Experimental results on the roommate problem*

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Abstract

We use laboratory experiments to analyze decentralized decision-making in one-sided matching markets. We find that subjects tend to make decisions in line with theoretical models, as their offering and accepting decisions are mostly guided by the objective of improving upon the status quo. However, isolated individual mistakes, that do not disappear with experience or time, often make theoretically-stable matchings unstable in the laboratory. Markets with incomplete information are especially prone to this problem.

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1 Introduction

Roommate markets, introduced by Gale and Shapley [11], consist of a (finite) set of agents who have to be paired among themselves according to their preferences. Despite the shortage of game theoretical papers on this subject and the lack of non-cooperative mechanisms that implement the socially desired outcomes, it is not difficult to find applications to it. Examples include the problem of finding roommates at the university that is frequently used to illustrate the model (hence the name of the problem), matching lab partners in a science class, creating a flight crew or a set of chess players who need to form pairs to play a game. The roommate problem is also useful in modelling exchange problems with a constraint on the size of the exchanges. For instance, the kidney exchange problem introduced by Roth et al. [24] was subsequently modeled by Roth et al. [25] as a roommate problem with dichotomous preferences. Also, the roommate problem is a special case of two more general models: hedonic coalition formation and network formation.

We focus on decentralized roommates markets, i.e. on markets where agents seek and are matched with each other by successively forming blocking pairs. We do so, because in many actual matching markets there is no central authority to match agents, nor is its existence assumed by the existing theoretical literature.

Knuth [17] was the first in addressing the existence of a convergence path to stability in matching markets. Since then, several papers have been written on the issue. Most of them study the theoretical conditions under which a finite sequence of blocking pairs to a stable matching exists in matching markets in the absence of a centralized procedure.[1] Stability plays a key role in matching markets, since stable matchings are considered the best solution to the problem. A matching is said to be stable if there are no agents preferring each other (or staying alone) rather than their current partners. The other part of the literature reports findings from laboratory experiments and usually focuses on centralized matching mechanisms designed for two-sided matching markets (e.g. Haruvy and Ünver [12], Niederle and Roth [19], Roth and Xing [27], Ünver [28]). The list of experimental studies that look at decentralized matching market is short and with one notable exception all of them consider two-sided matching markets (Echenique et al. [4], Kagel and Roth [14], Nalbantian and Schotter [18]). The only paper we are aware of and that analyzes decentralized roommate markets is that of Eriksson and Strimling [9] who are interested in how the size of the market and people's

[1] See for instance Roth and Vande Vate [26], Chung [1], Diamantoudi et al. [2], Klaus and Klijn [15], Klaus et al. [16] and Iñarra et al. [13].

preference structure influence the outcome of a matching process.

A common conclusion of the previous experimental works is that matching markets in the laboratory tend to deliver theoretically-unstable matchings. While we observe similar global results in all of our treatments, our aim is to analyze subjects' decentralized decision-making behavior to form blocking paths, and to understand why the market often fails to reach a stable matching the way theoretical papers predict. Our findings from decentralized matching markets can also be relevant for centralized ones, as we look directly at individual behavior without the black box created by a specific matching mechanism or clearing house.

We implement a dynamic matching market in the experimental laboratory in which offers can be made and decided upon at any moment. Only two restrictions are introduced. First, subjects can send only one offer at a time, and second, the market is open for a predetermined and announced period of time. This setup has been chosen for its simple and intuitive rules that closely mimic real-life examples. Our experimental design is a 2x2 design. We study the matching market with two different preference profiles under two different informational treatments. In the first treatment subjects have complete information, while in the second individual preference orderings constitute private information.

Many theoretical studies of strategic behavior in a matching market rely on the assumption of complete information. This is a rather implausible assumption since knowing the true preferences of every agent in the market is more than we may reasonably expect from agents in most situations. The literature, both theoretical and empirical, offers numerous results on the importance of information, however it concentrates on two-sided matching markets for which several non-cooperative mechanisms have been designed.[2]

We find, in both informational treatments, that experimental subjects tend to make decisions in line with theoretical models, in that they do not take into consideration neither the other agents' status nor whether they have formed a pair with them previously. In general, agents are only guided by the objective of improving with respect to their status quo, as theoretical

[2]Roth [22] made the first theoretical attempt to deal with the incomplete information case. Ehlers and Massó [7] study the Bayes-Nash equilibria of mechanisms that produce stable matchings and find a necessary and sufficient condition for truthtelling to be an equilibrium. Roth and Rothblum [23] and Ehlers [5], [6] are less ambitious and do not aim at characterizing equilibria, but give advice to individuals on how to act in matching markets when there is uncertainty about the others' strategies. As for experimental studies, Pais and Pintér [20] and Pais et al. [21] report data on the role of information on individual decision-making and the properties of several matching mechanisms in the school choice and college admission models (both are two-sided matching problems).

models assume. However, isolated individual mistakes often make subjects abandon theoretically-stable matchings and the market frequently ends up in an unstable one. As for the role of information, it does not seem to have a significant effect on subjects' rationality. However, the lack of information about the others' preferences increases activity levels and more blocking pairs are formed. Also, theoretically-stable matchings are abandoned more frequently in the incomplete-information treatments.

The theoretical work presented by Klaus et al. [16] helps to put our empirical findings into perspective. They introduce a refinement to the concept of theoretically-stable matchings by allowing for mistakes in the individual decision-making process. Nevertheless, while their solution is based on individual mistakes whose probability is approaching zero, in the laboratory we observe that mistakes do not disappear with time and experience, but tend to persist in the laboratory.

2 The roommate problem

The roommate problem (Gale and Shapley, [11]) is defined by a set of agents that must be divided into pairs. Each agent is assumed to have strict preferences over the other agents in the set and the prospect of remaining single. Formally, a roommate problem is a pair $(N, (\succ_x)_{x\in N})$ where N is a finite set of agents and for each agent $x \in N$, and $\succ_x$ is a complete, transitive and strict preference relation defined over N.

An outcome of this problem is a matching, i.e. a partition of the set of agents into pairs and singletons. A matching is unstable if there is a pair of agents (not necessarily distinct) who prefer each other to their partners under the matching. This pair of agents is called a blocking pair. Formally, a matching μ is a one-to-one mapping from N onto itself such that for all $x, y \in N$ if $\mu(x) = y$ then $\mu(y) = x$, where $\mu(x)$ denotes the partner of agent x under the matching μ. If $\mu(x) = x$, then agent x is single under μ. A pair of agents $\{x, y\} \subseteq N$ (possibly $x = y$) is a blocking pair of the matching μ if

$$y \succ_x \mu(x) \text{ and } x \succ_y \mu(y). \tag{1}$$

One matching is obtained from another by satisfying a blocking pair as follows. In the new matching the agents in the blocking pair are matched to each other, their partners under the previous matching are unmatched and all other agents are matched to the same partners. Formally, let $\{x, y\}$ be a blocking pair of μ. A matching μ' is obtained from μ by satisfying $\{x, y\}$ if

$\mu'(x) = y$ and for all $z \in N\backslash\{x, y\}$,

$$\mu'(z) = \begin{cases} z & \text{if } \mu(z) \in \{x, y\} \\ \mu(z) & \text{otherwise.} \end{cases}$$

A matching is called stable if it is not blocked by any pair of agents. Gale and Shapley [11] show by using an example that a roommate problem can have no stable matchings.

