature we review here suggests that many parents who submit ordered rankings of schools to centralized assignment mechanisms do not possess detailed knowledge of the attributes of the schools in their choice set. However, a recent paper from Chile suggests that many parents do not even know what schools are in their choice set. Chile uses a centralized DA mechanism to assign all students who attend schools that receive public funds, whether the schools are public or private. The mechanism allows students to rank as many schools as they desire, and Chile allows students to interact with the centralized choice platform for roughly one month before they submit their final list of schools. Further, the platform provides easy access to information about the locations of schools, their enrollments, their governance, curricula, fees, and other basic information. Nonetheless, Arteaga et al. (2022) show that the average student submits only three schools to the platform. Further, 30 percent of

[7] Cohodes et al. (2022) report the results of a series of experiments that provided information to the parents of middle school students about the graduation rates in different high schools. All three interventions reduced enrollment in high schools with low graduation rates.

students submit preferences to the mechanism that imply at least a 30 percent probability that they will receive no placement, and a non-trivial number of students face non-placement risks of more than 50 percent.[8]

Arteaga et al. (2022) conduct several information experiments. They find that a significant portion of students who initially submit risky lists will re-enter the mechanisms and add one or more schools to the list if warned of the risk and encouraged to act. However, far more than half who receive warnings do not change their lists. Arteaga et al. (2022) also conduct a detailed survey of parents who enter the mechanism, and they use the results of the survey to form hypotheses concerning why many initial lists are so short and why a significant fraction of those who receive warnings do not add schools to their list. Arteaga et al. (2022) present compelling evidence that many families overestimate their placement chances, but in our view, the most important survey results involve levels of parental knowledge about schools and their perceived costs of search. When asked about a randomly chosen nearby school, only 17 percent reported that they knew the school well. When asked why they did not add more schools to their list, 30 percent respond that there are no more schools around, even though this is typically not true. Finally, when asked about the steps required to know a school, many parents provided a long and costly list of actions including in-person visits and interviews with school staff.

The fact that many parents who initially submit risky lists respond to warnings by adding schools is consistent with Arteaga et al. (2022)'s claim that many parents do not understand the system that well and are overly optimistic about their placement chances,[9] but we see the overall reluctance to list more schools as equally important. Chilean families believe that participating in the assignment mechanism is quite costly, and most models of school assignment ignore these costs.

In the next section, we present a simple model that fleshes the consequences of these costs, but before turning to our model, we note that the results in Arteaga et al. (2022) are not unique to Chile. There are over 500 high schools in NYC, and the city provides a dense network of public transit options. Nonetheless, according to Abdulkadiroğlu et al. (2017), the behavior of participants in the NYC high school assignment system is similar to the behavior Arteaga et al. (2022) document in Chile. In NYC, students may list 12 schools, but only 20.3 percent use all 12 slots, and almost 40 percent list six or less. Further, over 17 percent receive no placement in the main round. In the next section, we highlight reasons that these outcomes may be expected. We then discusses potential policy responses.

2 A Simple Model

Arteaga et al. (2022) report survey evidence consistent with the claim that many families find search for schools quite costly, and many families give weight to the real possibility that, even if they search and find a great school for their child, there is no guarantee that their child will receive a placement in that school. For any given family, costs of search, beliefs about the likelihood of receiving an assignment, and beliefs about the difference between the expected quality of the school assignment that results from adding one more school to its ranked list and the expected quality of an assignment secured in the after-market processes should all impact the decision to investigate more schools and submit a longer list of school choices.

Here, we present a simple model that highlights these considerations. The model is highly stylized.

[8] Some of these students are enrolled in a school within the system and have the right to return to their current school if they do not receive a new placement. However, even among new students or students who must find a new school because they are matriculating to a new schooling level, many accept significant risks of receiving no assignment in the first round.

[9] Kapor et al. (2020) and Ajayi et al. (2020) describe environments where parents who are submitting lists to mechanisms that invite strategic play are often poorly informed concerning strategies that work well.

S1 a * * * b * c * * * d S2

Figure 1: 13 Locations, 4 Students, 2 Schools

However, Appendix section 6 demonstrates that our key results remain in a setting that does not involve the exact parametric assumptions we employ in the simple examples we work through here. Figure 1 describes the environment. There are two schools, indexed by $j \in \{1, 2\}$, at then ends of a line. There are four students indexed by $i \in \{a, b, c, d\}$. For a student i and a school j, $d(i, j)$ is the distance i needs to travel to attend j. For example, $d(b, 2) = 7$. Each school j has a quality $\theta_j \in \{0, 5\}$. These qualities are drawn independently and each value is equally likely. Both students learn the quality of the school closest to them at the beginning of the game. Students can pay a cost of 0.5 to learn the quality of the school that is farther away. Students also decide how to report to the centralized DA mechanism as a function of what they learn. They can submit a full ranking, list only one school or choose not submit a preference at all. Students who are closer to a given school have higher priority in the school. Students who are not assigned by the DA mechanism are administratively assigned to the nearest school with empty seats.

A student i assigned to school j gets a payoff of

$$u_i(j) = \theta_j - .5d(i, j) - m_i$$

where m_i is one if they chose to learn the quality of the other school and zero if not.

Students strategies are as follows. Each student decides whether to search as a function of the value of the local school. They also simultaneously choose a plan for how to submit preferences to the centralized match given the information they learn. This results in a Bayesian game between the agents. We search for pure strategy Bayes-Nash equilibria.

