Matching and Segregation: An Experimental Study*

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Abstract

Social segregation is a ubiquitous feature of human life. People segregate along the lines of income, religion, ethnicity, language, and other characteristics. This study provides the first experimental examination of decentralized matching with search frictions and institutionalized segregation. The findings indicate that, without a segregation institution, high types over-segregate relative to the equilibrium prediction. We observe segregation attempts even when equilibrium suggests that everyone should accept everyone else. In the presence of a segregation institution, we find that, while the symmetric segregation institution increases matching success rate and efficiency in one environment, it has weak or no effect in another environment. By adding an entry cost to one market, however, the asymmetric segregation institution leads to increased matching success rate and efficiency in both environments, which underscores the importance of a coordination device.

Keywords: decentralized matching, segregation, experiment

JEL Classification: C78, D83

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1 Introduction

Segregation manifests itself in various aspects of the social and economic structure. People segregate along the lines of income, religion, ethnicity, language, and other characteristics. Segregation also occurs when people form communities for social interactions. In these situations, people choose with whom they interact. Book clubs, bowling leagues and country clubs are traditional forms of social communities. More recently, cyberspace has become the home of thousands of online communities, i.e., groups of people who meet to share information, discuss mutual interests, play games and carry out business. Many of them have no central authority. Instead, the formation and maintenance of these online communities are completely voluntary. Many online groups provide not only information exchange, but also companionship, social support and a sense of belonging. For example, while the majority of users of "SeniorNet" report joining the Net to seek information, 47 percent also join to find companionship (Wellman and Gulia 1999). Such social communities lead to several interesting questions. How do these communities emerge? How do they evolve over time? Who joins which community?

Economists have long been interested in who interacts or trades with whom and how clubs form to facilitate interaction and trade. The earliest such work can be attributed to Becker (1973), who predicts that, without search frictions, perfect assortative matching arises when agents productively interact in a complementary fashion. Based on this work, Mortensen (1982), Diamond (1982) and Pissarides (1990) develop a decentralized matching framework with search frictions. This framework has proved to be a useful tool in labor economics, macroeconomics and monetary theory. Examples include the decision of a worker and a firm to enter into a employment relationship; the decision of a man and a woman to marry; and the decision of a buyer and a seller to complete a transaction. These models make clear equilibrium predictions of who matches with whom and whether agents with higher productivity spend more or less time searching than those with lower productivity before finding a suitable match. In particular, they predict that agents apply a threshold strategy, i.e. they accept types above a certain threshold and reject lower types. Furthermore, the thresholds are increasing in the types. Since higher types do not accept types below certain threshold, unsuccessful matches occur. The reduction of unsuccessful matches motivates a new stream of studies on matching and segregation.

Building on matching models with search frictions, several studies independently discover the perfect segregation result (Collins and McNamara 1990, Smith 1992, Bloch 2000, Morgan 1995, Burdett and Coles 1997, Chade 2001, Eeckhout 1999). This result indicates that, when it is possible to segment the market into multiple markets, there exists matching equilibria where agents sorted by ability (type) form clusters and mate only within these clusters. In this scenario, when type qualities are complementary in the production function, segregation improves market efficiency by reducing search costs and thus ameliorating the negative externality inflicted by low types. Morgan (1995) calls this result a theory of *club formation*, while Smith (2006) calls it *perfect segregation*. Burdett and Coles (1997) call it *formation of class*.

Empirical studies of matching and segregation mostly use survey data. For example, Wong (2003) uses a structural approach to estimate a two-sided matching model largely based on Burdett and Coles (1997). She uses the Panel Study of Income Dynamics (PSID, 1968-1993) and finds that wage is a more desirable trait than education in predicting marriageability for white men, while education is more desirable for black men.

While field studies are valuable to further our understanding of segregation, they are limited by the information available in field data. First, agent preferences are not observable. As a result, it is difficult to assess the welfare changes caused by institutionalized segregation. Second, we do not have detailed field data about how segregation occurs. In comparison, controlled laboratory studies enable us to induce agent preferences, to observe how segregation occurs, to separate rational and nonrational segregation, and to compare the efficiency difference with and without segregation institutions at a level of detail unavailable in field data.

We now summarize our main findings and compare them to the theoretical predictions. In our experiment, we implement treatments with and without segregation institution. We examine segregation attempts at both the individual level and the institution level. Our most important finding concerns the fact that high types oversegregate relative to the equilibrium prediction, suggesting strong segregation forces beyond those captured by theory. These individual attempts at oversegregation prevail in the presence and the absence of a segregation institution. Even in those environments where equilibrium predicts that everyone should accept everyone else, high types typically refuse to be matched with low types. We can explain this oversegregation by a noisy best reply model which indicates that, given the empirical distribution of acceptance thresholds, the observed behavior is a noisy best response.

In the presence of a segregation institution, when there are two types of equilibria, segregation equilibria where agents sort themselves into different markets and mate only within each respective market, and a collocation equilibrium where all agents collocate and mate in the same market, a segregation equilibrium is selected. We observe high types successfully segregate themselves from low types in most sessions. Theory also predicts that efficiency increases with a segregation institution. We find that, while the symmetric segregation institution increases matching success rate and efficiency in one environment, it has weak or no effect in another environment. By adding an entry cost to one market, however, the asymmetric segregation institution leads to increased matching success rate and efficiency in both environments, which underscores the importance of a coordination device.

This study provides the first experimental examination of decentralized matching with search frictions and institutionalized segregation. Although a fair number of experimental papers test the related search theory (Cason and Friedman 2003, Cason and Noussair 2007), they do not address the problem of social segregation. Another related experimental literature on centralized matching, e.g., Nalbantian and Schotter (1995), Kagel and Roth (2000), and Chen and Sönmez (2002), studies the incentive effects of various centralized clearinghouse mechanisms. Most of this literature does not deal with the issue of segregation. More recently, Niederle and Roth (2009) use laboratory experiments to isolate the effects of exploding offers and binding acceptances in labor markets. Some features of their setup, such as complementarity of the production function, are similar to our design. In an interesting study of self-selection and cooperation, Bohnet and Kübler (2005) experimentally investigate whether auctioning off the right to play a prisoner's dilemma game separates participants into conditional cooperators and money maximizers. They find that the auction does induce more cooperation compared to the status quo, although sorting is incomplete and cooperation deteriorates over time.

The remainder of this paper is organized as follows. In Section 2, we present the experimental design for a modified one-population decentralized matching model. We choose the one-population model, as it is the simplest one in this stream of research. Section 3 characterize the set of equilibria in the experimental environment. Section 4 presents the main results. Section 5 concludes.

2 Experimental Design

The goal of our experimental design is to test the theoretical predictions about equilibrium strategies, the role of institutions which facilitate segregation (hereafter called *segregation institution*), and welfare comparisons between treatments with and without segregation institution.

Our experiment is based on the following model. In a typical matching model, a continuum of heterogeneous agents search for a partner. Each agent is characterized by its productivity or type. In each period, each agent pays a fee to be matched with one other agent.[1] Each agent costlessly observes the other's type and decides whether the other is an acceptable mate. If each finds the other acceptable, then the pair mates. Mated agents then leave the market forever. When a mated pair exits the market, it is replaced by two unmated agents of the same respective types. If the paired agents do not mate, then they separate and remain alone until the next period. The utility from a mate increases in his or her type. We focus on environments with complementary production functions. In such an environment, there exists a unique perfect mating equilibrium in which all agents use reservation value search strategies, i.e., each agent only accepts a mate whose type is above a certain threshold.

With complementary production functions, search cost has two negative effects on efficiency. First, if a matched pair does not mate, we have a deadweight loss. Second, search cost changes the equilibrium strategies. For instance, it can decrease the threshold of high types, resulting in suboptimal mating. Hence, social welfare generated by the market can be improved by segmenting the market. In this context, a segment is a set of types that search and mate only among themselves. A mating equilibrium is inefficient if high types are obliged to sample from the the entire population of types, thereby reducing the chance that a high type will locate another high type on the next try and so making it rational for high types to accept lower types, a socially suboptimal action. Segregation provides higher types with a means of reducing search costs and ameliorating the negative externality inflicted by lower types. If utilities from a partner is increasing in his or her type, there exists a matching equilibrium in which agents partition into segments and mating occurs only among agents belonging to the same segment. The resulting assignment of types to segments is incentive-compatible for all types. In this scenario, segregation improves market efficiency.

The setup of the theoretical models is challenging for laboratory studies. For example, a typical decentralized matching model assumes a continuum of agents. To preserve stationary distribution of types on the market, the model assumes that a mated pair exits the market and is replaced by two unmated agents of the same respective types. These assumptions are difficult to implement in a laboratory setting. In our study, we relax some of these assumptions and numerically compute the equilibrium.

We implement a 2×3 factorial design. To test the robustness of the theoretical predictions with regard to changes in the environment, we use two different payoff matrices. For each payoff matrix, we implement three treatments, one with a single market (with no social institution to facilitate segregation), one with two symmetric markets with no entrance fee where agents can choose which market to join and trade exclusively in (with an institution to facilitate segregation), and lastly, one with two asymmetric markets where one has an entrance fee while the other does not. The entrance fee is introduced to facilitate coordination.[2]

[1] Morgan (1995) and Chade (2001) model search cost as a fixed cost per period, while the other studies model it as pure time cost and thus use discounting.

[2] We thank an anonymous referee for suggesting this treatment.

Our design is based on the theoretical literature, but is adapted to the laboratory setting. Our game departs from the theoretical models in two ways. First, as it is not feasible to have a continuum of agents in the laboratory, we use a discrete number of agents. Second, after each mated pair exits the market, they enter a queue and then enter the market again as new types. The latter is designed to reuse the same group of subjects but give them different types. The introduction of the queue is a novel feature of the experimental design. Without a queue, the likelihood that an agent leaving the market will assume the same type upon entering the market again is high, when the number of agents exiting the market is small. The queue reduces this likelihood, and therefore, allows each subject to make multiple rounds of decisions and learn about this rather complicated game. At the same time, it preserves the stationarity of the distribution of types on the market. As agents tend to assume different types in different "lives", this design feature minimizes motives such as envy and snobbery, which might appear if an agent has a fixed type throughout the experiment. These motives are not part of the theory. Therefore, we think that letting an agent be different types in different "lives" gives theory the best chance.

Since theory requires a stationary distribution of types on the market, we fix the distribution of types to a set of discrete points, $\{1, 2, \cdots, 6\}$. In our experiment, participants know the exact set of types. Each session has sixteen participants. During any given period, twelve of the participants are on the market(s) and four are in a queue. We randomly assign each of the twelve participants their types from the set, $\{1, 2, \cdots, 6\}$. Each type is assigned to exactly two participants, which allows for the possibility for each type to be matched with another of its own type. The four participants in the queue do not have types assigned to them. For treatments with one market (hereafter **no segregation institution**), the experiments uses the following procedure.

1. At the beginning of each period, each participant on the market is informed of his type, t_i. Each then submits a threshold value, τ_i, i.e., a reservation value which specifies the lowest type he is willing to accept.

2. The twelve participants in the market are randomly matched into six pairs. Each participant in a pair is informed of his match's type, t_j, and therefore, whether his match is acceptable or not, i.e., whether $t_j \geq \tau_i$. Furthermore, he is informed of whether his match accepts or rejects him, i.e., whether $t_i \geq \tau_j$. Participants are not informed of their match's threshold.

   (a) A mating is successfully made if and only if both partners accept each other. In this case, the mated pair exits the market, each with a profit of the payoff derived from mating, $\mu(t_i, t_j)$, minus the per period search cost, c.

   (b) Otherwise, participants remain on the market and keep their types, while incurring a search cost of c.

3. The four participants in the queue do not make any decisions and incur no search cost.

4. At the end of each period, all those who exit the market that period are put to the end of the queue in a randomized order. Participants in the queue enter the market sequentially, getting randomly assigned the types of the exiting participants.

5. At the end of each period, one of the participants throws a ten-sided die. The experiment ends when the numbers eight or nine show up. In other words, the discount factor is 0.8.

6. If there is an insufficient number of periods,[3] we start a new run from the very beginning. This means that all participants are randomly reassigned their roles. Twelve participants are assigned to the market with new types, while four participants are assigned to the queue.

7. Each participant is informed of her earnings for a period, as well as her cumulative earnings, at the end of each period. Subjects are paid for all periods.

The procedure for the treatments with two markets (**segregation institution**) is similar to that for the treatments with no segregation institution, except that participants need to choose between the two markets at the beginning of each period. More specifically,

1. At the beginning of each period, each of the participants independently and simultaneously decide whether to enter market A or market B.

   In treatments with symmetric markets, there is no entrance fee to enter either market. In comparison, in treatments with asymmetric markets, participants entering market A incur a small fee, while market B remains free.

2. If there are an even number of participants in both markets, pairs can be formed. However, if there are an odd number of participants in each market, this is not feasible. Whenever this odd problem occurs, one participant is chosen randomly to stay in a market which is not his choice. The selection of this participant is subject to the following constraints:

   (a) In the first period, those who choose to stay in market B have priority to stay in B. One of the participants who wants to go to A is randomly chosen to stay in B.

   (b) In subsequent periods, those who have been in a market in the previous period have priority to stay in that market. One of the participants who wants to switch markets is randomly chosen not to switch.

   (c) Participants who wanted to switch in the previous period have priority in choosing to go to a market.

3. After being informed about the market they belong but without knowing the composition of each market, each participant submits a threshold. Once everyone submits a threshold, each participant is informed of how many participants opt for market A, in addition to the information in treatments with no segregation institution. The period proceeds as in treatments with no segregation institution.

Table 1 presents the two payoff matrices in our experiments. Payoff matrix 1 is generated from the supermodular payoff function, $(t_i t_j)^{1.4}$, where t_i and t_j are the types of a matching pair of agents.[4] We take the integer part of this function, and modify the matrix so that, without segregation institution, the segregation equilibrium is asymmetric. We choose an asymmetric segregation equilibrium so that subjects cannot use a focal point, such as (1–3) and (4–6), to segment themselves.

[3]Operationally, we start a new run if the sum of periods of all runs is less than 40. Subjects know that there are restarts but do not know this criterion.

[4]To our knowledge, Haruvy, Roth and Ünver (2006) is the first matching paper that uses supermodular payoff functions.