A common approach in the analysis of roommate markets is assuming that agents have full knowledge of preferences and that they are rational, in the sense that they only deviate from one matching to another if they improve strictly with this movement. Under this assumption, Diamantoudi et al. [2] showed that there exists a finite sequence of myopic blocking pairs leading to a stable matching, whenever such a matching exists. Recently, Iñarra et al. [13] proposed absorbing sets as a solution for roommate markets and showed that these sets provide the stable matchings when they exist, and otherwise they provide a non-empty set of matchings satisfying the property of outer stability. That is, from any matching there is a finite sequence of myopic blocking pairs leading to them. Klaus et al. [16] analyzed these sequences of myopic blocking pairs in roommate markets, with and without stable matchings, by assuming that agents make mistakes in their decision with a small probability. Their solution refinement concept, i.e. the stochastically stable matchings, is based on individual mistakes whose probability is approaching zero. They show that whenever a stable matching exists it is also stochastically stable (and vice versa). In this experiment, for simplicity, we consider roommate problems with a unique stable matching that, therefore, is also stochastically stable.

3 Experimental design

We recruited 30 subjects to a computer laboratory through announcements posted across the campus of the Universitas Kristen Satya Wacana in Salatiga, Indonesia. They were informed that they would participate in a paid experiment on decision-making. The experiment was programmed and conducted with the software z-Tree (Fischbacher, [10]).

Two sessions with different subject pools took place in August 2009. We implemented one session with a low information environment in which participants' preference profiles were private information, and another with a high information environment, in which participants knew also the others' preference profiles.

At the beginning of each session, printed instructions were given to subjects and were read aloud to the entire room. These instructions explained all the rules determining the resulting payoff for each participant. They were written in Indonesian and presented sample screens to illustrate how the program worked. The English translation of the instructions can be found in Appendix B.

Each session consisted of one practice period and 10 paying rounds, and lasted around 90 minutes. At the beginning of the experiment the computer randomly assigned subjects to groups of 5. We used anonymous stranger matching, i.e. participants were not informed about who the other members of their group were, and they were informed that groups were changing randomly throughout the session. Subjects were not allowed to communicate with each other. In each round, subjects were asked to make private decisions about forming pairs with other members of their group.

The decentralized market that we implemented in the experimental laboratory was inspired by the real-time search game implemented by Eriksson and Strimling [9], a similar "free agency" treatment by Nalbantian and Schotter [18], and partly by the theoretical model described by Klaus et al. [16]. Given that the scarce experimental literature on decentralized matching markets does not agree on the design, we implemented an intuitive market with real-time interaction that allows to derive conclusions on individual behavior related to theoretical models.[3] In our sessions, each market round lasted for 4.5 minutes during which participants could send an offer to form a pair at any moment to any other participant in the same group. However, a participant could only make one offer at a time, i.e. could not send a new offer until the previous one has been either accepted, rejected by the other participant or withdrawn by herself. Matched couples did not leave the market as they could send and receive offers during the whole market round privately. In case an already-matched participant's offer was accepted or an already-matched participant accepted a new offer, the current partnership was dissolved and the new one was formed (leaving the abandoned partner alone). Participants were unmatched at the beginning of each round.

Subjects' preferences were induced by the monetary payoff that they earned depending on who their partner was at the end of each round. These

[3]The main difference between our design and the "cocktail game" by Eriksson and Strimling [9] is that we compute payoffs at the end of each market period, while they did it in a continuous manner, looking at the life-time of each partnership. As for Echenique et al. [4], although their game is dynamic, offers, decisions and the information flow are not observed in real time. They are structured into two stages in which offers and acceptance decisions are made separately by participants, without any information on what is happening on the market.

preferences were similar across subjects: every subject got 50 thousand Indonesian Rupiah (IDR) for the top choice, 40 thousand for the second choice, etc. Payoffs were computed according to the final matching at the end of each round. The final payoff of the session was computed as the average payoff over the 10 paying rounds. In order to keep the amount of real-time information on screen manageable, a participant only received information on the status of the offer she made and received, and on the current matching.

We implemented two numerical examples (games) of a roommate problem with one stable matching in each session (table 1). Participants played the same example in 5 rounds in a row, but individual roles (labels) were assigned randomly in each round. Therefore, participants were likely to have a different preference ordering in each round, while the global preference profile only changed after round 5.

Table 1: The preference profiles used in the experiment. Payoffs in thousand IDR.

partner in	game 1 rounds 1 - 5					game 2 rounds 6 - 10				
player	1	2	3	4	5	1	2	3	4	5
1	10	50	30	20	40	10	50	40	20	30
2	30	10	20	50	40	30	20	50	40	10
3	30	40	10	20	50	10	20	30	50	40
4	50	10	40	30	20	50	40	20	10	30
5	30	40	20	50	10	30	50	20	40	10
stable matching	{{1,3}, {2,5}, 4}					{{1,5}, {2,4}, 3}				

The sessions/treatments differed in the amount of information that participants had about one another's preferences. In the low information treatment preferences constituted private information, participants knew only their own payoff tables and the only information that we gave them about the others was that "they are similar".[4] In the high information treatment participants received on-screen information about all the others' payoffs.

At the end of the session, subjects were paid individually and confidentially. In addition to the 10 thousand IRD show-up fee, subjects earned an average of 31 thousand IRD. The final individual payoff ranged from 25 thousand to 40 thousand IRD with a standard deviation of 3.5 thousand IRD.[5]

[4]We did not specify any probability distribution or upper and lower limits for the others' valuations in the low information treatment.

[5]The minimum wage in the area (Central Java) was around 550 thousand IDR per

4 Experimental results

This section presents our experimental findings on individual behavior and matching stability in general and in comparison between the two informational treatments. As for the two games, i.e. preference profiles implemented in the laboratory, although we observe some differences, they seem to be unsystematic and will not be emphasized in the text (they appear in the tables).

We refer to matchings by 5-digit numbers whose ith digit represents participant i's partner. For example, 12345 is the matching in which all participants are alone (matched to themselves).

The statistical significance of the reported differences is based on standard proportion and count z-tests. When not stated otherwise, the results are significantly different from each other at the usual significance levels, i.e. the p-value is lower than 0.1.

4.1 Rationality

Our database contains observations on 1497 offers out of which 511 were accepted. Although matching theory suggests that blocking pairs are formed based uniquely on the partners' payoffs, we have looked for alternative naïve strategies in the laboratory. These have been defined with the help of three characteristics: rationality (R), status (S), and history (H).

Three levels of rationality are considered. They represent selection criteria from the set of eligible partners.

- Level -1: Send an offer to the agent that values the offerer most. This level is only relevant in the high information treatment.
- Level 0: Send an offer to the most preferred agent.
- Level 1: Send an offer to an agent who is preferred to status quo, i.e. the current partner.

Our decentralized matching market did not impose any restriction to the set of eligible partners (other than the one-player-one-offer rule). We say that status considerations are constraining the offering behavior, S(1), if only unmatched players are considered when sending an offer. Similarly, personal history may reduce the set of eligible partners in several ways out of which the following are considered.

month in 2008.

