Supplementary Appendix
Commitment and (In)Efficiency: a Bargaining Experiment

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This document contains supporting material for the document "Commitment and (In)Efficiency: A Bargaining Experiment," which herein we refer to as the "main document."

This document is structured as follows:

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Appendix J. Instructions, Screenshots and Quiz for Experiment II Game 30 treatment

Appendix K. Instructions, Screenshots and Quiz for Experiment III Game 25 treatment

Appendix D: Additional Analysis of Experiment I

D.1: Efficiency in Experiment I

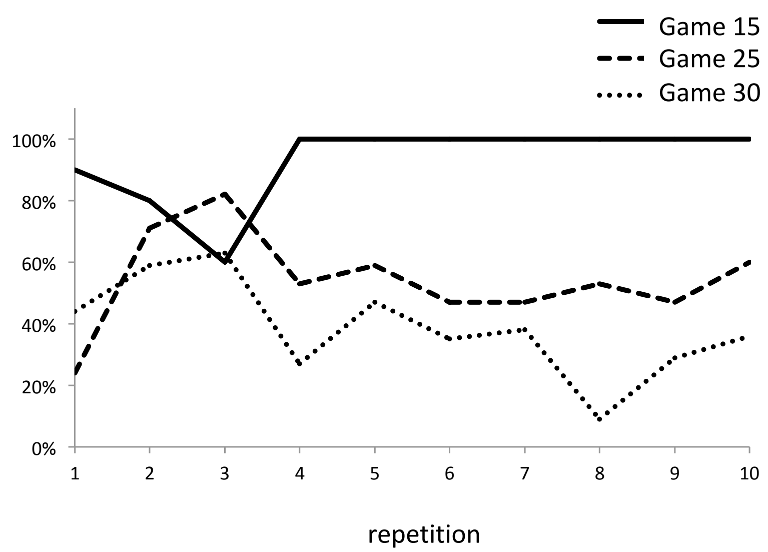


Figure D.11: Evolution of final match efficiency in Experiment I, by market.

Table D.12: Effect of First Mover's Network Position in the First Accepted Offer on Final Match Efficiency in Experiment I, experienced games

Dependent variable	Efficiency of final match
Constant (β_0)	1.00** (< 0.01)
Game 25 (β_1)	-0.83*** (0.08)
Game 30 (β_2)	-0.98*** (0.02)
First accepted offer made by weak player × Game 15 (β_3)	0.00 (0.00)
First accepted offer made by weak player × Game 25 (β_4)	0.80*** (0.07)
First accepted offer made by weak player × Game 30 (β_5)	0.93*** (0.04)
# of obs	197
# of clusters	10
R-squared	0.8041

Notes: Linear regressions with the dependent variable being an indicator of an efficient final match. Standard errors are clustered at the session level. The significance is indicated by *** and ** for 1% and 5% significance level.

D.2: Payoffs and delays in Experiment I

Table D.21: Players' payoffs and frequency of delays in Experiment I, experienced games

Dependent variable	Players' Payoffs in efficient matches	Players' Payoffs if two players active	Delay if four players active
Constant (β_0)	10.04*** (0.03)	10.03*** (0.02)	0.02** (0.007)
Game 25 (β_1)	-1.24*** (0.10)	-0.13** (0.05)	-0.02** (0.007)
Game 30 (β_2)	-2.30*** (0.08)	0.02 (0.04)	
Strong × Game 15 (β_3)	-0.07 (0.05)	-0.06 (0.03)	
Strong × Game 25 (β_4)	2.40*** (0.19)	0.20* (0.09)	0.01 (0.01)
Strong × Game 30 (β_5)	4.52*** (0.16)	-0.10 (0.07)	-0.01 (0.008)
# of obs	436	218	348
# of clusters	10	10	7
R-squared	0.4301	0.0170	0.1070

Notes: Linear regressions with the standard errors clustered at the session level. The significance is indicated by *** and ** for 1% and 5% significance level.

As we discussed in Section 5.2 in the main text of the paper, the strong players obtain higher payoffs in Games 25 and 30 when they exit the market first rather than second. Another way to statistically examine this claim is to construct two observations per subject in the following way. For each subject, we compute her average payoff when she was in a strong position and exited first and her average payoff when she was in a strong position and exited second (averages are taken over different repetitions of the game in a session). We then compare the distribution of average payoffs of subjects when they exit the market first and second as a strong player conditional on markets reaching efficient outcome, and find that average payoffs of strong players who exited first are higher than those who exited second in both Game 25 and Game 30. This refutes the concern that our result is driven by the selection of subjects, e.g., that some subjects are better at bargaining so tend to obtain higher payoffs, and these subjects also tend to exit the market first when in strong positions. Specifically, using two observations per subject, in Game 25 the average payoff of strong players when exiting first is 12.0, while the average payoff of strong players when exiting second is 10.1. Similarly, in Game 30, the average payoff of strong players when exiting first is 12.9, while the average payoff of strong players when exiting second is 10.1. Moreover, while different subjects have different numbers of times that they were assigned to the position of a strong player and exited first or second, in Game 25, for 65% (84%) of subjects, the number of times they exited first versus second differs at most by one (two) instance(s). The same statistics for Game 30 are 77% and 98%, respectively.

D.3: Players' strategies in Experiment I

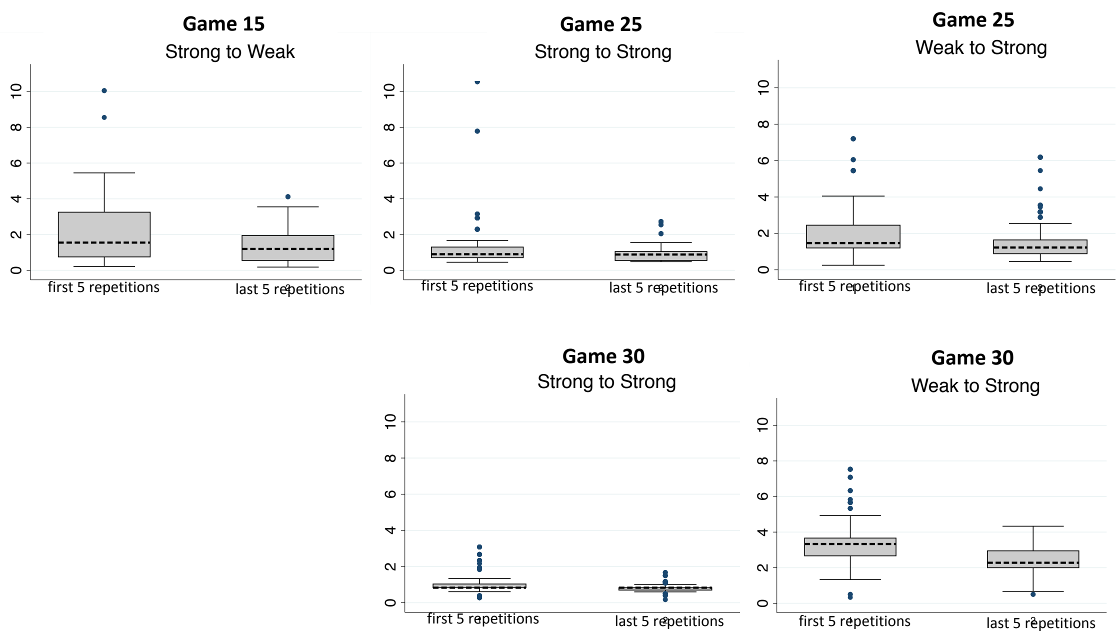


Figure D.31: Average absolute deviations of the amounts offered by players from the MPE predictions in Experiment I. Averages are computed separately for each subject in the first and last five repetitions of a session, and then combined with those of the other subjects. We focus only on cases in which markets were complete. Each box depicts the interquartile range (between the 25th and 75th percentiles), with the median value indicated by the thick dashed line. The length of whiskers is set at 1.5 times the interquartile range.