First, we note that there is no equilibrium with search in this game. To see why, imagine that an equilibrium with search could be found. Clearly, this equilibrium will not involve search in the state where the quality of both schools is high. In this case, all students want to attend their local school where they enjoy priority. Thus, an equilibrium with search must involve a student i who chooses to search when the quality of her local school is low. However, this search cannot prove beneficial unless her non-local school is high quality, and in this case, students who have priority at this school can and will adopt strategies that exhaust the capacity of their school. As a result, student i can never benefit from search when she observes that her local school is low quality.

Furthermore, there is a Bayes-Nash equilibrium of this game in which all players follow the same strategy: if a student observes that her local school quality is high, she does not search and submits a preference list to the mechanism that contains only her local school, but if she observes that her local school quality is low, she not only chooses not to search, but in addition, does not bother to submit a list to the mechanism. To understand why this is an equilibrium, we start by assuming that c, d, and a play this strategy and show that the strategy is a best response for b. In our setting, suppose b could search for free and observe the quality of both schools before submitting her preferences to the mechanism. Here, even in the state where she observes $\theta_1 = 0$ and $\theta_2 = 5$, she would gain nothing from listing school 2 first since school 2 is always filled with local students, c and d, when $\theta_2 = 5$. Thus, choosing not to pay for costly search is always optimal for b. Choosing not to search is always optimal for a regardless of the strategies that others play since any potential gain from an improved school match would be less than the extra travel cost required to access school 2, i.e. $11 * .5 = 5.5$. Further, students a and b lose nothing from refusing to submit a list when they observe that their local school is low quality. In this state, c and d will never want to attend $S1$, and a and b will be assigned to $S1$ whether they list it or not, since administrative assignments place students in the nearest school with empty seats.[10]

Horizontal Differentiation

So far, we have only modeled vertical differentiation in school quality. Here we consider the opposite case where all match qualities are idiosyncratic. Let $\theta_{i,j}$ denote the value of the match between student i and school j. For every i and j, $\theta_{i,j}$ takes values in $\{0, 5\}$. These draws are independent and each value is equally likely. Now, the strategic considerations are more interesting. It remains true that a and d still refuse to invest in search, since the extra travel costs associated with attending a non-local school exceed any possible gain in match quality. However, we need to do more work to find equilibrium strategies for b and c. Suppose b and c adopt the following strategy. As before, if the local school match quality is high, do not search and submit only the local school to the mechanism. If the local school match quality is low, search. If the match with the non-local school is high, list the non-local school first and the local school second. If it is low, again submit a list with only the local school. Here, if b searches when $\theta_{b,1} = 0$, there is a one-half chance that $\theta_{b,2} = 5$ and there is a one-fourth chance that both $\theta_{c,2} = 0$ and $\theta_{c,1} = 5$. This means that there is a .125 probability that she will gain 5 in match quality for an extra travel cost of 1, and therefore the expected gain from search is $.125 * 4 = .5$ which is exactly the cost of search. Since a symmetric argument holds for c, we have found an equilibrium involving search. However, if we increase the cost of search slightly, e.g. to .51, no equilibrium of the game involves search.

Next, set the cost of search to .51, but imagine that, in addition, we move c one unit to the left so that $d(c, 1) = d(c, 2) = 6$.[11] The no-search equilibrium remains the only equilibrium because the private returns from search are negative for b, even if c were to search when $\theta_{c,2} = 0$. However, this equilibrium is inefficient. A planner who maximizes the sum of utilities would prefer both b and c to search when they observe low match quality with their local schools. With these strategies, the expected search costs are the following: with probability one fourth both b and c will search. With probability one half, only one will search. So the expected costs from search are $.25 * 1.02 + .5 * .51 = .51$. The gains from search occur when both search and trade assignments as a result. This outcome occurs with probability one sixteenth. So, the expected gains from search are $\frac{(5-1)+(5)}{16} = \frac{9}{16} > .51$.

This result is not simply a knife-edge case given our choice of parameters. It is possible to create many examples with asymmetric returns from search where the private equilibrium involves inefficiently low levels of search. Since centralized assignment mechanisms do not allow transfers among participants, this result may not be surprising. In Appendix 6 we analyze a similar environment with two symmetric students and two schools. Once again, each student directly observes how she matches with her local school, and as above, she may pay a cost to see how she matches with a non-local school. In many cases, the private equilibrium involves no search in states where the planner wants both students to search. This result reflects, in part, the fact a student who relinquishes a slot in her local school receives no compensation from the student who fills this open slot, even if the incoming student benefits greatly from the assignment.

Taken together, the examples above and the material in Appendix 6 illustrate several important

[10] In this example, it is not an equilibrium for all students to simply refuse to submit lists regardless of what they observe. If c and d play this strategy, then the best response for b is to pay the cost of search whenever she observes $\theta_1 = 0$ knowing that there is a one-half chance that she will learn that $\theta_2 = 5$ and pay an extra travel cost of 1 to gain five units of match quality. This $.5 * 4 = 2$ expected gain from search exceeds the search cost of .5. Students near good local schools list them to avoid losing them.