- Criterion 1: Only consider agents who have not been matched to the offerer before.
- Criterion 2: Only consider agents who have not been matched to the offerer nor have rejected the offerer before.

Table 2 shows that among the 12 possible naïve strategies in the low information treatment and the 18 in the high information treatment, the R(1) - S(0) - H(0) combination explains the data best by accounting for 96% of all offers. The use of the same strategy characterizes the entire subject pool and accounts for 72% of the offers sent by the least predictable participant (subject 3 in the complete information treatment). If subjects are considered separately, the R(1) - S(0) - H(0) combination explains 95% of their offer decisions on average (table 6). This strategy corresponds to the rational behavior embedded in most theoretical models on the roommate problem.

Observation 1. *96% of all offer decisions have been made to improve upon the status quo without taking the others' status and history into account. If subjects are considered separately, this strategy explains on average 95% of the offer decisions.*

The picture is less clear when acceptance decisions are considered, but the R(1) - S(0) - H(0) combination still outperforms the other naïve strategies both when decisions are pooled and when they are considered separately for each participant.[6] In this case the performance of R(1) - S(0) - H(0) and R(0) - S(0) - H(0) lies close to each other in explaining the data due to the small number of offers that had to be considered simultaneously (tables 3 and 7). However, the former never performs worse than the latter.

Observation 2. *75% of all acceptance decision have been made to improve upon the status quo without taking the others' status and history into account. If subjects are considered separately, this strategy still explains on average 75% of their acceptance decisions.*

Although the R(1) - S(0) - H(0) combination, i.e. the theoretically rational behavior, explains the vast majority of individual decisions, subjects seems to make systematic mistakes whose probability is not zero nor converges to zero with time and play experience. Klaus et al. [16] study the roommate problem in an environment where agents make mistakes in accepting or rejecting offers. In their theoretical model offers appear randomly, given that

[6]The success of naïve strategies in explaining the observed behavior is significantly lower for acceptance decisions than for offer decisions.

Table 2: Proportion of offer decisions in line with naïve strategies.

information			incomplete			complete			total
game			1	2	total	1	2	total	
# of offers			348	463	811	307	379	686	1497
% of offers by unmatched			61%	52%	56%	58%	48%	53%	55%
length (time)			67.5'	67.5'	135.0'	67.5'	67.5'	135.0'	270.0'
R(0)	S(0)	H(0)	44%	52%	49%	49%	61%	56%	52%
		H(1)	42%	43%	43%	47%	52%	50%	46%
		H(2)	28%	24%	26%	37%	36%	36%	30%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%
R(1)	S(0)	H(0)	94%	96%	95%	96%	96%	96%	96%
		H(1)	70%	62%	65%	72%	74%	73%	69%
		H(2)	54%	40%	46%	60%	56%	58%	51%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%
R(-1)	S(0)	H(0)	-	-	-	4%	4%	4%	-
		H(1)	-	-	-	31%	42%	37%	-
		H(2)	-	-	-	3%	3%	3%	-
	S(1)	H(0)	-	-	-	0%	0%	0%	-
		H(1)	-	-	-	0%	0%	0%	-
		H(2)	-	-	-	0%	0%	0%	-

R(·): -1 - offer to the agent that values the offerer most, 0 - offer to the best agent, 1 - offer to an agent who is better than the status quo;
S(·): 0 - offer to matched or unmatched agents, 1 - offer to unmatched agents only;
H(·): 0 - offer to agents who have and who have not been a partner before, 1 - offer to agents who have not been a partner before, 2 - offer to agents who have not been a partner nor have rejected before.

agents must decide upon a random sequence of partnerships and irrational partnerships are formed with a small probability $\epsilon > 0$.[7] Inspired by their model, we have estimated ϵ as the proportion of decisions that are not in line with the R(1) - S(0) - H(0) combination.[8] The ϵ related to offers is roughly

[7]Klaus et al. [16] use this setup to present a refinement to the solution of the roommate problem. They consider the matchings that arise as from a blocking dynamics with vanishing mistakes, i.e. $\epsilon \to 0$, and show that for any roommate market the set of such matchings (stochastically stable matchings) coincides with the set of absorbing matchings.

[8]An important assumption of the model is that all possible matchings are proposed with a positive probability. Given that in our decentralized market offers are made by the agents, this is not guaranteed. However, our experimental data shows that, in spite of the relatively small number of rounds, all possible matchings have been proposed at some point during the experiment (table 13 in appendix C). The only exception seems to be the matching 12345, but it was the one proposed by the computer as the original matching in

4%, while the ϵ linked to acceptance decisions is 25% (table 4). The latter is the relevant empirical result for Klaus *el al.* [16].

Observation 3. *Subjects make systematic mistakes when offering and when accepting offers. The probability of doing so is significantly different from zero and does not diminish with time (experience).*

Table 3: Proportion of acceptance decisions in line with naïve strategies.

information			incomplete			complete			total
game			1	2	total	1	2	total	
# of decisions			125	179	304	106	101	207	511
length (time)			67.5’	67.5’	135.0’	67.5’	67.5’	135.0’	270.0’
R(0)	S(0)	H(0)	75%	73%	74%	72%	74%	73%	73%
		H(1)	56%	42%	48%	53%	55%	54%	50%
	S(1)	H(0)	48%	39%	42%	45%	49%	47%	44%
		H(1)	42%	27%	33%	38%	44%	41%	36%
R(1)	S(0)	H(0)	76%	75%	75%	74%	76%	75%	75%
		H(1)	57%	43%	49%	55%	56%	56%	51%
	S(1)	H(0)	49%	40%	43%	47%	49%	48%	45%
		H(1)	42%	28%	34%	40%	44%	42%	37%

R(·): 0 - offer from the best agent, 1 - offer from an agent who is better than the status quo;
S(·): 0 - offer from matched or unmatched agents, 1 - offer from unmatched agents only;
H(·): 0 - offer from agents who have and who have not been a partner before, 1 - offer from agents who have not been a partner before, 2 - offer from agents who have not been a partner nor have rejected before.

As for the differences between our two informational treatments, information on the others’ preferences does not alter the level of rationality, nor the ranking of the analyzed naïve strategies. It does, however, reduce the total number of offers and the total number of blocking pairs. This is a fairly intuitive result, since knowing how the others think about the offerer can help to judge potential partners better and can avoid sending offers that are likely to be rejected.

Observation 4. *The amount of information does not have a significant effect on agents’ rationality level, but it is important for their activity level: more offers are made and more blocking pairs are formed if information is incomplete.*

It is interesting that the statistically significant difference between the two informational treatments in terms of offer and acceptance counts is mostly

each round.

