How to Reserve Seats in School Choice*

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Abstract

We study the effect of reserving seats for specific groups of students under the Deferred Acceptance (DA) Mechanism and the Top Trading Cycles (TTC) Mechanism. By extending the traditional mechanisms, we allow schools to process seats based on a defined precedence order that determines whether schools fill reserved seats or open seats first. Our theoretical predictions suggest that changing precedence order can lead to large differences in assignment outcomes. The data from a laboratory experiment strongly support the theoretical predictions. The results of interest are students' incentives to report preferences truthfully and assignment outcomes along important dimensions such as efficiency and stability. Our findings suggest that processing open seats first is more efficient and is a more effective way to reserve seats in school choice.

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1 Introduction

When deciding how to assign students to schools, school districts often choose to include reserved seats in their assignment process. Reserves involve setting aside a certain number of seats for students who meet certain criteria. There are many reasons to reserve seats when assigning students to schools. Affirmative action based on race/ethnicity is a common type of reserved seat, but this is just one example. Schools frequently reserve seats for students who live in the neighborhood or for students with specific interests in the areas of speciality of the school (such as an arts program or a STEM concentration). Further, schools use reserves for first generation college students, limited English proficiency students, special education students, and other characteristics beyond the commonly discussed racial and ethnic group designations. We study reserved seats in school choice in a general environment that can handle any of these types of reserves. The main research question is how schools should design reserves, specifically whether reserved seats or open seats should be processed first. In a laboratory experiment where subjects play the role of students seeking assignment, we find that processing open seats first is more efficient.

Since the seminal work of Abdulkadiroğlu and Sönmez (2003), the mechanism design approach to studying school assignment has expanded to address complexities such as reserved seats. There are three main outcomes of interest when studying assignment systems: strategic behavior, efficiency, and stability. Strategic behavior asks whether students have an incentive to misreport their preferences or not, and a mechanism is strategy-proof or not. Efficiency concerns maximizing students' welfare in terms of being assigned to your most preferred school. Stability involves schools' priority orders over students, where a stable assignment is one that respects school priorities. In the past, the most common school choice mechanism was the Boston Mechanism (BM). But it encourages students and parents to manipulate their preference rankings of the schools (Abdulkadiroğlu and Sönmez, 2003). As a result, two strategy-proof mechanisms have received more attention: the student-proposing Deferred Acceptance algorithm (DA) of Gale and Shapley (1962) and the Top Trading Cycles mechanism (TTC) of Shapley and Scarf (1974). There is a trade-off between efficiency and stability of the mechanism. While DA is stable, it is not Pareto efficient. TTC is Pareto efficient but is not stable.

Our contribution to the school choice literature is by extending the TTC mechanisms with reserves, and testing it with different sequences of precedence order in the laboratory. While much work has been done to DA with reserves and precedence order (Dur et al., 2020), there is much left to explore with TTC both theoretically and experimentally. TTC is a mechanism of interest because it can outperform DA in terms of students' welfare. We compare TTC and DA with reserves in a laboratory setting to deepen our understanding of precedence order. As the role of precedence order has been highlighted in Dur et al. (2020), we also emphasize the importance of precedence order under both mechanisms, and how it has potential to affect assignment outcomes.

We conduct a laboratory experiment that studies DA with reserves and TTC with reserves. Our setting is a between-subject design for mechanisms (DA and TTC) and a within-subject design for precedence order (processing open seats first or reserved seats first). We analyze strategic behavior, efficiency, and stability. To provide a comprehensive analysis, we introduce two different settings in which the theoretical predictions differ. These two settings use the same student preferences but different school priorities and are explained to subjects in the lab using neutral language: Blue and Green priority order. Under the Green priority order, theory predicts different assignment outcomes depending on precedence order. Under the Blue priority order, theory predicts a unique assignment outcome irrespective of the choice of mechanism or precedence order.

Our experimental results show a significant increase in efficiency when schools process open seats before reserved seats under both settings. The efficiency improvements are very large: 21.5% and 27.5% under the Green and Blue priority orders, respectively. This means processing open seats first consistently increases efficiency, regardless of whether theory predicts open first to be more efficient (Green) or whether theory predict no efficiency differences (Blue). Importantly, our analysis shows that these effects are driven by how subjects' understanding of how precedence order affects their admission probabilities at schools. Our results provide evidence that policy makers can use in designing reserves in practice.

1.1 Related Literature

In the early strand of the school choice experiments literature, tools aimed at balancing the student body primarily focused on directly adjusting the size of the seats allocated to a group of students. For example, Kojima (2012) uses quota systems under DA and TTC by enforcing a strict constraint on quota capacity or giving minorities a higher priority than majority students. He finds both approaches do not improve the welfare of minority students compared to mechanisms without majority quota. Alternatively, Hafalir et al. (2013) suggest a reserve system where schools set seats aside for a single group of minority students. An advantage of reserves over quota is that reserves are flexible. It allows majority students to be considered for reserved seats when available. They find that DA with minority reserves improve welfare of minority students compared to DA with majority quota while preserving its nice theoretical properties. Unlike the clear improvement of DA with reserves from DA with quotas, TTC with minority reserves does not Pareto improve on TTC with majority quotas or standard TTC. Additionally, Ehlers et al. (2014) introduce a soft-bound interpretation of quota and reserves constraints to ensure fair and non-wasteful assignments. Moreover, a several studies have introduced diversity objectives for schools in matching mechanisms (Echenique and Yenmez, 2015; Fragiadakis et al., 2016; Kominers and Sönmez, 2016; Sönmez and Yenmez, 2022).

Following the above theoretical findings, subsequent papers conduct experiments to test these findings in laboratory settings. Klijn et al. (2016) test robustness of minority reserves under DA relative to TTC. They confirm that minority reserves outperform under DA than that of TTC in terms of stability and efficiency. Hafalir et al. (2013) show that extending DA and TTC with reserve systems still preserves its properties for each mechanism. We extend their DA with minority reserves by using a seat-specific priority model. A use of precedence order allows schools to handle different sequences of processing seats. A difficulty in defining TTC with reserve systems has to do with different priority order for seats. When a school has priority orders of open and reserved seats, does the school point to the student with the highest priority at open seats or reserved seats? In standard TTC, a school points to the top priority student. In TTC with reserves, school points to students based on the order of processing seats using slot-specific priorities.

The precedence order in the school choice literature has been studied by Dur et al. (2018, 2020). They examine the use of reserve systems in Boston and Chicago exam schools.[1] Specifically, they study how processing open seats before reserved seats could have a similar impact to explicitly increasing the number of seats allocated to the targeted group through quotas or reserves. When schools first fill open seats, it could potentially reduce the competition among targeted students. It is because targeted students who hold the top priority could get a seat through open seats instead of reserved seats. Since the use of an increasing or decreasing number of reserved seats are more apparent and easier to comprehend than those of precedence order, Pathak et al. (2023) demonstrate how people perceive these two tools in the laboratory. While our paper treats subjects as students competing for a seat, their subjects take on the role of policy makers selecting policies between processing open or reserved seats first. The study finds that most participants do not understand the sequence in which they need to correctly set to give more seats to the targeted group.

More broadly, a growing number of laboratory experiments have been conducted to test and compare the theoretical properties of mechanisms, building on the seminal work of Chen and Sönmez (2006). They present how students are more inclined to manipulate preferences under the Boston Mechanism relative to the DA and TTC mechanisms, ultimately affecting the efficiency of these mechanisms. Many other topics have been studied as well, including the role of providing different levels of information to students (Pais and Pintér, 2008; Featherstone and Niederle, 2016), social network (Ding and Schotter, 2017), and evaluating parallel mechanisms used in many Chinese provinces (Chen and Kesten, 2019). Moreover, researches have explored dynamic mechanisms that provide iterative feedback to incentivize students to adopt more equilibrium strategies (Bó and Hakimov, 2020; Dur et al., 2021; Stephenson, 2022).

[1] Ellison and Pathak (2021) evaluate how place-based affirmative action used in Chicago exam schools could be modified to improve the efficiency of their plan.

2 Model

We consider the school choice problem introduced by Abdulkadiroğlu and Sönmez (2003) where schools may have seats reserved for students of a particular type. The problem consists of a finite set of students, I, a finite set of schools, A, and a finite set of types, T. Each student has a strict preference ordering over schools and being unassigned option denoted with $\emptyset$. Let P_i represent the strict preference ordering of student i. Let $\mathrm{P} = (P_i)_{i \in I}$ be the preference profile of students. Let $\tau : I \to T$ denote the function mapping students to their respective types. Notice that $\tau(i) \neq \emptyset$ for all $i \in I$. Let the set of students of type t be denoted with $I_t = \{i \in I : t = \tau(i)\}$. By definition, $I_t \cap I_{t'} = \emptyset$ for all $t, t' \in T$.

Each school $a \in A$ has capacity q_a and strict priority ordering over students, denoted with $\succ_a$. Let $q = (q_a)_{a \in A}$ be the vector of school capacities and $\succ = (\succ_a)_{a \in A}$ be the priority profile over students. Let S_a be the set of seats at school a and let $S = (S_a)_{a \in A}$. At schools, some seats are reserved for students of a particular type. This reservation provides students of the relevant type with increased priority for those seats. We denote the set of seats at school a reserved for type t students with S_a^t and refer to them as *type-t seats*. Let q_a^t be the number of seats reserved for type t at a, i.e., $q_a^t = |S_a^t|$. We refer to seats that are not reserved for any type as *open seats*. Let S_a^o be the set of open seats at school a. Let q_a^o be the number of open seats at a. We assume that the total number of reserved seats does not exceed the capacity of the school, i.e., $q_a^o = q_a - \sum_{t \in T} q_a^t \geq 0$.

Students do not have preferences over different seats at the same school. However, due to the reservation of some seats, it would be the case that not all students have the same claim for all seats. To this end, we use seat-specific priorities in our model. Let $\succ_a^t$ be the priority order over students for seats in S_a^t which is induced by $\succ_a$, and rank type t students above all other students. That is, for each $t \in T$,

- $i \succ_a^t j$ for all $i \in I_t$ and $j \notin I_t$,
- $i \succ_a^t j$ if and only if $i \succ_a j$ for all $i, j \in I_t$, and

- $i \succ_a^t j$ if and only if $i \succ_a j$ for all $i, j \notin I_t$.

Let $\succ_a^o$ be the priority order for open seats at school a and $\succ_a^o = \succ_a$ for all $a \in A$.

A problem is an eight-tuple $[I, A, q, P, \succ, T, \tau, S]$. To simplify notation, we denote a problem with P.

A **matching** is a function $\mu : I \to A \cup \ \{\emptyset\}$ such that $|\mu^{-1}(a)| \leq q_a$ for all $a \in A$. Next, we define some desirable properties for a matching. A matching is **individually rational** if there does not exist any student i such that $\emptyset \ P_i \ \mu(i)$. A matching μ is **non-wasteful** if there does not exist a student-school pair (i, a) such that $|\mu^{-1}(a)| < q_a$ and $aP_i\mu(i)$. A matching μ is **fair** if there does not exist any student-school pair (i, a) such that $a \ P_i \ \mu(i)$ and $i \succ_a j$ for some $j \in \mu^{-1}(a)$. Notice that fairness does take reserves into account. A matching μ is **stable** if μ is individually rational, non-wasteful, and fair.

Matching μ **Pareto dominates** matching ν if there exists at least one student $i \in I$ such that $\mu(i) \ P_i \ \nu(i)$ and there does not exist any student $j \in I$ such that $\nu(j)P_j\mu(j)$. A matching μ is **Pareto efficient** if there does not exist another matching ν such that ν Pareto dominates μ.

A matching μ **respects reserves** if whenever a student i prefers a school a to their own assignment under μ, then there are no seats wasted at a, and there are at least $q_a^{\tau(i)}$ type $\tau(i)$ students assigned to a. More formally, a matching μ respects reserves if whenever there exists a student-school pair (i, a) such that $aP_i\mu(i)$, then $|\mu^{-1}(a)| = q_a$ and $|\mu^{-1}(a) \cap I_{\tau(i)}| \geq q_a^{\tau(i)}$. A matching μ **respects reserves fairly** if whenever there exists a student-school pair (i, a) such that $aP_i\mu(i)$, μ respects reserves and for all $j \in \mu^{-1}(a) \cap I_{\tau(i)}$, $j \succ_a i$.

Let $r_i(\succ_a^t)$ be the rank of student i under $\succ_a^t$, where $t \in T \cup \{o\}$. That is, $r_i(\succ_a^t) = |\{j \in I : j \succ_a^t i\}| + 1$ for any given type t or unnreserved seat denoted with o. For any $\alpha \in \mathbb{R}_+$, a matching μ is **α-stable with respect to reserves** if it is individually rational, non-wasteful, and there does not exist a student-school pair (i, a) such that $aP_i\mu(i)$ and either $r_i(\succ_a^{\tau(i)}) \leq \lceil \alpha \times q_a^{\tau(i)} \rceil$ or $r_i(\succ_a^o) \leq \lceil \alpha \times q_a^o \rceil$.

A **mechanism** ϕ selects a matching for any problem. We denote the outcome of mechanism ϕ in problem P with $\phi(P)$ and student i's assignment under ϕ with $\phi_i(P)$. A mechanism ϕ satisfies an axiom if ϕ selects a matching that satisfies that axiom for any problem. A mechanism is **strategy-proof** if there does not exist a problem P, a student i, and preference relation P'_i, such that $\phi_i(P'_i, P_{-i})\ P_i\ \phi_i(P)$. Here P_{-i} represents truthful preferences for all students except i.

2.1 School Choice Mechanisms

Next, we provide a definition of the Top Trading Cycles (TTC) mechanism by modifying it to incorporate seat reservation, which we will call the Top Trading Cycles with Reserves (TTC-R) mechanism.

Top Trading Cycles with Reserves (TTC-R)

Step 1: Each student points to their most preferred school.[2] Let t_a^* be the type with the highest precedence under $\triangleright_a$ among the types in $T \cup \{o\}$ with available reserved seats. Each remaining school points to the top-ranked student under $\succ_a^{t_a^*}$. Being unassigned option, $\emptyset$, points to all students pointing to it. Due to finiteness, there exists at least one cycle.[3] Assign each student in a cycle to the school they point to and remove them. Reduce $q_a^{t_a^*}$ and q_a by one for each school a in a cycle.

Step k>1: Each student points to their most preferred school with remaining capacity. Let t_a^* be the type with the highest precedence under $\triangleright_a$ among the types in $T \cup \{o\}$ with available reserved seats. Each remaining school points to the top-ranked student under $\succ_a^{t_a^*}$. Being unassigned option, $\emptyset$, points to all students pointing to it. Due to finiteness, there exists at least one cycle. Assign each student in a cycle to the school they point to and remove them. Reduce $q_a^{t_a^*}$ and q_a by one for each school a in a cycle.