Payoff Matrix 1							Payoff Matrix 2						
Type	1	2	3	4	5	6	Type	1	2	3	4	5	6
1	1	2	4	6	10	17	1	10	11	12	13	14	16
2	2	6	10	14	27	38	2	11	13	16	18	21	24
3	4	10	25	39	57	74	3	12	16	20	24	28	33
4	6	14	39	50	68	89	4	13	18	24	30	35	41
5	10	27	57	68	90	116	5	14	21	28	35	43	51
6	17	38	74	89	116	150	6	16	24	33	41	51	60

Table 1: Two Payoff Matrices

We design payoff matrix 2 to check whether segregation occurs even when theory does not predict it. The latter is motivated from the sociological studies of residential segregation where neighborhood preferences rather than economic forces are the main cause for segregation. In payoff matrix 2 without segregation institution, in equilibrium, there is no segregation, i.e., everyone always accepts everyone else. In this environment, where economic forces do not lead to stable segregation patterns, we are interested in whether socio-psychological forces lead agents to segregate.

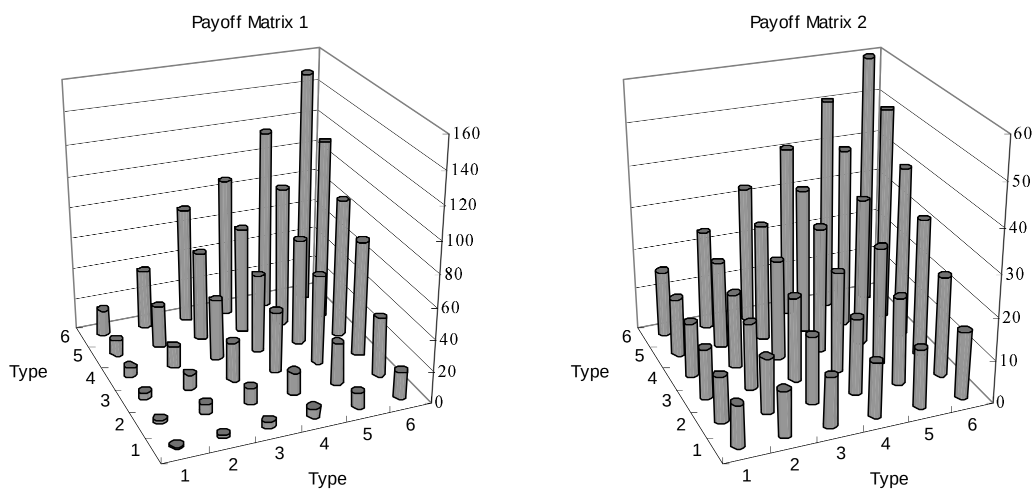

Figure 1: Payoff Matrices 1 and 2

Figure 1 is a three-dimensional representation of the two payoff matrices. Note that the payoff landscape of payoff matrix 1 is much steeper than that of payoff matrix 2. This difference creates different levels of incentives for high types to accept low types, which will be discussed in detail in Section 4. In all treatments, we set search cost to $c = 2$ points. In treatments with asymmetric segregation institutions, the entrance fee to market A is set to one point, which does not change the equilibrium predictions.

Table 2 summarizes the features of our experimental sessions, including the payoff matrix, seg-

Payoff Matrix	Seg. Inst.	Session Number	Number of runs															Total # Periods
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	no	1	6	1	12	8	33											60
1	no	2	6	4	3	5	3	5	3	7	6							42
1	no	3	2	14	1	2	1	1	1	7	9	3						41
1	no	4	1	1	11	3	4	2	12	3	11							48
2	no	5	1	13	1	7	1	4	4	2	4	2	3					42
2	no	6	1	2	10	5	2	7	2	8	4							41
2	no	7	5	1	7	6	6	5	1	3	18							52
2	no	8	6	8	3	4	1	1	9	2	9							43
1	sym	9	11	6	2	3	4	11	1	1	2							41
1	sym	10	4	4	6	4	7	1	4	9	6							45
1	sym	11	4	1	8	1	7	3	5	20								49
1	sym	14	3	3	3	4	3	4	1	3	18							42
2	sym	12	1	1	3	9	5	3	16	1	1							40
2	sym	13	3	3	1	1	1	2	4	1	3	4	6	3	1	3	7	43
2	sym	15	9	1	8	2	3	1	1	2	2	1	4	2	9			45
2	sym	16	2	1	4	13	2	5	4	4	3	4						42
1	asym	17	6	4	9	3	9	3	9									43
1	asym	18	3	8	2	5	2	3	2	6	2	11						44
1	asym	19	2	1	2	10	3	4	4	1	8	5						40
1	asym	20	3	1	4	17	1	1	3	9								39
2	asym	21	1	3	12	8	5	8	12									49
2	asym	22	1	3	12	8	5	8	12									49
2	asym	23	1	6	17	4	6	1	13									48
2	asym	24	1	6	17	4	6	1	13									48

Note:

1. Sym stands for symmetric segregation institutions, i.e., with no entrance fee.
2. Asym stands for asymmetric segregation institutions, i.e., market A with entrance fee, and market B without.

Table 2: Features of Experimental Sessions

regation institution, session number, number of runs in each session and total number of periods in each session. Each session has sixteen subjects. As explained before, at the end of each period, one of the participants throws a ten-sided die to determine whether a run ends that period. Therefore, each run has a different number of periods, ranging from 1 to 33. If the total number of periods is less than 40, we start a new run. This way, the participants in each session have sufficient opportunity to learn about the game. The total number of periods in each session varies from 40 to 60.

For each of the six treatments, we conduct four independent sessions. Overall, 24 independent computerized sessions were conducted at the University of Zürich from December 2001 to January 2002, and in April and May 2009. We use z-Tree (Fischbacher 2007) to program our experiments. The subjects of the 2009 sessions were recruited using the online recruiting system ORSEE (Greiner 2004). Our subjects are students from the University of Zürich and the Swiss Federal Institute of Technology (ETH). No subject is used in more than one session. This gives us a total of 384 subjects. Each session lasts between one hour thirty minutes to one hour fifty minutes, with the first thirty to thirty-five minutes being used for instructions. The exchange rate is ten points for SFr 0.23 for payoff matrix 1, and SFr 0.42 for payoff matrix 2. The average earning is SFr 32.15.[5] The experimental instructions are included in Appendix C. Data are available from the authors upon request.

3 Characterization of Matching Equilibria

In this section, we characterize the matching equilibria in the simple experimental setting. Our notion of equilibrium is the standard *matching equilibrium* in the theoretical literature (Chade 2001). Intuitively, a matching equilibrium is a profile of stationary strategies such that each agent uses an optimal strategy given her conjecture about the strategies chosen by other agents, and these conjectures are correct in equilibrium. In doing so, we only consider symmetric and stationary (i.e., non-history-dependent) strategies.[6]

As we have a discrete number of types and a queue in the experimental implementation which differ from the theoretical models, we compute the matching equilibrium numerically. In what follows, we briefly describe the algorithm. A more detailed description of the computation algorithm is in Appendix A.

For treatments without segregation institutions, in computing the equilibrium, we iterate through all combinations of reservation values for the six types of agents. For each combination of reservation values, we calculate the distribution of types in the queue, which allows us to determine the expected value for each type. Given the expected values for a combination of reservation values, we check the equilibrium conditions. Given the combination of reservation values of other agents, if none of the agents can be made better off by using other reservation values, then we have found an equilibrium.

For treatments with segregation institution, we iterate through every monotonic segregation composition. First, we calculate the equilibrium threshold for each type in each segment. We then check whether any player can do better in the other market. For the latter, we assume that any

[5] The exchange rate between Swiss francs and U.S. dollars was approximately \$1 = SFr 1.65 in January 2002, and \$1 = SFr 1.11 in May 2009.

[6] By symmetry, we mean that agents of the same type choose the same strategy.

player can move to the other market without restrictions. The computation yields the following results.

Proposition 1 (No Segregation Institution)**.** *For payoff matrix 1, without segregation institution, the equilibrium threshold for types 1 and 2 is 1, for type 3 is 2, and for types 4–6 is 3.*
For payoff matrix 2, without segregation institution, the equilibrium threshold for all types is equal to 1. That is, all types are mutually acceptable to each other.

With segregation institution, we have multiple equilibria in each payoff matrix.

Proposition 2 (Segregation Institution)**.** *In both payoff matrices, there is a collocation equilibrium (i.e., everyone in the same market), where the thresholds are the same as in the corresponding treatments without segregation institution.*
In addition, in payoff matrix 1, there is a segregation equilibrium where (1, 2) and (3, 4, 5, 6) are segregated into different markets, and thresholds correspond to the lowest type in each market.

These two propositions serve as the theoretical benchmarks for our data analysis. In the treatments with an entry cost, we choose the entry cost such that it does not change the equilibrium predictions.

In Appendix B, we provide proofs for the existence of the matching equilibrium in the one-market (no segregation institution) and two-market (segregation institution) case, respectively .

4 Results

In this section, we first examine segregation attempts at the individual level by looking at the submitted thresholds. For the treatments with segregation institutions, we examine the segregation patterns in each treatment. We then examine factors affecting matching success rate and efficiency in each treatment.

In our experimental setting, segregation can occur at two levels. At the individual level, attempts to segregate manifest themselves as submitted thresholds, i.e., the lowest type an agent is willing to accept as a trading partner. This type of segregation occurs in all treatments. At the institution level, segregation manifests itself by separating agents into two markets. We investigate each level of segregation and their effects on matching frequency and efficiency. For simplicity of exposition, we call types 1 and 2 low types, types 3 and 4 medium types, and types 5 and 6 high types.

4.1 Individual Segregation Attempts: Submitted Threshold

First, we examine the submitted threshold from each type in each of the six treatments. Note that the submitted threshold is meaningful in treatments with segregation institution, as subjects submit their thresholds each round before observing the market composition of that round.

Figure 2 presents the average submitted thresholds of each type in each treatment, as well as the corresponding theoretical predictions based on Propositions 1 (empty squares) and 2 (empty triangles). The left column presents the average submitted threshold in payoff matrix 1, whereas the right column presents the average submitted threshold in payoff matrix 2. From Figure 2, we can see that the average submitted threshold largely conforms with the theoretical predictions in

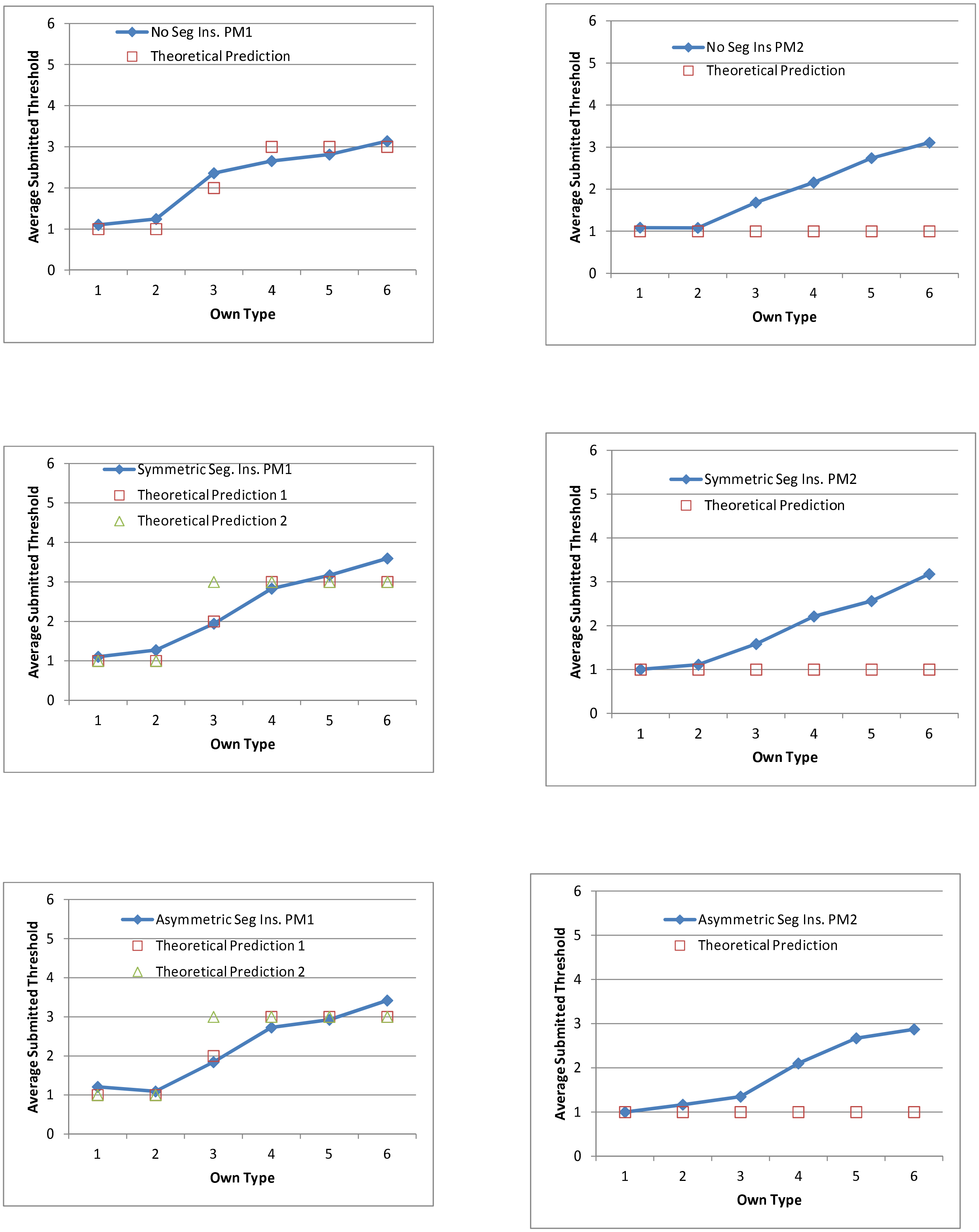

Figure 2: Average Threshold in Payoff Matrices 1 (Left) and 2 (Right)

payoff matrix 1. In particular, with segregation institution, the segregation equilibrium fits the data better than the collocation equilibrium. However, in payoff matrix 2, high type thresholds are markedly higher, although theory predicts everyone should accept everyone else. The following result formally states this finding.