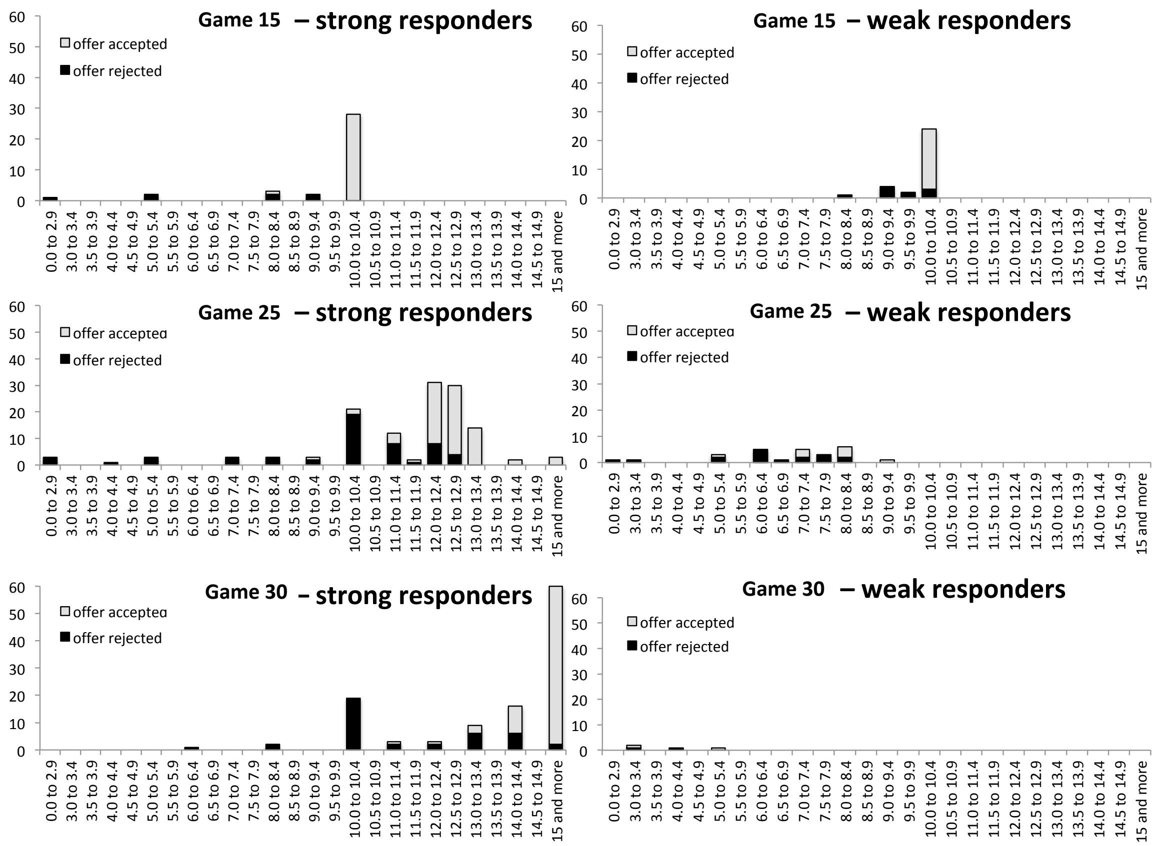


Figure D.32: Responders' behavior by network position in Experiment I, experienced games. Offers received by responders are depicted on the horizontal axes. The height of each bar represents the number of observations in each offer range.

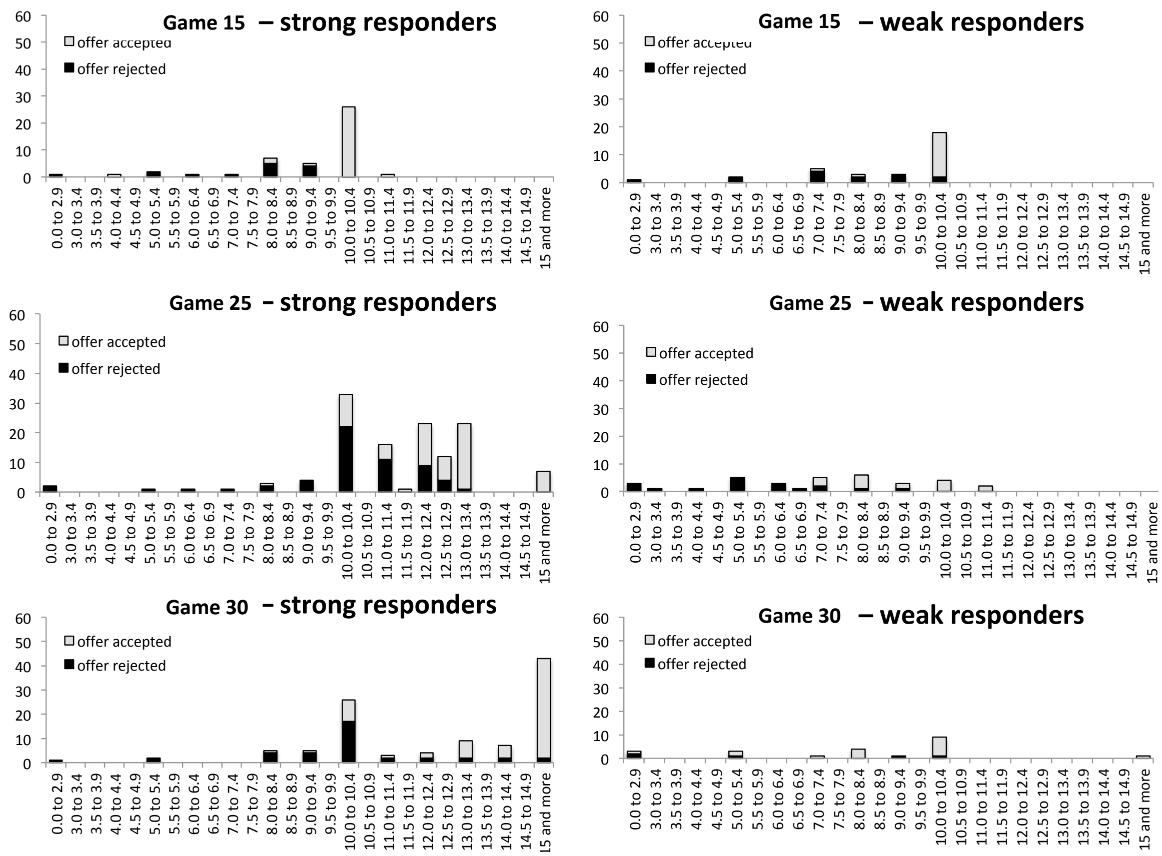


Figure D.33: Responders' behavior by network position in Experiment I in the first half of the experiment. Offers received by responders are depicted on the horizontal axes. The height of each bar represents the number of observations in each offer range.

Appendix E: Derivation of Cooperative Predictions

E.1: Symmetric Pairwise Bargained Outcomes

This approach extends Nash bargaining to networks. A player's disagreement payoff is the surplus they could obtain by just enticing someone else to match with them. Of course, this depends on the agreements others have reached, and so the solution boils down to finding a fixed point of a large system of equations.

Worker i's disagreement payoff when matching to j is given by

$$\underline{u}_i = \max\left(0, \max_{k \in F \setminus j} s_{ik} - v_k\right),$$

and the firms' disagreement payoffs are defined analogously. Given these disagreement payoffs, an outcome is an SPB outcome if and only if the match is efficient and the payoffs solve the following system of equations:

$$\begin{aligned}
u_i &= \underline{u}_i + \frac{1}{2}\left(s_{i\mu^*(i)} - \underline{u}_i - \underline{v}_{\mu^*(i)}\right) && \text{for all workers } i && (1)\\
v_j &= \underline{v}_j + \frac{1}{2}\left(s_{\mu^*(j)j} - \underline{u}_{\mu^*(j)} - \underline{v}_j\right) && \text{for all firms } j. && (2)
\end{aligned}$$

It is shown in **?** that a solution to this system of equations always exists. While in principle there can be multiple solutions in all the games we study it is unique.

In the four-player games we study, the system of equations we need to solve to find the fixed point reduces to

$$\begin{aligned}
u_A &= (s_{AD} - v_D) + \frac{1}{2}\left(20 - (s_{AD} - v_D) - 0\right)\\
u_B &= 0 + \frac{1}{2}\left(20 - 0 - (s_{AD} - u_A)\right)\\
v_C &= 0 + \frac{1}{2}\left(20 - 0 - (s_{AD} - v_D)\right)\\
v_D &= (s_{AD} - u_A) + \frac{1}{2}\left(20 - (s_{AD} - u_A) - 0\right)
\end{aligned}$$

for $s_{AD} \in \{15, 25, 30\}$. Solving this system of equations yields the predictions stated.