Terminate when all students have been assigned.

We next define the student-proposing DA mechanism with reserves as follows:

Deferred Acceptance with Reserves

Step 0: For seats reserved for type t at school a, let $\succ_a^t$ be defined as follows: $i \succ_a^t j$ for any $i \in I_t$

[2]Without loss of generality, we assume $q_a > 0$ for all $a \in A$.

[3]A cycle is a list of (distinct) schools and students, $\{a_1, i_1, ...a_k, i_k\}$ such that $a_{k'}$ points to $i_{k'}$ and $i_{k'}$ points to $a_{k'+1}$ for all $k' \in \{1, ..., k\}$ and $k + 1 = 1$.

and $j \notin I_t$, for $i, j \in I_t$, $i \succ_a^t j$ if and only if $i \succ_a j$, and for $i, j \notin I_t$, $i \succ_a^t j$ if and only if $i \succ_a j$. For unreserved seats, students are ranked following $\succ_a^o = \succ_a$. Define a vector of precedence orderings, $\rhd = (\rhd_a)_{a \in A}$ where each $\rhd_a$ represents the precedence ordering over $T \cup \{o\}$ at school a. Here, $t \rhd_a t'$ implies that seats reserved for type t are filled before seats reserved for type t' at school a. Let $C^a(J)$ be the choice of school a over set of students $J \subseteq I$ be defined as follows. First add the $q_a^{t_1}$ highest priority applicants from J under $\succ_a^{t_1}$ to $C^a(J)$, where t_1 is the type with highest precedence under $\rhd_a$. Next add the $q_a^{t_2}$ highest priority applicants from $J \setminus C^a(J)$ under $\succ_a^{t_2}$ to $C^a(J)$, where t_2 is the type with second highest precedence under $\rhd_a$. Continue for each $t \in T \cup \{o\}$ following $\rhd_a$.

Step 1: All students apply to the school they rank highest. Let J_1^a denote the applicants to school a. Each school a tentatively holds all $j \in C^a(J_1^a)$ and rejects the remaining applicants.

Step k>1: Each student rejected in step $k-1$ applies to the school they rank highest among those they have not previously been rejected by. Let J_k^a denote the set of students applying to school a in step k and those held by school a in step $k-1$. Each school a tentatively holds all $j \in C^a(J_k^a)$ and rejects the remaining applicants.

The mechanism terminates after the step such that no students are rejected. Students are assigned to the schools who held their application in that step. The theoretical properties of the mechanisms are in An and Paiement (2023).

3 Experimental Design

We design our experiment to compare the performance of TTC and DA with reserves when schools have open and reserved seats based on a student's type. All subjects play the role of students competing for seats at schools and submit a rank ordered list of schools. Students have a complete information in which they know the following information: all students' ordinal preferences and types, and all schools' priority orders and capacities.

Six students are competing for a seat at three schools. Let $S = \{a, b, c\}$ be the set of schools with two seats each where only schools b and c have one reserved seat. Schools with reserved seats have two priority orders: one for the open and the reserved seat. The priority order for reserved seats moves minority students to the top priority positions with their relative positions unchanged within types.[4] Let $I = \{i_1, i_2, i_3, i_4, i_5, i_6\}$ be the set of students where they are further divided into Subgroups S and T. Four students, i_1, i_2, i_3, and i_4, belong to Subgroup S and remaining students, i_5 and i_6, belong to Subgroup T. Subgroup S represents majority students and Subgroup T represents minority students. During the entire experiment and in the instructions, we avoid using any loaded language such as minority or majority students to minimize experimenter demand effects and instead use the term Subgroups S and T.

We use a two-by-two-by-two design, with treatment variation in mechanism (DA or TTC), precedence order (O=OpenFirst or R=ReservedFirst), and priority order (B=Blue or G=Green). Subjects participate in one mechanism (between-subjects design) but both precedence orders and priority orders (within-subjects designs). We randomize the order of precedence order with a ORRO/ROOR design and priority order with a BG/GB design to control for possible order effects.[5] Our main treatment variable is precedence order, the order of processing different types of seats. Schools fill seats according to the priority order associated with the type of seat. The two processing orders for each mechanism are as follows: (i) schools fill open seats first (OpenFirst) then reserved seats or (ii) schools fill reserved seats first (ReservedFirst) then open seats. The standard priority order is used to fill open seats whereas the reserve priority order is used to fill reserved seats.

We introduce two environments that differ in terms of school priorities, Blue and Green. Table 1 describes student preferences in the top rows and school priorities in the bottom rows: Blue in the left panel and Green in the right panel. Table 2 summarizes the theoretical predictions of assignment outcomes in all settings. There are two stable matchings in the Green priority order where the assignment outcome depends on the precedence order only. Both mechanisms

[4]For example, two minority students are in the second and third highest position at School b in the open priority order and are moved to the highest and second highest position at School b in the reserved priority order.

[5]For example, a group of subjects play in the following order: OpenFirst Blue, ReservedFirst Blue, ReservedFirst Green, OpenFirst Green. Each block contains five periods.

under Open First select $\mu_1 = \{(i_1, b), (i_2, a), (i_3, b), (i_4, a), (i_5, c), (i_6, c)\}$ and under Reserved First select $\mu_2 = \{(i_1, b), (i_2, a), (i_3, c), (i_4, a), (i_5, b), (i_6, c)\}$. With the Blue priority order, there is a unique Pareto-efficient stable matching. Both mechanisms select the same assignment outcome, $\mu_1 = \{(i_1, b), (i_2, a), (i_3, b), (i_4, a), (i_5, c), (i_6, c)\}$.

Note that student preferences do not change while priorities at Schools b and c change. The set of preferences and priorities are designed so that DA and TTC with reserves select the same assignment outcome regardless of precedence order under Blue priorities whereas different precedence order leads to different assignment outcome under Green priorities. One can see that it is only Student 3 and 5 who have different assignments across priority orders. They are competing over their most preferred school; either one of them is assigned to the most preferred school and the other to the second most preferred school depending on the precedence order. Furthermore, having two priorities help us obtain more comprehensive analysis of the effect of precedence order.

Table 1: Preferences, Blue and Green priorities

Preferences					
i_1	i_2	i_3	i_4	i_5	i_6
b	b	c	b	c	c
c	c	b	c	b	b
a	a	a	a	a	a

Priorities									
Blue					Green				
a^O	b^O	b^R	c^O	c^R	a^O	b^O	b^R	c^O	c^R
i_1	i_3	i_5	i_5	i_5	i_1	i_3	i_5	i_6	i_6
i_2	i_5	i_6	i_1	i_6	i_2	i_1	i_6	i_3	i_5
i_3	i_6	i_3	i_6	i_1	i_3	i_2	i_3	i_5	i_3
i_4	i_1	i_1	i_3	i_3	i_4	i_4	i_1	i_1	i_1
i_5	i_2	i_2	i_2	i_2	i_5	i_5	i_2	i_2	i_2
i_6	i_4	i_4	i_4	i_4	i_6	i_6	i_4	i_4	i_4

Table 2: Theoretical Prediction

Blue	$DA(R \to O) = DA(O \to R) = TTC(R \to O) = TTC(O \to R)$: $\mu_1 = \{(i_1, b), (i_2, a), (i_3, b), (i_4, a), (i_5, c), (i_6, c)\}$
Green	$TTC(O \to R) = DA(O \to R)$: $\mu_1 = \{(i_1, b), (i_2, a), (i_3, b), (i_4, a), (i_5, c), (i_6, c)\}$ $DA(R \to O) = TTC(R \to O)$: $\mu_2 = \{(i_1, b), (i_2, a), (i_3, c), (i_4, a), (i_5, b), (i_6, c)\}$

3.1 Experimental Sessions

We conducted the experiment using oTree (Chen et al., 2016) at the TIDE Lab at The University of Alabama between March and April of 2023. A total of 144 students participated in 13 independent sessions. On average, each session lasted approximately 80 minutes.

In each session, one or two groups of six students were seated at a private workstation. Students were in the same group during the entire session. A recorded video walked students through the instructions, explained each step of the mechanism, and provided examples of assignment outcomes more in detail. It did not guide students towards particular strategies, instead only provided information about the mechanism (either DA or TTC) and rules of the experiment. After watching the video, students took an incentivized quiz at their own pace to check their understanding of the instructions. Our quiz and the example were adapted from Dur et al. (2021). The first four questions asked students to determine the allocation of each student in the provided example where schools process open seats first. To allow students to observe that the assignment could depend on the precedence order, the next question asked students to determine the allocation in the same example where schools process reserved seats first instead. The remaining questions checked students' basic understanding of the environment. Students were told that they must repeat the quiz (with no earnings on the retake) if they answer fewer than 11 questions correct on the quiz out of 13 questions. The average quiz score is 11.16.

After the quiz, each student participated in two practice periods where schools process open seats first and two practice periods where schools process reserved seats first.[6] In each session, students are randomly assigned to a role and roles changed each period. Students are asked to submit a ranking of schools for 20 periods excluding practice periods. Every period on the decision screen, students are shown their preferences, priority orders used for the period, roles, and precedence order for the period. Once all students submit their rankings, the computer determines the assignment and informs students of their assigned school and corresponding payoff. Students were told to ask any questions at any point of the experiment.

The payoffs in the experiments were in dollars; \$0, \$10, and \$20. A student's payment was determined by the payoff of the assigned school in one randomly chosen period. Earnings in dollars were \$21.42 on average, with a range of \$9 and \$30.75. These numbers include a \$7.5 show-up fee and payments from the quiz. Earnings from the experiment itself were \$11.16 on average, with a range of \$0.00 and \$20.00. Earnings from the quiz were \$2.76 on average, relative to a maximum possible quiz earnings of \$3.25.

4 Experimental Results

We present the analyses of three major properties; strategic behavior, efficiency, and stability. Strategic behavior concerns the strategic simplicity of the mechanism, specifically do students have any incentive to misreport their preferences? If not, the mechanism is strategy-proof. Strategy-proofness is crucial in school choice because it levels the playing field for students and students do not need to manipulate their preferences to obtain their preferred school. Efficiency concerns the welfare of students and whether students could be assigned to more preferred schools. Within a school assignment process, school districts intend to assign as many students as possible to their favorite school. Stability involves the elimination of justified envy, where a student i has a justified envy of student

[6]The environment of the practice periods is the same as the periods for pay except that payoffs students earn in practice periods were excluded from the random payment.

j if she prefers j's school to her own assignment and she has a higher priority than j at the school. Intuitively, stability can be thought of as respecting schools' priorities. These three properties are also the policy objectives that school districts and policy makers consider when designing a school assignment process. We present analyses on strategic behavior and efficiency at the individual level and stability at the group level. In the results that follow, we use Wilcoxon rank-sum tests for all nonparametric tests. Test statistics on joint hypotheses use F-tests when comparing linear regression models and likelihood ratio tests when comparing probit regression models.

4.1 Individual-level Analysis on Strategic Behavior

We examine the proportion of students playing the equilibrium strategy. Because DA and TTC are strategy-proof mechanisms, it is a weakly dominant strategy for students to report their true preferences. From our theoretical evidence, extending standard DA and TTC to incorporate reserved seats preserves strategy-proofness and this leads us to our first hypothesis:

Table 3: Proportion of Truth-telling by Mechanism

	None	Top Choice	All Three
DA	0.0590	0.7486	0.7243
TTC	0.0597	0.7201	0.6958
All	0.0594	0.7444	0.7101

Notes: None = No preferences reported truthfully;
Top Choice = Favorite school reported truthfully;
All Three = All preferences reported truthfully.

Hypothesis 1a. All students report their true preferences.

Result 1a. Students report all three schools truthfully 71.01% of the time from Table 3.

Table 3 reports the proportions of students who truthfully submit none, only their top choice, or all of their preferences. Around 70% of students truthfully report all of their preferences and

Table 4: Proportion of Truth-telling by Precedence Order, Types of Students, and Mechanism

	DA		TTC	
	Majority	Minority	Majority	Minority
Open First	0.6146	0.9458	0.5917	0.9167
Reserved First	0.6854	0.8000	0.6458	0.7833

Notes: Shown is the proportion of truth-telling for all three schools.

about three out of four students truthfully report their favorite school. We thereby reject our first hypothesis that all students report their true preferences. However, these truth-telling rates with DA and TTC are relatively high and similar to related papers.[7] We separately report truth-telling rates by mechanisms in the first and second rows. Specifically, the students are more likely to report their true preferences under DA than TTC by about 2 to 3 percentage points. Since the difference between truth-telling rates for top choice only relative to all choices do not seem to be large, we use the proportion of truthfully reporting all three schools for further analyses of strategic behavior. In order to examine how precedence order and student types affect students' strategies, Table 4 presents the proportions of truth-telling rates by different subgroups. Most minority students report their preferences truthfully, while approximately 60% of majority students do so. Furthermore, the precedence order has the opposite effects on the truth-telling rates for majority and minority students. Majority students are more likely to truthfully report their preferences when schools process reserved seats first, whereas minority students are more likely to do so when schools process open seats first.

To investigate the significance of the treatments in Tables 3 and 4, Table 5 presents the estimation results of probit regressions under the Green priority order. The dependent variable is the rate at which all three school are reported truthfully. The independent indicator variables include mechanisms (TTC), precedence order (OpenFirst), student types (Minority), and the full set

[7]The truth-telling rates observed with DA and TTC are high but consistent with findings in related experimental literature. For example, other papers have reported truth-telling rates of 72.2% and 50.0% for DA and TTC, respectively (in the "designed" environment of Chen and Sönmez (2006)), and 79.5% for DA (in the "sequential" move environment of Dur et al. (2021)).

Table 5: Truthful Reporting under Green Priority Order

Treatment:	Green	
Dependent variable:	Truth-telling	
	(1)	(2)
TTC	-0.080	-0.183
	(0.108)	(0.124)
OpenFirst	0.065	-0.303^{**}
	(0.072)	(0.065)
Minority	0.474^{***}	-0.092
	(0.090)	(0.097)
Period		0.031
		(0.023)
OpenFirst x TTC		0.149
		(0.138)
OpenFirst x Minority		1.276^{***}
		(0.262)
TTC x Minority		0.181
		(0.248)
OpenFirst x Minority x TTC		-0.227
		(0.343)
Intercept	0.566^{***}	0.601^{***}
	(0.103)	(0.144)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level;
$^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01

of interaction terms involving these three variables. Standard errors are clustered at the session level.

Hypothesis 1b. Mechanisms do not affect rates of truth-telling.

Result 1b. The rate of truth-telling is lower under TTC than DA, however the effect is statistically insignificant.