Payoff Matrix 1: No Segregation Institution							**Payoff Matrix 2: No Segregation Institution**						
	Submitted Threshold							Submitted Threshold					
Type	1	2	3	4	5	6	Type	1	2	3	4	5	6
1	**0.93**	0.04	0.03	0.01	0.00	0.00	1	**0.92**	0.02	0.03	0.01	0.01	0.01
2	**0.70**	0.22	0.04	0.02	0.01	0.00	2	**0.89**	0.07	0.03	0.01	0.01	0.00
3	0.24	0.22	**0.48**	0.06	0.01	0.00	3	**0.42**	0.34	0.20	0.03	0.01	0.00
4	0.17	0.15	**0.49**	0.18	0.00	0.00	4	0.24	0.29	**0.34**	0.13	0.01	0.00
5	0.12	0.13	**0.54**	0.16	0.04	0.01	5	0.15	0.20	**0.33**	0.26	0.05	0.00
6	0.13	0.10	**0.38**	0.30	0.10	0.00	6	0.15	0.07	**0.36**	0.26	0.15	0.01
PM 1: Symmetric Segregation Institution							**PM 2: Symmetric Segregation Institution**						
	Submitted Threshold							Submitted Threshold					
Type	1	2	3	4	5	6	Type	1	2	3	4	5	6
1	**0.92**	0.03	0.03	0.02	0.01	0.00	1	**0.96**	0.02	0.01	0.00	0.00	0.01
2	**0.74**	0.19	0.04	0.01	0.02	0.00	2	**0.88**	0.10	0.01	0.01	0.00	0.00
3	**0.34**	0.32	0.27	0.07	0.00	0.00	3	**0.49**	0.36	0.14	0.01	0.00	0.00
4	0.17	0.12	**0.49**	0.21	0.01	0.00	4	0.29	0.29	**0.36**	0.06	0.00	0.00
5	0.15	0.07	**0.35**	0.32	0.11	0.00	5	0.23	0.17	**0.38**	0.21	0.01	0.00
6	0.11	0.04	0.30	**0.36**	0.17	0.02	6	0.19	0.10	0.18	**0.46**	0.08	0.00
PM 1: Asymmetric Segregation Institution							**PM 2: Asymmetric Segregation Institution**						
	Submitted Threshold							Submitted Threshold					
Type	1	2	3	4	5	6	Type	1	2	3	4	5	6
1	**0.86**	0.06	0.05	0.02	0.00	0.01	1	**0.97**	0.01	0.01	0.00	0.00	0.01
2	**0.82**	0.13	0.03	0.01	0.01	0.00	2	**0.85**	0.09	0.04	0.01	0.00	0.00
3	**0.48**	0.18	0.29	0.05	0.00	0.00	3	**0.69**	0.17	0.11	0.03	0.01	0.00
4	0.17	0.16	**0.51**	0.14	0.02	0.00	4	**0.41**	0.20	0.27	0.12	0.01	0.00
5	0.16	0.11	**0.40**	0.23	0.10	0.00	5	**0.30**	0.12	0.28	0.25	0.05	0.00
6	0.13	0.05	**0.33**	0.29	0.19	0.01	6	0.27	0.09	0.24	**0.31**	0.07	0.01

Note:
1. Boldface indicates mode of distribution.
2. Grey shade indicates equilibrium threshold.

Table 3: Distribution of Submitted Thresholds by Type: All Runs

Result 1 (Distribution of thresholds)**.** *For payoff matrix 1, the mode of the distribution coincides with the theoretical prediction for five (four) out of six types with no segregation institution, and with asymmetric (symmetric) segregation institution.*
For payoff matrix 2, while the mode coincides with the theoretical prediction for types 1, 2 and

3, high type thresholds are higher than the equilibrium predictions with no segregation institution and with symmetric segregation institution. With asymmetric segregation institution, the mode coincides with the theoretical prediction for five out of six types for payoff matrix 2.

SUPPORT: Table 3 presents the empirical distribution of submitted threshold by each type in each of the six treatments. In each panel, for a given type, each row reports the proportion of submitted threshold by that type. Boldfaced numbers are the mode of the distribution in each row, while shaded numbers represent equilibrium predictions. ∎

Result 1 indicates that theory predicts reasonably well in payoff matrix 1 with no segregation institution. The mode of distribution overlaps with the theoretical prediction for most types. It is interesting to note that, when both segregation and collocation equilibria exist with segregation institution, the segregation rather than collocation equilibrium is selected. However, for payoff matrix 2, the results do not correspond as well to the theoretical predictions. What is striking about the submitted thresholds in payoff matrix 2 is that, even though theory predicts that everyone accepts everyone else, i.e., all submitted thresholds should equal one, high types try to segregate at the individual level by submitting much higher thresholds with no segregation institution and with symmetric segregation institution. With asymmetric segregation institution, however, submitted threshold are slightly closer to the theoretical predictions, possibly due to coordination effect of the entry cost.

To investigate this high-threshold puzzle in payoff matrix 2 with no segregation institution and with symmetric segregation institution, we use two different approaches. The first approach uses a static noisy best response model to explain the distribution of thresholds across treatments. The second approach analyzes the adjustment dynamics of threshold choices.

In the first approach, we check whether the chosen thresholds can be rationalized given the behavior of other players. Using simulation analysis, we determine the payoff difference between accepting and rejecting a particular type, assuming the empirical distribution. From the submitted threshold, we compute the probability of mutual acceptance between types, i.e., who mate with whom. We next use the empirical distribution of submitted thresholds (Table 3) and the probabilities of mutual acceptance, to compute the probability that an agent leaves the market. We then compute the probability distribution that a given type will be in various positions in the queue after mating. Next, we compute the expected value for each type, following the same iterative algorithm described in Appendix A. Finally, we use these values to compute the payoff difference between accepting and rejecting a type.

Table 4 presents our simulation results. In Table 4, each entry represents the payoff difference between accepting and rejecting a given type. This payoff difference indicates the optimal decision rule given the empirical distribution of thresholds. The sign of the payoff difference indicates whether a player should accept a given type, while the magnitude of the payoff difference indicates the strength of the incentives. For example, in the last line at the middle right panel (PM2: Symmetric Segregation Institution), we examine a type 6's optimal decision rule. Given the empirical distribution, a type 6's expected payoff difference between accepting and rejecting a type 1 is -5, indicating that she should not accept a type 1. Accepting types 2 and above gives her a positive expected payoff difference. However, the payoff difference between accepting and rejecting a type 2 is only 3, which does not provide a strong incentive, while the payoff difference between accepting and rejecting a type 3 is 12, which provides a stronger incentive. Comparing this line with the last line in the middle panel of Table 3, where 46% of the participants submitted a threshold of 4, the

PM 1: No Segregation Institution							**PM 2: No Segregation Institution**						
	Payoff Difference							Payoff Difference					
Type	1	2	3	4	5	6	Type	1	2	3	4	5	6
1	24	25	27	29	33	40	1	15	16	17	18	19	21
2	19	23	27	31	44	55	2	13	15	18	20	23	26
3	-3	3	18	32	50	67	3	8	12	16	20	24	29
4	-13	-5	20	31	49	70	4	4	9	15	21	26	32
5	-25	-8	22	33	55	81	5	-1	6	13	20	28	36
6	-34	-13	23	38	65	99	6	-4	4	13	21	31	40
PM 1: Sym. Segregation Institution							**PM 2: Sym. Segregation Institution**						
	Payoff Difference							Payoff Difference					
Type	1	2	3	4	5	6	Type	1	2	3	4	5	6
1	25	26	28	30	34	41	1	15	16	17	18	19	21
2	20	24	28	32	45	56	2	14	16	19	21	24	27
3	-2	4	19	33	51	68	3	8	12	16	20	24	29
4	-13	-5	20	31	49	70	4	4	9	15	21	26	32
5	-26	-9	21	32	54	80	5	-1	6	13	20	28	36
6	-36	-15	21	36	63	97	6	-5	3	12	20	30	39
PM 1: Asym. Segregation Institution							**PM 2: Asym. Segregation Institution**						
	Payoff Difference							Payoff Difference					
Type	1	2	3	4	5	6	Type	1	2	3	4	5	6
1	25	26	28	30	34	41	1	8	9	10	11	12	14
2	20	24	28	32	45	56	2	6	8	11	13	16	19
3	-1	5	20	34	52	69	3	1	5	9	13	17	22
4	-12	-4	21	32	50	71	4	-5	0	6	12	17	23
5	-27	-10	20	31	53	79	5	-10	-3	4	11	19	27
6	-36	-15	21	36	63	97	6	-13	-5	4	12	22	31

Table 4: Simulated Payoff Difference between Accepting and Rejecting a Match

empirical distribution is consistent with the simulation results. From our simulation, we find that the payoff differences are largely consistent with the modes of empirical distribution presented in Table 3. In particular, the high thresholds in payoff matrix 2 is optimal given the empirical distribution of thresholds.

While the above analysis looks at the distribution of thresholds over all runs, Tables 5 and 6 present the distribution of thresholds in the first (left panel) and last run (right panel) of each treatment. When comparing the distribution of thresholds between the first and last run of each treatment, we find a fair amount of learning across all types. For example, the proportion of type 1 equilibrium thresholds increases from between 70 and 80 percent in the first run, to nearly 100 percent in the last run. The proportion of equilibrium thresholds for type 2s also increases, by a substantial margin. While we see improvement of equilibrium play in medium and high types, this improvement is not nearly as dramatic.

This comparison of the first and last run behavior leads to our second approach, which examines the dynamics of the submitted thresholds. In particular, we are interested in how prior experience changes a subject's decision. We use the following specification to look at whether a subject increases or decreases her threshold if she is accepted by her match in the previous period and if that match is successful:

$$\text{Threshold}_i^t - \text{Threshold}_i^{t-1} = a + b * \text{Accepted-by-other}_i^{t-1} + c * D_{mate}^{t-1} + e_i^t, \tag{1}$$

where $\text{Accepted-by-other}_i^{t-1}$ is a dummy variable which equals one if a subject is accepted by her match in the previous round and zero otherwise, and D_{mate}^{t-1} is a dummy variable which equals one if the two players are mutually acceptable and zero otherwise. To examine threshold adjustment, we consider two cases. In the first case, an agent is accepted by her partner, but does not accept her partner in round $t-1$. In round t, she might realize that she is too picky and therefore might want to lower her threshold. Therefore, we expect $b < 0$. In the second case, two agents are mutually acceptable to each other and therefore the match is successful in round $t-1$. If the agent in round t is endowed with the same type again, we expect that she does not change her threshold, i.e., $b + c = 0$. We test this model by examining the case when an agent keeps the same type in two consecutive periods.

Result 2 (Dynamic Adjustment of Threshold)**.** *An agent significantly decreases her threshold if she is accepted by her partner but the match is unsuccessful in the previous period. The threshold remains the same if a match is successful in the previous period.*

SUPPORT: Table 7 reports the OLS regression results from six specifications using Equation (1). In each of these specifications, robust standard errors are adjusted for clustering at the session level.[7] The bottom panel presents the null and alternative hypotheses, as well as the corresponding p-values for the F-tests. For all types, we can reject $H_0 : b = 0$ in favor of $H_1 : b < 0$ at the 1% level. Furthermore, for types 1, 2, 4 and 5, we cannot reject $H_0 : b + c = 0$ at the 5% level. For type 3, however, we can reject the null at the 1% level. Therefore, if successfully matched in the previous period, a type 3 upgrades her threshold by 0.21. This upgrade is statistically significant at the 1% level, but not economically significant, as the mean threshold for type 3s is 1.90. ■

[7] As observations within a session are not independent, clustering at the session level allows the error term to be heteroscedastic, and correlated across both individuals and rounds, but independent across sessions.

	Submitted Threshold: First Run						Submitted Threshold: Last Run					
Payoff Matrix 1: No Segregation Institution												
Type	1	2	3	4	5	6	1	2	3	4	5	6
1	**0.83**	0.13	0.03	0.00	0.00	0.00	**1.00**	0.00	0.00	0.00	0.00	0.00
2	**0.60**	0.17	0.20	0.03	0.00	0.00	**0.86**	0.12	0.02	0.00	0.00	0.00
3	0.13	0.27	**0.53**	0.07	0.00	0.00	0.28	0.14	**0.57**	0.01	0.00	0.00
4	0.23	0.07	**0.67**	0.03	0.00	0.00	0.18	0.24	**0.37**	0.22	0.00	0.00
5	0.07	0.10	**0.57**	0.23	0.03	0.00	0.13	0.21	**0.56**	0.09	0.01	0.00
6	0.13	0.03	0.17	**0.57**	0.10	0.00	0.12	0.13	**0.51**	0.18	0.06	0.00
Payoff Matrix 1: Symmetric Segregation Institution												
Type	1	2	3	4	5	6	1	2	3	4	5	6
1	**0.73**	0.11	0.09	0.05	0.02	0.00	**0.95**	0.01	0.03	0.01	0.00	0.00
2	**0.61**	0.27	0.05	0.05	0.02	0.00	**0.77**	0.16	0.04	0.01	0.00	0.01
3	0.18	**0.41**	0.25	0.16	0.00	0.00	0.41	0.24	**0.26**	0.09	0.00	0.00
4	0.20	0.18	**0.48**	0.09	0.05	0.00	0.11	0.14	**0.45**	0.29	0.01	0.00
5	0.18	0.09	**0.34**	0.16	0.23	0.00	0.15	0.01	0.36	**0.37**	0.11	0.00
6	0.11	0.07	**0.32**	0.30	0.18	0.02	0.11	0.00	0.28	**0.40**	0.18	0.02
Payoff Matrix 1: Asymmetric Segregation Institution												
Type	1	2	3	4	5	6	1	2	3	4	5	6
1	**0.75**	0.11	0.04	0.11	0.00	0.00	**0.97**	0.01	0.01	0.00	0.00	0.00
2	**0.79**	0.11	0.07	0.04	0.00	0.00	**0.90**	0.10	0.00	0.00	0.00	0.00
3	**0.57**	0.14	0.29	0.00	0.00	0.00	**0.57**	0.13	0.29	0.00	0.00	0.00
4	0.14	0.18	**0.39**	0.25	0.00	0.04	0.19	0.09	**0.54**	0.18	0.00	0.00
5	0.11	0.14	**0.54**	0.14	0.07	0.00	0.10	0.15	**0.51**	0.18	0.06	0.00
6	0.14	0.21	**0.32**	0.25	0.07	0.00	0.10	0.04	**0.35**	0.28	0.21	0.01

Note:
1. Boldface indicates mode of distribution.
2. Grey shade indicates equilibrium threshold.