Remark 1. *In all the games we study there is a unique symmetric pairwise bargained outcome, and this outcome corresponds to (i) the nucleolus, (ii) the kernel, and (iii)* *the pre-kernel.*[1]

E.2: Core

In all pairwise stable/core outcomes, the match that is implemented must maximize the total surplus. As generically there is a unique match with this property, pairwise stability alone pins down who must be matched to whom and there is no scope for inefficiency. While pairwise stability, or equivalently the core, pins down the match, many payoff vectors can typically be supported as core outcomes. In particular, **?** show that there is a core outcome in which all agents on one side of the market simultaneously receive their minimum possible core payoff, while all agents on the other side of the market simultaneously receive their maximum possible core payoff.

Defining $\underline{\mathbf{u}}'$ as the workers' minimum core payoffs, letting $\overline{\mathbf{u}}'$ be the workers' maximum core payoffs, defining $\underline{\mathbf{v}}'$ as the firms' minimum core payoffs, and letting $\overline{\mathbf{v}}'$ be the firms' maximum core payoffs, the bargaining outcomes $(\underline{\mathbf{u}}', \overline{\mathbf{v}}', \mu^*)$ and the bargaining outcomes $(\overline{\mathbf{u}}', \underline{\mathbf{v}}', \mu^*)$ are in the core. Moreover, as the core is convex, the mid-point of these outcomes, $\left(\frac{1}{2}(\underline{\mathbf{u}}' + \overline{\mathbf{u}}'), \frac{1}{2}(\underline{\mathbf{v}}' + \overline{\mathbf{v}}'), \mu^*\right)$, is also in the core. As $u_i + v_{\mu^*(i)} = s_{i\mu^*(i)}$, these outcomes simplify to

$$u_i = \underline{u}_i' + \frac{1}{2}\left(s_{ij} - \underline{u}_i' - \underline{v}_j'\right) \qquad \text{for all workers } i \tag{3}$$

$$v_j = \underline{v}_j' + \frac{1}{2}\left(s_{ij} - \underline{u}_i' - \underline{v}_j'\right) \qquad \text{for all firms } j \tag{4}$$

This is the same payoff structure that we found in Equations (1) and (2), but with each disagreement payoff replaced by the minimum payoff that player could receive in any core outcome. In the four-player games we study, $\underline{u}_B' = \underline{v}_C' = 0$. In Game 15, $\underline{u}_A' = \underline{v}_D' = 0$; in Game 25, $\underline{u}_A' = \underline{v}_D' = 5$; and in Game 30, $\underline{u}_A' = \underline{v}_D' = 10$.

For completeness, and despite making only set-valued predictions of the payoffs, we also report the range of **core payoffs** each player can receive.[2] All the cooperative theories we consider capture the idea that the simple threat of players A and D reaching agreement and leaving B and C unmatched should be enough to induce B and C to reach agreements that do not leave A and D with a profitable deviation.

[1] Equivalence of the kernel, pre-kernel, and SPB outcomes holds generally for all assignment games and follows from results in **?** and **?**. The nucleolus is contained in the kernel, and so equivalence of it with the other solution concepts follows the uniqueness of the SPB outcomes for the games we study.

[2] Some papers, such as **?**, look for results that are robust to any selection from the core.

Appendix F: Behavioral MPE

In this section we derive equilibria for Game 25 and Game 30 in which a proportion of the players play behaviorally. We refer to these equilibria as behavioral MPE and their derivations are similar to those of the MPE. We make the realistic assumption that players' types are private information. This makes the predictions sensitive to how off-path beliefs are specified, but we choose beliefs that we view as realistic while keeping the analysis as simple as possible.

We let some players be rational while others only make offers that leave them with at least 10 (the equitable payoff in the efficient match), and only accept offers that leave them with at least 10. We refer to such players as behavioral. When this lower bound is not binding, the behavioral players play rationally. This will imply, in equilibrium, that strong rational and behavioral players play identically.[3]

For both Game 25 and Game 30, in the subgames in which only players A and C (B and D) are active, both players receive payoffs of W, which converges to 10 as the players become patient. Second, in the subgames in which only B and C are active, both players receive payoff of 0 regardless of their type.

We permit private information about players' types. We thus look for strategy and belief profile pairs that together constitute a Markov perfect Bayesian equilibrium,[4] where the Markov state reflects both the set of active players and beliefs about these players' types.

The details of what information is revealed when is important. Each player's type is drawn independently at the start of the game, such that a given player is behavioral with probability x. We let the observation structure of the game be such that at the end of each round the offer made in that round, identity of the proposer, identity of the recipient and response of the recipient become public information. To pin down off-path beliefs in the simplest way possible, we assume that prior beliefs are retained except in one instance where such beliefs are unnatural, as we discuss later. Our assumptions on off-path beliefs make the value functions relatively tractable. With our information structure there is only limited updating of beliefs on- and off-path. First, there is never any updating on strong players. As behavioral weak players offer

[3] We would not expect these predictions to change markedly if behavioral players demanded 50% of the surplus available in the current match, such that behavioral strong players demand at least half the value of the diagonal link when bargaining with each other. We work with the definition of behavioral players we use because it keeps play a little closer to the MPE and because we do not observe large systematic deviations from rational play by the strong players.

[4] More formally, we refine the set of perfect Bayesian equilibria by looking for equilibria in which the strategies played are history dependent only through the current Markov state. The set of Markov states is determined by first partitioning histories into those with same number of active players as before, and then partitioning these states further by the beliefs held about the active players' types.

10 while their rational counterparts will not offer 10 in equilibrium, an offer of 10 is on path and leads everyone to believe the weak player is behavioral. Similarly, a refusal by a weak player to accept an on-path offer a rational weak player should accept leads everyone to believe the weak player is behavioral. Of course, we need to take into account the possibility that rational weak players can mimic the play of behavioral weak players. In equilibrium, there is, however, no way for a weak player to signal that they are rational without exiting the game. An on-path offer will be accepted and an off-path offer will result in prior beliefs being retained. This simplifies the analysis considerably. For the equilibrium we construct only a few Markov states need to be considered. In any subgame with two players, regardless of their types, either all players receive limit payoffs of 10, or else no match is possible and both players receive limit payoffs of 0. The other relevant Markov states will be:

(i) All players are active and none have been revealed to be behavioral;

(ii) All players are active and only B has been revealed to be behavioral;

(iii) All players are active and only C has been revealed to be behavioral;

(iv) All players are active and both B and C have been revealed to be behavioral.

Game 25: To solve for the behavioral MPE of Game 25 we first need to consider the different Markov states enumerated above. We guess and the verify equilibrium strategies for these subgames, solving the problem by backward induction.

If both weak players have taken actions that, applying Bayes rule, reveal them to be behavioral we denote the continuation value of player i by $\widehat{W}_i(\delta)$. In this case, as both weak players are behavioral, they always make offers of 10. These offers are rejected in equilibrium and the strong players only offer to each other. Thus, in this subgame, strong players receive limit payoffs of $\widehat{W}_i = 25/2$, while the weak players receive limit payoffs of $\widehat{W}_i = 0$.

Suppose instead that both weak players are believed to be behavioral, but that actually player C has taken an off-path action to generate this belief and that C is rational. If C delays in this subgame, C will get 0 for sure as the strong players just offer to each other. The best C can do is to offer to A when selected as the proposer. As such offers are off-path, we assume that following them current beliefs are retained. Thus, C must offer A at least $\delta\widehat{W}_A(\delta)$ for the offer to be accepted. Making exactly this offer is the best that C can do, and this leaves C with a limit payoff of $(20 - 12.5)/3 = 2.5$.

Consider now the subgame in which player C has been revealed to be behavioral, but not player B. In this subgame, as long as $x < 2/3$, such that less than two thirds the players are behavioral on average, there is an equilibrium in which C's offers of

10 are rejected, B always offers to D, D always offers to B and A mixes between delaying and offering to D. Given this play and letting $\rho(x,\delta)$ be the probability that A delays, equilibrium continuation values are given by the solution to the following system of equations.

$$\begin{aligned}
4\widehat{V}_B &= (20-\delta\widehat{V}_D)+(2+\rho)\delta\widehat{V}_B \\
4\widehat{V}_D &= (1-x)(20-\delta\widehat{V}_B)+2x\delta\widehat{W}_D+(3-x)\delta\widehat{V}_D \\
4\widehat{V}_A &= (1-\rho)(25-\delta\widehat{V}_D)+\rho\delta\widehat{V}_A+2x\delta\widehat{W}_A+2(1-x)\delta W+\delta\widehat{V}_A \\
4\widehat{V}'_B &= 2\delta\widehat{W}_B+(1+\rho)\delta\widehat{V}'_B \\
4\widehat{V}'_C &= (1+\rho)\delta\widehat{V}_C+2(1-x)\delta W \\
(25-\delta\widehat{V}_D) &= \delta\widehat{V}_A
\end{aligned}$$

where, $\widehat{V}_i$ is the continuation value of i conditional on i being rational and $\widehat{V}'_i$ is the continuation value of i conditional on i being behavioral. The last condition is the indifference condition for A who mixes between offering to D and delaying.