Support. In both specifications (1) and (2) of the Table 5, the coefficients for TTC are negative and statistically insignificant.[8] In addition, the likelihood ratio test indicates that the inclusion of the interaction terms involving the TTC variable does not significantly improve predicting the rate of truth-telling ($p = 0.795$).

Hypothesis 1c. The precedence order does not affect rates of truth-telling.

Result 1c. The rate of truth-telling is lower (higher) for majority (minority) students under OpenFirst than under ReservedFirst.

Support. In specification (2) of the Table 5, the coefficient for OpenFirst is negative and weakly statistically significant. However, the coefficient for OpenFirst + OpenFirst x Minority is positive and statistically significant.[9] This implies that there is an opposite effect of precedence orders for majority and minority students at work. In addition, the likelihood ratio test indicates that the inclusion of the interaction terms involving the OpenFirst variable significantly improves predicting the rate of truth-telling ($p < 0.01$).

Hypothesis 1d. Student types do not affect rates of truth-telling.

Result 1d. The rate of truth-telling is lower when students are of minority types under ReservedFirst.

Support. In specification (2) of the Table 5, the coefficient for Minority is negative and statistically

[8] According to a Wilcoxon rank-sum test, the differences in rates of truth-telling in these two mechanisms is statistically insignificant ($p = 0.269$).

[9] According to a Wilcoxon rank-sum test, the differences in rates of truth-telling in these two precedence orders is statistically insignificant ($p = 0.539$).

insignificant.[10] As discussed previously, the rates of truth-telling is positive and statistically significant under OpenFirst for minority students. In addition, the likelihood ratio test indicates that the inclusion of the interaction terms involving the Minority variable significantly improves predicting the rate of truth-telling ($p < 0.01$).

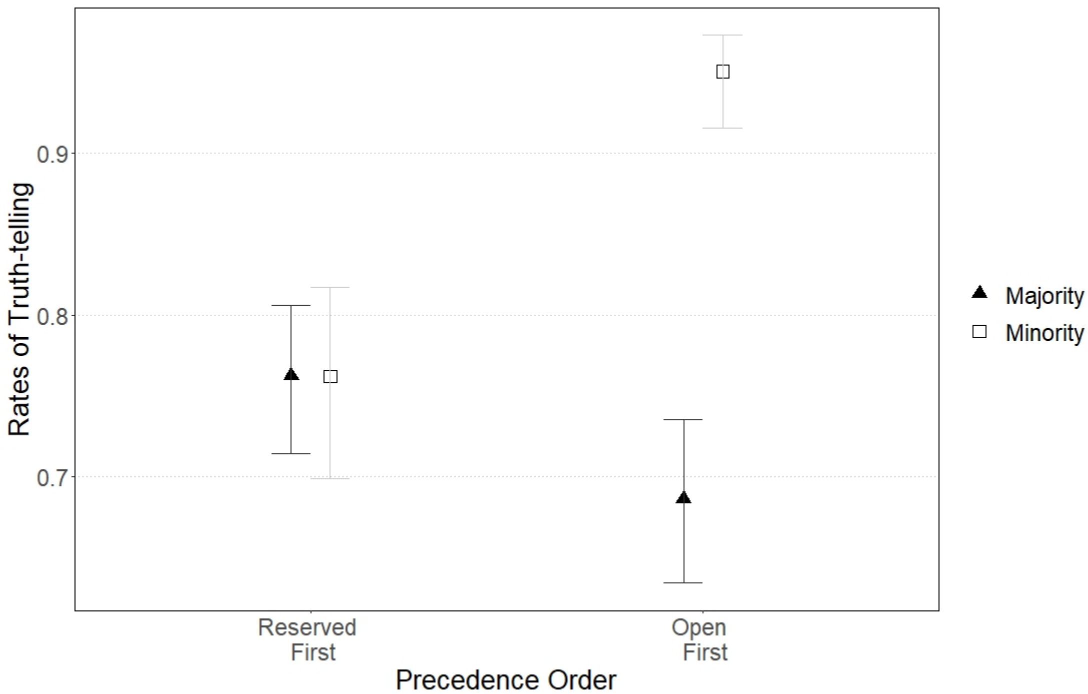

Figure 1: Rates of Truth-telling by Precedence order and Student Types under Green Priority

Figure 1 provides a graphical summary of the regression results on rates of truth-telling by precedence order and student types.[11] In this environment, theory predicts different assignment outcomes across precedence orders.[12] Despite our hypothesis that precedence order should not affect students' strategies, we observe different behaviors under ReservedFirst and OpenFirst for both types of students. Under ReservedFirst, three-quarters of all students truthfully report their preferences.

[10] According to a Wilcoxon rank-sum test, the differences in rates of truth-telling in students types is statistically significant ($p < 0.01$).

[11] Although students play equilibrium strategy more often under DA than TTC, there is no statistical significance difference in students' strategies across mechanisms from Result 1b. Thereby, we do not differentiate between DA and TTC in Figure 1.

[12] Refer to Table 2 for our theoretical predictions.

However, the truth-telling rates diverge under OpenFirst. Minority students are significantly more likely to report their true preferences ($p < 0.01$), while the same does not hold true for majority students ($p < 0.01$). We revisit why we observe a different pattern for student types in Section 5.

Table 6: Truthful Reporting under Blue Priority Order

Treatment:	Blue	
Dependent variable:	Truth-telling	
	(1)	(2)
TTC	−0.100	−0.054
	(0.149)	(0.152)
OpenFirst	0.002	−0.108
	(0.080)	(0.111)
Minority	1.008***	0.805***
	(0.198)	(0.164)
Period		−0.179
		(0.026)
OpenFirst x TTC		−0.030
		(0.138)
OpenFirst x Minority		0.645**
		(0.222)
TTC x Minority		−0.082
		(0.248)
OpenFirst x Minority x TTC		−0.170
		(0.332)
Intercept	0.193***	0.179
	(0.088)	(0.162)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level;
*p <0.1; **p <0.05; ***p <0.01

To supplement our analysis on precedence order, we reevaluate *Hypotheses 1b* and *1c* under the other environment where we predict both mechanisms to select the same assignment outcome under either precedence order. Table 6 presents the estimation results of probit regressions under the Blue priority order. The dependent variable is the rate at which all three school choices are reported truthfully. The independent indicator variables include mechanisms (TTC), precedence order (OpenFirst), student types (Minority), and interaction terms involving these three variables. Standard errors are clustered at the session level.

Hypothesis 1c′. The precedence order does not affect rates of truth-telling.

Result 1c′. The rate of truth-telling is lower (higher) for majority (minority) students under OpenFirst than under ReservedFirst.

Support. In specification (2) of the Table 6, the coefficient for OpenFirst is negative and statistically insignificant for majority students. However, the coefficient for OpenFirst + OpenFirst x Minority is positive and weakly statistically significant.[13] This again implies that there is an opposite effect of precedence orders for majority and minority students at work. In addition, the likelihood ratio test indicates that the inclusion of the interaction terms involving the OpenFirst variable significantly improves predicting the rate of truth-telling ($p < 0.05$).

Hypothesis 1d′. Student types do not affect rates of truth-telling.

Result 1d′. The rate of truth-telling is higher when students are of minority types.

Support. In specification (2) of the Table 6, the coefficient for Minority is positive and statistically significant.[14] The rates of truth-telling is positive and statistically significant under OpenFirst. In addition, the likelihood ratio test indicates that the inclusion of the interaction terms involving the Minority variable significantly improves predicting the rate of truth-telling ($p < 0.05$).

Under the Blue priority order, all students should not change their strategies across treatments. They are predicted to be assigned to the same school, regardless of the precedence order. However, that is not what we see from the Table 6 and the Figure 2. In fact, the precedence order does change truth-telling rates for both types of students. For minority students, processing open seats first

[13] According to a Wilcoxon rank-sum test, the differences in rates of truth-telling in these two precedence orders is statistically insignificant ($p = 0.867$).

[14] According to a Wilcoxon rank-sum test, the differences in rates of truth-telling in students types is statistically significant ($p < 0.01$).

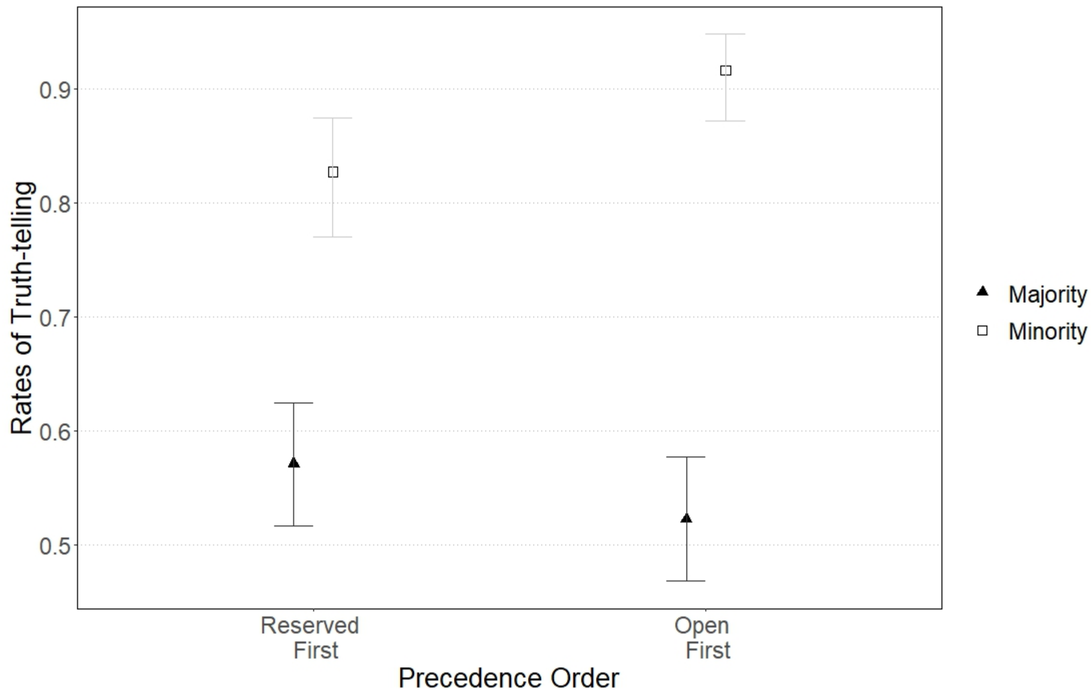

Figure 2: Rates of Truth-telling by Precedence order and Student Types under Blue Priority

statistically and significantly increases the likelihood of students submitting their true preferences (p <0.01). For majority students, the effect of processing open seats first works in the opposite direction; their truth-telling rates decrease but the decrease is statistically insignificant ($p = 0.135$). Even when students have no incentive to change their strategies, they do so. We provide a more in depth analysis of this behavior in Section 5. This environment supports our earlier results with Green priority order that students behave inconsistently when precedence order changes.[15]

To closely examine strategies students play other than equilibrium strategy, we look at the distribution of all possible strategies. Figure 3 shows six possible strategies under each mechanism. Students are grouped according to their equilibrium strategy; i_3, i_5, and i_6 (light gray) have Schools c, b, and a as their first, second, and third preferred school; i_1, i_2, and i_4 (dark gray) have Schools b, c, and a as their first, second, and third preferred school. There are a total six possible strategies listed on the horizontal axis as students cannot rank the same school twice. For example, "abc"

[15]We repeat the entire analysis with a weaker definition of truth-telling in the Appendix 7.1. These results are quite consistent with those analysis shown in Section 4.1.

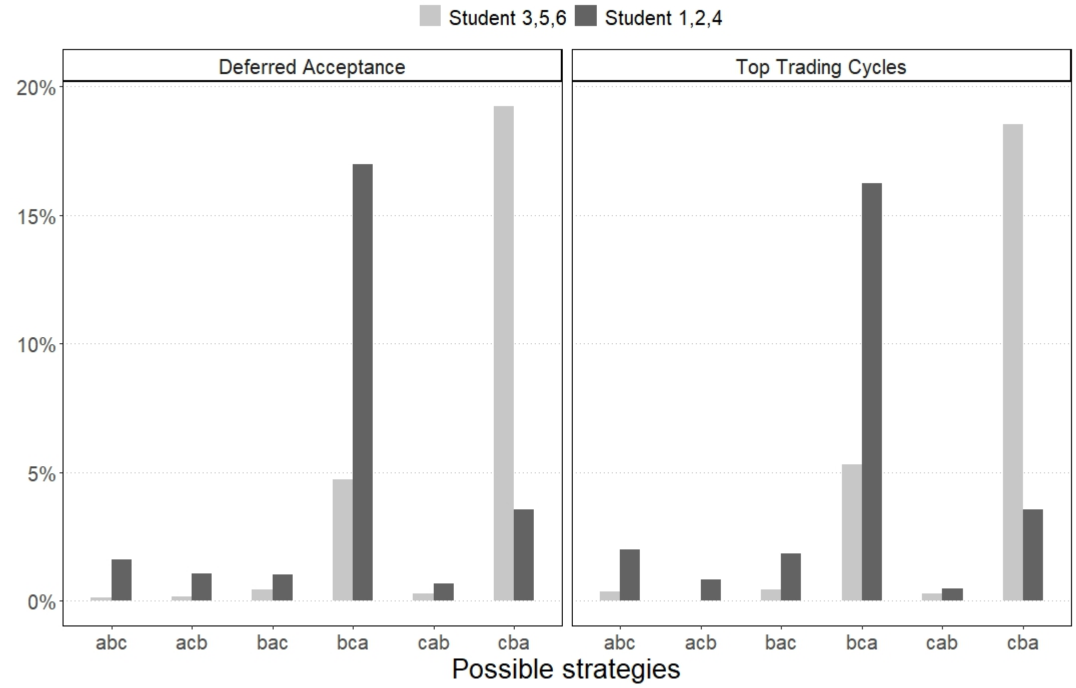

Figure 3: Strategy Distribution

represents reporting Schools a, b, and c as first, second, and third preferred school, respectively. For those who are not reporting their preference truthfully, the most frequently played strategy is to flip their first and second preferred school while reporting their third school truthfully ("bca" for i_3, i_5, and i_6 and "cba" for i_1, i_2, and i_4). Approximately 17.19% of the students flip their first and second preferred schools. Among those who do flip, 58.79% of the students are doing so because they have higher priority at the respective school. For instance, i_1 might consider reporting Schools c, b, and a instead of her true preference, b, c, and a because she has a higher priority at both open and reserved seat at c under the Blue priority order.