Table 5: Distribution of Submitted Thresholds by Type in Payoff Matrix 1: First vs. Last Run

Payoff Matrix 2: No Segregation Institution

	Submitted Threshold: First Run						Submitted Threshold: Last Run					
Type	1	2	3	4	5	6	1	2	3	4	5	6
1	**0.73**	0.12	0.08	0.04	0.00	0.04	**0.99**	0.00	0.00	0.00	0.01	0.00
2	**0.58**	0.27	0.04	0.04	0.08	0.00	**0.99**	0.01	0.00	0.00	0.00	0.00
3	**0.38**	0.31	0.23	0.08	0.00	0.00	**0.49**	0.38	0.09	0.01	0.03	0.00
4	0.12	0.15	**0.46**	0.27	0.00	0.00	**0.43**	0.38	0.18	0.00	0.01	0.00
5	0.04	0.23	**0.42**	0.27	0.04	0.00	0.19	**0.38**	0.26	0.10	0.06	0.00
6	0.08	0.08	**0.42**	0.19	0.23	0.00	0.21	0.09	**0.34**	0.28	0.09	0.00

Payoff Matrix 2: Symmetric Segregation Institution

	Submitted Threshold: First Run						Submitted Threshold: Last Run					
Type	1	2	3	4	5	6	1	2	3	4	5	6
1	**0.80**	0.10	0.03	0.00	0.00	0.07	**1.00**	0.00	0.00	0.00	0.00	0.00
2	**0.83**	0.13	0.03	0.00	0.00	0.00	**0.90**	0.10	0.00	0.00	0.00	0.00
3	0.33	**0.47**	0.20	0.00	0.00	0.00	**0.38**	0.33	0.29	0.00	0.00	0.00
4	0.13	0.30	**0.47**	0.10	0.00	0.00	0.21	0.26	**0.48**	0.05	0.00	0.00
5	0.13	0.30	**0.43**	0.10	0.03	0.00	**0.31**	0.26	**0.31**	0.12	0.00	0.00
6	0.07	0.07	0.23	**0.53**	0.10	0.00	0.24	0.10	0.21	**0.43**	0.02	0.00

Payoff Matrix 2: Asymmetric Segregation Institution

	Submitted Threshold: First Run						Submitted Threshold: Last Run					
Type	1	2	3	4	5	6	1	2	3	4	5	6
Type	1	2	3	4	5	6	1	2	3	4	5	6
1	**0.88**	0.00	0.00	0.00	0.00	0.13	**1.00**	0.00	0.00	0.00	0.00	0.00
2	**0.63**	0.00	0.38	0.00	0.00	0.00	**0.91**	0.09	0.00	0.00	0.00	0.00
3	**0.50**	0.13	0.25	0.13	0.00	0.00	**0.84**	0.12	0.04	0.00	0.00	0.00
4	0.25	0.13	**0.50**	0.13	0.00	0.00	**0.42**	0.17	0.27	0.14	0.00	0.00
5	**0.38**	0.25	0.13	0.25	0.00	0.00	**0.31**	0.06	0.29	0.27	0.07	0.00
6	0.13	**0.38**	0.25	0.13	0.13	0.00	0.29	0.09	0.24	**0.30**	0.07	0.01

Note:
1. Boldface indicates mode of distribution.
2. Grey shade indicates equilibrium threshold.

Table 6: Distribution of Submitted Thresholds by Type in Payoff Matrix 2: First vs. Last Run

	Dependent Variable: Change in Submitted Threshold					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Accepted-by-other^{t-1}	-1.262***	-0.716***	-0.182***	-0.200***	-0.461***	
	(0.225)	(0.125)	(0.0539)	(0.0363)	(0.159)	
D_{mate}^{t-1}	1.307***	0.804***	0.388***	0.251***	0.353***	0.380***
	(0.217)	(0.126)	(0.0633)	(0.0395)	(0.0455)	(0.0496)
Constant	-0.0237	-0.0620***	-0.145***	-0.0118	0.167	-0.332***
	(0.0198)	(0.0198)	(0.0362)	(0.0318)	(0.161)	(0.0264)
Observations	1,050	879	683	667	699	792
Adjusted R-squared	0.099	0.089	0.063	0.041	0.043	0.051
$H_0 : b = 0$, $H_1 : b < 0$	0.000	0.000	0.001	0.000	0.004	-
$H_0 : b + c = 0$						
$H_1 : b + c \neq 0$	0.099	0.080	0.001	0.255	0.512	-

Notes:

1. Robust standard errors in parentheses are adjusted for clustering at the session level.

2. Significant at: * 10%; ** 5%; *** 1%.

3. The variable Accepted-by-other^{t-1} is dropped in the last column since type 6s are always accepted by their partners.

4. The bottom panel presents the null and alternative hypotheses, as well as the corresponding p-values for the F-tests.

Table 7: Change in Submitted Threshold as a Function of Prior Experience

Result 2 indicates that agents learn to adjust their thresholds from prior experience. As a result, a comparison of the distribution of submitted thresholds in the first and the last run of each session indicates a substantial increase in the proportion of equilibrium thresholds, especially by low types.

We note from the previous analysis that the increase in equilibrium thresholds from medium and high types is not as dramatic. We now use probit analysis to examine whether the proportion of equilibrium thresholds decreases with type. Table 8 reports the results of probit regressions with Equilibrium Threshold as the dependent variable. In these regressions, Equilibrium Threshold is a dummy variable, which equals one if a submitted threshold is the equilibrium value and zero otherwise. The independent variables are Own Type and a constant. In all six specifications, standard errors are adjusted for clustering at the session level. From Table 8, we see that coefficients of Own Type in all four specifications are negative and highly significant, indicating that the proportion of equilibrium threshold indeed decreases with type. This result could be due to two reasons. First, a higher type might face a more complex decision problem than a lower type. For example, if agents accept own type or lower, then a type 2 agent's problem is whether to accept type 1, while a type 6's decision is whether to accept any of the types lower than himself. Second, consistent with our simulation analysis presented earlier, higher thresholds by high types are optimal given the empirical distribution. Comparing specifications (2) and (3), as well as (5) and (6), we find that the decrease of equilibrium play with type is ameliorated by about 5 percentage points with entry cost in the asymmetric segregation institutions.

In sum, our analysis of submitted thresholds indicates that the equilibrium model predicts reasonably well for payoff matrix 1, but high types over-segregate in payoff matrix 2. Furthermore,

	Dependent Variable: Equilibrium Threshold					
	Payoff Matrix 1			Payoff Matrix 2		
	(1)	(2)	(3)	(4)	(5)	(6)
	No Seg.	Sym. Seg.	Asym. Seg.	No Seg.	Sym Seg.	Asym Seg.
Own Type	-0.225***	-0.352***	-0.301***	-0.559***	-0.536***	-0.477***
	(0.0274)	(0.0537)	(0.0581)	(0.0528)	-0.0502	(0.0421)
Constant	0.908***	1.430***	1.243***	1.847***	1.924***	1.961***
	(0.107)	(0.107)	(0.159)	(0.0821)	(0.105)	(0.106)
Observations	2,292	2,124	1,992	2,136	2,040	2,328

Notes:

1. Robust standard errors in parentheses are adjusted for clustering at the session level.

2. Significant at: *** 1% level.

Table 8: Probit: Proportion of Equilibrium Play and Own Type

learning increases equilibrium play of all types. Lastly, relative to the symmetric segregation institution treatments, the entry cost in the asymmetric segregation institution treatments increases the likelihood of equilibrium play.

4.2 Segregation Institutions

We now examine the effects of segregation institutions in each of the two environments. Recall that Proposition 2 predicts that, in payoff matrix 1, the segregation equilibrium should be (1–2)(3–6), i.e., types 1 and 2 should be in one market, while types 3 – 6 should be in another market, and the collocation equilibrium should be (1–6). In payoff matrix 2, there is only a collocation equilibrium.

We first investigate the segregation desires expressed by the participants. In this situation, we are interested in whether the segregation or the collocation equilibrium is selected in payoff matrix 1, whether all types stay in the same market in payoff matrix 2, and whether the entry cost facilitates coordination.

To study segregation desires, we use a probit specification with standard errors clustered at the session level. The dependent variable is Desired Market, which equals one if market A is preferred, and zero otherwise. The independent variables are the number of low, medium, and high types in the previous two periods, respectively. We also explore specifications with the number of each type as independent variables. However, as the number of types 1 and 2 tends to have the same effects, as does the number of types 5 and 6, we aggregate each respective pair into one variable. The number of types 3 and 4 in previous periods sometimes gives different predictions; therefore, we keep them as two separate independent variables in the regressions. In determining how many periods participants look back on to make their decisions, we try specifications with one, two and three periods, and find that the two-period model is the simplest one which captures all the basic insights. Thus we report our results using the two-period model. Results from the analysis are summarized below.

Dependent Variable: Desired Market at Round t under Payoff Matrix 1						
Symmetric	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
$n_{1,2}^{t-1}$	0.1867***	0.2616**	0.0693	-0.1435**	-0.0172	-0.1158***
	(0.0624)	(0.1078)	(0.1114)	(0.0683)	(0.0844)	(0.0221)
n_{3}^{t-1}	0.0582	0.0012	0.2517*	-0.0134	-0.0057	-0.2159
	(0.1623)	(0.0736)	(0.1493)	(0.1243)	(0.0466)	(0.1588)
n_{4}^{t-1}	-0.0970*	-0.0048	-0.0129	0.2701	-0.0318	-0.0591
	(0.0549)	(0.0922)	(0.2176)	(0.2221)	(0.1481)	(0.1891)
$n_{5,6}^{t-1}$	0.1009***	0.0039	0.1298**	0.4303***	0.5617***	0.4937***
	(0.0292)	(0.0956)	(0.0582)	(0.0657)	(0.0670)	(0.0480)
$n_{1,2}^{t-2}$	0.0598*	0.0839***	-0.0837	-0.0710	-0.2036***	0.1132
	(0.0362)	(0.0285)	(0.0642)	(0.0490)	(0.0543)	(0.0705)
n_{3}^{t-2}	0.0964	-0.1188	-0.1559**	0.0579	0.0388	-0.0903
	(0.1130)	(0.1218)	(0.0655)	(0.0590)	(0.0718)	(0.0592)
n_{4}^{t-2}	-0.0352	0.1813*	-0.0153	-0.0574	0.0976	0.0819
	(0.0475)	(0.1012)	(0.0474)	(0.1253)	(0.0853)	(0.0832)
$n_{5,6}^{t-2}$	-0.0313	-0.0880**	0.1159	-0.0228	0.0448	0.0902
	(0.0964)	(0.0424)	(0.0903)	(0.1451)	(0.0521)	(0.1066)
Constant	-0.9213**	-0.5270	-0.4788**	-0.5159	-0.5581*	-0.8223
	(0.3902)	(0.5394)	(0.2294)	(0.5326)	(0.3193)	(0.6058)
Observations	338	338	338	338	338	338
Asymmetric	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
$n_{1,2}^{t-1}$	0.1555***	0.6408***	0.0350	-0.2128	-0.0712	-0.3046**
	(0.0605)	(0.0978)	(0.0806)	(0.1489)	(0.0712)	(0.1450)
n_{3}^{t-1}	-0.0687	-0.4651*	0.4176***	0.0054	-0.0328	0.2626
	(0.1050)	(0.2697)	(0.1604)	(0.1387)	(0.1850)	(0.1667)
n_{4}^{t-1}	0.0409	0.2069***	0.1096	0.2396*	0.3222**	0.0854
	(0.2123)	(0.0804)	(0.0698)	(0.1373)	(0.1563)	(0.1588)
$n_{5,6}^{t-1}$	0.1181	-0.0622	0.1334***	0.0348	0.1480*	0.2531***
	(0.0735)	(0.0751)	(0.0380)	(0.0957)	(0.0789)	(0.0452)
$n_{1,2}^{t-2}$	0.4119***	-0.4146***	0.0047	-0.0974	0.0005	0.0506
	(0.1400)	(0.1231)	(0.1315)	(0.1198)	(0.0937)	(0.1328)
n_{3}^{t-2}	0.0990	0.2886***	-0.1139	0.1512	0.1416	-0.2965**
	(0.1492)	(0.0517)	(0.2219)	(0.1730)	(0.2012)	(0.1268)
n_{4}^{t-2}	0.1361	0.2351	-0.0336	0.1891*	0.2334*	0.0130
	(0.1368)	(0.1471)	(0.1011)	(0.1037)	(0.1372)	(0.1315)
$n_{5,6}^{t-2}$	0.1092	-0.2072**	0.0623	0.1687**	0.1350	0.1608***
	(0.1204)	(0.1000)	(0.0793)	(0.0837)	(0.1122)	(0.0411)
Constant	-1.6715*	0.7784*	-0.2742	0.2974	-1.3264*	-0.0937
	(0.8659)	(0.4599)	(1.1816)	(0.3709)	(0.7021)	(0.4912)
Observations	316	316	316	316	316	316

Notes:

1. Independent variable, $n_{1,2}^{t-1}$, denotes the number of types 1 and 2 in market A at round $t-1$, etc.

2. Robust standard errors in parentheses are adjusted for clustering at the session level.

3. Significant at: * 10% level; ** 5% level; *** 1% level.

Table 9: Desired Market Under Payoff Matrix 1

Dependent Variable: Desired Market at Round t under Payoff Matrix 2						
Symmetric	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
$n_{1,2}^{t-1}$	0.3549***	0.2076**	0.0106	-0.1557***	-0.1150	-0.2085**
	(0.1308)	(0.0898)	(0.0387)	(0.0383)	(0.0716)	(0.0994)
n_{3}^{t-1}	0.0398	-0.1540*	0.2739	-0.1144	-0.0482	-0.1058
	(0.1131)	(0.0810)	(0.1831)	(0.1645)	(0.0952)	(0.1215)
n_{4}^{t-1}	0.0962	-0.0492	-0.0821	0.3128**	0.2170***	0.3650**
	(0.1240)	(0.0383)	(0.0916)	(0.1489)	(0.0781)	(0.1582)
$n_{5,6}^{t-1}$	-0.0126	0.1289**	0.3282***	0.2984***	0.3583***	0.3961***
	(0.0497)	(0.0575)	(0.1097)	(0.0762)	(0.0661)	(0.1023)
$n_{1,2}^{t-2}$	0.0073	0.0673	-0.0774	0.0030	-0.0787	0.0510
	(0.0313)	(0.0696)	(0.1347)	(0.1223)	(0.0934)	(0.0711)
n_{3}^{t-2}	-0.1099	-0.2707***	0.2237**	0.0885	0.2802***	-0.1323
	(0.1145)	(0.0614)	(0.1020)	(0.1333)	(0.1031)	(0.1285)
n_{4}^{t-2}	0.0447	0.1765	0.0380	-0.0425	-0.0519*	-0.0069
	(0.0322)	(0.1297)	(0.0831)	(0.1146)	(0.0300)	(0.2080)
$n_{5,6}^{t-2}$	-0.0933	-0.0653	0.0446	0.1538	0.1543***	0.2769**
	(0.1287)	(0.1156)	(0.0711)	(0.1033)	(0.0556)	(0.1102)
Constant	-0.4944**	-0.0755	-1.0625*	-0.8655	-1.1178***	-1.1681***
	(0.2376)	(0.3458)	(0.5521)	(0.6723)	(0.2436)	(0.4505)
Observations	324	324	324	324	324	324
Asymmetric	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
$n_{1,2}^{t-1}$	0.3125***	0.332***	0.0324***	-0.0662	-0.1251***	-0.0771***
	(0.0404)	(0.0105)	(0.0118)	(0.0578)	(0.0313)	(0.0105)
n_{3}^{t-1}	0.0483	-0.33***	0.4828***	0.1665***	0.1042**	0.2217**
	(0.0732)	(0.0946)	(0.0229)	(0.0376)	(0.045)	(0.1133)
n_{4}^{t-1}	-0.0874	0.043	0.1922***	0.2726***	-0.1044***	-0.1101
	(0.1499)	(0.1936)	(0.0616)	(0.0200)	(0.0251)	(0.2266)
$n_{5,6}^{t-1}$	0.1585	0.2058**	0.1933***	0.1379***	0.2341***	0.2623***
	(0.216)	(0.0817)	(0.0309)	(0.0289)	(0.0293)	(0.0744)
$n_{1,2}^{t-2}$	0.0279	-0.002	0.0287	-0.3595**	0.1228	0.0364
	(0.1491)	(0.0097)	(0.1788)	(0.1909)	(0.0831)	(0.2151)
n_{3}^{t-2}	0.3499**	0.2217***	0.0997	0.2923***	-0.054	0.1028
	(0.1591)	(0.0108)	(0.0727)	(0.1059)	(0.0912)	(0.1289)
n_{4}^{t-2}	0.0845	-0.2416**	-0.0015	0.2719*	0.2919***	0.1644**
	(0.0937)	(0.098)	(0.0568)	(0.1599)	(0.0743)	(0.0656)
$n_{5,6}^{t-2}$	-0.2244***	0.0691***	-0.0066	-0.007	0.2071***	0.2272*
	(0.052)	(0.0255)	(0.0272)	(0.0043)	(0.0598)	(0.1355)
Constant	-0.4029	-0.1413	-0.9249**	-0.325*	-1.354***	-1.7525***
	(0.3723)	(0.3511)	(0.369)	(0.173)	(0.3227)	(0.6708)
Observations	372	372	372	372	372	372

Notes:

1. Independent variable, $n_{1,2}^{t-1}$, denotes the number of types 1 and 2 in market A at round $t-1$, etc.
2. Robust standard errors in parentheses are adjusted for clustering at the session level.
3. Significant at: * 10% level; ** 5% level; *** 1% level.