Table 4: The evolution of ϵ over time, i.e. the evolution of the average proportion of decisions that are not in line with the R(1) - S(0) - H(0) naïve strategy.

	offer decisions					acceptance decisions				
	complete inf.		incomplete inf.			complete inf.		incomplete inf.		
round	game 1	game 2	game 1	game 2	total	game 1	game 2	game 1	game 2	total
1	12%		4%		8%	33%		17%		27%
2	7%		5%		6%	24%		27%		25%
3	6%		2%		4%	19%		18%		19%
4	3%		3%		3%	14%		38%		27%
5	1%		6%		4%	26%		3		28%
6		8%		2%	5%		39%		35%	38%
7		3%		3%	3%		11%		1	11%
8		1%		6%	3%		16%		18%	17%
9		4%		4%	4%		18%		22%	2
10		5%		5%	5%		45%		29%	37%
total	6%	4%	4%	4%	4%	24%	25%	26%	24%	25%
#	348	463	307	379	1497	125	179	106	101	511

driven by differences in game 2. While the activity level is always higher in the complete information scenario, the observed differences in offer and acceptance decisions for game 1 are only significant at 10% and at 20%, respectively.

4.2 Stability

Our observations on individual behavior in the experimental laboratory suggest that the vast majority of participants act as predicted by the theoretical models, i.e. they are guided by the sole objective of improving upon their current situation. However, a non-negligible and non-decreasing portion of actions can not be reconciled with theory. We shall refer to them as individual mistakes. In this section, we study how they affect the outcome of the interaction and, in particular, we look at the observed stability of the theoretically-stable matchings.

The most important finding is that the above-detailed individual behavior renders the theoretical concept of stable matching a less accurate solution concept for the roommate problem (table 5). We observe that although groups reach stable matchings through the decentralized interaction of agents, they also frequently abandon them.

Observation 5. *The final matching reached through decentralized interaction in the laboratory coincides with the theoretically-stable matching in approxi-*

Table 5: Stability of theoretically-stable matchings.

information	incomplete			complete			total
game	1	2	total	1	2	total	
# of blocking pairs	110	166	276	101	93	194	470
length (time)	67.5’	67.5’	135.0’	67.5’	67.5’	135.0’	270.0’
% of rational blocking pairs	73%	80%	77%	70%	80%	75%	76%
% of irrational blocking pairs	27%	20%	23%	30%	20%	25%	24%
# of reached stable matchings	9	21	30	18	10	28	58
# of final stable matchings	2	5	7	6	7	13	20
% of final stable matchings	22%	24%	23%	33%	70%	46%	34%
# of abandoned stable matchings	7	16	23	12	3	15	38
% of abandoned stable matchings	78%	76%	77%	67%	30%	54%	66%
% of periods with stable final matching	13%	33%	23%	40%	47%	43%	33%

mately $\frac{1}{3}$ of all cases. Also, $\frac{2}{3}$ of all theoretically-stable matchings (that are reached) are abandoned.

Even if the individual levels of rationality are unaffected by the amount of information, information has a significant role on the stability of the observed final matchings and on the empirical performance of theoretically-stable matching in general.

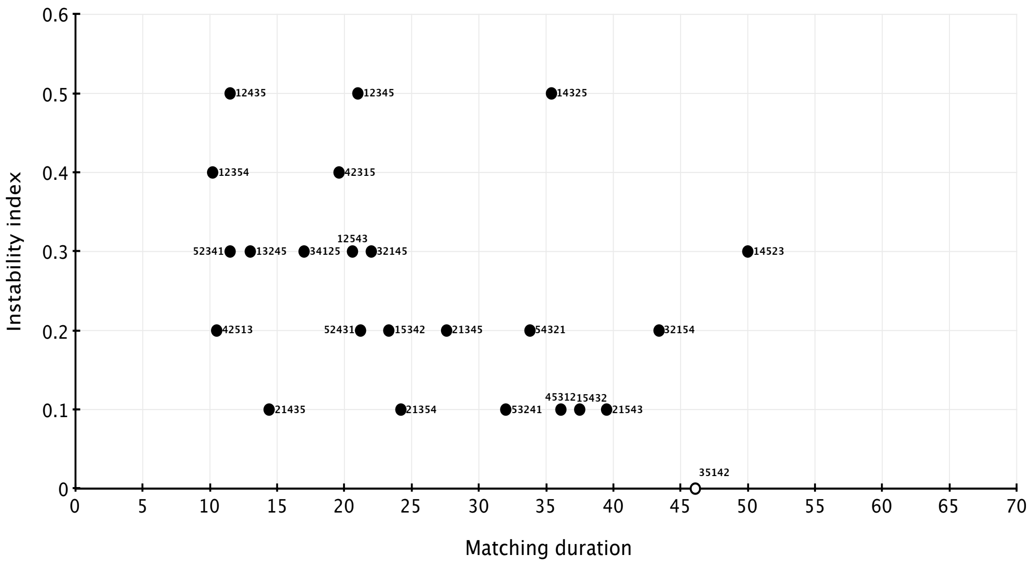
Observation 6. *Significantly less theoretically-stable matchings are abandoned under complete information than under incomplete information (54% vs. 77%, p-value=0.06). Also the proportion of periods, i.e. experimental markets, that conclude with a theoretically-stable matching is higher under complete information (43% vs. 23%, p-value=0.03).*

Following our previous speculations on the effects of incomplete information on individual behavior, in light of our observations we believe that it makes participants to keep sending offers even if the status quo is theoretically-stable. Then, individual mistakes (whose probability is not affected by the level of information) have a wider ground to move the market to an unstable matching. It is interesting that the total number of theoretically-stable matchings reached during a treatment is not significantly affected by the amount of information.

Motivated by the possibility that decentralized roommate markets may fail to have a theoretically-stable matching, and also by the related experimental literature that delivers observations on the instability of matching markets, Eriksson and Häggström [8] define two measures of instability. The instability index of a matching is defined as the proportion of blocking pairs among all possible pairs of agents (including singles). Then, the relative instability index of a matching μ is the proportion of those matchings (among all possible matchings) whose stability index is strictly lower than μ's. Table 12 (in appendix C) and figures 1 and 2 show how unstable are the matchings in our example. Given that the instability and relative instability indexes are highly correlated (0.98 in game 1, 0.97 in game 2), only the instability index that is slightly more correlated to the duration of matchings is included in the figures.[9]

The figures show that the theoretically-stable matchings—marked with empty circles as their instability index is equal to 0—are durable. Nevertheless, they are "outperformed" by other matchings. 14523 in game 1, and by 13254, 15432 and 42513 in game 2. It is not clear why this pattern arises, since these matchings are not stable, nor lie on the blocking path to a stable matching (figure 3 in appendix C).

Figure 1: Observed in/stability of matchings in game 1.