Solving this system of equations and letting $\delta\to 1$, for $x\le 2/3$

$$\begin{aligned}
\widehat{V}_B &\to 5(2-x)/2 \\
\widehat{V}_D &\to 5(6-x)/2 \\
\widehat{V}_A &\to 5(4+x)/2 \\
\widehat{V}'_B &\to 0 \\
\widehat{V}'_C &\to 10-15x+5x^2 \\
\rho &\to (2-3x)/(2-x)
\end{aligned}$$

This is an equilibrium for $x\le 2/3$. First note that for $x\le 2/3$ the mixing probability $\rho\in[0,1]$. Second, we are considering acceptance strategies in which all on-path offers by rational players are accepted. As players are always offered their discounted continuation value from rejecting the offer, acceptance is optimal. Consider then possible deviations in the offers made. A deviation by player A to make an offer to C that C would accept would leave A with at most 10, and so is unprofitable for all x. A deviation by player D to instead offer to A or instead delay is also unprofitable. Finally, if rational, a deviation by player B to delay or else make an offer of 10 such that B will be thought to be behavioral is unprofitable. In the later case, B will end up in the subgame in which both weak players are thought to be behavioral and will receive a limit payoff of $2.5<20-\widehat{V}_D$. We have therefore found an equilibrium for this subgame.

Suppose instead that both weak players are rational, but that player C has taken an off-path action to generate the belief that C is behavioral. Player C can then either continue to mimic the behavioral type or else make an acceptable offer to A. Any off-path offer that is rejected by A, or delaying, leads the current beliefs to be retained and so is equivalent to C mimicking the behavioral type. As C does not receive any offers on path, C's acceptance strategy does not matter. For an offer made by C to A to be accepted, C must therefore offer A at least $\delta\widehat{V}_A(\delta)$ (as rejection of the offer by A will result in prior beliefs being retained leaving A with $\delta\widehat{V}_A(\delta)$). Making exactly this offer is the best offer C can do, and better than continuing to mimic the behavioral type. This leaves C with a limit payoff of $M_C = 5(24 - 26x + 7x^2)/(12 - 2x)$.

A third new subgame to consider is one in which player B but not C has been revealed to be behavioral. By symmetry, there is an equilibrium with the following limit payoffs for $x < 2/3$

$$
\begin{aligned}
\widetilde{V}_C &\to 5(2-x)/2 \\
\widetilde{V}_A &\to 5(6-x)/2 \\
\widetilde{V}_D &\to 5(4+x)/2 \\
\widetilde{V}'_C &\to 0 \\
\widetilde{V}'_B &\to 10 - 15x + 5x^2 \\
\widetilde{\rho} &\to (2-3x)/(2-x),
\end{aligned}
$$

and $M_B = 5(24 - 26x + 7x^2)/(12 - 2x)$.

Now we have solved for the on-path subgames, we can consider equilibrium play in the initial state. There is an equilibrium in which the strong players offer to each other while the weak players offer to the strong players. Given these offer strategies, equilibrium continuation values are given by the solution to the following system of value equations,

$$
\begin{aligned}
4V_A &= (25 - \delta V_D) + \delta V_A + (1-x)\delta V_A + x\delta\widehat{V}_A + (1-x)\delta W + x\delta\widetilde{V}_A \\
4V_D &= (25 - \delta V_A) + \delta V_D + (1-x)\delta V_D + x\delta\widetilde{V}_D + (1-x)\delta W + x\delta\widehat{V}_D \\
4V_C &= (20 - \delta V_A) + (1-x)\delta W + x\delta\widetilde{V}_C \\
4V_B &= (20 - \delta V_D) + (1-x)\delta W + x\delta\widehat{V}_B \\
4V'_C &= \delta\widehat{V}'_C + (1-x)\delta W + x\delta\widetilde{V}'_C \\
4V'_B &= \delta\widetilde{V}'_B + (1-x)\delta W + x\delta\widehat{V}'_B
\end{aligned}
$$

where V_C (V_B) is the continuation value of C (B) when C (B) is rational and

V_C' (V_B') is the continuation value of C (B) when C (B) is behavioral. Solving this system yields the following limit payoffs

$$\begin{aligned}
\lim_{\delta\to 1} V_A = \lim_{\delta\to 1} V_D &= 5(7+3x)/(3+x) \\
\lim_{\delta\to 1} V_C = \lim_{\delta\to 1} V_B &= 5(22-5x^2-x^3)/(24+8x) \\
\lim_{\delta\to 1} V_C' = \lim_{\delta\to 1} V_B' &= 5(4-5x+x^2)/4
\end{aligned}$$

We show now that this is an equilibrium. As before, by construction, acceptance strategies are optimal and so we consider deviations in offer strategies. It is straightforward to show that weak players do not have a profitable deviation to delay and that strong players do not have a profitable deviation to either delay or else make an offer to their efficient partner that would leave that partner with a payoff of at least 10 and so would be acceptable regardless of whether that partner is rational or behavioral. The final deviation available to strong players is to make an offer to their efficient partner that would be accepted if and only if that partner is rational. Suppose that A made such an offer to C. The offer that A would have to make for it to be accepted depends on the off-path beliefs. Arguably most reasonable off path beliefs in such a situation are that C is behavioral if the offer is rejected and rational if it is accepted. Indeed, Bayes rule would imply these beliefs if A's offer to C was on path. Given these off-path beliefs, which differ from prior beliefs, the incentives of C if rational to pretend to be behavioral need to be considered. Indeed, as $M_C > V_C$, if A were to offer C an amount δV_C, C would reject it. Doing so, C would be though to be behavioral and would therefore secure a continuation value of δM_C. Thus, if A wants to deviate and make an offer to C that C would just accept conditional on C being rational, A will have to offer C and amount δM_C. This gives A an expected limit payoff of $(1-x)(20-M_C)+x\widehat{A} < 25 - V_D$ for all $x \leq 0.55$.

The limit payoffs for strong players are plotted in panel (a) of Figure **??**. To find the expected ex-ante payoff of a weak player, which is what we observe in our data, we take the weighted average of the expected payoff of a rational weak player and the expected payoff of a behavioral weak player. This gives the limit payoffs for the weak behavioral players also shown in panel (a) of Figure **??**. Finally, to calculate the probability that the efficient match is reached, we consider all possible realizations of proposer sequences and offer strategies that will result in the efficient match, and find the combined probability of all such events. How the probability the efficient match is reached varies with the proportion of behavioral players is shown in panel (a) of Figure **??**.

Game 30: We solve for the behavioral MPE of Game 30 in much the same way as in game 25, although the calculations are a bit simpler. In the subgame where both players have been revealed to be behavioral, the strong players end up matched together for sure, as before. Suppose one of the weak players has taken an off-path action leading others to believe she is behavioral when in fact she is rational. The best this weak player can do it so make a just acceptable offer to her efficient partner. Doing so yields a payoff of 5 when she is selected to move before either of the strong players, and so an expected limit payoff of 5/3.