Table 10: Desired Market Under Payoff Matrix 2

Result 3 (Segregation Desires)**.** *In both payoff matrices, medium and high types prefer to be in the market which contains high types in the previous period, and prefer not to be in the market which contains low types in the previous period. While low types prefer to be in markets which contain low types in the previous period, type 1 in PM 1 (symmetric) and type 2 in PM 2 also prefer to be in markets which contain high types in previous period.*

SUPPORT: Tables 9 and 10 present the results of our probit regressions for payoff matrices 1 and 2, respectively. In each table, the top (bottom) panel presents results with symmetric (asymmetric) segregation institution. In both payoff matrices, coefficients for $n_{1,2}^{t-1}$ are positive and significant for types 1 and 2, and negative and significant for types 4 and 6 (type 6) under symmetric (asymmetric) segregation institutions. Additionally, the coefficients for $n_{5,6}^{t-1}$ are positive and significant for types 3 to 6 in both payoff matrices (except types 4 and 5 in PM 2 under asymmetric segregation institutions), for type 1 in payoff matrix 1 and for type 2 in payoff matrix 2, under symmetric segregation institutions. ∎

Result 3 indicates that, without entry cost, in payoff matrix 1, medium and high types try to separate themselves from the low types, while low types prefer to stay in the "low" market, although type 1s also desire to enter the "high" market. With entry cost, the high type attempts to segregate from low types are only significant for type 6.

In payoff matrix 2, theory predicts that there is only one collocation equilibrium. However, we observe that medium and high types try to segregate themselves from low types. The results for low types are mixed. That is, while low types generally prefer to stay in the "low" market, some try to enter the market which contains higher types in the previous periods.

A straightforward implication of theory is that the same type should always be in the same market. In the experiment, due to the odd problem,[8] limited computation capacity and other reasons, we observe many different segregation patterns. Figures 3 and 4 present the average type in markets A (solid circle) and B (solid square) in each of the sessions under payoff matrices 1 and 2, respectively. In each figure, the left (right) column presents the four sessions with symmetric (asymmetric) segregation institution. These figures indicate that, in some sessions, e.g., sessions 9, 18, 16 and 24, high types successfully segregate themselves into one market, while in other sessions, e.g., sessions 12 and 15, there seems to be considerable moving and chasing between markets. Note that when all types stay in the same market, the average type of the empty market is not well defined. In this case, we define the average type of the empty market to be zero. Comparing the left and right columns in each figure, we observe that the gap between the mean type in each market is more pronounced with entry cost (right column), and that it is increasing over time. We summarize the results below.

Result 4 (Entry cost and segregation stability)**.** *Entry cost significantly (weakly) increases the gap between the mean types in the two markets under payoff matrix 1 (2). This gap increases over time.*

SUPPORT: Table 11 presents four OLS specifications. The dependent variable is the absolute difference between the mean types in the two markets, whereas the independent variables include entry cost and time. The coefficient for entry cost (c) is positive and significant (weakly significant) in payoff matrix 1 (2). The null $c = 0$ is rejected in favor of $c > 0$ at $p < 0.05$ for specifications (1) and (2), and at $p < 0.10$ for specifications (3) and (4). ∎

[8]The odd problem affects 4.3% of the subjects on the market per period in our experiment.

Figure 3: Average Type in Each Market with Symmetric (Left) and Asymmetric (Right) Segregation Institutions under Payoff Matrix 1

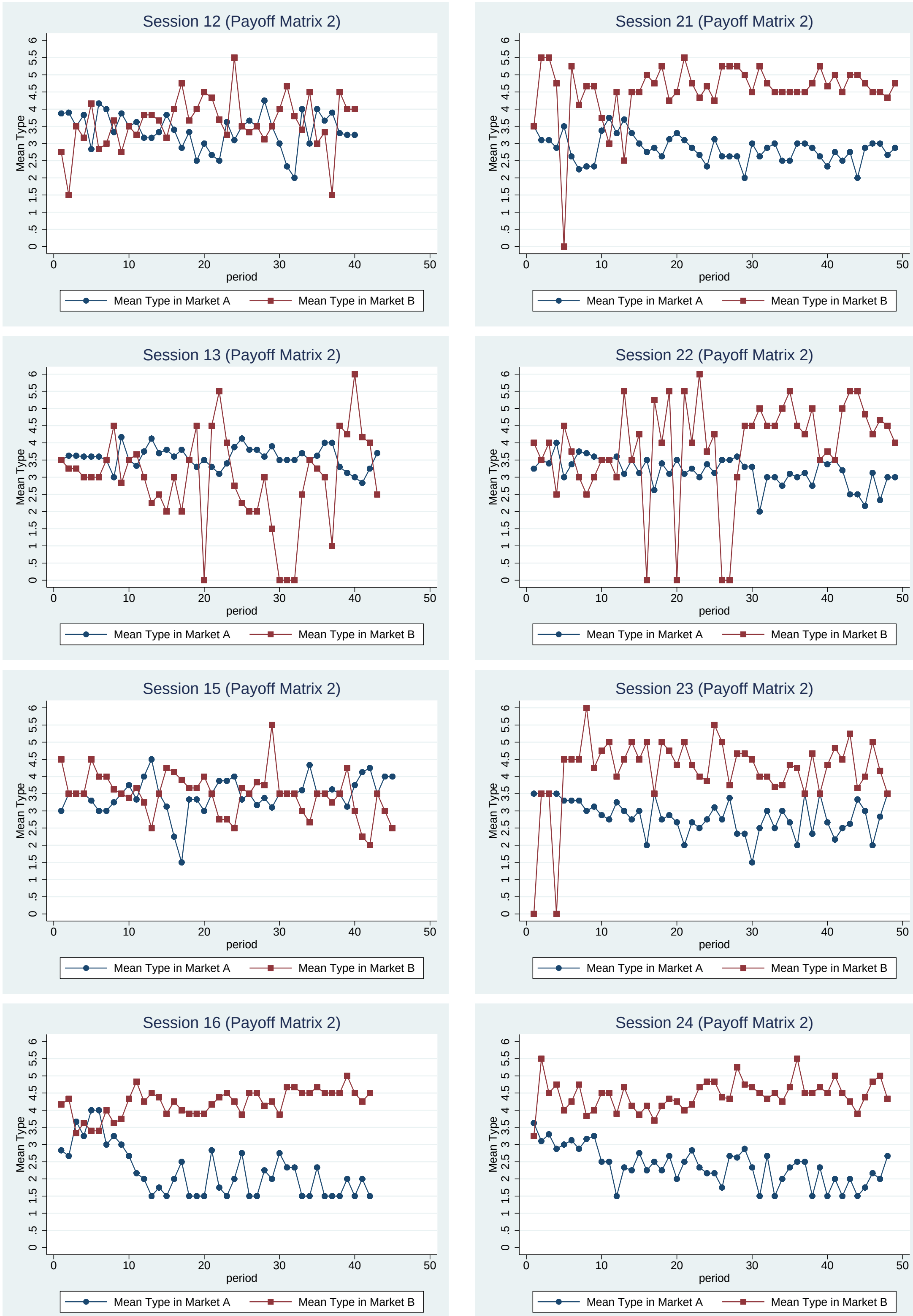

Figure 4: Average Type in Each Market with Symmetric (Left) and Asymmetric (Right) Segregation Institutions under Payoff Matrix 2

Table 11: Segregation Stability: OLS

DV: $\lvert\overline{t_A} - \overline{t_B}\rvert$	Payoff Matrix 1		Payoff Matrix 2	
	(1)	(2)	(3)	(4)
Entry Cost	0.377**	0.404**	0.510*	0.461*
(c)	(0.160)	(0.158)	(0.295)	(0.306)
Time		0.019***		0.017**
		(0.006)		(0.006)
Constant	1.336***	0.901***	1.278***	0.917***
	(0.120)	(0.149)	(0.270)	(0.217)
Observations	4,116	4,116	4,368	4,368
R^2	0.033	0.087	0.068	0.119
H_0: $c = 0$, H_1: $c > 0$	0.025	0.019	0.064	0.088

Notes:
1. Standard errors in parentheses are adjusted for clustering at the session level.
2. Significant at: * 10% level; ** 5% level; *** 1% level.

Result 4 indicates that entry cost facilitates segregation between the high and low types in both environments. While we expect high types to move to the market with an entry fee (Market A), in our experiment, high types are more likely to stay in the free market (Market B) (right column in Figures 3 and 4). When high types move to the free market and refuse to accept low types, the latter have no choice but to enter the market with a fee.

We now investigate the effects of segregation institutions on matching success rate, individual profit and efficiency. To study factors affecting matching success rate, we use eight probit specifications with standard errors clustered at the session level (Table 12). The dependent variable is Matching Success, a dummy variable which equals one if the two players are mutually acceptable, and zero otherwise. The independent variables include segregation institution, own type, partner's type, time, and entry cost. Segregation Institution is a dummy variable which equals one if there are two markets, and zero otherwise. Similarly, entry cost is a dummy variable which equals one if there is a participation fee, and zero otherwise. Specifications (1) through (4) ((5) through (8)) investigate treatment effects in payoff matrix 1 (2). Results are summarized below.

Result 5 (Segregation institutions and matching success rate)**.** *While the symmetric segregation institution has no significant effect on matching success in payoff matrix 1, it increases the likelihood of matching success by 10% in payoff matrix 2. Furthermore, the presence of entry cost significantly increases the matching success rate of segregation institution in both payoff matrices. Consequently, the asymmetric segregation institution weakly (significantly) increases matching success rate by 5% (18%) in payoff matrix 1 (2).*

SUPPORT: The lower panel of Table 12 reports our hypotheses and the corresponding p-values. In none of specifications (1) through (4), can we reject the null ($b = 0$) in favor of the alternative hypothesis ($b > 0$) at the conventional level. In contrast, the null is rejected in favor of H_1 ($b > 0$)

at $p < 0.01$ in each of specifications (5) through (8). In comparison, the null ($c = 0$) is rejected in favor of the alternative hypothesis ($c > 0$) at $p < 0.05$ in each of specifications (2), (4), (6) and (8). Lastly, the null of $b + c = 0$ is rejected in favor of $b + c > 0$ at the 10% (1%) level in specifications (2) and (4) ((6) and (8)). ∎

Result 5 indicates that the entry cost significantly increases matching success rate in both payoff matrices, possibly due to its ability to coordinate. In addition, as expected, matching success rate significantly increases with an increase in own type as well as that of a partner's type. If own type or a partner's type increases by one, the likelihood of a successful match increases by 5.1% (2.4%) in PM 1 (PM 2). We also observe that matching success rate significantly increases over time as participants gain experience ($p < 0.01$), but the magnitude is small.

Table 12: Segregation Institutions and matching success Rate: Probit

DV: Matching success	Payoff Matrix 1				Payoff Matrix 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Segregation institution	0.026	0.009	0.031	0.013	0.144***	0.100**	0.143***	0.104***
(b)	(0.032)	(0.031)	(0.030)	(0.028)	(0.035)	(0.039)	(0.032)	(0.038)
Own type			0.051***	0.051***			0.024***	0.024***
			(0.005)	(0.005)			(0.005)	(0.005)
Partner's type			0.051***	0.051***			0.024***	0.024***
			(0.005)	(0.005)			(0.005)	(0.005)
Time			0.002***	0.002***			0.003***	0.003***
			(0.001)	(0.001)			(0.001)	(0.001)
Entry cost		0.035*		0.037*		0.084**		0.075*
(c)		(0.020)		(0.020)		(0.040)		(0.041)
Observations	6,408	6,408	6,408	6,408	6,504	6,504	6,504	6,504
H_0: $b = 0$, H_1: $b > 0$	0.205	0.382	0.150	0.322	0.000	0.005	0.000	0.003
H_0: $c = 0$, H_1: $c > 0$		0.039		0.034		0.018		0.034
H_0: $b + c = 0$, H_1: $b + c > 0$		0.099		0.066		0.000		0.000

Notes:

1. Coefficients are probability derivatives.
2. Standard errors in parentheses are adjusted for clustering at the session level.
3. Significant at: * 10% level; ** 5% level; *** 1% level.

Matching success rate has direct implications on individual profit and efficiency. Table 13 reports eight OLS specifications, investigating treatments effects on individual profit. As in Table 12, independent variables include segregation institution, own type, partner's type, time, and entry cost. Again, standard errors are clustered at the session level. Results are summarized below.