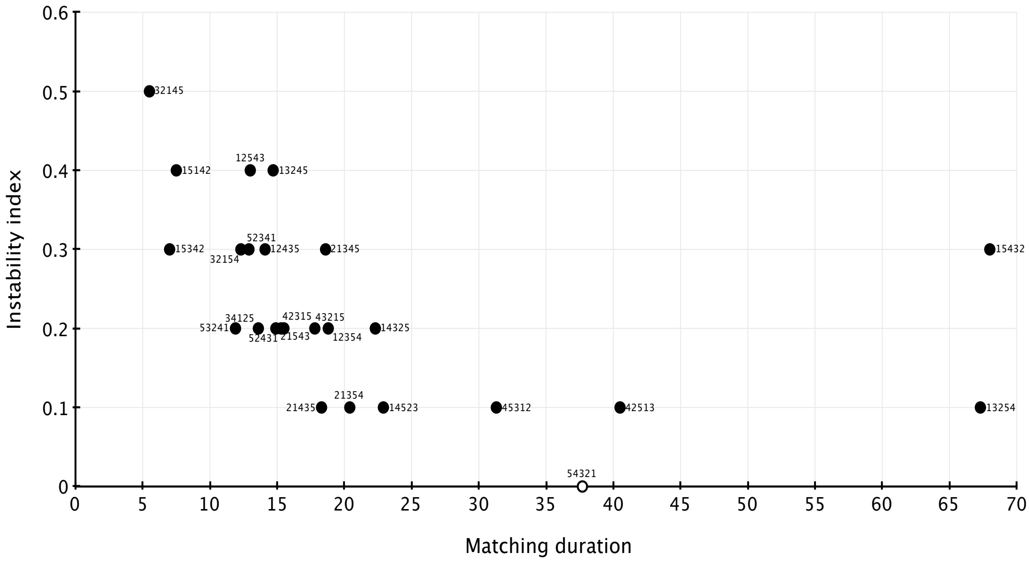
Note: The theoretically-stable matching is marked with empty circle.

4.3 Rationality in stable matchings

The previous sections have shown how theoretically-stable matching have proven to be rather unstable in the experimental laboratory due to systematic

[9]The correlation between the duration and the instability index is -0.46 in game 1 and -0.44 in game 2. Between the duration and the relative instability index it is -0.45 and -0.41, respectively.

Figure 2: Observed in/stability of matchings in game 2.



Note: The theoretically-stable matching is marked with empty circle.

mistakes made by subjects that otherwise seem to behave in line with the assumptions of the theoretical models (they try to improve upon the status quo by forming blocking pairs). In this section we analyze whether stable matchings are special in terms of subjects' rationality level.[10]

As opposed to the overall results, in stable matchings significantly more offers are made and are accepted in the full information treatment.

Other than that, situations that are considered stable by theoretical models are not different from the others in terms of subjects' rationality when making offers. However, acceptance decisions show a significantly lower rationality level. In any case, the naïve strategy described by the R(1)-S(0)-H(0) combination excels (just like in the overall analysis) in explaining the data.

Observation 7. *While 95% of all offer decisions made in stable matchings can be considered as rational, i.e. are in line with the R(1)-S(0)-H(0) naïve strategy, significantly less, barely 18% of all acceptance decisions in the same situations are rational.*

This observation gives additinal support to our previous finding according to which subjects are more prone to make mistakes when considering and

[10]Tables 8 to 11 in appendix A offer the results of the throughout statistical analysis whose main findings are reported in the text.

accepting an offer than when sending one. The rationality level of offers seem to be stable, 95% in stable matching and 96% in general, while the rationality level of acceptance decisions is lower in stable matchings, 18%, than in general, 75%. Information does not affect the rationality of offers or acceptance decisions in a significant way.

5 Conclusions

Individual mistakes render the theoretically-stable matchings a less accurate solution for the roommate problem. People seem to behave in line with theoretical assumptions most of the time, i.e. their actions are guided by the desire to improve upon the status quo, nevertheless they also make mistakes. These errors are persistent: they do not disappear with time and experience. Moreover, although the lack of information on the others' preferences does not seem to affect people's rationality level, it does render more theoretically-stable matchings unstable in the experimental laboratory. For this reason, refinements, like the so-called stochastically stable matchings (Klaus et al., [16]) are of little help, since although they allow for individual mistakes, they essentially consider the limiting case in which their probability goes to zero. We wish to join Eriksson and Häggström [8] in calling attention to the (empirical) instability of matching markets that requires its presence in the theoretical analysis, too.

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Table 6: Proportion of offer decisions in line with naïve strategies per subject.

subject			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	average	st.dev.
incomplete information																			
R(0)	S(0)	H(0)	32%	46%	34%	42%	60%	47%	38%	49%	39%	54%	70%	52%	42%	39%	45%	46%	10%
		H(1)	32%	27%	35%	42%	46%	53%	44%	42%	26%	44%	55%	56%	44%	41%	32%	41%	9%
		H(2)	29%	27%	24%	30%	28%	47%	34%	35%	26%	33%	10%	24%	19%	31%	20%	28%	8%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R(1)	S(0)	H(0)	100%	95%	95%	86%	100%	100%	97%	98%	92%	97%	96%	100%	93%	90%	90%	95%	4%
		H(1)	79%	51%	68%	65%	60%	80%	78%	78%	47%	56%	66%	76%	70%	61%	53%	66%	11%
		H(2)	76%	51%	52%	51%	40%	73%	69%	67%	47%	44%	19%	44%	42%	47%	38%	51%	15%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
# of decisions			38	37	62	57	65	30	32	55	38	61	128	54	43	51	60	54	24
complete information																			
R(0)	S(0)	H(0)	51%	53%	22%	55%	54%	43%	57%	81%	53%	11%	43%	29%	41%	43%	81%	48%	19%
		H(1)	57%	42%	16%	48%	37%	57%	53%	64%	47%	11%	40%	29%	28%	44%	78%	43%	18%
		H(2)	41%	30%	16%	45%	34%	57%	40%	38%	33%	11%	35%	14%	28%	27%	53%	33%	13%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R(1)	S(0)	H(0)	97%	95%	72%	100%	100%	96%	100%	99%	100%	100%	94%	76%	97%	98%	98%	95%	9%
		H(1)	84%	60%	44%	85%	51%	91%	77%	74%	69%	79%	69%	52%	66%	80%	89%	71%	14%
		H(2)	68%	46%	44%	79%	46%	91%	63%	47%	53%	79%	57%	38%	66%	59%	64%	60%	15%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R(-1)	S(0)	H(0)	3%	11%	9%	6%	0%	4%	0%	1%	0%	11%	1%	38%	7%	2%	0%	6%	10%
		H(1)	24%	12%	16%	36%	24%	35%	40%	36%	42%	26%	31%	24%	24%	41%	75%	32%	15%
		H(2)	8%	4%	6%	6%	0%	4%	3%	4%	0%	0%	1%	10%	7%	2%	1%	4%	3%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
# of decisions			37	57	32	33	41	23	30	101	36	19	68	21	29	51	108	46	27

R(·): -1 - offer to the agent that values the offerer most, 0 - offer to the best agent, 1 - offer to an agent who is better than the status quo;
S(·): 0 - offer to matched or unmatched agents, 1 - offer to unmatched agents only;
H(·): 0 - offer to agents who have and who have not been a partner before, 1 - offer to agents who have not been a partner before, 2 - offer to agents who have not been a partner nor have rejected before.