A notable difference from Game 25 is that in the subgame in which C but not B has been revealed to be behavioral, strong players both always offer to each other with probability 1 in equilibrium. Completing the description of offer strategies in this subgame, when rational, B makes an acceptable offer to D, when behavioral, B makes an unacceptable offer to D and C makes an unacceptable offer to A. The associated value equations are

$$
\begin{aligned}
4\widehat{V}_B &= (20 - \delta\widehat{V}_D) + \delta\widehat{V}_B \\
4\widehat{V}_D &= (30 - \delta V_A) + (3 - x)\delta\widehat{V}_D + x\delta\widehat{W}_D \\
4\widehat{V}_A &= (30 - \delta V_D) + 2\delta\widehat{V}_A + (1 - x)\delta W + x\delta\widehat{W}_A \\
4\widehat{V}'_B &= \delta\widehat{V}'_B + \delta\widehat{W}_B \\
4\widehat{V}'_C &= \delta\widehat{V}_C + (1 - x)\delta W + x\delta\widehat{W}_C
\end{aligned}
$$

The value equations when B but not C is known to be behavioral is symmetric, and solving these systems of equations we get the following limit continuation values for the various subgames:

$$
\begin{aligned}
\widehat{W}_A = \widehat{W}_D &\to 15 \\
\widehat{W}_B = \widehat{W}_C &\to 0 \\
\widehat{V}_B = \widetilde{V}_C &\to \frac{5x}{1+2x} \\
\widehat{V}_D = \widetilde{V}_A &\to \frac{25x+20}{1+2x} \\
\widehat{V}_A = \widetilde{V}_D &\to \frac{5x^2+30x+10}{1+2x} \\
\widehat{V}'_C = \widetilde{V}'_B &\to \frac{10(1-x)}{3} \\
\widehat{V}'_B = \widetilde{V}'_C &\to 0
\end{aligned}
$$

It can be verified that there are no profitable deviations when the players take these actions as long as $x > 1/7$. Two possible deviations are worth mentioning. When player C is behavioral, in the limit player D is indifferent between offering to player A, which generates an expected payoff of $30 - \lim_{\delta\to 1} \widehat{V}_A$, and offering to player B, which generates an expected payoff of $(1-x)(20 - \lim_{\delta\to 1} \widehat{V}_B) + x \lim_{\delta\to 1} \widehat{W}_D$. The equilibrium requires D to offer to player A for sure, so we need to check that A is incentivized to do so as $\delta \to 1$. Indeed, for all x and all $\delta < 1$, but sufficiently close to 1, D strictly prefers to offer to A as prescribed. Thus the play described is an equilibrium in the limit as $\delta \to 1$. The second deviation worth considering is the deviation by a weak rational player to mimic the behavioral type when their type is unknown and the other weak player is known to be behavioral. Doing so yields an expected payoff of 5/3 and at very low levels of x this deviation is profitable. It is not profitable for all $x > 1/7$.

The maximum payoff player C can achieve when thought to be behavioral but actually rational is obtained by C making just acceptable offers to A. As such offers are off-path, prior beliefs will be retained. Thus, C must offer A an amount $\delta\widehat{V}_A(\delta)$, leaving C with a limit payoff of $M_C = 0.25(20 - \widehat{V}_A) + 0.25(1-x)W + 0.25x(5/3)$.

Consider now the initial state. We let the strong players offer to each other and the weak players offer to the strong players yielding the following system

$$\begin{aligned}
4V_A &= (30 - \delta V_D) + (2-x)\delta V_A + x\delta\widehat{V}_A + (1-x)\delta W + x\delta\widetilde{V}_A \\
4V_D &= (30 - \delta V_A) + (2-x)\delta V_D + x\delta\widetilde{V}_D + (1-x)\delta W + x\delta\widehat{V}_D \\
4V_C &= (20 - \delta V_A) + (1-x)\delta W + x\delta\widetilde{V}_C \\
4V_B &= (20 - \delta V_D) + (1-x)\delta W + x\delta\widehat{V}_B \\
4V'_C &= V'_C + (1-x)\delta W \\
4V'_B &= V'_B + (1-x)\delta W
\end{aligned}$$

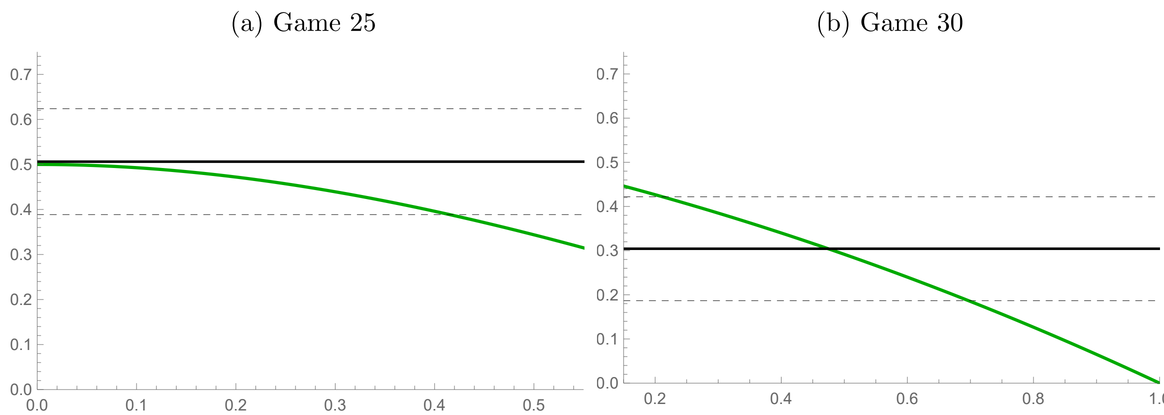
Solving this system yields the following expected limit payoffs.

$$\begin{aligned}
\lim_{\delta\to 1} V_A = \lim_{\delta\to 1} V_D &= 5(8 + 20x + 7x^2 + x^3)/((3+x)(1+2x)) \\
\lim_{\delta\to 1} V_C = \lim_{\delta\to 1} V_B &= 5(5 + 8x - 3x^2 - 2x^3)/(6 + 14x + 4x^2) \\
\lim_{\delta\to 1} V'_C = \lim_{\delta\to 1} V'_B &= 10(1-x)/3
\end{aligned}$$

Under the same off-path beliefs used in the construction of the equilibrium for Game 25, it can be verified that there are no profitable deviations when the players play in this way.

The ex-ante expected payoff of weak players can the be found by taking a weighted average of the expected payoff of a weak player conditional on being rational and

Figure F.1: The probability the efficient match is reached in the behavioral MPE as the proportion of behavioral players is varied.



Notes: Horizontal lines indicate the efficiency levels we observe in our data. Note the different values of x on the x-axis—we report results only for those values of x our equilibrium is valid for. The 95% confidence intervals are not discernible because they are located very tightly around the observe values.

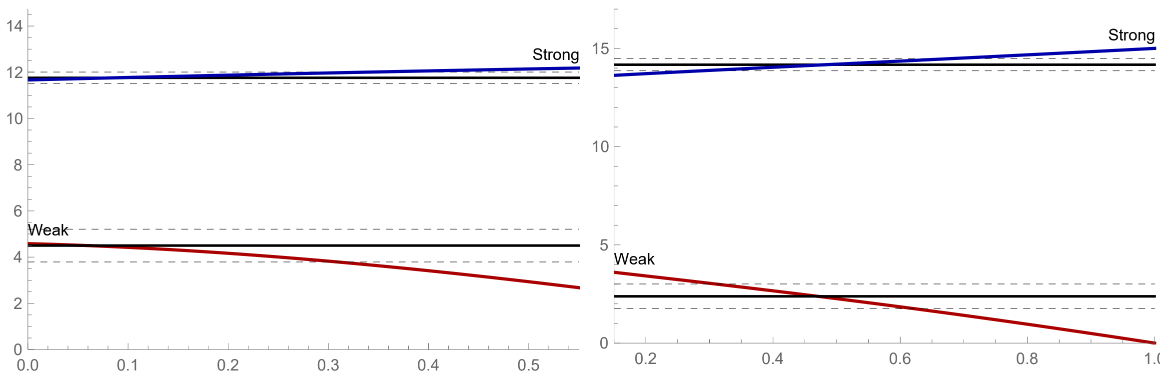
the expected payoff of a weak player conditional on being behavioral. Finally, the probability the efficient match is reached can be found by considering all the ways in which on path play can yield the efficient match. These expected payoff and the probability the efficient match is reached are reported in panel (b) Figure of Figure **??** and panel (b) of Figure **??** respectively.

Figure **??** shows that the probability the efficient match is reached decreases as the proportion of behavioral players increases in both Game 25 and Game 30. Figure **??** reports the expected payoffs of strong players and weak players as the proportion of behavioral players is increased. The mere possibility of players being behavioral makes a substantial difference to the equilibrium. It opens up the possibility of rational weak players mimicking behavioral weak players leading them to effectively extract an information rent were their efficient partners to try and trade with them. Indeed, in Game 25, this makes it credible for the strong players to just offer to each other decreasing efficiency. Even as the proportional of behavioral players goes to 0, efficiency is around 50% in comparison to more than 70% in the MPE.