Result 6 (Segregation institutions and profit)**.** *While the symmetric segregation institution has no significant effect on individual profit in payoff matrix 1, it significantly increases individual profit in payoff matrix 2. Furthermore, the presence of entry cost significantly increases profit in payoff matrix 2. Consequently, compared to the no segregation institution treatments, the asymmetric segregation institution has no significant effect on profit in payoff matrix 1, whereas it generates significantly higher profit in payoff matrix 2.*

SUPPORT: The lower panel of Table 13 reports our hypotheses and the corresponding p-values. In none of specifications (1) through (4), can we reject the null ($b = 0$) in favor of the alternative hypothesis ($b > 0$) at the conventional level. In contrast, $b = 0$ is rejected in favor of $b > 0$ at $p < 0.01$ in specifications (5) through (8). Likewise, we fail to reject $c = 0$ in favor of $c > 0$ at the conventional level in specifications (2) and (4), but we reject $c = 0$ in favor of $c > 0$ at $p = 0.036$ and $p = 0.060$ in specifications (6) and (8), respectively. Lastly, we fail to reject $b + c = 0$ in favor of $b + c > 0$ at the conventional level in specifications (2) and (4). However, we reject $b + c = 0$ in favor of $b + c > 0$ at $p < 0.01$ in specifications (6) and (8). ∎

Table 13: Segregation Institutions and Individual Profit: OLS

DV: Profit	Payoff Matrix 1				Payoff Matrix 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Seg. institution	0.225	-0.399	0.352	-0.299	3.440***	2.490**	3.409***	2.576**
(b)	(1.197)	(1.016)	(1.167)	(0.983)	(0.767)	(0.890)	(0.703)	(0.869)
Own type			13.392***	13.392***			4.637***	4.637***
			(0.251)	(0.251)			(0.096)	(0.096)
Partner's type			13.392***	13.392***			4.637***	4.637***
			(0.251)	(0.251)			(0.096)	(0.096)
Time			0.043	0.045			0.077***	0.073***
			(0.028)	(0.028)			(0.019)	(0.020)
Entry cost		1.290		1.355		1.782*		1.566
(c)		(1.437)		(1.438)		(0.894)		(0.928)
Constant	27.525***	27.525***	-67.299***	-67.343***	13.895***	13.895***	-20.345***	-20.244***
	(0.942)	(0.942)	(2.059)	(2.082)	(0.533)	(0.533)	(1.074)	(1.075)
Observations	6,408	6,408	6,408	6,408	6,504	6,504	6,504	6,504
R^2	0.000	0.000	0.608	0.608	0.009	0.011	0.455	0.456
H_0: $b = 0$, H_1: $b > 0$	0.427	0.351	0.384	0.383	0.000	0.009	0.000	0.006
H_0: $c = 0$, H_1: $c > 0$		0.194		0.183		0.036		0.060
H_0: $b + c = 0$, H_1: $b + c > 0$		0.303		0.268		0.000		0.000

Notes:

1. Standard errors in parentheses are adjusted for clustering at the session level.
2. Significant at: * 10% level; ** 5% level; *** 1% level.

Lastly, we investigate the effects of segregation institutions on efficiency. As indicated, the main benefit of segregation from an economic standpoint, is increased efficiency as a result of more frequent acceptance of a mate and thus reduced search costs. Following convention, we capture efficiency by the percentage of potential joint payoff above the minimum joint payoff that the players in a session receive in each period. Our normalized efficiency measure is defined as follows:

$$\text{Efficiency} = \frac{\text{Actual joint payoff} - \text{Minimum joint payoff}}{\text{Maximum joint payoff} - \text{Minimum joint payoff}}, \tag{2}$$

where the maximum joint payoff is the sum of payoffs with positive assortative matching, i.e., each type meets her own type in the first period and mate immediately.[9] We then use the empirical minimum joint payoff in each session to normalize the efficiency in that session.

Table 14: Segregation Institutions and Efficiency: OLS

DV: Efficiency	Payoff Matrix 1				Payoff Matrix 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Segregation Insitution	0.041*	0.021	0.042**	0.022	0.091**	0.072*	0.089**	0.076*
(b)	(0.023)	(0.024)	(0.023)	(0.023)	(0.040)	(0.052)	(0.037)	(0.050)
Entry Cost		0.041*		0.042*		0.035		0.026
(c)		(0.028)		(0.028)		(0.046)		(0.048)
Time			0.001	0.001			0.003***	0.003***
			(0.001)	(0.001)			(0.001)	(0.001)
Constant	0.480***	0.480***	0.465***	0.464***	0.457***	0.457***	0.382***	0.383***
	(0.017)	(0.017)	(0.019)	(0.019)	(0.033)	(0.033)	(0.027)	(0.027)
Observations	534	534	534	534	542	542	542	542
R^2	0.008	0.013	0.009	0.014	0.033	0.037	0.067	0.069
H_0: $b = 0$, H_1: $b > 0$	0.054	0.195	0.043	0.174	0.023	0.096	0.018	0.078
H_0: $c = 0$, H_1: $c > 0$		0.087		0.082		0.231		0.299
H_0: $b + c = 0$, H_1: $b + c > 0$		0.027		0.022		0.012		0.012

Notes:

1. Standard errors in parentheses are adjusted for clustering at the session level.
2. Significant at: * 10% level; ** 5% level; *** 1% level.

Result 7 (Segregation institutions and efficiency)**.** *While the symmetric segregation institution has no significant effect on efficiency in payoff matrix 1, it weakly increases efficiency in payoff matrix 2. However, the presence of entry cost weakly increases efficiency in payoff matrix 1. Consequently, the asymmetric segregation institution significantly increases efficiency in both payoff matrices compared to the no segregation institution treatments.*

SUPPORT: The lower panel of Table 14 reports our hypotheses and the corresponding p-values. In specification (2) and (4), we fail to reject the null ($b = 0$) in favor of the alternative hypothesis ($b > 0$) at the conventional level. In contrast, the null is rejected in favor of $b > 0$ at $p < 0.10$ in specifications (6) and (8). In comparison, we reject $c = 0$ in favor of $c > 0$ at $p < 0.10$ in specifications (2) and (4), but fail to reject $c = 0$ in favor of $c > 0$ at the conventional level in specifications (6) and (8). Lastly, we reject $b + c = 0$ in favor of $b + c > 0$ at $p < 0.05$ in each of specifications (2), (4), (6) and (8). ∎

In sum, while the symmetric segregation institution has weak or no effect in payoff matrix 1, it significantly increases matching success rate, profit and efficiency in payoff matrix 2. By adding an entry cost to facilitate coordination among different types, the asymmetric segregation institution leads to increased matching success rate and efficiency in both payoff matrices.

[9]We sum up the payoffs along the diagonal in each payoff matrix, multiply the sum by two, and subtract 24 as total search cost, yielding 620 for payoff matrix 1 and 328 for payoff matrix 2 (Table 1).

5 Conclusions

The formation of trading relationships, marriages, clubs, classes and communities has long fascinated both economists and sociologists. Decentralized matching theory with search frictions and endogenous segregation offers one plausible explanation of how people form such matchings. This theory predicts that, in a perfect mating equilibrium, a coarser version of Becker's assortative matching occurs, where blocks of agents sorted by ability mate with each other. Furthermore, this theory predicts that, when it is possible to segment the market into multiple markets, there exists a matching equilibrium where agents partition into segments and matching occurs only among agents belonging to the same segment. With complementary production functions, as segregation provides high types with a means to reduce search costs and ameliorate the negative externality inflicted by low types, the theory predicts that segregation will improve market efficiency.

This paper reports results from the first experimental study of decentralized matching theory with search frictions in the laboratory. In this experiment, we operationalize segregation institution by providing two markets. In one treatment, the two markets are symmetric, whereas in another treatment, agents need an entry fee to enter one market, thus creating asymmetry to facilitate coordination. We then compare agent strategies with and without segregation institution. To test the robustness of the theoretical predictions, we use two different environments, payoff matrix 1 and payoff matrix 2. In payoff matrix 1, in the segregation equilibrium, there are two groups of mutually-accepting agents with or without segregation institution, whereas in the collocation equilibrium, all agents collocate in the same market and they are mutually acceptable to each other. In payoff matrix 2, in equilibrium, everyone accepts everyone else without the segregation institution. However, with segregation institution in payoff matrix 2, the collocation equilibrium is the only pure strategy equilibrium.

We study segregation at both the individual and institution level. At the individual level, agents segregate by raising their thresholds. At the institution level, agents segregate by going into different markets. We find that equilibrium predictions about the threshold for mating are supported in payoff matrix 1, where agents partition themselves into two asymmetric groups. However, the theory is not well supported in payoff matrix 2, where in equilibrium everyone should accept everyone else. In this latter environment, we find that high types try to segregate themselves by raising their thresholds to exclude low types. We use simulations to evaluate the decisions of those agents. Our simulations indicate that, when agents take the empirical distribution of thresholds as given, their decisions are indeed close to optimal.

Our findings also indicate that, when formal segregation institutions exist, i.e., when there are two markets in our experimental setting, then both medium and high types prefer to be in the market which contains high types in the previous periods, and prefer not to be in the market which contains low types in the previous periods. Conversely, while most low types prefer the market containing low types in the previous periods, some low types try to chase high types. Despite these low type attempts to chase high types, high types consistently segregate themselves into one market in most sessions, especially when one market has an entry fee.

Furthermore, we find that, while the symmetric segregation institution significantly increases matching success rate, profit and efficiency in payoff matrix 2, it has weak or no effect in payoff matrix 1. By adding an entry cost, the asymmetric segregation institution leads to increased matching success rate and efficiency in both payoff matrices, which underscores the importance of a coordination device.

In sum, this study provides the first experimental examination of segregation behavior in the laboratory. It also provides an intriguing framework for future experimental work on how and why segregation occurs, as well as the consequences of market segmentation. As the first laboratory study of this kind, we restrict ourselves to the simplest one-population model. A natural extension is to study the two-population model in the laboratory to see if the main findings in this paper still hold. We believe that thorough laboratory studies of decentralized matching with search frictions and segregation might shed light on market design, for example, on whether providing multiple markets might facilitate job search at monster.com, and matching success rate at online dating sites, such as match.com.

Appendix A. Description of the Numerical Method

In this appendix, we summarize the algorithm which we use to numerically compute the equilibria of the game. Interested readers can find the complete algorithm at `http://yanchen.people.si.umich.edu/`.

In computing the equilibrium, we iterate through all combinations of reservation values for the six types of agents. For each combination of reservation values, we check whether it is an equilibrium by going through the following procedure.

For a given combination of reservation values, for each type, we first compute the probability distribution that this type will be in various positions in the queue after mating. We call this the *probability distribution of queue positions*. We calculate the probability distribution by exhaustively going through all matching combinations, and calculating the probability that a type is mated and ends at a particular position in the queue. We then use Bayes rule to compute the conditional probability that a type is in a particular position in the queue after being mated,[10] as well as the distribution of types leaving the queue and re-entering the market.

Next, we compute the *expected value* for each type, and the expected value of being reborn when an agent leaves the queue and enters the market. We call the latter an agent's *rebirth value*. Note that, for each treatment, there is an expected value for each type and a rebirth value for all types. We start with an initial value for the expected value of each type, and an initial value for the rebirth value. We then recalculate these values in the following way.

- The expected value of a type x consists of two parts: If he is mated, he receives this value and the discounted rebirth value, where the discount factor is computed by using the probability distribution of queue positions. If he is not mated, he receives the discounted expected value. We then subtract the search cost.
- The expected rebirth value is the weighted sum of the values, i.e., for each type, the value of that type is weighted by the probability distribution that the type leaves the market and enters the queue.

If an initial value is correct, it will be confirmed. If not, we replace that initial value with the recalculated new value. We repeat this procedure until all expected values and rebirth values converge.

Given the excepted values for a combination of reservation values, we check the equilibrium conditions. Given the combination of reservation values of other agents, if none of the agents can be made better off by using other reservation values, then we have found an equilibrium.

[10] This probability is not independent of the type. If, for instance, type x accepts types above $x-1$, then the extreme types are less likely to be mated than are the middle types. However, on the other hand, if they are mated, they are more likely to leave the queue early, as the mating of extreme types puts less restriction on the possibility of other matings.

Appendix B. Existence of Equilibrium

B.1. The One-Market Environment.

The argument presented here proceeds as follows. In any period the market contains twelve agents, each of whom chooses a reservation type that is a number in the set $\{1, \ldots, 6\}$. Consequently there are only finitely many possible ordered lists of the agents' choices. A fixed-point argument is used to show that for each such list there is a value for each agent for participating in the market and that the list of these twelve values is self-consistent in that these values imply each other. These values establish that the market environment is equivalent to a finite-player, finite-action, complete information noncooperative game. A market equilibrium is a Nash equilibrium for this game. A standard argument confirms that such an equilibrium exists.

The stock and the type distribution of the agents in the market are time-invariant; *viz.* in any period there are always six pairs of agents, one pair for each type $i = 1, \ldots, 6$. This is ensured by allowing at the start of a period entry to the market from the queue by exactly the number of agents who exited the market in the previous period and by assigning randomly to the entering agents the types of the agents who exited. The two agents of type i will be distinguished from each other by using the labels iA and iB. A strategy profile is a list $r = (r_{1A}, r_{1B}, r_{2A}, r_{2B}, \ldots, r_{6A}, r_{6B})$ where $r_{iA}, r_{iB} \in \{1, \ldots, 6\}$ are the reservation types chosen by the agents iA and iB. For example, if $r_{3A} = 1$ and $r_{3B} = 2$ then the type 3 agent labeled $3A$ will accept any agent and the type 3 agent labeled $3B$ will accept any agent with a type of 2 or higher. $\mathcal{R}$ is the finite set of all reservation type profiles. $\#\mathcal{R} = 6^{12} = 2,176,782,336$. A given profile $r \in \mathcal{R}$ implies a list $\mathcal{P}(r) = (\mathcal{P}_{1A}(r), \mathcal{P}_{1B}(r), \ldots, \mathcal{P}_{6A}(r), \mathcal{P}_{6B}(r))$ where $\mathcal{P}_{iA}(r)$ is the set of other agents who are mutually acceptable match partners for the type iA agent. That is, for each $i = 1, \ldots, 6$,

$$\mathcal{P}_{iA}(r) = \{kj \mid k \in \{1, \ldots, 6\},\ j \in \{A, B\},\ kj \neq iA,\ k \geq r_{iA},\ i \geq r_{kj}\}. \tag{3}$$

The sets $\mathcal{P}_{1B}(r), \ldots, \mathcal{P}_{6B}(r)$ are defined similarly. In what follows, for brevity the discussion will emphasize the behavior of the type iA agent only, but the reader should understand that this discussion applies equally to the type iB agent.

Given r, for $i = 1, \ldots, 6$ and $j = A, B$ let $\rho(kj, \Delta \mid iA, r)$ denote the joint probability that the type iA agent who leaves the market at the end of the current period will re-enter the market as the type kj agent after spending Δ periods in the queue; $\Delta = 0, 1, 2, \ldots$. A given strategy profile r, together with the purely random pairing of agents in the market and the maintenance of the same population of types in all periods, causes these probability distributions to be time-invariant for each type-iA agent.