Table 7: Proportion of acceptance decisions in line with naïve strategies per subject.

subject			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	average	st.dev.
incomplete information																			
R(0)	S(0)	H(0)	91%	100%	61%	47%	92%	77%	77%	87%	71%	63%	55%	100%	40%	84%	53%	73%	19%
		H(1)	48%	71%	30%	33%	62%	54%	36%	40%	57%	42%	45%	64%	27%	63%	39%	47%	14%
	S(1)	H(0)	52%	47%	48%	20%	46%	38%	32%	33%	50%	42%	27%	59%	20%	68%	33%	41%	14%
		H(1)	30%	47%	30%	20%	35%	23%	18%	27%	50%	32%	27%	45%	20%	53%	25%	32%	11%
R(1)	S(0)	H(0)	91%	100%	61%	47%	100%	77%	77%	87%	71%	68%	55%	100%	40%	84%	58%	74%	20%
		H(1)	48%	71%	30%	33%	62%	54%	36%	40%	57%	47%	45%	64%	27%	63%	44%	48%	13%
	S(1)	H(0)	52%	47%	48%	20%	46%	38%	32%	33%	50%	47%	27%	59%	20%	68%	39%	42%	14%
		H(2)	30%	47%	30%	20%	35%	23%	18%	27%	50%	37%	27%	45%	20%	53%	31%	33%	11%
# of decisions			23	17	23	15	26	13	22	15	28	19	11	22	15	19	36	20	7
complete information																			
R(0)	S(0)	H(0)	73%	64%	69%	100%	57%	67%	56%	75%	86%	100%	88%	81%	88%	42%	81%	75%	16%
		H(1)	67%	54%	50%	50%	50%	67%	38%	63%	71%	78%	75%	50%	47%	8%	69%	56%	18%
	S(1)	H(0)	40%	54%	38%	25%	36%	44%	25%	63%	43%	67%	88%	50%	47%	8%	75%	47%	20%
		H(1)	40%	43%	38%	25%	36%	44%	19%	63%	49%	56%	75%	31%	29%	8%	69%	41%	18%
R(1)	S(0)	H(0)	73%	64%	69%	100%	64%	67%	63%	81%	86%	100%	88%	88%	88%	42%	81%	77%	16%
		H(1)	67%	54%	50%	50%	57%	67%	44%	69%	71%	78%	75%	50%	47%	8%	69%	57%	17%
	S(1)	H(0)	40%	54%	38%	25%	36%	44%	31%	69%	43%	67%	88%	50%	47%	8%	75%	48%	20%
		H(2)	40%	43%	38%	25%	36%	44%	25%	69%	43%	56%	75%	31%	29%	8%	69%	42%	18%
# of decisions			15	28	16	8	14	9	16	16	7	9	8	16	17	12	16	14	5

R(·): 0 - offer from the best agent, 1 - offer from an agent who is better than the status quo;
S(·): 0 - offer from matched or unmatched agents, 1 - offer from unmatched agents only;
H(·): 0 - offer from agents who have and who have not been a partner before, 1 - offer from agents who have not been a partner before, 2 - offer from agents who have not been a partner nor have rejected before.

A Tables on rationality at stable matchings

Table 8: Proportion of offer decisions in theoretically-stable matchings in line with naïve strategies.

information			incomplete			complete			total
game			1	2	total	1	2	total	
# of offers			54	96	150	74	143	217	367
% of all offers			16%	21%	18%	24%	38%	32%	25%
% of offers by unmatched			39%	31%	34%	27%	14%	18%	25%
length (time)			9.9’	14.3’	24.2’	18.6’	25.3’	43.8’	68.0’
% of offers with									
R(0)	S(0)	H(0)	44%	59%	54%	62%	83%	76%	67%
		H(1)	43%	48%	46%	58%	73%	68%	59%
		H(2)	24%	11%	16%	39%	36%	37%	29%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%
R(1)	S(0)	H(0)	93%	91%	91%	96%	99%	98%	95%
		H(1)	54%	60%	58%	69%	85%	79%	71%
		H(2)	31%	18%	28%	46%	46%	46%	37%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%
R(-1)	S(0)	H(0)	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%

R(·): -1 - offer to the agent that values the offerer most, 0 - offer to the best agent, 1 - offer to an agent who is better than the status quo;
S(·): 0 - offer to matched or unmatched agents, 1 - offer to unmatched agents only;
H(·): 0 - offer to agents who have and who have not been a partner before, 1 - offer to agents who have not been a partner before, 2 - offer to agents who have not been a partner nor have rejected before.

Table 9: Proportion of acceptance decisions in theoretically-stable matchings in line with naïve strategies.

information			incomplete			complete			total
game			1	2	total	1	2	total	
# of decisions			9	19	28	13	3	16	44
% of all decisions			7%	11%	9%	12%	3%	8%	9%
length (time)			9.9'	14.3'	24.2'	18.6'	25.3'	43.8'	68.0'
% of decisions with									
R(0)	S(0)	H(0)	22%	21%	21%	15%	0%	13%	18%
		H(1)	22%	16%	18%	0%	0%	0%	11%
	S(1)	H(0)	22%	11%	14%	0%	0%	0%	9%
		H(1)	22%	5%	11%	0%	0%	0%	7%
R(1)	S(0)	H(0)	22%	21%	21%	15%	0%	13%	18%
		H(1)	22%	16%	18%	0%	0%	0%	11%
	S(1)	H(0)	22%	11%	14%	0%	0%	0%	9%
		H(1)	22%	5%	11%	0%	0%	0%	7%

R(·): 0 - offer from the best agent, 1 - offer from an agent who is better than the status quo;
S(·): 0 - offer from matched or unmatched agents, 1 - offer from unmatched agents only;
H(·): 0 - offer from agents who have and who have not been a partner before, 1 - offer from agents who have not been a partner before, 2 - offer from agents who have not been a partner nor have rejected before.

Table 10: Proportion of offer decisions in theoretically-stable matchings in line with naïve strategies per subject.

subject			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	average	st.dev.
incomplete information																			
R(0)	S(0)	H(0)	50%	83%	38%	42%	67%	-	67%	33%	50%	44%	66%	47%	78%	43%	47%	54%	15%
		H(1)	25%	33%	50%	42%	60%	-	67%	33%	50%	44%	52%	47%	67%	57%	13%	46%	15%
		H(2)	25%	33%	19%	17%	13%	-	33%	33%	50%	22%	0%	13%	22%	29%	7%	23%	13%
	S(1)	H(0)	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R(1)	S(0)	H(0)	100%	83%	94%	67%	100%	-	67%	83%	100%	78%	100%	100%	100%	100%	80%	89%	13%
		H(1)	50%	33%	69%	50%	67%	-	67%	83%	75%	44%	66%	47%	67%	86%	27%	59%	18%
		H(2)	50%	33%	31%	17%	20%	-	33%	83%	75%	22%	0%	13%	22%	43%	13%	33%	24%
	S(1)	H(0)	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
# of decisions			4	6	16	12	15	0	3	6	4	9	29	15	9	7	15	10	7
complete information																			
R(0)	S(0)	H(0)	50%	40%	0%	60%	0%	33%	69%	87%	50%	100%	45%	100%	0%	82%	91%	54%	35%
		H(1)	50%	30%	0%	40%	0%	67%	69%	66%	38%	100%	45%	100%	0%	82%	91%	52%	35%
		H(2)	25%	10%	0%	30%	0%	67%	46%	37%	13%	100%	18%	0%	0%	53%	53%	28%	29%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R(1)	S(0)	H(0)	100%	80%	0%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%	100%	92%	26%
		H(1)	75%	40%	0%	50%	0%	67%	77%	74%	50%	100%	91%	100%	67%	100%	100%	66%	33%
		H(2)	50%	20%	0%	40%	0%	67%	54%	43%	13%	100%	27%	0%	67%	62%	62%	39%	29%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R(-1)	S(0)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	S(1)	H(0)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
# of decisions			4	10	1	10	4	3	13	68	8	2	11	1	3	11	68	14	22

R(·): -1 - offer to the agent that values the offerer most, 0 - offer to the best agent, 1 - offer to an agent who is better than the status quo;
S(·): 0 - offer to matched or unmatched agents, 1 - offer to unmatched agents only;
H(·): 0 - offer to agents who have and who have not been a partner before, 1 - offer to agents who have not been a partner before, 2 - offer to agents who have not been a partner nor have rejected before.