4.2 Individual Behavior on Efficiency

We compare the efficiency of the mechanisms by precedence order and student types. Efficiency of the mechanisms is measured by examining the payoffs of students as it gauges how well off students are. In each period, student's payoff equals \$20, \$10, and 0 if she is assigned to her most, second most, and least preferred school, respectively. Thus, a mechanism that gives students the higher payoffs per period is more efficient. Table 7 presents the estimation results of linear regressions under the Green priority order. The dependent variable is the payoff-based efficiency. The independent indicator variables include mechanisms (TTC), precedence order (OpenFirst), student types (Minority), and the full set of interaction terms involving these three variables. Standard errors are clustered at the session level. In this environment, the assignments of i_3 and i_5 are predicted to differ depending on the precedence order when the assignments of remaining students do not change. From our theoretical predictions, i_5 (i_3), a minority (majority) student is assigned to her favorite school under OpenFirst (ReservedFirst). This implies that the efficiency is higher for minority students under OpenFirst but lower under ReservedFirst and vice versa for majority students. Ultimately, one of them is assigned to her top choice and the other to the second top choice under both scenarios. As a results, the individual-level efficiency changes under precedence order and student types whereas it does not across mechanisms. Therefore, we formulate our hypothesis:

Hypothesis 2a. The mechanisms are Pareto unrankable.

Result 2a. Payoff-based efficiency is lower under TTC than DA in specification (1) but is higher in specification (2) under TTC than DA. However, the changes in efficiency is statistically insignificant.

Support. In specification (2) of Table 7, the coefficient for TTC is 0.042 ($p = 0.954$) and is statistically insignificant.[16] In addition, the F-test indicates that the inclusion of the interaction terms involving the TTC variable does not significantly improve predicting payoffs ($p = 0.983$).

Hypothesis 2b. The precedence order does affect efficiency.

Result 2b. Payoff-based efficiency is \$$-1.667$ (\$4.166) lower (higher) for majority (minority) students under OpenFirst than ReservedFirst.

Support. In specification (2) of the Table 7, the coefficient for OpenFirst is negative and weakly

[16]According to a Wilcoxon rank-sum test, the differences in efficiency in these two mechanisms is statistically insignificant ($p = 0.894$).

Table 7: Payoff-based Efficiency under Green Priority

Treatment:	Green	
Dependent variable:	Payoffs	
	(1)	(2)
TTC	-0.056	0.042
	(0.120)	(0.309)
OpenFirst	0.167	-1.667^{**}
	(0.080)	(0.319)
Minority	8.813^{***}	5.792^{***}
	(0.158)	(0.379)
Period		0.047
		(0.031)
OpenFirst x TTC		-0.333
		(0.371)
OpenFirst x Minority		5.833^{***}
		(0.608)
TTC x Minority		0.042
		(0.566)
OpenFirst x Minority x TTC		0.333
		(0.809)
Intercept	8.590^{***}	9.321^{***}
	(0.138)	(0.281)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level; $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01

statistically significant, $-1.667 (p < 0.05)$. The coefficient for OpenFirst + OpenFirst x Minority is positive and statistically significant, 4.166 ($p < 0.01$).[17] This implies that there is an opposite effect of precedence orders for majority and minority students at work. In addition, the F-test indicates that the inclusion of the interaction terms involving the OpenFirst variable significantly improves predicting payoffs ($p < 0.01$).

Hypothesis 2c. Efficiency is higher for minority (majority) students under OpenFirst (ReservedFirst).

[17] According to a Wilcoxon rank-sum test, the differences in efficiency in these two precedence orders is statistically insignificant ($p = 0.690$).

Result 2c. Payoff-based efficiency is \$4.125 (\$11.625) lower (higher) for majority (minority) students under OpenFirst.

Support. The coefficient for OpenFirst is negative and weakly significant, $-1.667 (p < 0.05)$ in specification (2) of Table 7. This suggests that majority students have higher payoffs under ReservedFirst. The coefficient for Minority + OpenFirst x Minority is positive and statistically significant, 11.625 ($p < 0.01$). This suggests that minority students have higher payoffs under OpenFirst, but majority students have higher payoffs under ReservedFirst.[18] In addition, the F-test indicates that the inclusion of the interaction terms involving the Minority variable significantly improves predicting payoffs ($p < 0.01$).

From Result $2a$, we conclude that there is no Pareto ranking between the DA and TTC mechanisms. This finding aligns with our theoretical prediction because the two mechanisms select the same assignment outcomes. Our theory predicts that processing open seats first helps minority students in our environment. This is supported by the Results $2b$ and $2c$. Minority students earn \$4.166 (OpenFirst + OpenFirst x Minority) more when schools process open seats first when the predicted efficiency increase from ReservedFirst to OpenFirst is \$5.[19] These results imply that students respond to the incentives of precedence order. The efficiency increase is statistically significant compared to the theoretical prediction. On the contrary, efficiency is lower under OpenFirst for majority students by \$1.667 (OpenFirst) when the predicted decrease is \$2.5. This is graphically summarized in Figure 4.

We calculate the effect sizes to quantify the efficiency loss and gain that majority and minority students experience under OpenFirst. When schools process open seats first, efficiency decreases (increases) by 14.2% (35.7%) for majority (minority) students at the same time.[20] Because the net

[18] According to a Wilcoxon rank-sum test, the differences in efficiency in these two student types is statistically significant ($p < 0.01$).

[19] Student i_5 earns \$10 and \$20 under ResevedFirst and OpenFirst. i_6 earns \$20 under both precedence orders.

[20] We divide changes in payoffs by the average payoffs to compute effect size. For example, minority students earn \$9.958 (OpenFirst + Minority + OpenFirst x Minority) under OpenFirst and \$5.792 under ReservedFirst. The effect size of precedence order for minority students is (\$9.958−\$5.792) / \$11.67 = 0.357.

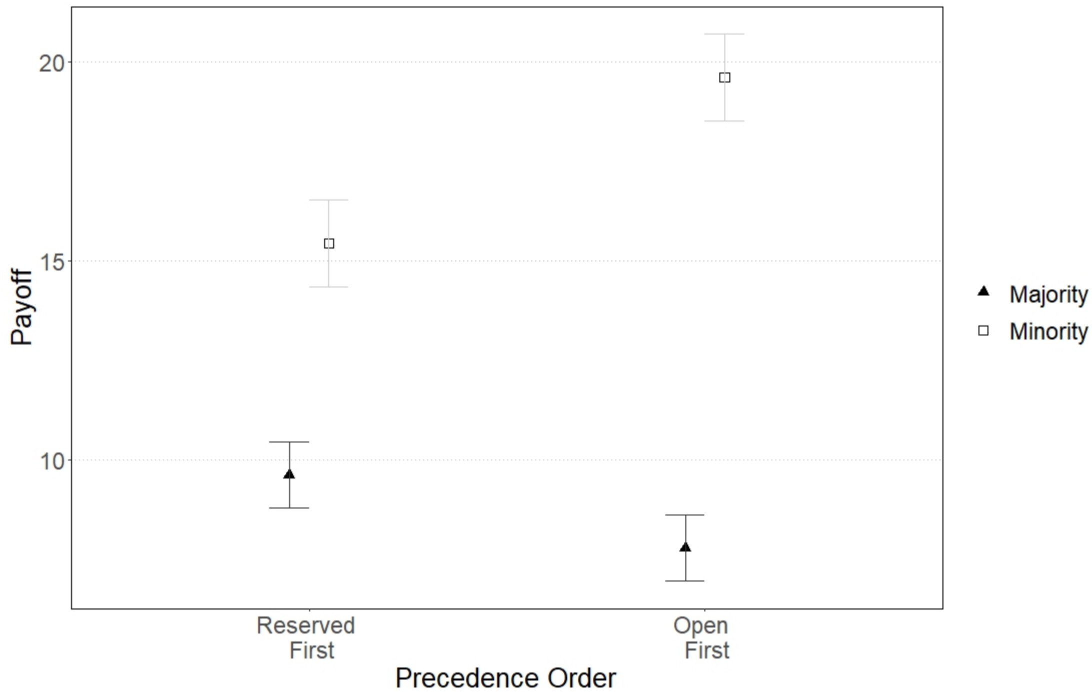

Figure 4: Payoffs by Precedence Order and Student Types under Green Priority

gain of processing open seats is positive, 21.5%, we conclude that processing open seats first increases efficiency overall because the gains to minority students outweigh the losses to majority students.

Next, we present the efficiency analysis under the Blue priority order in Table 8. In this environment, both DA and TTC mechanisms select the same assignment outcome regardless of precedence order. This implies that students are expected to earn the same payoffs irrespective of precedence order. We revisit *Hypotheses 2b* under the Blue priority order.

Hypothesis 2b′. The precedence order does not affect efficiency.

Result 2b′. Payoff-based efficiency is \$0.792 (\$2.417) higher for majority (minority) students under OpenFirst.

Support. In specification (2) of the Table 8, the coefficients for OpenFirst, 0.792 ($p = 0.204$), and OpenFirst + OpenFirst x Minority, 2.417 ($p = 0.132$), are positive but statistically insignificant.[21]

[21] According to a Wilcoxon rank-sum test, the differences in efficiency in these two precedence orders is statistically significant ($p < 0.01$).

Table 8: Payoff-based Efficiency under Blue Priority

Treatment:	Blue	
Dependent variable:	Payoffs	
	(1)	(2)
TTC	−0.194	−0.250
	(0.276)	(0.439)
OpenFirst	1.389***	0.792
	(0.207)	(0.265)
Minority	10.958***	10.250***
	(0.204)	(0.267)
Period		−0.026
		(0.060)
OpenFirst x TTC		0.250
		(0.348)
OpenFirst x Minority		1.625
		(0.397)
TTC x Minority		0.000
		(0.460)
OpenFirst x Minority x TTC		−0.417
		(0.493)
Intercept	6.486***	6.676***
	(0.249)	(0.355)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level;
$^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01

The the effect of OpenFirst on payoffs is positive for students of both types. In addition, the F-test indicates that the inclusion of the interaction terms involving the OpenFirst variable does not significantly improve predicting payoffs ($p = 0.315$).

This suggests that even in an environment wherein the expected payoffs are the same across precedence orders, both types of students earn higher payoffs when schools process open seats first. Figure 4 graphically summarizes the regression results of payoff-based efficiency by student types and precedence order. Majority students are expected to earn \$7.5 on average and minority students

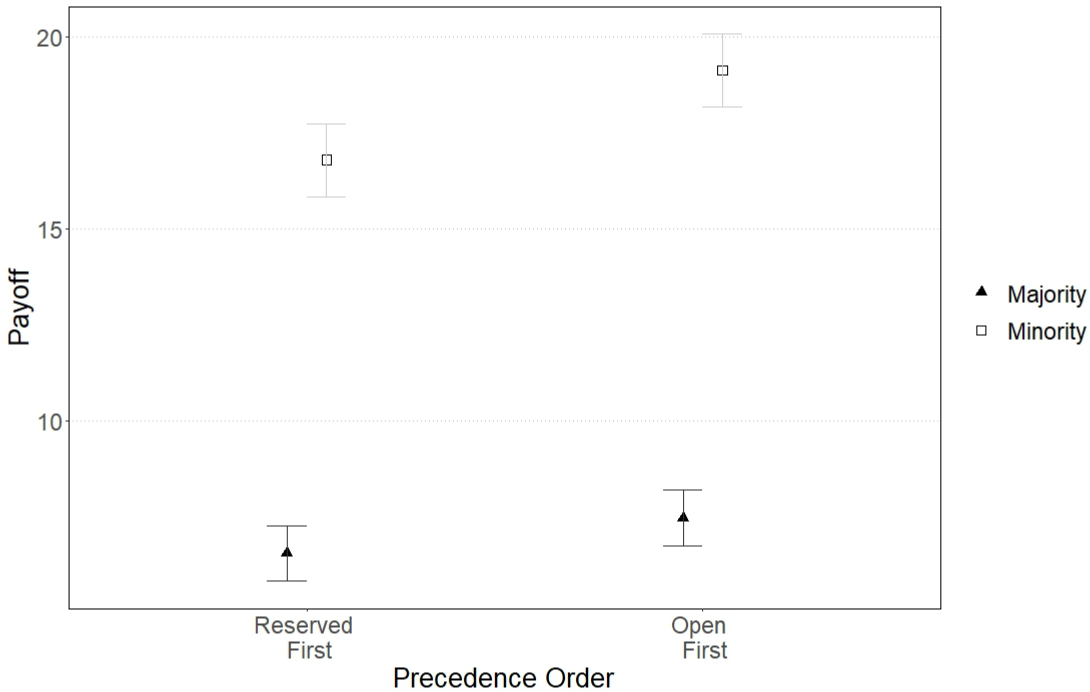

Figure 5: Payoffs by Precedence Order and Student Types under Blue Priority

are expected to earn \$20 on average. As discussed earlier, we see that students of both types earn close to the theoretical prediction under OpenFirst. To determine the effect sizes of precedence order for all students, we compare the changes in payoffs under precedence orders. When schools process open seats first, the overall efficiency increases by 27.5%.[22] This 27.5% increase in efficiency is very large and strongly supports the use of the open first precedence order. We conclude that processing open seats first increases the efficiency for all students (as found with Blue priorities) or for minority students by more than enough to outweigh the losses for majority students (as found with Green priorities). We present more in-depth analysis on the factors driving these results in the Section 5.

[22]We divide increases in payoffs under OpenFirst by the average payoffs to compute effect size. The effect size of OpenFirst in for all students is \$3.209 / \$11.67 = 0.275.

4.3 Group Behavior on Stability

Next, we examine the group-level rates of stability. A matching is stable if there is no justified envy. We consider the seat type when defining whether a student has a justified envy of other students. If a student is assigned to a reserved seat, we use the priority order of reserved seats to count justified envy.[23] The group-level matching is either stable or unstable. In all our environments, both DA and TTC select the same assignment outcomes. Hence we predict that group-level rates of stability will remain unaffected by the choice of mechanism. For instance, assignments differ depending on the precedence order in the Green priority order. But stability is guaranteed because DA respects school priority orders. This means even when the assignment outcomes differ depending on the order school processes seats, the group assignments are stable and the stability rates should not change.

Table 9: Stability Rates by Mechanism

	Stability
DA	0.700
	(0.030)
TTC	0.658
	(0.031)
N	480

Hypothesis 3a. Mechanisms do not affect rates of stability.

Result 3a. 70.0% and 65.83% of the group assignments are stable under DA and TTC, respectively, from Table 9.

Support. Table 9 reports the proportion of matchings that are stable. DA has higher stability rates than TTC by 4.2 percentage points but the difference is statistically insignificant ($p = 0.329$).[24]

[23] For example, i_5 has a justified envy of i_3 at reserved seat at c under the Green priority order if i_5 is not assigned to c although she has a higher priority than i_5 at that seat. This is one instance of justified envy. However, if she is assigned to an open seat at c, i_5 does not have a justified envy because she has lower priority than i_3 at that seat.

[24] According to a Wilcoxon rank-sum test, the differences in rates of stability in these two mechanisms is statistically insignificant ($p = 0.329$).