An example will help to make clear why the expected value to an agent of entering the queue depends upon the agent's type when it exits the market. Suppose that there are only three (pairs of) types in the market ($i = 1, 2, 3$) and that the profile r causes agents of types 2 and 3 to be mutually acceptable while type 1 agents are acceptable only to each other. Suppose that the type 1 agents exit the market. Then so do all of the other four agents since, if the type 1's were matched with each other then the types 2 and 3 were matched in some way with each other. According to r, all of these matches are mutually acceptable. All six agents leave the market and enter the queue. The four agents already in the queue and two, randomly chosen, of the six who have just left the market, re-enter the market in the next period. Now suppose instead that a type 1 agent is matched with a type 2 agent. Then the other type 1 agent is matched with some other type. Both of these matches are unacceptable. The remaining two agents are matched and accept each other. Thus only one pair exits the market. This pair consists of two type 3's or a type 2 and a type 3. These agents enter the queue in the fifth and sixth positions and wait there at least one period while the two agents in the first two positions in the queue re-enter the market, both with a type of at least 2. Thus the *ex ante* probabilities of an agent's post-exit position in the queue and the probabilities of the number of periods spent in the queue depend both upon r and the agent's type when it exits the market.

When emphasis is placed upon the choice of a reservation type by the type iA agent it is convenient to write the reservation profile as $r = (r_{iA}, r_{-iA})$ where $r_{-iA} = (r_{kj})_{\substack{k=1,\ldots,6\\ j=A,B\\ kj\neq iA}}$ is the profile of the other eleven agents' reservation type choices.

For each $i = 1, \ldots, 6$ let $V(iA, r_{iA}, r_{-iA})$ denote the expected value to the type iA agent of choosing the reservation type r_{iA} given the profile r_{-iA} of the other agents' reservation type choices. Let $V(r) = (V(1A, r), \ldots, V(6B, r))$. Then, for each $i = 1, \ldots, 6$,

$$\begin{aligned} &V(iA, r_{iA}, r_{-iA}) \equiv V(iA, r) = \\ &= -c + \sum_{kj\in\mathcal{P}_{iA}(r)} (\mu(i,k) + \delta Q(iA, r, V(r)))\frac{1}{11} + \delta V(iA, r) \sum_{kj\notin\mathcal{P}_{iA}(r)} \frac{1}{11} \end{aligned} \tag{4}$$

where $0 \le \delta < 1$ and where $Q(iA, r, V(r))$ is the expected value to the type iA agent of entering the queue following a successful match.

$$Q(iA, r, V(r)) = \sum_{\Delta=0}^{\infty}\sum_{k=1}^{6}\sum_{j=A,B} \delta^{\Delta} V(kj, r)\, \rho(kj, \Delta \mid iA, r). \tag{5}$$

(4), after substitution from (5), defines a mapping Γ_{iA} which states the value $V(iA, r)$ as a function of the twelve values $V(1A, r), \ldots, V(6B, r)$, for a given strategy profile r. Write (4) and (5) combined as $V(iA, r) = \Gamma_{iA}(V(r), r)$ for $i = 1, \ldots, 6$. Similarly, write $V(iB, r) = \Gamma_{iB}(V(r), r)$ for $i = 1, \ldots, 6$ and then write

$$\begin{pmatrix} V(1A, r) \\ \vdots \\ V(6B, r) \end{pmatrix} = \Gamma(V(r), r) \equiv \begin{pmatrix} \Gamma_{1A}(V(r), r) \\ \vdots \\ \Gamma_{6B}(V(r), r) \end{pmatrix}. \tag{6}$$

There exist values $V(1A, r), \ldots, V(6B, r)$ satisfying (4) and (5) for a given profile r if and only if the mapping Γ possesses a fixed-point. That such a fixed-point exists and is unique for given r is established by confirming that Γ satisfies Blackwell's sufficiency conditions for a contraction.

It is obvious from (4) and (5) that Γ satisfies Blackwell's monotonicity condition; *viz.* if $\hat{V}(r) \le \tilde{V}(r)$ then $\Gamma(\hat{V}(r), r) \le \Gamma(\tilde{V}(r), r)$. To establish that Γ also satisfies Blackwell's discounting condition let $a \in \Re_+$ and define $V(r) + a = (V(1A, r) + a, \ldots, V(6B, r) + a)$. Then

$$\begin{aligned} Q(iA, r, V(r) + a) &= \sum_{\Delta=0}^{\infty}\sum_{k=1}^{6}\sum_{j=A,B} \delta^{\Delta}(V(kj, r) + a)\, \rho(kj, \Delta \mid iA, r) \\ &= Q(iA, r, V(r)) + a\sum_{\Delta=0}^{\infty}\sum_{k=1}^{6}\sum_{j=A,B} \delta^{\Delta}\, \rho(kj, \Delta \mid iA, r) \\ &= Q(iA, r, V(r)) + a\mathrm{E}[\delta^{\Delta} \mid iA, r]. \end{aligned} \tag{7}$$

Note that $\mathrm{E}[\delta^\Delta \mid iA, r] \leq 1$. Also, from (4),

$$\begin{aligned} &\Gamma_{iA}(V(r)+a,r) = \\ &-c + \sum_{kj\in\mathcal{P}_{iA}(r)} (\mu(i,k) + \delta Q(iA,r,V(r)+a))\frac{1}{11} + \delta(V(iA,r)+a) \sum_{kj\notin\mathcal{P}_{iA}(r)} \frac{1}{11} \end{aligned} \tag{8}$$

which, after substitution from (7), becomes

$$\begin{aligned} &\Gamma_{iA}(V(r)+a,r) \\ &= -c + \sum_{kj\in\mathcal{P}_{iA}(r)} (\mu(i,k) + \delta Q(iA,r,V(r)))\frac{1}{11} + \delta V(iA,r) \sum_{kj\notin\mathcal{P}_{iA}(r)} \frac{1}{11} \\ &\qquad + \delta\left[\mathrm{E}[\delta^\Delta \mid iA,r] \sum_{kj\in\mathcal{P}_{iA}(r)} \frac{1}{11} + \sum_{kj\notin\mathcal{P}_{iA}(r)} \frac{1}{11}\right] a \\ &= \Gamma_{iA}(V(r),r) + \delta\left[\mathrm{E}[\delta^\Delta \mid iA,r] \sum_{kj\in\mathcal{P}_{iA}(r)} \frac{1}{11} + \sum_{kj\notin\mathcal{P}_{iA}(r)} \frac{1}{11}\right] a \qquad (9) \\ &\leq \Gamma_{iA}(V(r),r) + \delta a \quad (\because \mathrm{E}[\delta^\Delta \mid iA,r] \leq 1). \qquad (10) \end{aligned}$$

It follows from (6) that

$$\Gamma(V(r)+a,r) \leq \Gamma(V(r),r) + \delta \begin{pmatrix} a \\ \vdots \\ a \end{pmatrix}$$

which, since $0 \leq \delta < 1$, is a statement that Γ satisfies Blackwell's discounting condition. Accordingly, Γ is a contraction with modulus δ and so possesses a unique fixed-point $V^*(r) = (V^*(1A,r),\ldots,V^*(6B,r))$ of values for the given reservation-type profile r.

We have established the existence of a unique vector of values, or payoffs, for each strategy profile $r \in \mathcal{R}$. That is, we have established the existence of a payoff function defined on $\mathcal{R}$ and so we may view the market environment as a complete information noncooperative game containing twelve players each of whom has the same set of pure actions $\{1,\ldots,6\}$. The simplex $\Delta^6 = \{(\pi_1,\ldots,\pi_6) \mid \pi_1 \geq 0,\ldots,\pi_6 \geq 0,\ \pi_1+\cdots+\pi_6 = 1\}$ is the set of all possible probability distributions defined on $\{1,\ldots,6\}$ and is the strategy space for each player. The strategy space of the game is $\mathcal{S} = \times_{\substack{k=1,\ldots,6 \\ j=A,B}} \Delta^6$. For each $k = 1,\ldots,6$ and $j = A,B$ let $\pi_{kj} \in \Delta^6$ denote a strategy for agent kj and let $\pi \in \mathcal{S}$ denote a profile $\pi = (\pi_{1A},\ldots,\pi_{6B})$ of agents' strategies. Standard arguments may now be applied to establish that the game possesses at least one Nash equilibrium strategy profile; *i.e.* there exists $\pi^e \in \mathcal{S}$ with an associated payoff profile $V^*(\pi^e)$ such that

$$V^*(kj,\pi^e_{kj},\pi^e_{-kj}) \geq V^*(kj,\pi_{kj},\pi^e_{-kj})\ \forall\, \pi_{kj} \in \Delta^6,\ \forall\, k = 1,\ldots,6 \text{ and } j = A,B.$$

B.2. The Two-Market Environment.

The two markets will be called market α and market ω. In each period the agents seek mutually acceptable matches. Any agents matched, in either market, exit their markets and enter a queue. There is only one queue. From this queue agents eventually re-enter the markets.

In each period, in the two markets combined, there are always six pairs of agents, one pair of each type $i = 1, \ldots, 6$. The two agents of type i will again be labeled as iA and iB. The types of the agents who leave the markets at the end of a period and enter the queue are the types that are assigned randomly to the agents who, at the start of the next period, exit the queue and enter the markets. Each entering agent chooses which market to enter.

An equilibrium for the two-market environment is a profile of pairs consisting of a reservation-type and a market selection. For $i = 1, \ldots, 6$ and $j = A, B$ each agent ij's choice of a reservation type r_{ij} is a number in $\{1, \ldots, 6\}$ and a market selection $m_{ij} \in \{\alpha, \omega\}$. The sets of agents populating the markets α and ω are

$$\begin{aligned} & \mathcal{A}_\alpha = \{ij \mid i = 1, \ldots, 6,\ j = A, B,\ m_{ij} = \alpha\} \\ \text{and} \quad & \mathcal{A}_\omega = \{ij \mid i = 1, \ldots, 6,\ j = A, B,\ m_{ij} = \omega\}. \end{aligned}$$

$\mathcal{A}_\alpha \cap \mathcal{A}_\omega = \emptyset$. $\mathcal{A}_\alpha \cup \mathcal{A}_\omega = \{1A, \ldots, 6B\}$. Let $(r, m)_\alpha = (r_{ij}, m_{ij})_{ij \in \mathcal{A}_\alpha}$, $(r, m)_\omega = (r_{ij}, m_{ij})_{ij \in \mathcal{A}_\omega}$ and $(r, m) = ((r, m)_\alpha : (r, m)_\omega)$. $(r, m)_\alpha$ is a strategy profile for the agents in market α. $(r, m)_\omega$ is a strategy profile for the agents in market ω. (r, m) is a strategy profile for all agents. Let $\mathcal{S}_\alpha$ and $\mathcal{S}_\omega$ denote the finite sets of strategy profiles for the two markets.

A strategy profile (r, m) for all agents implies for each agent in market α a set (possibly empty) of mutually acceptable match partners in market α and, as well, implies for each agent in market ω a set (possibly empty) of mutually acceptable match partners in market ω. Denote these sets of match partners by $\mathcal{P}_{ij}(r, m, \alpha)$ and $\mathcal{P}_{ij}(r, m, \omega)$;

$$\begin{aligned} & \mathcal{P}_{ij}(r, m, \alpha) = \{kl \mid kl \in \mathcal{A}_\alpha,\ kl \neq ij,\ k \geq r_{ij},\ i \geq r_{kl}\} \text{ for } ij \in \mathcal{A}_\alpha \\ \text{and} \quad & \mathcal{P}_{ij}(r, m, \omega) = \{kl \mid kl \in \mathcal{A}_\omega,\ kl \neq ij,\ k \geq r_{ij},\ i \geq r_{kl}\} \text{ for } ij \in \mathcal{A}_\omega. \end{aligned}$$

Given (r, m), for $i, k = 1, \ldots, 6$ and $j, l = A, B$ let $\rho(kl, \Delta \mid ij, r, m)$ denote the probability that the type ij agent who exits waits Δ periods in the queue before being assigned the type kl; $\Delta = 0, 1, 2, \ldots$. Once assigned the type kl the agent enters market m_{kl} with the reservation type r_{kl}.

Given (r, m), for $ij \in \mathcal{A}_\alpha$ let $V_\alpha(ij, r, m)$ denote the expected value of being the type ij agent in market α and, for $ij \in \mathcal{A}_\omega$, let $V_\omega(ij, r, m)$ denote the expected value of being the type ij agent in market ω. Write $V(r, m) = (V_\alpha(ij, r, m)_{ij \in \mathcal{A}_\alpha} : V_\omega(ij, r, m)_{ij \in \mathcal{A}_\omega})$.

$$\begin{aligned} V_\alpha(ij, r, m) = & -c + \sum_{kl \in \mathcal{P}_{ij}(r,m,\alpha)} (\mu(i, k) + \delta Q(ij, r, m, V(r, m))) \times \frac{1}{2\#\mathcal{A}_\alpha - 1} \\ & + \delta V_\alpha(ij, r, m) \sum_{kl \notin \mathcal{P}_{ij}(r,m,\alpha)} \frac{1}{2\#\mathcal{A}_\alpha - 1} \end{aligned} \tag{11}$$

where

$$Q(ij, r, m, V(r, m)) = \sum_{\Delta=0}^{\infty} \sum_{k=1}^{6} \sum_{l=A,B} \delta^\Delta V_{m_{kl}}(kl, r, m) \rho(kl, \Delta \mid ij, r, m) \tag{12}$$

is the expected value to the type ij agent of entering the queue after a successful match.

$$V_\omega(ij,r,m) = -c + \sum_{kl\in\mathcal{P}_{ij}(r,m,\omega)} (\mu(i,k) + \delta Q(ij,r,m,V(r,m))) \times \frac{1}{2\#\mathcal{A}_\omega - 1} + \delta V_\omega(ij,r,m) \sum_{kl\notin\mathcal{P}_{ij}(r,m,\omega)} \frac{1}{2\#\mathcal{A}_\omega - 1}. \tag{13}$$

Substituting (12) into (11) expresses $V_\alpha(ij,r,m)$ as a function $\Gamma_{ij,\alpha}$ of (r,m) and of $V(r,m)$; *i.e.* $V_\alpha(ij,r,m) = \Gamma_{ij,\alpha}(V(r,m),r,m)$ for $ij \in \mathcal{A}_\alpha$. Substituting (12) into (13) expresses $V_\omega(ij,r,m)$ as a function $\Gamma_{ij,\omega}$ of (r,m) and of $V(r,m)$; *i.e.* $V_\omega(ij,r,m) = \Gamma_{ij,\omega}(V(r,m),r,m)$ for $ij \in \mathcal{A}_\omega$. Thus

$$\begin{pmatrix} V_\alpha(ij,r,m)_{ij\in\mathcal{A}_\alpha} \\ V_\omega(ij,r,m)_{ij\in\mathcal{A}_\omega} \end{pmatrix} = \Gamma(V(r,m),r,m) \equiv \begin{pmatrix} \Gamma_{ij,\alpha}(V(r,m),r,m)_{ij\in\mathcal{A}_\alpha} \\ \Gamma_{ij,\omega}(V(r,m),r,m)_{ij\in\mathcal{A}_\omega} \end{pmatrix}. \tag{14}$$

There exist values $V_\alpha(ij,r,m)$ for $ij \in \mathcal{A}_\alpha$ and values $V_\omega(ij,r,m)$ for $ij \in \mathcal{A}_\omega$ that satisfy (11), (12) and (13) if and only if Γ possesses a fixed-point. The same arguments as used in the previous section establish that Γ is a contraction with modulus δ and that it has a unique fixed-point $V^*(r,m) = (V^*_\alpha(ij,r,m)_{ij\in\mathcal{A}_\alpha},\ V^*_\omega(ij,r,m)_{ij\in\mathcal{A}_\omega})$ for a given strategy profile (r,m).