It might seem surprising that behavioral players do not adjust their insistence on equal payoffs over time as it has a detrimental effect on their own payoffs, and on market equality. However, it is worth noting that even though behavioral weak players' expected payoffs are lower than their rational counterparts because they match less frequently, conditional on being matched in equilibrium (which occurs with positive probability as long as the other weak player is rational), a behavioral

Figure F.2: Expected payoffs for strong and weak players in behavioral MPE depending on the proportion of behavioral players

(a) Game 25 (b) Game 30



Notes: Black solid lines show the observed payoffs for strong and weak players along with 95% confidence intervals indicated by the black dashed lines. Note the different values of x on the x-axis—we report results only for those values of x our equilibrium is valid for.

weak player receives a payoff of 10 which is substantially higher than their rational counterpart.

Overall, we view the behavioral adjustment we have considered to take the quantitative predictions of the theory closer to the data observed in Experiment I. Introducing a small number of behavioral players moves the predictions of the theory towards our observations, while the behavioral deviations we consider are motivated by the strategies we observed and consistent with other experimental investigations in related settings.

Appendix G: Sessions Conducted at UCI versus UCSB

Here we compare sessions conducted at the two universities: UC Irvine and UC Santa Barbara. Table G.1 lists the locations at which we conducted our experimental sessions, by treatment.

We will use Game 25 to compare the two subject pools, since this is the only market structure for which we conducted sessions at both locations for both Experiment I and Experiment III (3 sessions at UCSB and 1 session at UCI).

In Table G.2 we report the main features of market outcomes (efficiency levels and payoffs) observed in each of the experiments (Experiment I and Experiment III) as well as comparison between market outcomes in the two experiments. We perform

Table G.1: Locations of experimental sessions

	UC Irvine		UC Santa Barbara	
Treatment	# of sessions	# of subjects	# of sessions	# of subjects
Experiment I, Game 15			3 sessions	40 subjects
Experiment I, Game 25	1 session	20 subjects	3 sessions	48 subjects
Experiment I, Game 30	3 sessions	68 subjects		
Experiment II, Game 30	3 sessions	88 subjects		
Experiment III, Game 15	1 session	12 subjects	2 sessions	28 subjects
Experiment III, Game 25	1 session	16 subjects	3 sessions	44 subjects
Experiment III, Game 30	3 sessions	56 subjects		

Table G.2: Market Outcomes in UCSB and UCI sessions, experienced games

	UCSB	UCI
(1) Exp I: Efficiency is higher when weak players move first	yes** ($p = 0.024$)	yes ($p = 0.322$)
(2) Exp I: Strong players earn more than weak players	yes*** ($p = 0.001$)	yes*** ($p = 0.000$)
(3) Exp I: In efficient matchings, strong player earn more when exit the market first than second	yes*** ($p = 0.012$)	yes*** ($p = 0.000$)
(4) Exp III: Strong players earn more than weak players	yes*** ($p = 0.007$)	yes*** ($p = 0.000$)
(5) Efficiency in Exp III is higher than in Exp I	yes*** ($p = 0.000$)	yes ($p = 0.427$)
(6) Payoffs of strong players are higher in Exp III than in Exp I	yes* ($p = 0.101$)	yes*** ($p = 0.008$)
(7) Payoffs of weak players are higher in Exp III than in Exp I	yes*** ($p = 0.001$)	yes ($p = 0.766$)
(8) Conditional on efficient matching:		
(8a) strong players earn more in Exp III than in Exp I	yes*** ($p = 0.001$)	yes*** ($p = 0.000$)
(8b) weak players earn less in Exp III than in Exp I	yes*** ($p = 0.003$)	yes*** ($p = 0.000$)

Notes: We report results of regression analysis in this table. Specifically, we regress the variable of interest (efficiency level or players' payoffs) on a constant and an indicator function for one of the two groups we are interested in, while clustering standard errors by session when there is more than one session. We report the significance level of the estimated coefficient on the indicator function and provide the exact p-value in the parenthesis. ***, **, and * indicates significance at 1%, 5%, and 10% level, respectively.

these comparisons separately for sessions conducted at UCSB and at UCI to assess whether these outcomes are universal across the two subject pools.

Results reported in Table G.2 show that all eight different characteristics of market outcomes hold both in sessions conducted at UCSB as well as at UCI. While some of the comparisons are not statistically significant (mostly in UCI session, given the small number of observations due to the fact that we have only one session at UCI), vast majority of the characteristics are highly significant at both locations. This indicates that behavior of subjects in the two locations produces similar market outcomes, which justifies pooling the data together for the purpose of the analysis.

Appendix H: Learning in Experiments I, II, and III

In this section, we consider learning in all three experiments focusing on the final market outcomes. Table H.1 reports efficiency levels and payoffs of players by network position in all treatments of all three Experiments. We present the data from all repetitions played within each experimental session as well as the data from the first 5 and the last 5 repetitions separately.

We first focus on Experiment I and conduct the same type of the statistical analysis as in the main manuscript and present it in Tables H.2 and H.3. The market outcomes observed in all repetitions of all three games (Game 15, Game 25, and Game 30) are similar to the ones observed in the last five repetitions documented in Section 5.1. Specifically, we detect a significant decrease in efficiency as the value of the inefficient match (the diagonal link) increases from Game 15 to Game 25 to Game 30. Moreover, while players' payoffs do not depend on their network position in Game 15, in Game 25 and 30 strong players receive significantly higher payoffs compared with weak players. Finally, the value of the diagonal links affects the bargaining position of players insofar as strong (weak) players obtain significantly higher (lower) payoffs in Game 30 than in Game 25, and in Game 25 than in Game 15.

Table H.1: Efficiency and payoffs of players by network position

	Game 15			Game 25			Game 30		
	eff.	B (C)	A (D)	eff.	B (C)	A (D)	eff.	B (C)	A (D)
Exp I									
all	0.93 (0.04)	9.6 (0.15)	9.6 0.20)	0.54 (0.04)	4.9 (0.36)	11.6 (0.08)	0.40 (0.01)	3.5 (0.10)	13.4 (0.18)
first 5	0.85 (0.07)	9.1 (0.25)	9.3 (0.41)	0.57 (0.05)	5.3 (0.47)	11.4 (0.09)	0.48 (0.03)	4.4 (0.13)	12.7 (0.24)
last 5	1.00 (0.00)	10 (0.03)	10 (0.03)	0.51 (0.03)	4.5 (0.25)	11.8 (0.10)	0.30 (0.01)	2.4 (0.11)	14.2 (0.05)
Exp II									
all							0.59 (0.06)	4.9 (0.60)	13.1 (0.32)
first 5							0.59 (0.07)	5.1 (0.79)	12.9 (0.42)
last 5							0.59 (0.07)	4.7 (0.57)	13.2 (0.23)
Exp III									
all	0.90 (0.03)	9.5 (0.15)	9.5 (0.13)	0.73 (0.05)	5.8 (0.26)	12.0 (0.19)	0.61 (0.02)	3.7 (0.25)	14.1 (0.21)
first 5	0.84 (0.08)	9.1 (0.41)	9.3 (0.38)	0.62 (0.08)	5.4 (0.75)	11.7 (0.43)	0.50 (0.04)	3.9 (0.50)	13.3 (0.49)
last 5	0.96 (0.02)	9.8 (0.12)	9.8 (0.09)	0.82 (0.04)	6.2 (0.35)	12.3 (0.16)	0.73 (0.02)	3.6 (0.05)	14.8 (0.15)

Notes: We report efficiency and average payoffs of players by their network positions, with the corresponding robust standard errors in the parentheses, where observations are clustered at the session level.

The comparison between market outcomes in the first five and in the last five repetitions in Experiment I shows significant learning behavior that transpires as subjects gain experience with the game they play (see Table H.4). In particular, in Game 15, subjects converge towards efficient outcomes with experience: efficiency in the first five repetitions is significantly lower than the one in the last five repetitions. On the contrary, experience leads to lower efficiency levels in Game 25 and Game 30. With respect to subjects' payoffs, payoffs of the weak players increase significantly with the experience, while payoffs of the strong players remain stable. In Game 25

Table H.2: Efficiency and Payoffs in Experiments I and III, all repetitions

	Experiment I		**Experiment III**	
	Regression (1)	Regression (2)	Regression (3)	Regression (4)
Dependent Variable	Efficiency	Players' Payoffs	Efficiency	Players' Payoffs
Constant (β_0)	0.93*** (0.03)	9.60*** (0.13)	0.90*** (0.02)	9.46*** (0.13)
Game 25 (β_1)	−0.39*** (0.05)	−4.68*** (0.35)	−0.17*** (0.05)	−3.65*** (0.27)
Game 30 (β_2)	−0.53*** (0.03)	−6.12*** (0.16)	−0.29*** (0.03)	−5.71*** (0.25)
Strong × Game 15 (β_3)		0.05 (0.05)		0.07*** (0.02)
Strong × Game 25 (β_4)		6.69*** (0.37)		6.18*** (0.26)
Strong × Game 30 (β_5)		9.89*** (0.20)		10.33*** (0.39)
# of obs	n=409	n = 1640	n =340	n = 1368
# of clusters	10	10	10	10
R-squared	0.1638	0.5578	0.4304	0.6048

Notes: Linear regressions with standard errors clustered at the session level are reported. The significance is indicated by *** and ** for 1% and 5% significance level.