Table 10: Stability Rates by Precedence Order under Green Priority

	Stability
OpenFirst	0.856
	(0.176)
ReservedFirst	0.759
	(0.164)
N	240

Hypothesis 3b. The precedence order does not affect rates of stability.

Result 3b. Rates of stability increase under OpenFirst relative to ReservedFirst in Table 10, however, the effect is only weakly statistically significant.

Support. Table 10 reports the predicted probabilities of stable matchings under OpenFirst and ReservedFirst. Group-level matchings are 0.097 percentage points more likely to be stable under OpenFirst.[25]

While our theory and hypotheses predict all assignment outcomes to be free of justified envy, about 30% of the assignments are unstable (i.e., have at least one instance of justified envy).[26] This is due to students' strategic behavior because matchings can be unstable when students fail to play equilibrium strategy. Recall from Table 3, approximately 30% of the students do not report their preferences truthfully. We next study stability in the Blue priority order where both mechanisms select the same assignment. Since the matchings are not predicted to change, we predict the rates of stability to be the same under both precedence orders.

Hypothesis 3b′. The precedence order does not affect rates of stability.

[25]According to a Wilcoxon rank-sum test, the differences in rates of stability in these two precedence orders is statistically significant ($p < 0.1$).

[26]The stability rates observed with DA and TTC are high but consistent with findings in related experimental literature. For example, other papers have reported stability rates of 34.71% and 4.60% for DA and TTC, respectively (in the "standard" environment of Klijn et al. (2016)), and 83% for DA (in the "sequential" move environment of Dur et al. (2021)).

Table 11: Stability Rates by Precedence Order under Blue Priority

	Stability
OpenFirst	0.721
	(0.156)
ReservedFirst	0.330
	(0.153)
N	240

Result 3b′. Rates of stability increase under OpenFirst relative to ReservedFirst in Table 10 and the effect is statistically significant.

Support. Table 11 reports the predicted probabilities of stable matchings under OpenFirst and ReservedFirst. Group-level matchings are 0.391 percentage points more likely to be stable under OpenFirst.[27]

Under both environments, we observe that there are more likely to be stable matchings when schools process open seats first. We discuss why stability is relatively low under ReservedFirst in the Blue priority order in Section 5.

5 Role by Role Analysis

In the following section, we provide explanations on the observed students' behavior and the assignment outcomes as presented in Section 4.1, Section 4.2, and Section 4.3. There are six students in the experiment, i_1, i_2, i_3, i_4, i_5,and i_6, where i_5 and i_6 are minority students and the remaining are majority students. Recall that subjects are randomly assigned a role in each period. Throughout, students and roles are used interchangeably.

Figure 6 summarizes the mean truth-telling rates for each role under the Green priority order.

[27] According to a Wilcoxon rank-sum test, the differences in rates of stability in these two precedence orders is statistically significant ($p < 0.01$).

For instance, on average, i_1 is predicted to report her true preferences 81.4% and 85.7% of the time under ReservedFirst and OpenFirst, respectively. From Figure 6, it is readily apparent that i_3 and i_5 play different strategies across precedence orders (statistically significant differences for both players, $p < 0.01$). Student i_3 reports her true preferences more frequently under ReservedFirst, while i_5 does so under OpenFirst. This suggests that both students are more likely to report their true preferences when they believe they have a high admission probability at their favorite school. When they believe they have low admission probability at their favorite school, we see students deviating from equilibrium strategies. As for the remaining students, the assignment outcomes do not change across precedence orders. As such, the strategies i_1, i_2, i_4, and i_6 play are similar and statistically not different across precedence orders. This explains why truth-telling rates increase for minority students from ReservedFirst to OpenFirst in Table 1. It is due to i_5's high truth-telling rates under OpenFirst. Similarly, the decrease in the truth-telling rate for majority students from ReservedFirst to OpenFirst is because i_3 has low truth-telling rates under ReservedFirst. This is because i_3 and i_5 understand the role that precedence order plays in determining students' admission probabilities. This is evidence that our subjects understand the incentives of precedence order despite the fact that they do not perfectly perceive the strategy-proofness of the mechanisms.

We next present Figure 7 which helps us understand truth-telling rates by student types observed in Figure 2. In this environment, we predict that the precedence order does not change assignment outcomes. Thus students' strategies are much more consistent across precedence order for most students. As can be seen, one pattern we observe is that the truth-telling rates are relatively higher under ReservedFirst for majority students, while minority students do so under OpenFirst. This again aligns with our earlier claim that students are more truthful when they believe they have a higher admission probability at their favorite school.

In addition, note that i_6 is much less truthful under ReservedFirst. In fact, she is predicted to be assigned to her favorite school whenever she reports truthfully under both precedence orders. However, her truth-telling rate is higher under OpenFirst. We speculate that it is because of the

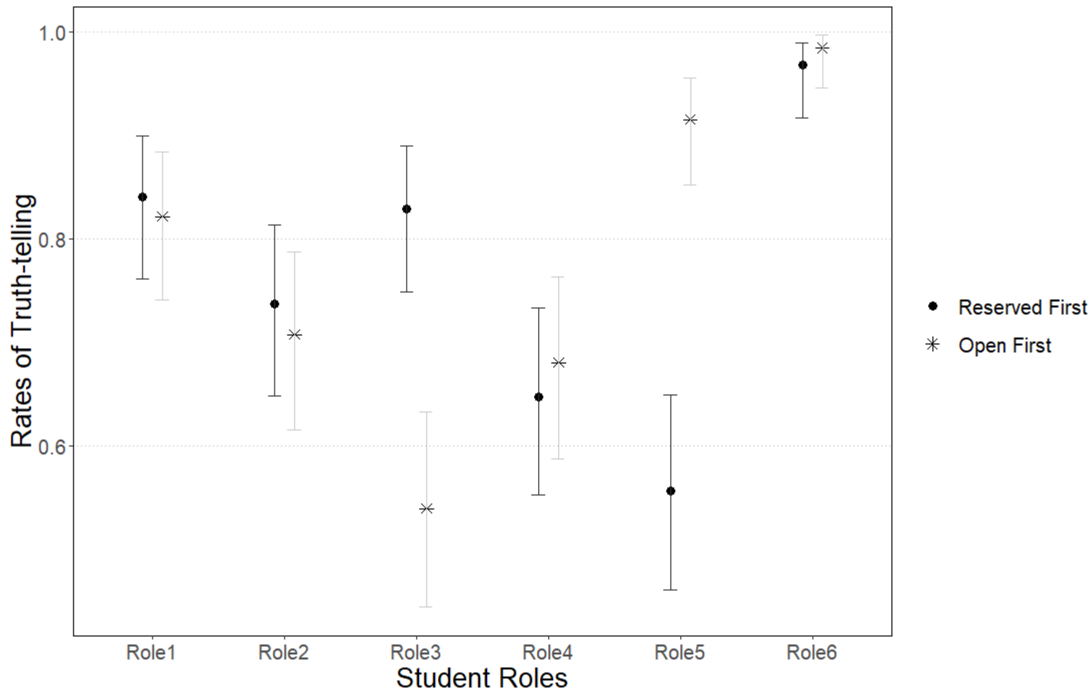

Figure 6: Truth-telling Rates by Student Roles under Green Priority

following reason: School c ranks i_5 highest for both Open and Reserved seat. Student i_6 is ranked third highest for the Open seat and second highest for the Reserved seat. Under OpenFirst, i_5 is assigned to the Open seat and i_6 could use the Reserved seat to get into c. Although i_6 has the similar opportunity under ReservedFirst, she assumes that there is more competition for a seat at c because i_1 has the second highest rank instead of herself. There are two students with higher priority than her at c. But, i_1 prefers School b most and her weakly dominant strategy is to list b first then c. Student i_6 sometimes do not recognize this and fails to play equilibrium strategy instead. Deviating from this equilibrium strategy could potentially result in losing her seat to someone with lower priority at her favorite school, leading to justified envy. This is why the stability rates under ReservedFirst in the Blue priority order is much lower compared to stability rates in other settings.

Figure 8 presents the mean payoffs by precedence order and student roles under the Green priority order.[28] As discussed in the analysis of strategic behavior for each student, the payoffs for i_1, i_2,

[28]Our theory predicts i_1 through i_6 are predicted to earn \$20, \$0, \$20, \$0, \$10, and \$20 under Reserved First and \$20, \$0, \$10, \$0, \$20, and \$20 under Open First.

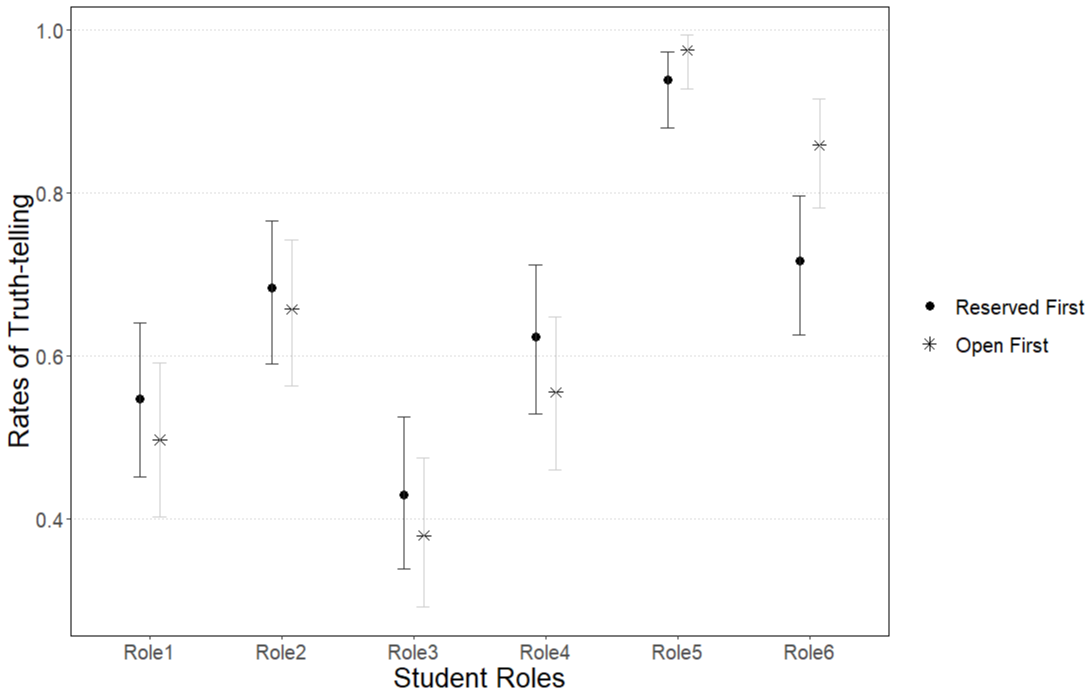

Figure 7: Truth-telling rates by Student Roles under Blue Priority

i_4, and i_6 do not significantly differ across precedence orders, primarily because their strategies did not deviate significantly. As i_3 and i_5 are expected to be assigned to different schools, their different mean payoffs across precedence orders is no surprise. Finally, some students such as i_3 is expected to earn \$20 under ReservedFirst but she does not because of her non-equilibrium strategies. In this scenario, it is other students who benefit from her deviation and earn more than our prediction.

Under the Blue priority order, the mean payoffs by precedence order are not predicted to change.[29] Indeed payoffs do not differ much across precedence orders for most students. Student i_6 has the largest difference in her payoffs across precedence order because of how she falsely assumes she has lower admission probability at her favorite school under ReservedFirst. As a result, she sometimes fails to earn the predicted payoffs of \$20. Further, note that while theory predicts i_2 and i_4 to earn \$0, they sometimes earn more than what they could have. This is due to the misreports i_1 and i_6 make. When the actual mean payoffs deviate from the prediction, it is because of students' strategic

[29] Our theory predicts i_1 through i_6 are predicted to earn \$20, \$0, \$10, \$0, \$20, and \$20, respectively.

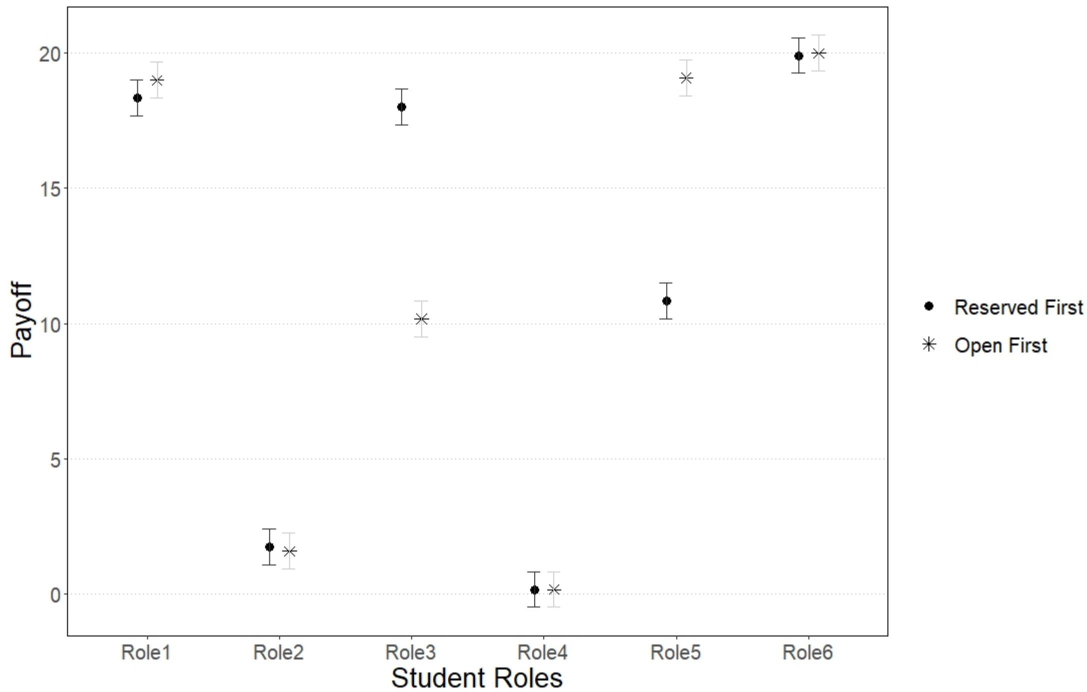

Figure 8: Payoffs by Student Roles under Green Priority

behaviors. It is the non-equilibrium strategy that exemplifies the effect of the precedence order on payoffs.