Table 11: Proportion of acceptance decisions in theoretically-stable matchings in line with naïve strategies per subject.

subject			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	average	st.dev.
incomplete information																			
R(0)	S(0)	H(0)	67%	-	33%	0%	100%	-	33%	-	33%	0%	-	-	0%	-	0%	30%	35%
		H(1)	67%	-	0%	0%	100%	-	33%	-	33%	0%	-	-	0%	-	0%	26%	36%
	S(1)	H(0)	33%	-	33%	0%	100%	-	0%	-	33%	0%	-	-	0%	-	0%	22%	33%
		H(1)	33%	-	0%	0%	100%	-	0%	-	33%	0%	-	-	0%	-	0%	19%	34%
R(1)	S(0)	H(0)	67%	-	33%	0%	100%	-	33%	-	33%	0%	-	-	0%	-	0%	30%	35%
		H(1)	67%	-	0%	0%	100%	-	33%	-	33%	0%	-	-	0%	-	0%	26%	36%
	S(1)	H(0)	33%	-	33%	0%	100%	-	0%	-	33%	0%	-	-	0%	-	0%	22%	33%
		H(2)	33%	-	0%	0%	100%	-	0%	-	33%	0%	-	-	0%	-	0%	19%	34%
# of decisions			3	0	3	4	1	0	3	0	3	1	0	0	4	0	6	2	2
complete information																			
R(0)	S(0)	H(0)	0%	0%	0%	100%	0%	-	0%	0%	100%	-	-	0%	-	-	0%	20%	42%
		H(1)	0%	0%	0%	0%	0%	-	0%	0%	0%	-	-	0%	-	-	0%	0%	0%
	S(1)	H(0)	0%	0%	0%	0%	0%	-	0%	0%	0%	-	-	0%	-	-	0%	0%	0%
		H(1)	0%	0%	0%	0%	0%	-	0%	0%	0%	-	-	0%	-	-	0%	0%	0%
R(1)	S(0)	H(0)	0%	0%	0%	100%	0%	-	0%	0%	100%	-	-	0%	-	-	0%	20%	42%
		H(1)	0%	0%	0%	0%	0%	-	0%	0%	0%	-	-	0%	-	-	0%	0%	0%
	S(1)	H(0)	0%	0%	0%	0%	0%	-	0%	0%	0%	-	-	0%	-	-	0%	0%	0%
		H(2)	0%	0%	0%	0%	0%	-	0%	0%	0%	-	-	0%	-	-	0%	0%	0%
# of decisions			1	3	2	1	2	0	3	1	1	0	0	1	0	0	1	1	1

R(·): 0 - offer from the best agent, 1 - offer from an agent who is better than the status quo;
S(·): 0 - offer from matched or unmatched agents, 1 - offer from unmatched agents only;
H(·): 0 - offer from agents who have and who have not been a partner before, 1 - offer from agents who have not been a partner before, 2 - offer from agents who have not been a partner nor have rejected before.

B Instructions

B.1 Complete information treatment

The purpose of this experiment is to study how people make decisions in a particular situation. If you have any question, you can pose it at any time by raising your hand first. From this moment until the end of the session any communication among participants is forbidden.

The instructions are simple and if you follow them carefully you will receive some money in cash by the end of the experiment. The money that you earn partly depends on your decisions, but also on the decisions of the other members in your group. At the end of the session, payments will be made confidentially, so no one will receive information about the earnings of the other participants.

Instructions

This session consists of 1 practice round and 10 paying rounds that will determine your final payoff. At the beginning, the computer will randomly assign the participants into groups of five. This assignment will change in each round, so you are likely to interact with a different group of people from round to round.

In each round, your task is to form a couple with another member of your group. The money that you earn depends on who is your partner at the end of the round. In order to find a partner, you have the opportunity to send offers to any member of your group, and also to receive offers from them. If you want, you also have the option of staying alone.

In each round, you will be randomly assigned an identification number from 1 to 5 and a payoff table that shows your earnings at the end of each round depending on who is your partner.

The upper part of the screen displays the parameters of the experiment. On the left hand side the payoffs are shown, while on the right hand side you can see the current matching of participants in your group. In the center, you find your identification number, the identification number of your current partner and the payoff that this partner gives you.

If you are, for example, player 2 and your partner is player 4, then your payoff can be seen in the 4th row and 2nd column of the payoff matrix. In this case, player 4's payoff is located in the 2nd row and 4th column of the table.

In order to make an offer, write the identification number of the participant in the purple box that appears in the center of the screen and click the button “send offer”.

The lower part of the screen shows the offers you have sent and received. On the left hand side you can check the list of the offers that you have received. The table shows you who has made the offer and also its status (“pending” for new offers). In order to accept or to reject an offer, you have to select the offer by clicking on its row and then clicking on one of the buttons; “accept offer” and “reject offer”. The status of the offer will change accordingly. If you happen to accept an offer your partner’s identification number and your payoff are updated immediately. On the right hand side you see the list of the offers you have made. If you regret sending an offer you can withdraw it by selecting its row and clicking the button “withdraw offer”.

You can only make one offer at a time. It means that you can only send a new offer if the previous one has been accepted, rejected by someone or withdrawn by you.
Note that there are three ways of being alone in this experiment.

1. You do not make and do not accept any offer. Participants are alone at the start of each round.

2. If you already have a partner, but your partner decides to abandon you and form a couple with somebody else.

3. If you already have a partner, but you send an offer to yourself and you accept it.

Each round lasts for 4.5 minutes. Your identification number and payoff table may change from round to round.

Payment

At the end of each round, the computer will show the final matching within your group and determine your payment taking into account who is your partner. The average earning along the 10 periods will give your final payment.

B.2 Incomplete information treatment

The purpose of this experiment is to study how people make decisions in a particular situation. If you have any question, you can pose it at any time by raising your hand first. From this moment until the end of the session any communication among participants is forbidden.

The instructions are simple and if you follow them carefully you will receive some money in cash by the end of the experiment. The money that you earn partly depends on your decisions, but also on the decisions of the other members in your group. At the end of the session, payments will be made confidentially, so no one will receive information about the earnings of the other participants.

Instructions

This session consists of 1 practice round and 6 paying rounds that will determine your final payoff. At the beginning, the computer will randomly assign the participants into groups of five. This assignment will change in each round, so you are likely to interact with a different group of people from round to round.

In each round, your task is to form a couple with another member of your group. The money that you earn depends on who is your partner at the end of the round. In order to find a partner, you have the opportunity to send offers to any member of your group at any time, and also to receive offers from them. If you want, you also have the option of staying alone.

In each round, you will be randomly assigned an identification number from 1 to 5 and a payoff table that shows your earnings at the end of each round depending on who is your partner.