Table H.3: Hypothesis tests for efficiency and players' payoffs in Experiments I and III, all repetitions

	Regression	Null Hypothesis	Alternative Hypothesis	P-Value
Experiment I				
Test 1	Regression (1)	$\beta_0+\beta_1=\beta_0+\beta_2$	$\beta_0+\beta_1>\beta_0+\beta_2$	$p=0.003$
Test 2	Regression (1)	$\beta_0+\beta_1=0.72$	$\beta_0+\beta_1<0.72$	$p=0.0005$
Test 3	Regression (1)	$\beta_0+\beta_2=0.50$	$\beta_0+\beta_2<0.50$	$p<0.0001$
Test 4	Regression (2)	$\beta_0+\beta_1=\beta_0+\beta_2$	$\beta_0+\beta_1>\beta_0+\beta_2$	$p=0.001$
Test 5	Regression (2)	$\beta_0+\beta_1+\beta_4=\beta_0+\beta_2+\beta_5$	$\beta_0+\beta_1+\beta_4<\beta_0+\beta_2+\beta_5$	$p<0.001$
Experiment III				
Test 6	Regression (3)	$\beta_0+\beta_1=\beta_0+\beta_2$	$\beta_0+\beta_1>\beta_0+\beta_2$	$p<0.0001$
Test 7	Regression (4)	$\beta_0+\beta_1=\beta_0+\beta_2$	$\beta_0+\beta_1>\beta_0+\beta_2$	$p=0.0237$
Test 8	Regression (4)	$\beta_0+\beta_1+\beta_4=\beta_0+\beta_2+\beta_5$	$\beta_0+\beta_1+\beta_4<\beta_0+\beta_2+\beta_5$	$p<0.0001$

and Game 30, experience differentially affects the payoffs of players: weak players earn less in the last five repetitions than in the first five in both games, while strong players earn more.

In Experiment II, we observe very little learning. Indeed, both the efficiency levels and the payoffs of players by network positions are very similar in the first and in the last five repetitions of each experimental session.[5]

In Experiment III, we observe similar learning effects as in Experiment I, albeit some of the comparisons are not statistically significant (see Table H.4). For instance, while in Experiment I, payoffs of the weak players are different in the first and in the last five repetitions of the experiment, these payoffs are not statistically different in Experiment III. The notable difference in learning trends between Experiment I and

[5]These regressions are available upon request from the authors.

Table H.4: Comparing first 5 and last 5 repetitions of a game in each session, Experiments I and III

	Experiment I		
	Regression (5)	Regression (6)	Regression (7)
Dependent Variable	Efficiency	Strong Players' Payoffs	Weak Players' Payoffs
Constant (β_0)	0.85*** (0.06)	9.32*** (0.35)	9.14*** (0.22)
Game 25 (β_1)	-0.28***(0.07)	2.11*** (0.37)	-3.84*** (0.48)
Game 30 (β_2)	-0.37***(0.06)	3.36*** (0.41)	-4.74*** (0.24)
Last 5 $\times$ Game 15 (β_3)	0.15** (0.06)	0.65 (0.38)	0.90*** (0.19)
Last 5 $\times$ Game 25 (β_4)	-0.07*** (0.02)	0.33*** (0.09)	-0.79*** (0.22)
Last 5 $\times$ Game 30 (β_5)	-0.18*** (0.04)	1.49*** (0.16)	-2.04*** (0.19)
# of obs	n= 409	n = 820	n = 820
# of clusters	10	10	10
R-squared	0.4500	0.3154	0.2680
	Experiment III		
	Regression (8)	Regression (9)	Regression (10)
Dependent Variable	Efficiency	Strong Players' Payoffs	Weak Players' Payoffs
Constant (β_0)	0.84*** (0.07)	9.27*** (0.33)	9.15*** (0.35)
Game 25 (β_1)	-0.23**(0.10)	2.40*** (0.51)	-3.77*** (0.78)
Game 30 (β_2)	-0.34***(0.08)	4.06*** (0.54)	-5.28*** (0.56)
Last 5 $\times$ Game 15 (β_3)	0.52 (0.40)	0.65 (0.38)	0.62 (0.43)
Last 5 $\times$ Game 25 (β_4)	0.20** (0.08)	0.62 (0.46)	0.84 (0.95)
Last 5 $\times$ Game 30 (β_5)	0.23*** (0.05)	1.51*** (0.54)	-0.24 (0.44)
# of obs	n= 340	n = 684	n = 684
# of clusters	10	10	10
R-squared	0.4211	0.3619	0.3172

Notes: Linear regressions with standard errors clustered at the session level are reported. The significance is indicated by *** and ** for 1% and 5% significance level.

Experiment III is the dynamics of efficiency. Efficiency levels decrease in Games 25 and 30 in Experiment I with experience, while they increase in Games 25 and 30 in Experiment III as subjects gain experience with the game.

Appendix I: Experiment I Instructions

I.1: Instructions for Experiment I Game 25 treatment

Welcome. You are about to participate in an experiment on decision-making and you will be paid for your participation in cash privately at the end of the session. Please turn off all electronic devices, especially phones. During the experiment you are not allowed to open or use any other applications on these laboratory computers, except for the interface of the experiment.

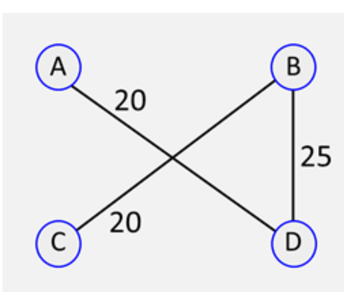
Structure of the experiment. The experiment consists of 10 games. Each game consists of several rounds. Before the beginning of each game, you will be randomly divided into groups of 4 people and assigned an ID letter (A, B, C or D). Your group assignment and your ID letter will be the same in all rounds of the same game, but will vary from game to game. In other words, at the end of each game, you will be randomly divided into new groups and you will be assigned new ID letters. The game number, the round number and your ID letter will be clearly displayed on the top of the screen.

To determine your payment, at the end of the experiment, the computer will select one game from the 10 games played. Each game is equally likely to be chosen for payment. Your earnings will be equal to your earnings in this randomly selected game. In addition you will receive $15 for completing the experiment. All the payoffs on the computer screen are in dollars.

What happens in each game. In each game you will engage in anonymous bargaining. A network describes who is connected to whom and how many dollars pairs of players will receive if they are matched at the end of the game. Throughout the game, there will be opportunities for pairs to become matched and reach agreement on how to split the amount of dollars the match will generate. Each person can be matched with at most one other person in her group. We will explain below in details what it means to be matched with another person.

The screen has three main parts: the top-left part depicts the diagram of a network, the top-right part keeps track of matches established in your group in each round and the bottom-right part is where you will make your decisions. We will describe now in details each of these parts and the game.

In today's experiment, the structure of the network will be the same in all 10 games (see diagram below). This diagram depicts the connections between people and amounts of dollars available for matches between these participants.

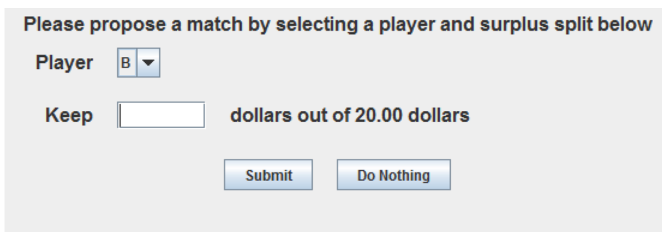


This is a 4-person network with each person identified by the letters A, B, C and D. Different people in the network can have different numbers of connections. For instance, A is connected to C and to D, while B is only connected to D. The number next to the line connecting two people represents the surplus (the number of dollars) that pair would generate by matching with each other. For example, if A matched to C, A and C will receive a combined total of 10 dollars.