6 Conclusion

School districts often seek to set aside seats for underrepresented students for multiple reasons. In this paper, we study Deferred Acceptance (DA) Mechanism and Top Trading Cycles (TTC) Mechanism with reserves to examine how precedence order affects student assignments. Our experimental evidence suggests that processing open seats first is the most efficient approach to reserving seats. In the first setting of interest, we show that processing open seats first is predicted by theory to increase efficiency. The data support this prediction: OpenFirst increases efficiency overall because the gains to minority students outweigh the losses to majority students. In the second setting of interest, theory predicts no efficiency differences across precedence order. However, in the data, processing

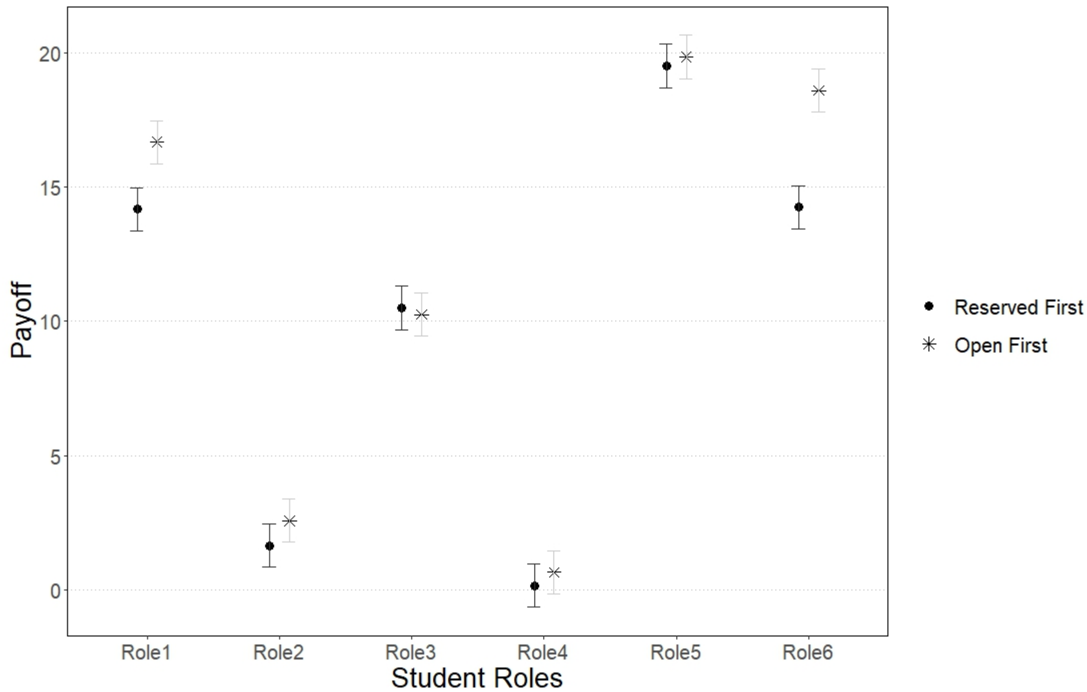

Figure 9: Payoffs by Student Roles under Blue Priority

open seats first does increase efficiency and represents a Pareto improvement. The driving forces behind these results are that students perceive the effect precedence order has on their probability of admission to schools. These findings suggest that precedence order is highly salient to our subjects in these experiments. Further, the efficiency increases associated with processing open seats first are very large (21.5% and 27.5% in the two settings, respectively). Thus, the use of precedence order in school choice can be an effective tool for schools when they reserve seats for underrepresented students.

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7 Appendix

7.1 Appendix A. Additional Strategic Behavior Analysis

This appendix provides a supplementary analysis of strategic behavior with an alternate truth-telling definition. In addition to the students we categorize as being truthful (the definition used for the Section 4), we include students who deviate from playing the equilibrium strategy but have inconsequential deviations. A subject has an inconsequential deviation from truth-telling if she fails to play truth-telling but her report results in the same assignment as she would have received had she reported truthfully.[30] Approximately 92.92% of the students are being truthful under this definition.

Table 12: Proportion of Truth-telling under Alternate Truth-telling Definition

	DA		TTC	
	Majority	Minority	Majority	Minority
Open First	0.9646	0.9542	0.9396	0.9375
Reserved First	0.9104	0.9292	0.8958	0.9083

Notes: Shown is the proportion of truth-telling for all three schools.

[30]More formally, define a consequential deviation from truth-telling as follows: A student's strategy is a consequential deviation if the counterfactual assignment under truth-telling would resulted her being assigned to a different school. For example, the true preferences for i_1 is "bca", but she reports "cba" and is assigned to c. She has consequential deviation if the counterfactual report of "bca" would have resulted in her being assigned to b.

Table 13: Truthful Reporting under Green Priority Order: Alternate Truth-telling Definition

Treatment:	Green	
Dependent variable:	Truth-telling	
	(1)	(2)
TTC	−0.145	−0.241
	(0.157)	(0.201)
OpenFirst	0.302**	0.282
	(0.148)	(0.301)
Minority	−0.028	0.048
	(0.114)	(0.168)
Period		0.028
		(0.053)
OpenFirst x TTC		0.165
		(0.373)
OpenFirst x Minority		−0.279
		(0.328)
TTC x Minority		0.010
		(0.254)
OpenFirst x Minority x TTC		0.168
		(0.342)
Intercept	1.656***	1.599***
	(0.124)	(0.234)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level;
$^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01

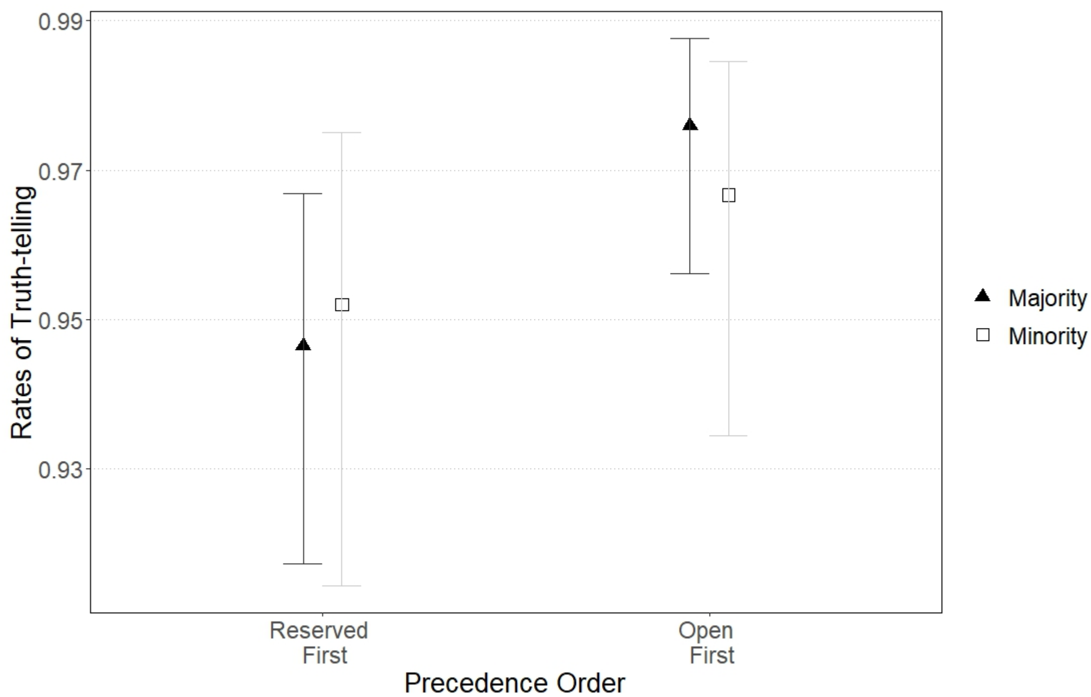


Figure 10: Rates of Truth-telling by Precedence order and Student Types under Green Priority: Alternate Truth-telling Definition

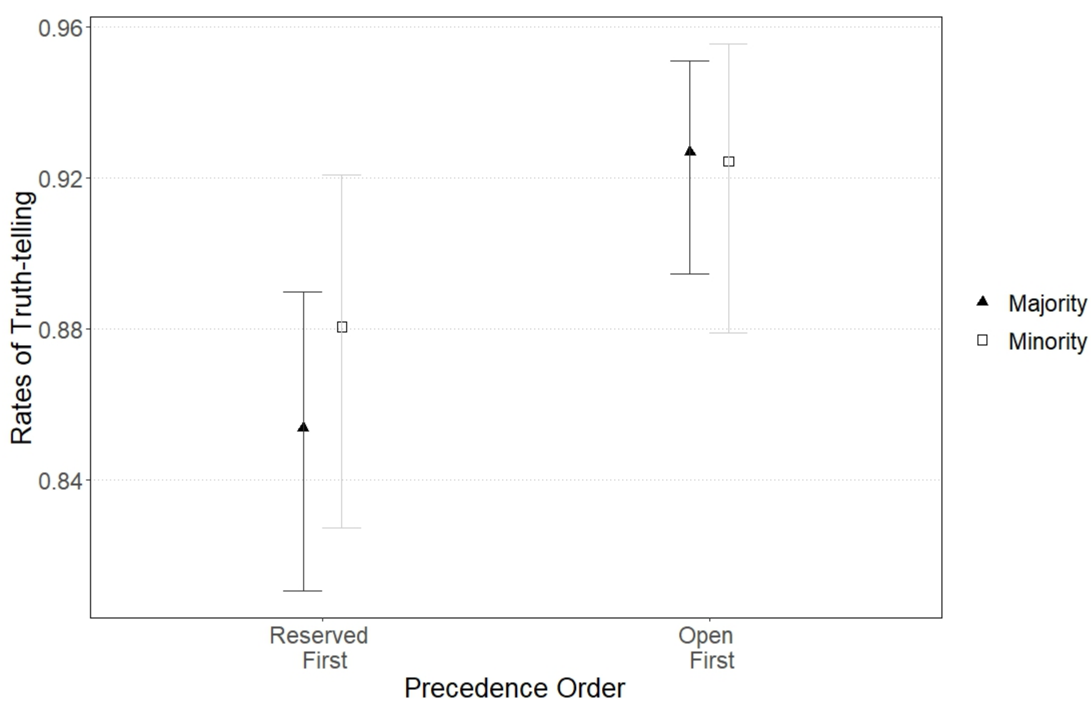


Figure 11: Rates of Truth-telling by Precedence order and Student Types under Blue Priority: Alternate Truth-telling Definition

Table 14: Truthful Reporting under Blue Priority Order: Alternate Truth-telling Definition

Treatment:	Blue	
Dependent variable:	Truth-telling	
	(1)	(2)
TTC	−0.155	−0.001
	(0.132)	(0.120)
OpenFirst	−0.334***	−0.575***
	(0.136)	(0.158)
Minority	0.066	0.171
	(0.094)	(0.176)
Period		−0.028
		(0.036)
OpenFirst x TTC		−0.351
		(0.255)
OpenFirst x Minority		−0.206
		(0.177)
TTC x Minority		−0.092
		(0.257)
OpenFirst x Minority x TTC		0.127
		(0.285)
Intercept	1.209***	1.150***
	(0.073)	(0.149)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level; *p <0.1; **p <0.05; ***p <0.01

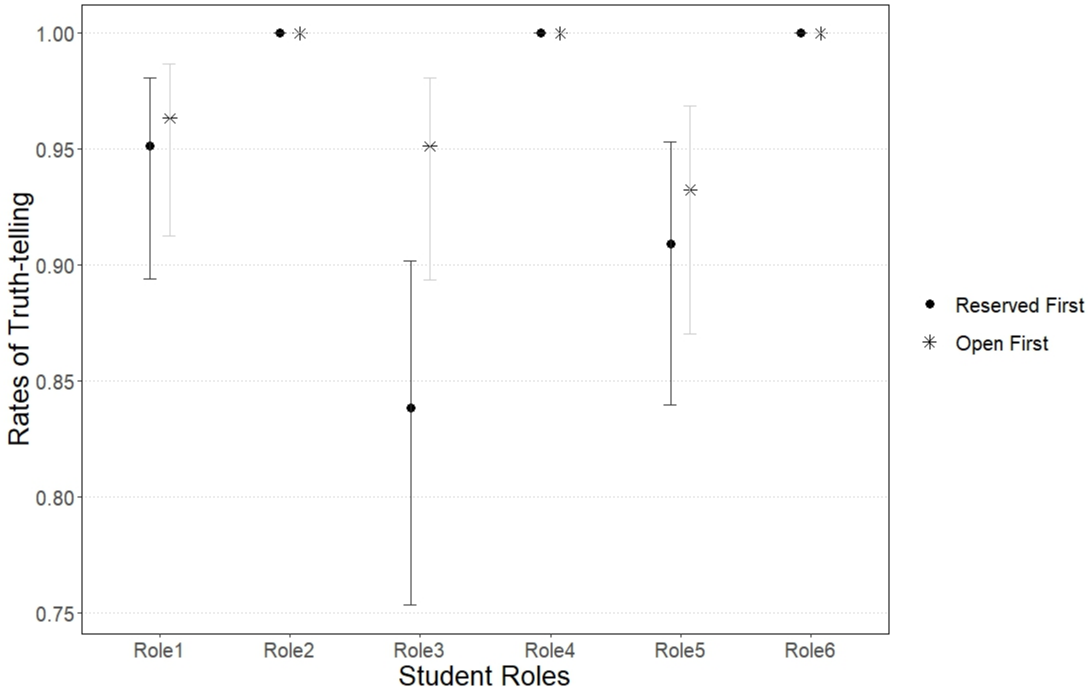


Figure 12: Rates of Truth-telling by Student Roles under Green Priority: Alternate Truth-telling Definition

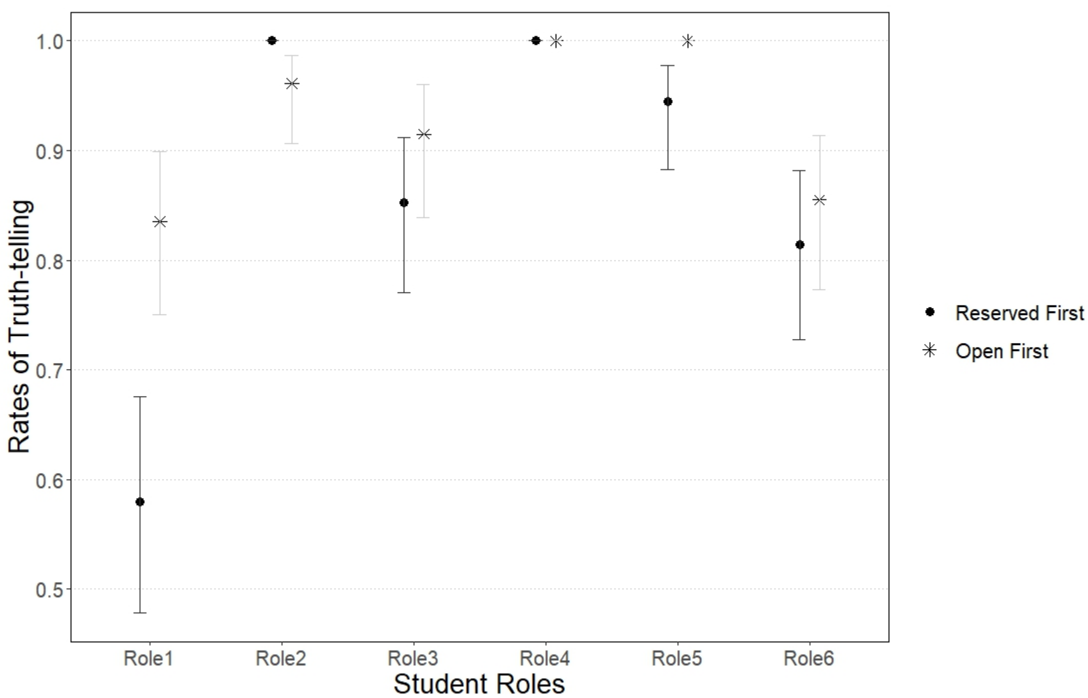


Figure 13: Rates of Truth-telling by Student Roles under Blue Priority: Alternate Truth-telling Definition

7.2 Appendix B. Additional Efficiency Analysis

This appendix provides supplementary analysis using ordinal efficiency measures to assess efficiency. We use an assigned rank variable equal to one if the student is assigned to her favorite school, ..., and three if the student is assigned to her least preferred school. Tables 15 and 17 present the estimation results of ordered logit regression. Tables 16 and 18 present the marginal effects of the aforementioned Tables, respectively. Consistent with our findings in Section 4.2 on cardinal efficiency analysis, minority students have lower assigned rank under OpenFirst under both environments; Green and Blue. This indicates that they are more likely to be assigned to the favorite or second most preferred school under OpenFirst.