[11] Even though c is half way between the two schools, we still assume that c views school 2 as her local school since she has priority two in school 2 and priority three in school 1.

lessons. First, if school match qualities primarily reflect vertical differentiation, there are strategic reasons to expect that students will be reluctant to pay substantial search costs to learn about a school where they do not have high priority. They know that, even if they discover that this school is high quality and rank this school as their first choice, the mechanism is almost surely not going to assign them to this school, since students with high priority are likely to exhaust the capacity of a high-quality school. Second, horizontal variation in match quality creates more scenarios where students may find it optimal to pay search costs to learn about more schools and submit longer ranked lists to the mechanism, but there still exist combinations of search costs, priority rules, travel costs, and rules for administrative placement such that individual students rationally choose to forgo search, submit short lists, and accept non-trivial probabilities of administrative placement. Finally, in many settings, the planner can improve welfare by mandating or subsidizing search, but details matter. In our example above, the planner does not want to pay additional costs to subsidize search for a or d since information about other schools is not valuable to them. This reality suggests that, in many settings, interventions that lower search costs likely dominate interventions that seek to provide full-information at no cost to all students. While the levels of search present in decentralized equilibrium are likely too low, the social returns from efficient levels of search vary among students as a function of their preferences, their characteristics, and the priorities chosen by the education authority, and there is no reason to believe that a social planner would, in general, fully subsidize all search activities for all students.

Arteaga et al. (2022) conclude that some parents submit ranking lists that are too short because they over-estimate their placement chances, and this conclusion is likely correct. In any given year, many families who participate in the mechanism are participating for the first or second time. They have little past experience that would have allowed them to learn about placement probabilities through experimentation, and any one family would find it prohibitively expensive to acquire all the information that the Smart Platform uses to calculate the likelihoods that specific students will receive no assignment. However, other Arteaga et al. (2022) results are equally important. Many families know little about the schools that are available to them, and obtaining the information required to place an additional school in a ranked list is costly. Therefore, the logic of the model presented above, implies that some families knowingly accept a non-trivial risk of receiving no school assignment in the first round because the costs of search are greater than the expected gain in final school quality associated with ranking one additional school. These expected gains may be small because there is no guarantee that the quality of the next school that a family investigates will be greater than the quality they expect to receive from after-market mechanisms, and even if this investigation results in the family adding one more school to the ranking it submits, the family may still receive no school assignment from the mechanism. The costs of learning about one more school are roughly known. The gains are not, and the logic of the scenarios we describe above suggest that these uncertain gains may often be small in expected value.

In the next section, we discuss what information education authorities should provide for parents and how they should provide it. However, before turning to these details, we take a moment to discuss possible points of connection between Pathak (2016)'s focus on transparency and Wilson (1985)'s observations about trading rules that survive as equilibrium institutions.

More than Transparency

Wilson (1985) argues that some trading rules, e.g. the double auction, survive as institutions because they create an environment where participants believe that simply bidding their true valuations is an approximately optimal strategy, and further, when participants do bid their valuations, market outcomes exhaust potential gains from trade. Wilson does not offer a specific reason that an equilibrium would exist in which all agents ignore strategic considerations and simply bid their values, but when the number of participants is finite but large, and participants find it quite costly to acquire even imprecise estimates of the distribution of valuations among other participants, it is seems reasonable to conjecture that each participant would find that the best response in a market when other participants are bidding their values is to simply bid one's own value.

As a result, we see overlap between Wilson's conjecture and Pathak's emphasis on transparency. Pathak argues that school assignment mechanisms are more likely to survive as institutions if families believe that there is no gain from engaging in strategic behavior. Gaming activities likely amplify inequality and may produce inefficient outcomes that create justified envy. On the other hand, any education authority that convinces all families to truthfully report a complete ranking of schools to a DA mechanism eliminates the resource costs associated with strategic play and produces the student optimal-match among the set of assignments that avoid justified envy.

Nonetheless, there is an important difference between the problems that Pathak and Wilson consider. No one is required to bid in any particular auction, and the participants in most auctions are a highly select sample of individuals. When the US Treasury holds a T-bill auction, almost all bidders have participated in many similar auctions, and for most bidders, a key task in their day-jobs is the creation of estimates of their valuations for different securities. Wilson is arguing that certain trading rules that minimize gains from strategic behavior survive as institutions because they produce efficient outcomes when all participants simply bid their valuations, and this conjecture is compelling, in part, because it seems reasonable to assume that all participants in these markets know their valuations. Pathak is to correct to highlight the value of convincing parents to report their true rankings over schools, but the papers reviewed in section 1 suggest that many parents cannot provide a meaningful ranking over a substantial number of schools because they just do not know enough about the schools available to them. A given parent who is not wealthy enough to afford private schools that refuse public funding may be forced to choose between incurring a significant risk of administrative placement or paying substantial search costs with no guarantee that information acquired through search will allow her to secure better ex post school quality for her child.

Traders in markets know their valuations or know a great deal about them because they trade frequently. Families interact with these school assignment mechanisms a few times in their whole life. So, they have little information, and the model above suggests that they may be reluctant to pay huge costs to acquire it. This observation suggests that education authorities that design and operate centralized assignment mechanisms must also create mechanisms that share information about schools with families. Next, we consider what information they should provide and how they should provide it.

3 Providing Information

We argue that researchers who work on the design of centralized assignment mechanisms should also move beyond the design of the algorithms that produce assignments and explore the design of systems that provide information to parents before parents are asked to submit rankings. Here, we discuss topics that are likely central to this research agenda, and we offer some conjectures about several features of optimal information provision.

Ordinal Information

Education authorities are able to provide considerable information about schools that parents value and comprehend. Most education authorities that design school information portals for parents can easily provide school locations, enrollments, average class sizes, historical average test scores, graduation rates, etc. Further, they can easily allow individual schools to add information about the education practices and philosophies that guide each school.