The upper part of the screen displays the parameters of the experiment. On the left hand side the payoffs are shown, while on the right hand side you can see the current matching of participants in your group. In the center, you find your identification number, the identification number of your current partner and the payoff that this partner gives you.

It is important that the payoff table shows your profit depending on who is your partner. The other participants have similar payoff tables, but they are typically different from yours. Payoff tables are private information and no one has information about the others' payoffs.

In order to make an offer, write the identification number of the participant in the purple box that appears in the center of the screen and click the button “send offer”.

The lower part of the screen shows the offers you have sent and received. On the left hand side you can check the list of the offers that you have received. The table shows you who has made the offer and also its status (“pending” for new offers). In order to accept or to reject an offer, you have to select the offer by clicking on its row and then clicking on one of the buttons; “accept offer” and “reject offer”. The status of the offer will change accordingly. If you happen to accept an offer your partner’s identification number and your payoff are updated immediately. On the right hand side you see the list of the offers you have made. If you regret sending an offer you can withdraw it by selecting its row and clicking the button “withdraw offer”.

You can only make one offer at a time. It means that you can only send a new offer if the previous one has been accepted, rejected by someone or withdrawn by you.
Note that there are three ways of being alone in this experiment.

1. You do not make and do not accept any offer. Participants are alone at the start of each round.

2. It you already have a partner, but your partner decides to abandon you and form a couple with somebody else.

3. If you already have a partner, but you send an offer to yourself and you accept it.

Each round lasts for 4.5 minutes. Your identification number and payoff table may change from round to round.

Payment

At the end of each round, the computer will show the final matching within your group and determine your payment taking into account who is your partner. The average earning along the 10 periods will give your final payment.


Sisa waktu [detik]: 28
KEUNTUNGAN ANDA
PASANGAN SEMENTARA
Rp. (ribu)
dengan pemain No.1 10
dengan pemain No.2 50
dengan pemain No.3 30
dengan pemain No.4 20
dengan pemain No.5 40
Anda pemain No. 1
Pasangan Anda pemain No. 1
Keuntungan sementara 10
Tawaran ke
kirim
pasangan
Pemain 1 1
Pemain 2 2
Pemain 3 3
Pemain 4 4
Pemain 5 5
TAWARAN YANG ANDA TERIMA
TAWARAN YANG ANDA BUAT
dari
status
kepada
status
tolak
terima
batal

C Additional tables

Table 12: Observed in/stability of matchings.

	game 1			game 2		
matching	duration	instability	rel. instability	duration	instability	rel. instability
12345	21.0	0.5	1.0	-	0.5	0.9
12354	10.2	0.4	0.8	18.8	0.2	0.3
12435	11.5	0.5	0.9	14.1	0.3	0.7
12543	20.6	0.3	0.5	13.0	0.4	0.8
13245	13.0	0.3	0.7	14.7	0.4	0.8
13254	-	0.2	0.3	67.3	0.1	0.1
14325	35.4	0.5	0.9	22.3	0.2	0.3
14523	50.0	0.3	0.5	22.9	0.1	0.1
15342	23.3	0.2	0.3	7.0	0.3	0.7
15432	37.5	0.1	0.1	68.0	0.3	0.6
21345	27.6	0.2	0.3	18.6	0.3	0.6
21354	24.2	0.1	0.1	20.4	0.1	0.0
21435	14.4	0.1	0.1	18.3	0.1	0.1
21543	39.5	0.1	0.0	14.9	0.2	0.3
32145	22.0	0.3	0.7	5.5	0.5	0.9
32154	43.4	0.2	0.3	12.3	0.3	0.6
34125	17.0	0.3	0.5	13.6	0.2	0.3
35142	46.1	0.0	0.0	7.5	0.4	0.8
42315	19.6	0.4	0.8	15.5	0.2	0.3
42513	10.5	0.2	0.3	40.5	0.1	0.1
43215	-	0.3	0.5	17.8	0.2	0.3
45312	36.1	0.1	0.0	31.3	0.1	0.1
52341	11.5	0.3	0.5	12.9	0.3	0.6
52431	21.2	0.2	0.3	15.3	0.2	0.3
53241	32.0	0.1	0.1	11.9	0.2	0.3
54321	33.8	0.2	0.3	37.7	0.0	0.0

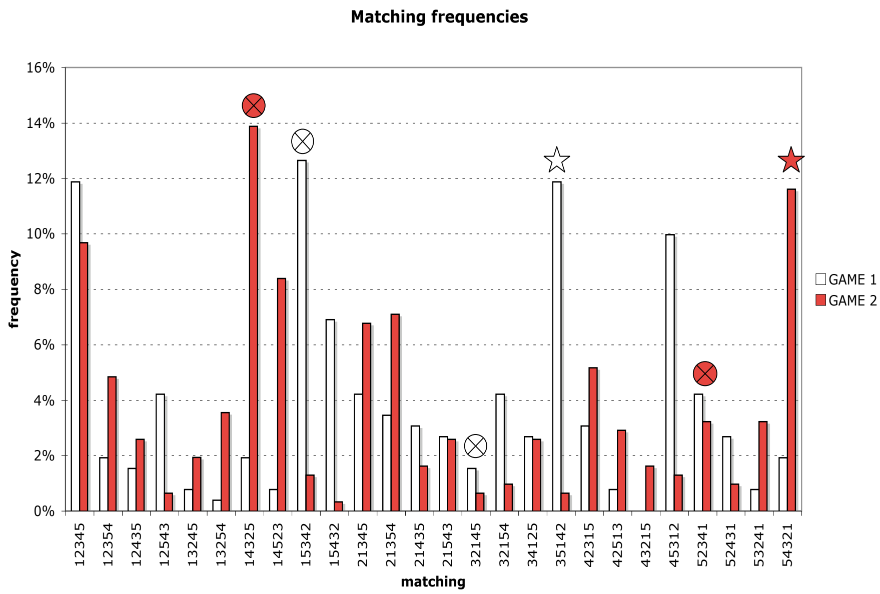
Matching code: agent 1's partner, agent 2's partner, etc.
Duration: measured in seconds, first and last matchings are excluded.
Instability and stability indexes: as defined in the text.

Table 13: Distribution of the matchings proposed by subjects.

matching	game 1	game 2	total
12345	1%	0%	0%
12354	5%	6%	6%
12435	4%	6%	5%
12543	7%	1%	4%
13245	5%	5%	5%
13254	1%	2%	1%
14325	7%	7%	7%
14523	1%	5%	3%
15342	6%	11%	9%
15432	6%	0%	3%
21345	6%	11%	9%
21354	2%	3%	3%
21435	2%	1%	1%
21543	2%	2%	2%
32145	2%	1%	2%
32154	5%	2%	3%
34125	4%	4%	4%
35142	7%	1%	4%
42315	6%	8%	7%
42513	2%	1%	1%
43215	2%	1%	2%
45312	7%	1%	4%
52341	7%	2%	4%
52431	2%	3%	3%
53241	1%	9%	5%
54321	2%	5%	3%
total	100%	100%	100%

Matching code: agent 1's partner, agent 2's partner, etc.

Figure 3: Frequency of observed matchings.



Star: stable matching; Circle: matching on the path to a stable matching.