Table 15: Ordinal Efficiency under Green Priority

Treatment:	Green	
Dependent variable:	Assigned Rank	
	(1)	(2)
TTC	0.004	−0.011
	(0.107)	(0.182)
OpenFirst	−0.240	0.339*
	(0.108)	(0.177)
Minority	−2.029***	−1.085***
	(0.124)	(0.211)
Period		−0.018
		(0.040)
OpenFirst x TTC		0.061
		(0.250)
OpenFirst x Minority		−2.962***
		(0.517)
TTC x Minority		−0.024
		(0.298)
OpenFirst x Minority x TTC		−0.254
		(0.765)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level; $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01

Table 16: Marginal Effects under Green Priority: Ordinal Efficiency

	Assigned rank 1	Assigned rank 2	Assigned rank 3
Minority OF	0.964	0.021	0.015
	(0.347)	(0.339)	(0.351)
Minority RF	0.637	0.175	0.188
	(0.134)	(0.095)	(0.139)
Majority OF	0.289	0.211	0.500
	(0.110)	(0.075)	(0.106)
Majority RF	0.370	0.221	0.409
	(0.113)	(0.072)	(0.113)

Notes: Assigned Rank 1 = Assigned to favorite school;
Assigned Rank 2 = Assigned to second favorite school;
Assigned Rank 3 = Assigned to least preferred school.

Table 17: Ordinal Efficiency under Blue Priority

Treatment:	Blue	
Dependent variable:	Assigned Rank	
	(1)	(2)
TTC	0.069	0.047
	(0.109)	(0.171)
OpenFirst	-0.446^{***}	-0.146
	(0.109)	(0.174)
Minority	-3.011^{***}	-2.537^{***}
	(0.141)	(0.267)
Period		0.008
		(0.040)
OpenFirst x TTC		-0.048
		(0.246)
OpenFirst x Minority		-1.794^{***}
		(0.495)
TTC x Minority		0.081
		(0.324)
OpenFirst x Minority x TTC		0.560
		(0.641)
Observations	1,440	1,440

Notes: Clustered standard errors at the session level; $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 18: Marginal Effects under Blue Priority: Ordinal Efficiency

	Assigned rank 1	Assigned rank 2	Assigned rank 3
Minority OF	0.931	0.053	0.016
	(0.269)	(0.261)	(0.278)
Minority RF	0.715	0.205	0.079
	(0.101)	(0.126)	(0.164)
Majority OF	0.197	0.335	0.468
	(0.119)	(0.075)	(0.110)
Majority RF	0.172	0.318	0.511
	(0.119)	(0.077)	(0.107)

Notes: Assigned Rank 1 = Assigned to favorite school;
Assigned Rank 2 = Assigned to second favorite school;
Assigned Rank 3 = Assigned to least preferred school.

7.3 Appendix C. Learning Effects

This appendix provides figures for learning effects.

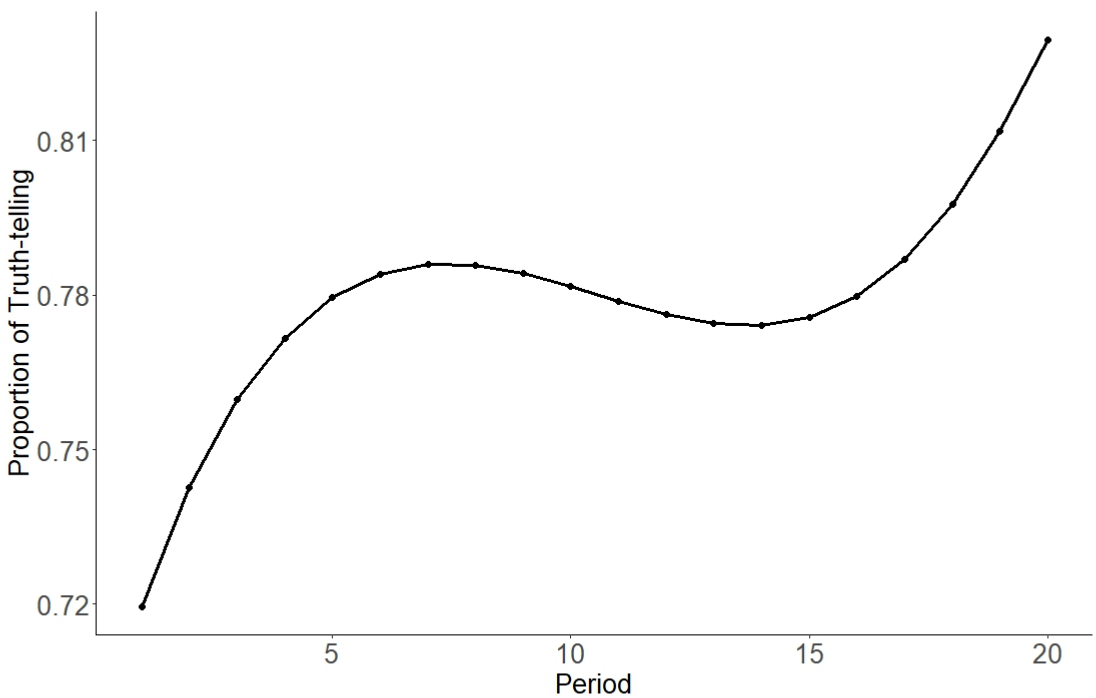


Figure 14: Learning Effect: Overall Proportion of Truth-telling rates

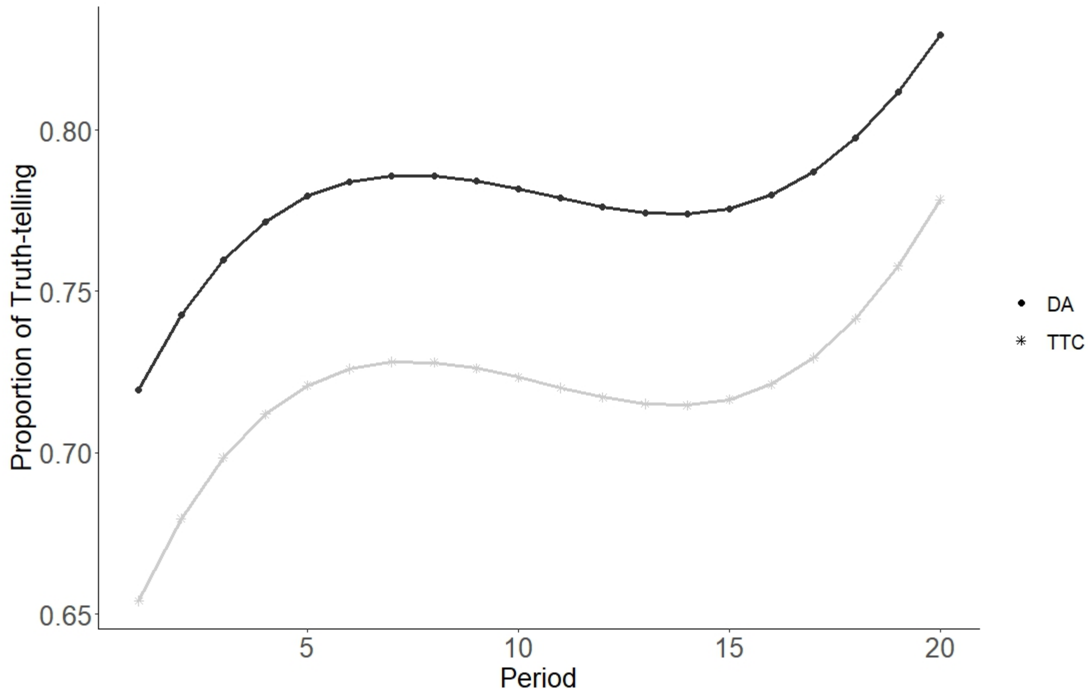


Figure 15: Learning Effect: Proportion of Truth-telling rates by Mechanism

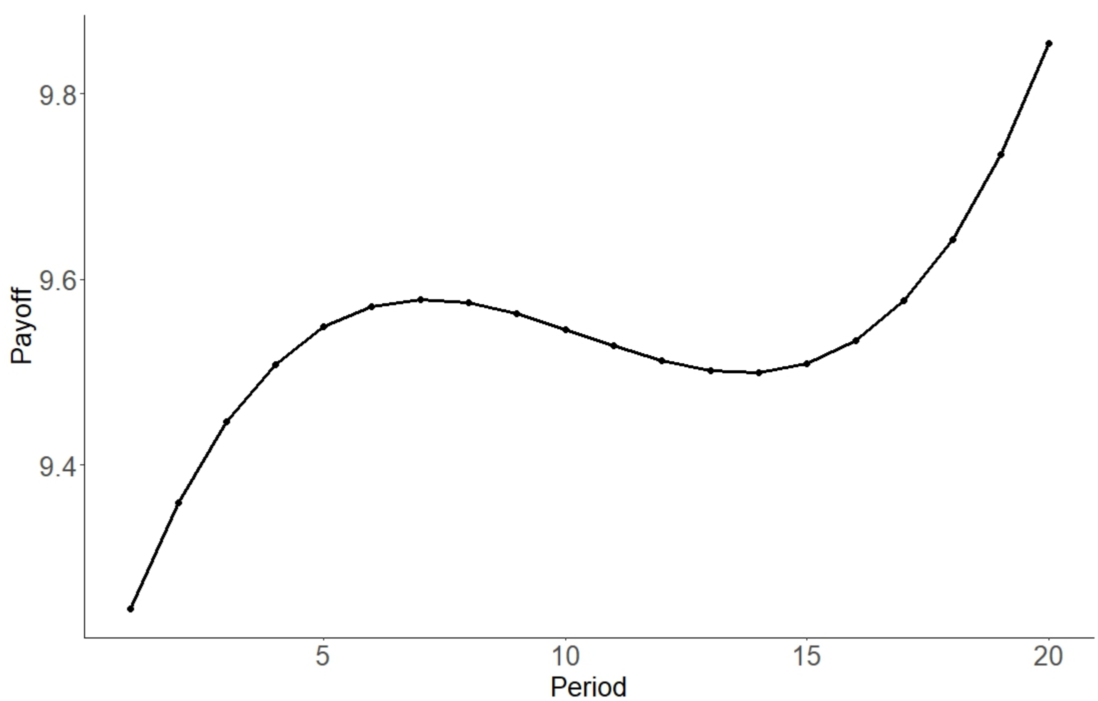


Figure 16: Learning Effect: Overall Payoff

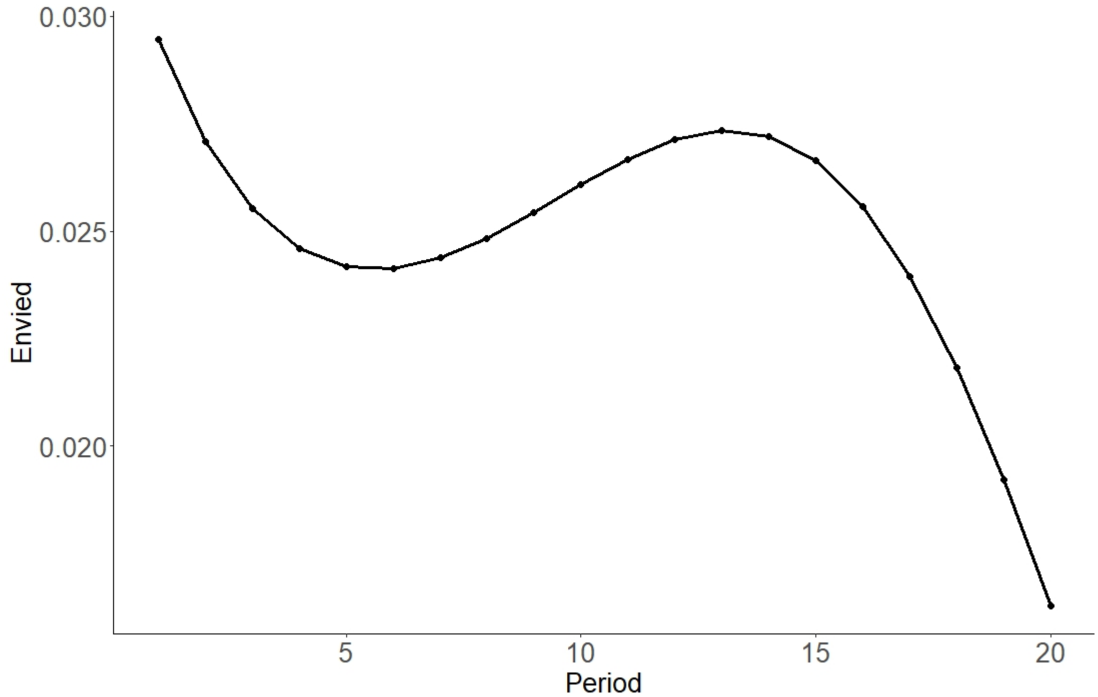


Figure 17: Learning Effect: Overall Proportion of being Envied with Justified Envy

7.4 Appendix D. Experimental Instructions

Welcome!