This establishes the existence of a unique vector of values for each strategy profile $(r,m) \in \mathcal{S} = \mathcal{S}_\alpha \times \mathcal{S}_\omega$. The same arguments as used for the one-market environment establish that the two-market environment is a complete information noncooperative game and that the game possesses at least one Nash equilibrium strategy profile; *i.e.* there exists $\pi^e \in \mathcal{S}$ with an associated payoff profile $V^*(\pi^e)$ such that

$$V^*_\alpha(kj,\pi^e_{kj},\pi^e_{-kj}) \geq V^*_\alpha(kj,\pi_{kj},\pi^e_{-kj})\ \forall\,\pi_{kj} \in \Delta^6,\ \forall\,kj \in \mathcal{A}_\alpha \text{ and}$$
$$V^*_\omega(kj,\pi^e_{kj},\pi^e_{-kj}) \geq V^*_\omega(kj,\pi_{kj},\pi^e_{-kj})\ \forall\,\pi_{kj} \in \Delta^6,\ \forall\,kj \in \mathcal{A}_\omega.$$

Appendix C. Experimental Instructions

The original instructions are in German. We present the English translation of a treatment with symmetric segregation institutions. Instructions for treatments with no segregation institution are identical except they do not contain the "Two Markets" section nor parts related to two markets. Those for treatments with asymmetric segregation institution are again identical except for the mention of a participation fee. Hence we omit these instructions here. Interested readers can find the complete set of instructions at `http://yanchen.people.si.umich.edu/`.

You are taking part in an economic experiment, which is being financed by various research-promoting foundations. If you read the following instructions carefully, you can - depending on the decisions you will make - earn money in addition to the 10 francs start-up capital you receive as a fee for your participation. It is, therefore, important indeed that you accurately pay attention to the instructions given below.

The instructions distributed are intended for your personal information only. **Absolutely no communication whatsoever is allowed for the duration of the experiment.** Please address any questions you might have to us directly. The violation of this rule automatically leads to exclusion from both the experiment itself and all pertaining payments.

During this experiment, we do not deal with francs, but with points. In each period you will, therefore, earn points. The total amount of points earned in the course of the 10 periods will, on completion of the experiment, be converted into francs at the rate of

1 point equals 23 centimes.

General Idea of the Experiment

In this experiment, you will do business with the other participants. Both you and the other participants are allotted different assets, i.e., a figure which represents the value of the asset of the person who is making the deal. There are two different markets, market A and market B. First, you choose one of the two markets. Then you are matched with a partner of "your" market, you learn the value of his asset, and you decide whether or not you want to make a deal with him. If both partners come to an agreement, the deal is on and both you and your partner give away their asset. If you and your partner are not in agreement, the deal is off. Both you and he keep your respective assets and can make a deal with another partner in the next period.

The experiment's completion is not determined in advance, meaning that, at the end of each period a dice decides if the experiment is to be continued.

On the following pages we explain the procedure in detail.

The Experiment's Procedure in Detail

Allotment of Assets

At the beginning of the experiment, 12 out of 16 participants are each allotted an asset at random between 1 and 6. Each asset is allotted to exactly two individuals. So, two participants receive an asset of one, two participants receive an asset of two, etc. With the asset received, the participants can make one deal. The 12 participants with an asset at their disposal go on the market; the 4 participants with no asset are put on hold on a waiting list.

The Two Markets

You can choose between the possible markets, A and B. At the start, all participants in a market are on market B. However, they can decide if they want to move into market A or if they want to remain in market B. The participants of both markets are then, at random, matched as pairs, i.e., each participant in the market is, for the duration of a period, linked with a partner with whom he can make a deal. Pairs are matched within one market. If you choose market A, you will be matched with a partner of market A. If you remain on market B, you will be matched with a partner of market B. Both participants of one pair are informed of their respective partner's asset and decide, simultaneously and independently, whether or not to make a deal with their partner. The deal is on if both partners are in agreement, in which case both leave the market and are put on hold on a waiting list. The income earned from one deal depends on the involved partners' assets.

In order to join the participants of a market in pairs, each of the two markets must include an even number of participants. It may, thus, happen that not every participant can join the market he opts for. In such a case, a participant not able to enter the market of his choice is randomly chosen, in which event the following two rules prevail: 1) all participants insisting to remain on the market chosen can do so. 2) participants who in the previous period wished to change the market take precedence over the participants who wish to change the market in the current period.

How to Calculate Incomes

In the event of a deal reached, both partners achieve a profit depending on one's own and the partner's asset. The table below lists the profits resulting for each partner, if they agree on a deal. Suppose you have an asset of 2 and agree on a deal with a partner having an asset of 5. Then both you and your partner achieve a profit of 27 points.

As you see from the table, the profit from a deal is higher, the higher the respective partners' assets are. So, the higher your own asset, the higher is your profit from the deal. In addition, your profit is also higher, the higher your partner's asset is. If, for instance, you have an asset of 3, the profit achieved in the deal is 4, if you reach an agreement with a partner having an asset of 1. It is 74, if you reach an agreement with a partner having an asset of 6. The same applies to your partner: The higher his asset is, the higher is his profit from a deal, and the higher your own asset, the higher is the profit your partner makes from the deal.

Table: Profit from a deal achieved by each partner

		your partner's asset					
		1	2	3	4	5	6
	1	1	2	4	6	10	17
	2	2	6	10	14	27	38
your asset	3	4	10	25	39	57	74
	4	6	14	39	50	68	89
	5	10	27	57	68	90	116
	6	17	38	74	89	116	150

In **each period** you are on the market, you have to bear a **cost of 2 points**. In the event that in one period you make no deal, you have to bear the cost of only these 2 points. If a deal is reached, you make the profit as per the table minus the cost of 2 points. If you have an asset of, say, 4 and agree on a deal with a partner having an asset of 3, your earnings from the current period result in 37 points.

When on hold on the waiting list, you can make no decision. Neither do you make any profit nor do you bear any cost.

At the End of a Period

All participants having made a deal leave the market and are randomly put on hold on the waiting list. (Keep in mind that not those participants are first put on hold who decided first in the current period.) The assets of the participants who made a deal during the current period are randomly transferred to the first participants on hold on the waiting list. These latter participants can make a deal with these assets during the next period.

The participants having agreed on no deal keep their assets and remain on the market.

If you are on hold, you have to wait your turn until other participants reach an agreement and you can take over the asset of one of the leaving participants. In the event that you find yourself at the head of the waiting list, you get a leaving participant's asset at random. This may already be the case at the end of the period in which you yourself made a deal, provided that, in the current period, more than two pairs agreed on a deal. In the other event, you have to stay on hold, and wait for a new asset for one or several periods.

This experiment allots an asset between 1 and 6 to exactly two individuals. However, this asset does not belong to the same individuals each time. Let's assume that two persons are allotted the asset of 3. In different periods, however, this asset may belong to different participants: If, for instance, you get an asset of 3 and, in an earlier period, you were matched with a partner having an asset of 3, and a few periods later you are again matched with a partner having an asset of 3, it does not mean that you will also deal with the same participant.

End of the Experiment

The experiment does not end after a predetermined number of periods. At the end of each period, the participant occupying the place A2 will throw a 10-face dice. The experiment reaches its end when either 8 or 9 is thrown. In each of the other events, the experiment continues.

Should the experiment last too few periods, it will be repeated from the very start. Above all, the assets will be allotted anew. By this, all participants, those on the market and those on hold, have the same prospect of being allotted a certain asset.

Example for the Experiment's Procedure

The following table illustrates how the experiment is run. The table is explained in detail below.

Period	1	2	3	4	5	6	7	8	9	10	11
your asset	2	2	2	2	W	W	5	5	4	4	4
partner's asset	1	3	6	5			6	4	6	3	3
you accept	no	yes	no	yes			yes	yes	no	no	no
partner accepts	no	no	yes	yes			no	yes	no	yes	no
deal	no	no	no	yes			no	yes	no	no	no
profit				27	-	-		68			
cost	2	2	2	2	-	-	2	2	2	2	2
earnings	-2	-2	-2	25	0	0	-2	66	-2	-2	-2

In the first period, you are allotted the asset of 2. You choose and receive market A. Hence, you are matched with a partner from market A. Your partner is allotted the asset of 1. Both you and your partner decline the deal. The deal is off. As a result, your cost in this period amounts to 2 and your profit is -2.

In the second period, you still have the asset of 2. You again choose market A, and again you are matched with a partner from market A. Your partner has an asset of 3. You accept the deal, whereas your partner does not. The deal is not on, and your cost is again 2 and your earnings result in -2.

In the third period, you choose and receive market B. You are matched with a partner from market B. Your partner is allotted the asset of 6. In this period, your partner accepts the deal, but you don't. No deal is on. Again you have a cost of 2 and, hence, a loss of -2.

In the fourth period, you again opt for market B. You are again matched with a partner from market B. He is allotted an asset of 5. Both you and your partner accept the deal. The deal is on and you earn a profit of $27 - 2 = 25$ points in this period.

During the next two periods, you are on hold on the waiting list. Neither cost nor earnings result for you.

In the seventh period, you are allotted an asset of 5 with which you make a deal in the eighth period. In period 8, a great many participants reach a deal, so that you enter the market again in period 9. You are allotted an asset of 4. As the experiment is terminated after period 11 (participant A2 throws the number 8 on the die), you can no longer make any deal with the asset of 4.

Procedure on the Computer

You are informed when you are on hold on the waiting list.

In the event that you are not on hold, you first decide which market you want to enter. The following screen is presented for you to enter your choice. The left side of the screen shows the number of participants who, in earlier periods, opted for market A. It also indicates how many participants received asset 1 in market A, how many received asset 2 in market A, etc.

The right side of the screen again shows your asset. Furthermore, you are reminded of the market in which you currently are dealing. You make your entry below by activating either the button "market A" or the button "market B." In case you enter market A, you are matched with a partner in market A. If you enter market B, you are matched with a partner in market B.

When you have decided on the market to enter, you will be shown the following screen. You are again informed of your asset and have to make up your mind whether or not to reach a deal with your partner. You do so by determining a **threshold value**, indicating the minimum value you accept as your partner's asset in order to agree on a deal. You must decide on a threshold value before you know your partner's actual asset. Whether the deal is accepted is determined by both the threshold value and your partner's actual asset: If your partner's asset is at least as high as the amount of your threshold value, the deal is accepted; otherwise, it is not. If you insert a threshold value of, suppose, 4, and your partner has an asset of 1, 2, or 3, the deal is not accepted (and the deal is off). If you insert a threshold value of 4, and your partner has an asset of 4, 5, or 6, however, the deal is accepted. (The deal is on if your partner accepts it, too.)

You insert your threshold value on the following screen. As soon as your decision is made, mouse-click the "OK" button. As long as you don't activate the OK button, you can revise your decision by highlighting your input and inserting a new figure.

When all participants have reached a decision, the screen below shows your earnings. On the left side, you are informed of how many participants opted for market A. In addition, you can see the value of your asset, the value of your partner's asset, and the threshold value you determined. You also learn if your partner was prepared to make the deal (however you do not see his threshold value) and, finally, the resulting profits from the decisions made and both the cost and earnings of the current period. At last, the total income from the experiment is shown. (In the event that the experiment is repeated, the total income is reduced to 0 again. Of course, you will be paid *all* the money earned during all experiments.)

As soon as all participants have mouse-clicked the “continue” button, or when time is up, one period is complete. A2 throws the ten-face dice. If he throws a figure between 0 and 7, the experiment goes on. If he throws the figures 8 or 9, the experiment is discontinued. In case the experiment has too few periods, it is repeated.

Control Questions

1. Your asset is 5 and you determine a threshold value of 2. Your partner is willing to make a deal with you. What is your income from this period, if ...
   (a) ... your partner’s asset is 1 ? ....
   (b) ... your partner’s asset is 2 ? ....
   (c) ... your partner’s asset is 3 ? ....
   (d) ... your partner’s asset is 4 ? ....
   (e) ... your partner’s asset is 5 ? ....
   (f) ... your partner’s asset is 6 ? ....
2. You have an asset of 1. Your partner has an asset of 4.
   (a) What is your income from this period, if you decide on a threshold value of 1 and your current partner is prepared to deal? ....
   (b) What is your income from this period, if you decide on a threshold value of 2 and your current partner is not prepared to deal? ....
   (c) What is your income from this period, if you decide on a threshold value of 3 and your current partner is prepared to deal? ....
   (d) What is your income from this period, if you decide on a threshold value of 4 and your current partner is not prepared to deal? ....
   (e) What is your income from this period, if your decide on a threshold value of 5 and your current partner is prepared to deal? ....
   (f) What is your income from this period, if you decide on a threshold value of 6 and your current partner is not prepared to deal? ....
3. Suppose you have an asset of 5 and opt for market A. Apart from you, there are five other participants in market A, of which one has an asset of 1, one has an asset of 2, one has an asset of 3, one has an asset of 4, and one has an asset of 6. What is the probability of your partner having ...
   (a) ... the asset 1 ? ....
   (b) ... the asset 2 ? ....
   (c) ... the asset 3 ? ....
   (d) ... the asset 4 ? ....
   (e) ... the asset 5 ? ....

(f) ... the asset 6 ? ....

4. Suppose you have an asset of 4 and opt for market A. Apart from you, there are three other participants in market A, of which two have an asset of 5 and one has an asset of 6. What is the probability of your partner having ...

   (a) ... the asset 1 ? ....
   (b) ... the asset 2 ? ....
   (c) ... the asset 3 ? ....
   (d) ... the asset 4 ? ....
   (e) ... the asset 5 ? ....
   (f) ... the asset 6 ? ....

5. What is your income in the event that you are on hold on the waiting list? ....

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