However, measures of achievement growth and many other metrics of school performance that education researchers create may be difficult for non-researchers to interpret. For example, value-added performance measures are standardized averages of deviations from statistical benchmarks. Since many students and parents may find it hard to understand what is means for school A to earn a value-added score of .05 in reading while school B earns a score of .03, it may be more useful to report that school A ranks 35th in reading value added while school B ranks 40th in reading value-added. We return to this topic in section 4 when we discuss the provision of incentives, but for now we note that whenever researchers use complex statistical methods to create performance metrics, education authorities that place a premium on transparency may choose not to report the metrics directly but instead report the ordinal performance rankings implied by these metrics.

Along these same lines, an education authority that creates multiple performance metrics for schools, e.g. reading growth, math growth, standardized measures of graduation rates, etc. may choose to report separate rankings of schools on each dimension of performance and abstain from creating or producing a single ranking of overall school quality. The NYC public schools and many other education authorities have, at different times, produced school report cards that contain rankings of schools based on some metric of overall quality, and some parents may value these reports. However, these composite rankings raise transparency concerns. Any attempt to create a one-dimensional ranking of school quality requires those involved to make numerous choices about how to scale and weight the various performance metrics used to create an overall measure of quality. As a result, an education authority that reports overall rankings of school quality may find it difficult to explain to parents what these rankings mean.

Finally, while value-added measures of school performance are ubiquitous in education research and policy discussions, reports of these measures or rankings of schools based on these measures may raise important conceptual questions for some parents. Consider two high schools, school A is an elite exam school that places high priority on math and science scores when ranking prospective students. School B is a neighborhood high school in an extremely disadvantaged area that serves mostly kids who tested far below grade level in math during middle school. Now, suppose that the local education authority reports that school B ranks higher than school A on math value-added between 10th and 8th grade. Informed parents may ask what it means to rank school B as a higher performer than school A given that the math faculty at the two schools were likely not doing the same job. The ninth and tenth grade faculty at school B were likely focused on remedial pre-algebra work, while their counterparts at school A were teaching advanced geometry, trigonometry, and even calculus. Since these two groups of educators were doing quite different jobs, does it makes sense to report to parents that one group performed better than the other? The hidden assumption behind the claim that school B performed better than school A is the decision by value-added researchers to treat units of scale scores as meaningful welfare measures. When researchers uses value-added models (VAM) to create performance metrics for educators, they are assuming that helping a student move from a score of 120 to a score of 130 requires the same skills and creates the same value for society as helping a student progress from 420 to 430. VAM advocates defend this approach by arguing that policy makers and parents demand universal school quality rankings, but it is not obvious that education authorities should provide answers to nonsensical questions. In our example above, the math faculty at school A is doing a different job than the math faculty at school B, and it therefore makes no sense to ask which faculty did a *better* job.

Barlevy and Neal (2012) propose an alternative performance metric that makes different performance growth comparisons among schools. Returning to our example above, suppose that the education authority is able to place each entering high school student in a math league based on the history of each student's past performance in math and the average performance of other students entering her school. Then, at the end of tenth grade, the authority can assign a percentile rank to each of these students within her own league based on her tenth-grade math score. These percentile ranks are invariant to any re-scaling of the tenth grade test scores that preserves ordering, and they have a natural interpretation. If Sue's within league percentile rank is .6, Sue scored better than sixty percent of students who began high school in her cohort with comparable records of elementary school math achievement and comparable peer-achievement levels. Further, Barlevy and Neal (2012) note that average within league percentile rank over all students in a given school is a Percentile Performance Index (PPI) that reports the average within-league winning percentage of students in that school. In our example, knowing that school A receives a math PPI of .7 and school B receives a math PPI of .8 tells us nothing about the relative performance of these schools because the students in these schools do not compete in the same leagues. However, if school C is another neighborhood high school that serves disadvantaged students, and school C receives a math PPI score of .5, we know that entering students in school B are, on average, earning higher within-league percentile scores in tenth grade than comparable students from school C.

If education authorities report PPI performance measures for schools as well as the baseline achievement levels and background characteristics of entering students, they can explain clearly to parents what PPI scores mean. In our example, a PPI score of .55 means that 10th-grade students in a given school perform better than fifty-five percent of students who entered high school with comparable expected math achievement and similar peers. Parents may find this type of information quite useful. The parents of a child who struggles in math should not care about the performance of elite exam schools when choosing a high school for their child. Parents should be most interested in comparisons among schools that serve many students who are comparable to their own children in terms of past achievement.

Hidden Action and Multitasking

In any environment where a school benefits when students rank it higher on their lists of submitted schools, the public provision of information on school quality creates multi-tasking concerns. The logic of Holmstrom and Milgrom (1991) warns that, once an education authority constructs any particular measure of school quality and then shares it publicly, schools will almost certainly search for low-cost ways to improve their measured school quality even if these strategies produce no real improvements or degrade true school quality.

Neal (2011) and Neal (2018) catalog several simple steps that education authorities may take to avoid some rather ubiquitous hidden action problems that arise when students take tests that create high-stakes for educators. To begin, education authorities should enlist third-parties to administer high-stakes assessments. Events during the No Child Left Behind (NCLB) era revealed that, in high-stakes settings, some educators are willing to give students answers, change students' answers, and engage in other forms of explicit cheating if given the opportunity. Education authorities should also avoid reporting proficiency rates for schools. Proficiency standards are quite manipulable, and there is considerable evidence that, during NCLB, many schools reported increases in the fractions of their students who score above the proficiency threshold in math or reading primarily because actors in state testing agencies made a series of scoring decisions over time that compromised proficiency standards. Using data from Chicago, IL, Neal and Schanzenbach (2010) also demonstrate that, when education authorities build accountability systems around proficiency standards, some educators respond by devoting less attention to students who are far below grade-level and therefore not able to become proficient in the near term.[12]