Today you will participate in an experiment where you can earn a considerable amount of money that will be paid to you in cash as you leave today. The following instructions tell you everything you need to know to earn as much as possible, so please read them carefully. If you have any questions, please raise your hand and a monitor will come and answer them.

You will play the role of a student choosing a school. You will rank schools in an application process to try to get a seat at the best school you can. Your payoff is determined by which school you are assigned to. You will receive higher payoffs for being assigned to a school that you desire more and lower payoffs for being assigned to a school that you desire less. Desirability of each school is summarized in the payoffs on the final two pages.

You have been randomly assigned to a group of six students (you and five other students). The other students in the room are also in groups of six students but may be in a different group than you are. You will not be told who else in the room is in your group and they will not be told that you are in their group.

We will repeat the application process several times; each repetition is called a period. In each period, you will rank the schools and submit your ranking. Once all students in your group have submitted their rankings, all applications are submitted to schools to determine which students get admitted to which schools. Schools are played by the computer.

You will participate in 20 periods in today's experiment. After the last period, the computer will randomly choose one period to count for your payment. Any one of the periods could be the period that counts! It is in your best interest to treat each period as if it is the one that determines your payment. Payment that you earn in today's experiment will be paid in cash at the end of the experiment.

You will always have a copy of these instructions to refer to and you are encouraged to look over the instructions again during the experiment.

Payoffs

There are three schools: A, B, and C. Each school has two available seats. There are 6 students (including you) trying to gain admission to one of the schools.

Each student (you and the other students in your group) will be assigned a role for each period. Your role is determined by your number: 1, 2, 3, 4, 5, 6. Roles are randomly selected by the computer program for each period and change from period to period. In each period, your role determines which school has the highest, second highest, and lowest payoff for you:

Highest Payoff = 20 dollars
Second Highest Payoff = 10 dollars
Lowest Payoff = 0 dollars

Being assigned to a school that gives you a higher payoff earns you higher payment and therefore more cash in your pocket!

More information on the student in each role (1, 2, 3, 4, 5, 6) is shown on the final page of these instructions. Refer to this information throughout.

Application Process

Subgroups

Six students (1, 2, 3, 4, 5, 6) are further divided into Subgroup S and T. Students 1, 2, 3, and 4 belong to Subgroup S. Students 5 and 6 belong to Subgroup T.

Open First and Reserved First

Schools have a priority order that is predetermined independently for each school which depends on types of seats: **Open (O)** and **Reserved (R)** seats.

School A has two open seats. Schools B and C have one open seat and one reserved seat. All players in either subgroup, S and T, are eligible for both open and reserved seats.

When filling open seats, schools use the priority orders of Open seats. When filling reserved seats, schools use the priority orders of Reserved seats.

There are two different scenarios: Open First and Reserved First. In Open First, schools first fill Open (O) then Reserved (R) seats (hence Open First). In Reserved First, schools first fill Reserved (R) then Open (O) seats (hence Reserved First). If schools fill open seats first, they only fill reserved seats after open seats are filled, and likewise for reserved seats first.

The priority orders of Reserved seats for each school are slightly modified from Open seats such that the students of Subgroup T are placed at the top of the priority order for reserved seats without affecting the orders of the students of Subgroup S.

In today's experiment, priority orders will change, but you will always be told at the beginning of each period which priority order you are about to play.

Your chance of being assigned to a school depends on three things:

• The order in which schools process seats,
• The place you rank that school in your submitted list,
• Schools' priority orders.

Steps of the Application Process

When you submit your rankings of schools, the system takes your rankings with those of the other students in your group to determine which students get which seats. This process works as follows:

• Each student points to her first-choice school that she reported in the submitted ranking of schools.

• Each school points to the student with the highest priority at the school based on the type of the seat it is filling at that step.

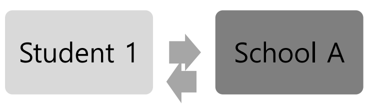
• The computer identifies a cycle. A cycle occurs when a student (school) draws an arrow to the school (student) and, following the arrows, loops back to where the arrow started. A student is assigned to the school she is pointing to, and this only happens when she is in the cycle. The matched student and the seat she is assigned to are removed from the remaining steps. A school is removed from the remaining steps once all the seats are taken.

• The process repeats with each unassigned student pointing to her highest ranked school for which seats are remaining. Each school with an available seat points to the student with the next highest priority based on the type of the seat it is filling at that step.

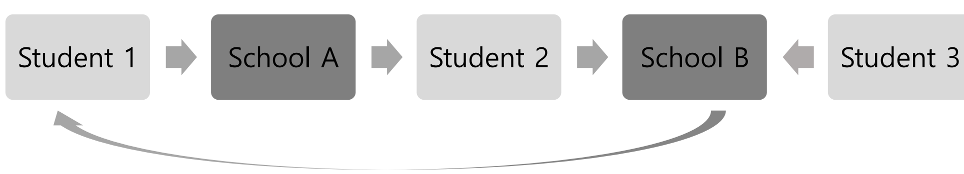
• The process ends when all seats are taken.

You will have up to three minutes to submit your rankings of schools each period.

EX) Here is an example of a cycle. Student 1 points to School A, School A points back to her. Student 1 is assigned to School A.

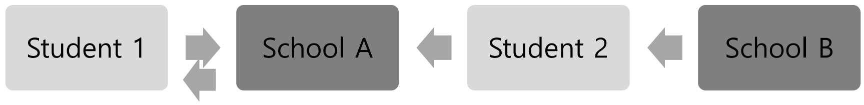


EX) Here is an example of a different kind of cycle that is a longer loop. There are three students; Student 1, 2, and 3. There are two schools; School A and B each with one seat. Student 1 points to School A, School A points to Student 2, Student 2 points to School B, and School B points back to Student 1. This is considered to be a cycle because one directional arrow begins and ends with Student 1. Student 1 is assigned to School A and Student 2 to School B. The matched students and the seat they are assigned to are removed from the remaining steps. Although Student 3 points to School B, she is not in the cycle and therefore will be left unassigned.

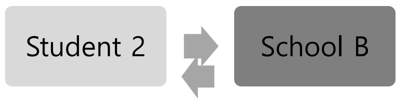


EX) Here is an example where the application process takes more than one step. There are two students; Student 1 and 2. There are two schools; School A and B each with one seat. In the first step, both Students 1 and 2 point to School A, but School A only points back to Student 1 who has the highest priority at School A. The first cycle only has Student 1 and School A. Student 1 is assigned to School A and they are removed from the remaining steps. Student 2 and School B proceed to the next step. In the second step, Student 2 applies to her next highest (best) school, School B, and it points back to her. She is assigned to School B.

Step 1)



Step 2)



As a reminder, you as a student are asked to submit a ranking of schools. The description of the above Steps of the Application Process is here to help you understand how the application process works. Once you submit your rankings of schools, the computer program determines which students get which seats following the steps above.

Review Questions

We will go through an example to illustrate how the application process works. Feel free to refer to the experimental instructions before you answer any question. Each correct answer is worth 0.25 cents, which will be added to your total earnings. You can earn up to 3.25 dollars for the review questions.

Review Questions 1-4
Where would each student be assigned to if schools fill **open seats first**?

Information for Review Question 1-5 only

Students: 1, 2, 3, and 4 (1 and 2 belong to Subgroup S and 3 and 4 belong to Subgroup T).

Schools: A, B, and C (A has one open and one reserved seat and School B and C have one open seat only).

Priority Order

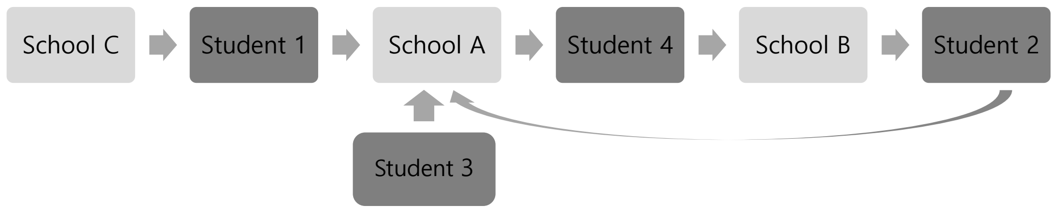
	School A		School B	School C
	Open	Reserved	Open	Open
Highest Position	4	4	2	1
Second Position	1	3	4	2
Third Position	2	1	1	3
Lowest Position	3	2	3	4

Submitted School Rankings: The students submit the following school rankings:

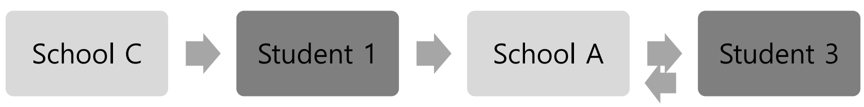
	Student 1	Student 2	Student 3	Student 4
First Choice	A	A	A	B
Second Choice	B	B	B	A
Third Choice	C	C	C	C

Once school rankings are submitted, the assignment of the students to the schools is determined by a procedure in the computer program. Please use this sheet to work out the assignment and enter the final assignment into the computer for Review Question #1-4. The process consists of the following steps:

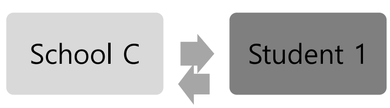
Step 1: Each student points to their first-choice school. Each school points to the student with the highest priority at the school based on the type of the seat it is filling. Look for a cycle. The matched student and the seat she is assigned to are removed from the remaining steps. A school is removed from the remaining steps once all the seats are taken.



Step 2: Each unassigned student in Step 1 points to highest ranked school for which seats are remaining. Each school with an available seat points to the student with the next highest priority based on the type of the seat it is filling. Look for a cycle. The matched student and the seat she is assigned to are removed from the remaining steps. A school is removed from the remaining steps once all the seats are taken.



Step 3: Each unassigned student in Step 2 points to highest ranked school for which seats are remaining. Each school with an available seat points to the student with the next highest priority based on the type of the seat it is filling. Look for a cycle. The matched student and the seat she is assigned to are removed from the remaining steps. A school is removed from the remaining steps once all the seats are taken.



The process ends at Step 3.

Please enter your answers into the computer for Review Question 1-4. Feel free to look through the instructions and the example as you complete this and the remaining Review Questions.

1-4. Where would each student be assigned to if schools fill **Open seats first**? *Correct Answer: Student 1 is assigned to School C, 2 to A, 3 to A, and 4 to B.*

5. In the first review question you just worked on, suppose instead schools fill **Reserved seats first**. In Step 2 of the application process, to which student would School A be pointing to? *Correct Answer: Student 1*

Please refer to page 2, 3, and 9-10 of the instructions for remaining questions.

6. How many schools are available for students to be assigned in each period? *Correct Answer: 3*

7. How many open seats do schools A, B, and C have? How many reserved seats do schools A, B, and C have? *Correct Answer: School A has two open seats, Schools B and C each have one open seat. School A has zero reserved seats, Schools B and C each have one reserved seat.*

8. Fill in the blank: In Open First, schools first fill _____ seats then _____ seats. In Reserved First, schools first fill _____ seats then _____ seats. *Correct Answer: Open, Reserved, Reserved, Open*

9. True or False: When schools fill Reserved seats, Student 5 and 6 of Subgroup T, are placed on top of the priority order without affecting the orders of the students in Subgroup S. *Correct Answer: True*

10. True or False: When schools fill Open seats, Student 5 and 6 of Subgroup T, are placed on top of the priority order without affecting the orders of the students in Subgroup S. *Correct Answer: False*

11. True or False: The school that gives you the highest payoff will be the same for the entire 20 periods. *Correct Answer: False*

12. True or False: Roles (1, 2, 3, 4, 5, 6) change from period to period. *Correct Answer: True*

13. True or False: The other students in your group may have a different favorite school than you. *Correct Answer: True*

As a reminder, each correct answer is worth 0.25 cents, which will be added to your total earnings. You can earn up to 3.25 cents for the review questions.

Of the 13 review questions, you need to answer at least 11 correctly to continue to the experiment. If you answer fewer than 11 questions correctly, you will be asked to retake the quiz until you correctly answer at least 11 questions. However, you will be only paid for the number of questions correct on the first quiz attempt. You may ask questions at any point and may refer to the instructions and the example throughout the quiz and the experiment itself.

If you have any questions, please raise your hand and a monitor will come to answer your questions in private.

You will now do four practice periods before the periods for pay begin.

Information for Today's Session

Students: 1, 2, 3, 4, 5, and 6 (1 – 4 belong to Subgroup S and 5 – 6 belong to Subgroup T).

Schools: A, B, and C (A has two open seats, and B and C have one open and one reserved seat).

Blue Priority Order

	School A	School B		School C	
	Open	Open	Reserved	Open	Reserved
Highest Position	1	3	5	5	5
Second Position	2	5	6	1	6
Third Position	3	6	3	6	1
Fourth Position	4	1	1	3	3
Fifth Position	5	2	2	2	2
Lowest Position	6	4	4	4	4

For example, School B gives highest priority to Student 3, second highest priority to Student 5, third highest priority to Student 6, etc. **when filling open seats**. However, it gives highest priority to Student 5, second highest priority to Student 6, and third highest priority to Student 3, etc. **when filing reserved seats**.

Payoff

	Subgroup S				Subgroup T	
	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
Highest Payoff ($20)	B	B	C	B	C	C
Second Highest Payoff ($10)	C	C	B	C	B	B
Lowest Payoff ($0)	A	A	A	A	A	A

For example, Student 1 earns $20, $10, and $0 if she is assigned to School B, C, and A while Student 5 earns $20, $10, $0 if she is assigned to School C, B, and A.

Information for Today's Session

Students: 1, 2, 3, 4, 5, and 6 (1 – 4 belong to Subgroup S and 5 – 6 belong to Subgroup T).

Schools: A, B, and C (A has two open seats, and B and C have one open and one reserved seat).

Green Priority Order

	School A	School B		School C	
	Open	Open	Reserved	Open	Reserved
Highest Position	1	3	5	6	6
Second Position	2	1	6	3	5
Third Position	3	2	3	5	3
Fourth Position	4	4	1	1	1
Fifth Position	5	5	2	2	2
Worst Position	6	6	4	4	4

For example, School C gives highest priority to Student 6, second highest priority to Student 3, third highest priority to Student 5, etc. **when filling open seats**. However, it gives highest priority to Student 6, second highest priority to Student 5, and third highest priority to Student 3, etc. **when filing reserved seats**.

Payoff

	Subgroup S				Subgroup T	
	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
Highest Payoff ($20)	B	B	C	B	C	C
Second Highest Payoff ($10)	C	C	B	C	B	B
Lowest Payoff ($0)	A	A	A	A	A	A

For example, Student 1 earns $20, $10, and $0 if she is assigned to School B, C, and A while Student 5 earns $20, $10, $0 if she is assigned to School C, B, and A.