An additional set of multi-tasking concerns fall under the broad heading of *gaming the system.* Recent controversies concerning the influential US News and World Report (USNWR) rankings of colleges provide one example. Critics of these rankings have long complained that, because students pay close attention to these rankings, colleges and universities distort their educational practices to earn higher rankings. For example, Yale Law School recently refused to supply data to USNWR, in part, because their ranking system counts graduates as unemployed if they accept fellowships to work in public interest organization or enter PhD programs, regardless of how prestigious the fellowship or graduate program may be. Yale announced that it would rather not participate in the USNWR rankings than limit its support for students who desire a career in public interest work. Other prestigious law schools joined the boycott, and USNWR announced changes to their scoring system.[13]

USNWR has long known that law school and colleges manipulate their practices and reporting procedures to improve their USNWR rankings without improving and while possibly harming the quality of instruction they provide. Yet, the fact that USNWR has tolerated these behaviors while building a successful ranking service does not imply that public education officials should tolerate similar actions. Education authorities and USNWR are pursuing different goals. USNWR is trying to produce rankings that readers value. If their methods induce all or most schools to engage in the some wasteful gaming activities, the rankings USNWR produces ex post will still likely be highly correlated with the true rankings that readers desire. Thus, as long as the gaming costs are not so large that schools refuse to participate, USNWR cares little about the resources that schools waste trying to manipulate the metrics they submit to USNWR. However, an education authority cares not only about producing valid ranks, it also cares about the efficient use of public funds allocated for the education of children. If education authorities produce performance rankings using metrics that are manipulable, they invite schools to allocate public funds to wasteful gaming activities. Since these wasted resources could be allocated to productive instructional activities, an education authority that invites wasteful gaming may well harm learning outcomes.

Many of the most studied gaming behaviors fall under the headings of *coaching rather than teaching* or *teaching to the test*. We return to these behaviors in section 4, but first, we discuss information policies that have received much less attention from education researchers.

Face-to-Face Encounters

The results presented by Arteaga et al. (2022) indicate that many parents are not going to feel comfortable ranking a particular school if they have not had an opportunity to interview teachers and administrators from the school. Therefore, education authorities may entertain creating school fairs that allow parents to speak with teachers and administrators from many different schools in one place. For example, numerous researchers have studied various aspects of the high school assignment system in NYC, but school officials in NYC have likely not explored holding an annual high-school fair in a large hall in the Javits Center. Officials could invite each high school in the city to staff an information booth with current students, former students, faculty, and administrators who are prepared to answer questions about the school.

Many economists and policy makers may respond to this idea by noting that many high schools already hold open house events for prospective students, and some may even argue that, in a world where large school fairs are valuable to parents, we expect private actors to organize such events and

[12] Chapter 2.6 in Neal (2018) catalogues much of the sizeable literature on incentive alignment problems created by accountability and incentive programs for educators that involve high-stakes student assessments.

[13] Before implementing these changes, USNWR released a set of rankings that still ranked Yale Law first. See https://law.yale.edu/, 11/16/22, and https://www.forbes.com, 4/12/23.

charge admission to families seeking information about schools. Yet, two rejoinders are obvious. First, some schools may not participate in such school fairs unless they are compelled to do so. A public school that expects to be over-subscribed simply because it is located in an area with many children and few other schools may have little incentive to participate in such events. Second, the model we present above suggests that, in this setting, market mechanisms may fail to provide efficient levels of information for parents. When deciding whether to attend such a fair, family A does not consider the possibility that, if they discover a new school that works well for their child, they may open up a slot in their default school that turns out to be a great match for a different student.[14]

So far, we have discussed information interventions that may improve the value of the assignments produced by centralized assignment mechanisms holding the quantity and qualities of existing schools fixed. However, as we illustrate in our simple model above, the gains from centralized assignment are limited in settings where vertical quality differentiation is the primary source of school heterogeneity. Given numerous potential rules for assigning priorities, many parents may have little to gain from participating in a centralized assignment mechanism if there is an acute shortage of high-quality schools. Further, this may remain the case even if the school district provides parents with detailed information about all schools. In the next section, we therefore consider how education officials may embed accountability and incentive mechanisms within centralized assignment mechanisms. Successful assignment mechanisms must not only help parents make informed choices but also provide parents with options worth choosing.

4 Shaping the Supply of School Quality

The centralized school choice mechanism in Chile likely facilitates competition between public and private schools, and since funding levels for schools in both sectors are tied to enrollment, schools have incentives to compete in ways that increase parental satisfaction with schools. Further, providing parents with better information about schools may enhance the value created by this competition, but several of the papers we review above raise the possibility that information provision alone may not guarantee the outcomes that advocates of school choice systems expect.

Recall Abdulkadiroğlu et al. (2018)'s description of learning outcomes for students participating in the LSP voucher plan and Walters (2017)'s conclusions concerning the potential gains for students who never apply to charter schools in Boston. School choice mechanisms create incentives for schools to provide what parents demand, but both papers raise concerns about the decision rules that some parents use to choose schools for their children. As a result, policy makers cannot be certain that the competitive pressures generated by the introduction of centralized school choice will generate significant improvements in the distribution of academic quality among schools. Further, there is no guarantee that policy makers can design information platforms, school fairs, and other mechanisms that will induce all parents to acquire the information they need to make informed schooling choices for their children, and even in a hypothetical world where all parents knew everything about the academic performance of different schools, there is no guarantee that all parents would make school choice decision that serve their children well. Some parents may place inefficient weight on factors like convenience, the beauty of a school's campus, or the success of a school's sports teams.

For these reasons, education policy makers may find it helpful to create explicit incentive systems for educators that supplement the competitive pressures created by centralized mechanisms that provide information for parents and facilitate school choice. We have already discussed how PPI performance

[14] We learned from Dunia Fernandez of the Los Angeles Unified School District that ZOC program hosted this type of school fair prior to 2018. However, when faced with funding cuts, even this small program abandoned this approach. We know of no large centralized system that hosts an event that allows parents to speak with faculty and staff of all schools in their choice set.

measures provide useful information for parents and students. Barlevy and Neal (2012) describe a Pay for Percentile (PFP) incentive system that rewards schools based on their PPI scores. PFP works as follows: for each grade-subject combination, place each student in a league at the beginning of each year based on the student's past record of achievement and summary measures of the past achievement of her classmates. At the end of the year, calculate each student's winning percentages within her different leagues, and then calculate PPI scores at the school*grade*subject level. Finally, reward each school with a set of performance bonuses that are proportional to its vector of PPI scores. Barlevy and Neal (2012) characterize the bonus rates that induce teachers in all schools to allocate efficient effort to all tasks that promote achievement among students. If the education authority can correctly place students in leagues, PFP elicits efficient effort from educators under quite general conditions.[15]

PFP also allows an education authority to reward educators for improving measured student performance without creating incentives for educators to coach students on test-taking strategies that raise scores without improving student mastery of the tested subject. Neal (2013) explains how the test-development procedures that modern psychometricians use to create scale scores for results from different test forms in an assessment series necessarily make test items predictable in ways that make coaching rather teaching profitable. However, PPI scores require only ordinal information about the relative performance of different students on a given exam. Therefore, education authorities can implement PFP using a series of exams that do not repeat questions, follow predictable formats, or meet other development criteria used to create most modern test score scales, and in this scenario, the best response for educators would be to teach for mastery rather than coach students on test-taking strategies.[16]

We have already noted that parents do not possess perfect information about the schooling options available to them. However, parents do possess important information that policy makers may not. Parents know if their child is eager to go to school. Parents often know if their child feels safe in school. Parents observe whether their child is developing important social and emotional skills in school. Thus, the rankings that parents submit to centralized assignment mechanisms likely contain information that is valuable for education authorities. However, future research is needed to determine the optimal method for extracting performance information from these rankings.

Education authorities cannot use these rankings to create additional PPI scores. Even when choice is organized around mechanisms that induce parents to submit truthful rankings, most parents rank few schools. Thus, we cannot give each school a set of percentile scores that reveal how each student ranks the school relative to all other schools. Further, even if all parents ranked all schools truthfully, education officials would likely find it difficult to create desirable leagues that contain large numbers of schools. School location is a primary concern for parents, and most schools are not located within a short distance of a significant number of schools that serve the same grade levels. Thus, how would one create a league of schools that compete on a level playing field for a common set of students?

Nonetheless, education authorities can glean important information from the lists that parents submit to centralized assignment mechanisms. Each year in Chile, NYC, and other cities, some portion

[15] A number of researchers have tested PFP in field experiments. See Loyalka et al. (2019), Chang et al. (2020), Gilligan et al. (2022), Fryer Jr et al. (2022), and Mbiti et al. (2023). These experiments implemented several different variations on PFP. In each study, some version of PFP generated significant improvements in academic outcomes for a significant population of students. Forming leagues correctly would be an important challenge for any education authority that attempts to implement PFP on a large scale. One approach is to estimate the conditional distribution of year-end scores controlling for a rich set of controls that characterize each student's past achievement, the past achievement of their peers, the size of their class, student demographics, etc. Given this estimated distribution, each student's year-end score can be converted into a conditional percentile. https://voices.uchicago.edu/derekneal/ provides a User's Guide for an R package that computes PPI scores using this method. The package is available upon request.

[16] The A-level leaving exams in the UK are an example of high-stakes exams that have historically been created without the strict item-development requirements that make modern Item Response Theory (IRT) scales possible and coaching on test-taking strategies profitable. See Wheadon (2013).

of the students entering a centralized assignment mechanism are already attending a school in the system and could continue in the school during the next academic year. However, they are participating in the mechanism because they believe they may be served better by another school. Thus, education authorities can measure the fraction of students in each school who are searching for better options. Further, they can examine the lists submitted by these students and see how many of the listed schools would require parents to incur additional travel costs. More work is needed, but if education authorities observe that a high fraction of students in school A seek assignments in different schools and also observe that significant fractions accept new assignments that require additional travel costs, they likely need to investigate school A.

Shaping the Choice Set

Researchers should also turn their attention to the design of rules that determine the eligibility of schools to receive public funds through centralized mechanisms. Some advocates of school choice may note that centralized choice systems, e.g. the current system in Chile, allow parents to decide which schools receive public funds. Any school that does not receive sufficient demand through the assignment mechanism will not be able to cover the fixed costs of running a school and be forced to close. However, Gallego (2013) argues that, historically, local governments in Chile have subsidized municipal schools that face declining enrollment. He claims that, in 2002, voucher revenue accounted for only seventy percent of funding for public schools in Chile. Further, in the US, some school districts find it politically difficult to close low-performing public schools that have many empty classrooms.[17]

In competitive markets for consumer goods, firms may exit the market if only a portion of consumers understand that they are producing low-quality products. If a firm facing decline demand for its products finds that it can no longer cover its fixed costs, it can limit its losses by shutting down. However, failing public schools often possess political clout that insulates them from similar pressures.

In addition, we note above that parents who participate in the LSP voucher program expressed high levels of satisfaction with the voucher schools they selected for their children, even though many of these children experienced stunning learning losses as a result. It is possible that similar outcomes would not occur in systems that provided parents with better information about the academic performance of different schools, but we see no reason to assume that better information alone would produce sets of parental choices that would force the closure of all low-quality schools.[18]

These observations suggest that researchers working on the design of centralized choice systems should tackle the following questions: (i) how should education authorities evaluate the applications of organizations that wish to open a new school that receives public funds, and (ii) how should education authorities form decision rules that map the history of parental demand for a given school as well as the school's history of academic performance into a determination concerning the school's eligibility to continue receiving public funding?[19] These are challenging problems, and even if researchers discover the optimal rule for deeming schools eligible for public funding, policy makers may be unwilling or unable to adopt it. However, these questions are first order. The best centralized assignment systems cannot guarantee effective schooling for all children unless they are paired with mechanisms that shape the quality of the menu of schools available to students.

[17]See Fay (2017) for a description of the political backlash that followed the closing almost fifty Chicago schools that were grossly underutilized.

[18]Given the high-levels of parental satisfaction, we realize that these LSP schools were likely doing some things well. However, we contend that schools that reduce math achievement by .4 standard deviations in one year are likely low-quality schools.

[19]Neal (2018) notes that any school system that adopted a PFP scheme would also need to adopt procedures for reseeding competition among schools over time. The details required for dynamic implementation of PFP remain for future research, but the optimal dynamic system almost certainly involves a rule for deeming low-performing schools ineligible to receive public funds based on some summary measure of their historical performance.

5 Conclusion

Over the past quarter century, researchers have learned a great deal about the design of school assignment mechanisms and how different design choices impact student welfare. We agree with Pathak (2016)'s claim that centralized assignment systems are more likely to be effective and politically stable if they are transparent. Yet, we contend that recent research suggests that transparency is not enough. Education authorities must find better ways to provide parents with clear information about the schools in their choice set that is easy to process. We conjecture that better information provision will not only improve efficiency but also equity since several studies have shown that advantaged parents often possess superior information about the schools available to them and how assignment systems work.[20]

Researchers must also tackle the task of designing mechanisms that shape the menu of schools offered to students. For example, it may be possible to improve the quality of schools offered to students in historically disadvantaged communities by combining school choice, centralized assignment, and a PFP scheme that offers exceptionally high bonus rates to schools that operate in disadvantaged communities. In contrast, public school leaders in Chicago are now considering proposals to restrict school choice. Advocates of these proposals argue that the centralized assignment mechanisms that allow students from across the city to apply to charter schools, magnet schools, and selective admissions schools harm neighborhood schools, especially schools in historically disadvantaged areas that may see the best students in their neighborhoods enroll elsewhere in the city.[21] However, to date, these reform proposals contain no mechanisms that provide additional performance-based rewards for educators who operate excellent schools in disadvantaged areas or new sanctions for educators who fail to serve disadvantaged students well, and any reforms that places new restrictions on school choice may limit the capacity of parents to register their dissatisfaction with failing neighborhood schools.

Critics of the current school choice system in Chicago correctly note that high-quality schools remain in short supply, especially in the historically disadvantaged areas of the city. However, limiting choice makes it more difficult for families to find schools that match the interests and needs of their children while doing nothing directly to improve the supply of high-quality schools. Well-designed systems that combine centralized school choice with mechanisms that offer additional rewards for educators who expand the supply of high-quality schools may prove a valuable option for Chicago and other cities. Further, cities that operate centralized choice systems while failing to provide detailed school quality information for parents or clear performance incentives for educators should expect to face political pressure to limit choice or dismantle these systems altogether.

[20] See Pathak and Sönmez (2008) and Coraradini and Idoux (2023).

[21] See https://www.chalkbeat.org/chicago/2023/12/12/chicago-public-schools-moves-away-from-school-choice/

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6 Theory Appendix

6.1 Model

There are two students a and b and two schools 1 and 2. Each school has capacity 1. At the beginning of the game, student i's value for school x denoted θ_{ix} is drawn i.i.d from the uniform distribution on $[0, 1]$. Students are matched to schools using the deferred acceptance algorithm. School 1 prioritizes student a over student b while school 2 prioritizes student b over student a. We refer to school 1 and 2 as the "local school" for students a and b respectively. Each student learns without cost their value from the local school but can only learn their value from the other school at cost $c \geq 0$. We assume that students only rank schools for which they know their value and that, when they know both values, they rank schools truthfully. Pure strategies are measurable maps $\sigma_i : [0, 1] \to \{0, 1\}$ which indicate whether or not an agent decides to learn when the value from the local school is $v \in [0, 1]$. We look for symmetric pure strategy Bayes-Nash equilibria.

Lemma 1. *In any symmetric equilibrium, there is a value v for which a learns when $\theta_{a1} \leq v$ and b learns when $\theta_{b2} \leq v$.*

Proof. We prove this for student a since the analogous result for student b is entirely symmetric. Suppose that student b learns when θ_{b2} is contained in a (Borel) set A. Let

$$A' = \{(\theta_{b2}, \theta_{b1}) : \theta_{b2} \in A \text{ and } \theta_{b1} > \theta_{b2}\}.$$

The marginal payoff for agent a from learning θ_{a2} when $\theta_{a1} = x$ is given by

$$m(A') \int_x^1 (\theta_{a2} - x) \, d\theta_{a2} - c.$$

where m is the Lebesgue measure on $\mathbb{R}^2$. Note that $m(A')$ is the probability that b will top-rank 1 given that they search when θ_{b2} is in A and the integral measures the expected marginal utility when a learns that $\theta_{a2} > x$. This expression can be simplified to

$$m(A') \left(\frac{x^2}{2} - x + \frac{1}{2} \right)$$

which is a strictly decreasing function over $[0, 1]$, so that if it a weak best response for a given type x to search, it is a strict best response for all lower types to search. ■

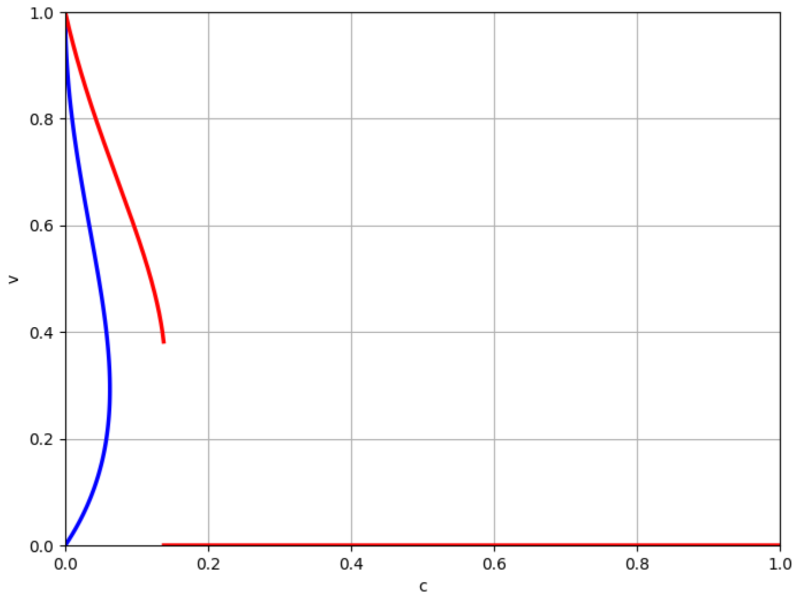
In general, this game has multiple equilibria as it is a game of strategic complements. For example, the strategy in which neither student ever learns is an equilibrium. For any interior v which constitutes an equilibrium, we must have that

$$\left(v - \frac{v^2}{2} \right) \left(\frac{v^2}{2} - v + \frac{1}{2} \right) - c = 0$$

since this is the marginal value from learning the utility of the other school at the cutoff. The pairs $(c, v) \in [0, 1] \times [0, 1]$ satisfying this equation are shown in Figure 2 with the blue line. We see that for sufficiently high c there is no equilibrium with search. For low levels of c, however, there can be multiple equilibria.

There is a potential inefficiency to these equilibria. When either agent learns about the other school, there are two effects. First, they increase their options in the case where their non-local school is high value. Second, they open up the possibility of trade with the other student. This second effect is

Figure 2: Equilibrium and Efficient v as a Function of Cost



not fully internalized by the student, so a planner might want to encourage search. We can formalize this by asking what level of v would the planner choose to maximize social welfare.

Welfare $W(v,c)$ is given by

$$\int_v^1 \int_v^1 (\theta_{a1} + \theta_{b2})\, d\theta_{a1} d\theta_{b2} + 2\int_v^1 \int_0^v (\theta_{a1} + \theta_{b2} - c)\, d\theta_{a1} d\theta_{b2}$$

$$+ 2\int_0^v \int_0^v \int_0^{\theta_{b2}} (\theta_{a1} + \theta_{b2} - 2c)\, d\theta_{b1} d\theta_{a1} d\theta_{b2} - \int_0^v \int_0^v \int_0^{\theta_{b2}} \int_0^{\theta_{a1}} (\theta_{a1} + \theta_{b2} - 2c)\, d\theta_{a2} d\theta_{b1} d\theta_{a1} d\theta_{b2}$$

$$+ \int_0^v \int_0^v \int_{\theta_{b2}}^1 \int_{\theta_{a1}}^1 (\theta_{a2} + \theta_{b1} - 2c)\, d\theta_{a2} d\theta_{b1} d\theta_{a1} d\theta_{b2}.$$

The first expression calculates expected utility when both students learn that the value from the local school is at least v. The second term measures the expected utility when exactly one of the students observes a value lower than v at their local school. Since this is symmetric across the two agents,

$$\int_v^1 \int_0^v (\theta_{a1} + \theta_{b2} - c)\, d\theta_{a1} d\theta_{b2} = \int_0^v \int_v^1 (\theta_{a1} + \theta_{b2} - c)\, d\theta_{b2} d\theta_{a1}$$

and the sum of these two terms is twice the first.

In the third term, we have the expected utility when both agents see a value at their local school less than v but one of them gets an even lower value for the non-local school so that there is no trade. Since this is symmetric across the agents, this term has a weight of two. However, this double-counts the region where both agents get an even lower value from their non-local school, so the fourth term corrects this. Finally, the last term is the expected gains from trade.

This expression simplifies to

$$-\frac{1}{6}v^5 + \frac{5}{6}v^4 - \frac{3}{2}v^3 + v^2 - 2cv + 1.$$

For each c, we can calculate the v^* which maximizes this expression. These values are shown in Figure 2 by the red line. As we can see, the planner always prefers more search than will arise in equilibrium.

For a concrete example, when $c = \frac{1}{16}$, the equilibrium with the most learning occurs when $v = 1 - \frac{1}{\sqrt{2}}$ which is approximately 0.3. For the same cost, the planner prefers v of approximately 0.7. This results in a roughly 4% increase in welfare.