Each game will consist of several rounds.

First round. At the beginning of a round, each member of the network can choose one of two actions: 1) propose a match or 2) do nothing. Proposing a match means choosing a person in the network with whom you are connected and proposing how to divide available dollars between the two of you. In other words, a proposal of a match is a suggestion of how many dollars you would receive and how many dollars the other person would receive. To make a proposal, please choose the ID letter of the member you want to propose a split using the drop-down menu. Then underneath that type the number of dollars that you propose to keep to yourself. The remaining dollars will be allocated to the member you chose to propose to if he/she accepts your proposal.

Here is how the interface looks like (bottom-right corner of the screen). This picture shows the interface for player C:



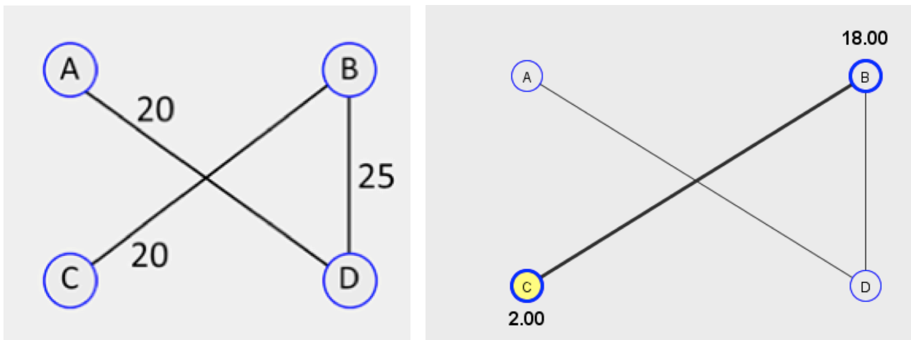
In the example shown in the network diagram above, there are 20 dollars to be divided between players A and D, there are 20 dollars to be divided between players B and C, while there are 25 dollars available for division between players B and D. Therefore, if, for instance, member C makes a proposal to member B and proposes to keep 2 dollars, this means that if member B accepts this proposal she will receive 18 dollars.

Once you finalize your proposal, please click SUBMIT button. At this moment you won't be able to modify your proposal any more in this round. If you do not wish to make a proposal in this round, you can press DO NOTHING button, located to the right of SUBMIT button.

After all members of the group made their moves (submitted a proposal or done nothing), *the computer will select one participant at random*. Each participant is equally likely to be selected.

Only the move of the selected member will be implemented. If selected member chose to do nothing, then the current round will be over and the group will move on to the next round of the same game. If the selected member proposed a match then the person to whom a match was proposed will be prompted to respond to the proposal. This person may choose to accept or to reject the proposal. If a proposal is accepted, the match is formed. If a proposal is rejected, then we move onto the next round without anything changing; both the selected member and the participant proposed to remain unmatched.

If a match is formed, then it will be displayed in subsequent rounds in top-right diagram located on the screen. Here is an example of what a match between B and C would look like:



The diagram on the right mimics the diagram on the left, indicating the connections between people in this network with thin lines. It also indicates your position in the network with the yellow circle. A **thick line** connecting two subjects indicates that a match between these two subjects was formed. The numbers outside the circles indicate the number of dollars each subjects receives according to this agreement. For instance in the example above, in the first round B and C formed a match and agreed to split 20 dollars so that C gets 2 and B gets 18 dollars.

Second and the following rounds. The second, and all the remaining rounds in this game, look very similar to the first round of the except for one feature. At the beginning of each round, all members of the group are asked to choose either to propose a match or to do nothing (just like in the first round). However, while in the very first round all members of the group are unmatched, in the subsequent rounds some members might be matched based on agreements they have reached in the previous rounds. Since any person can be matched with at most one other person in the group, people that formed matches in the previous rounds have no active choice in the subsequent rounds of the game and will be prompted to choose DO NOTHING button. Other people, those that are not matched yet, can either propose a match to someone with whom they have a potential connection (indicated by a thin line on the top-right or top-left diagrams) or DO NOTHING.

History. The right-hand side diagram will keep track of the current status of all members of the network in each round. This right-hand side diagram will also allow people to observe how the matches have evolved over the course of the previous rounds for the current game by clicking arrow buttons below the diagram. Notice there is fast-back button. If pressed, this button will show the very first round of the game.

There is also a fast-forward button which if pressed will show the current round of the game. The simple arrows are to go back and forth one round at a time. The number between arrows indicates the round number that the diagram is showing.

When does game end and your payment in a game. There are two possibilities for how a game may come to an end. The first possibility involves chance. At the end of each round, the computer randomly chooses an integer number between 1 and 100 (inclusive), with each number being equally likely. If the chosen number is below 100, then game proceeds to the next round. However, if the computer chose the number 100, then current game ends. In other words, there is 1% chance that the current round is the last round in this game and 99% chance game is not over and group proceeds to the next round.

The second possibility is the one in which players who proposed new matches cannot form matches without players who chose to do nothing. In other words, there are no possible matches between any two players who are both still proposing. If that is the case, then the current game comes to an end.

When game comes to an end, *each member of the group receives the amount of dollars given by the current agreement (last round agreement).* The dollars each person will receive from the current agreement are shown on the right-hand side diagram of the network for the current round. If a person is unmatched when the game ends, that participant receives zero dollars.

At the end of each game, you will observe the message that indicates why this game ended.

Payment. At the end of the experiment, the computer will randomly choose one of the 10 games that you just played and the number of dollars that you earned in this game will be paid to you together with the participation fee. Each game is equally likely to be selected for payment.

Are there any questions?

I.2: Screenshots for Experiment I Game 25

This is the screenshot of player C at the beginning of Round 1 of the first game in Experiment I Game 25 treatment. The network position of player C is indicated by the filled yellow circle in the right diagram.

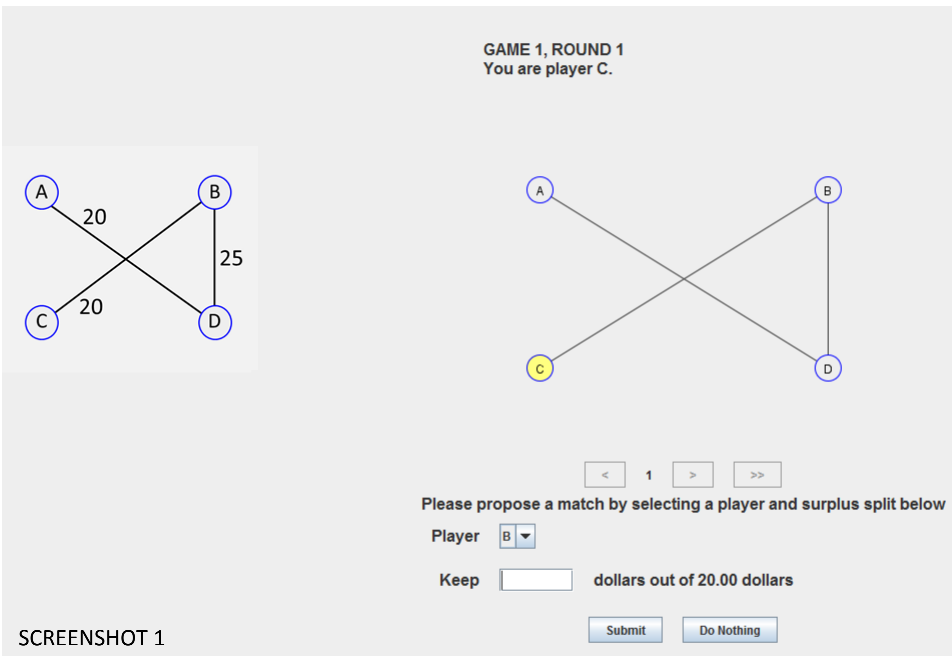


Figure I.21: Screenshot 1 (Experiment I)

This is the screenshot of player B in the middle of Round 1 of the first game in Experiment I, Game 25 treatment. At this moment all players made a move (chose to DO NOTHING or proposed a match). The proposal from player C was selected to be implemented. Player C made an offer to player B to keep \$12 out of \$20. At this moment in the game, player B has to choose whether to accept this offer or reject it.

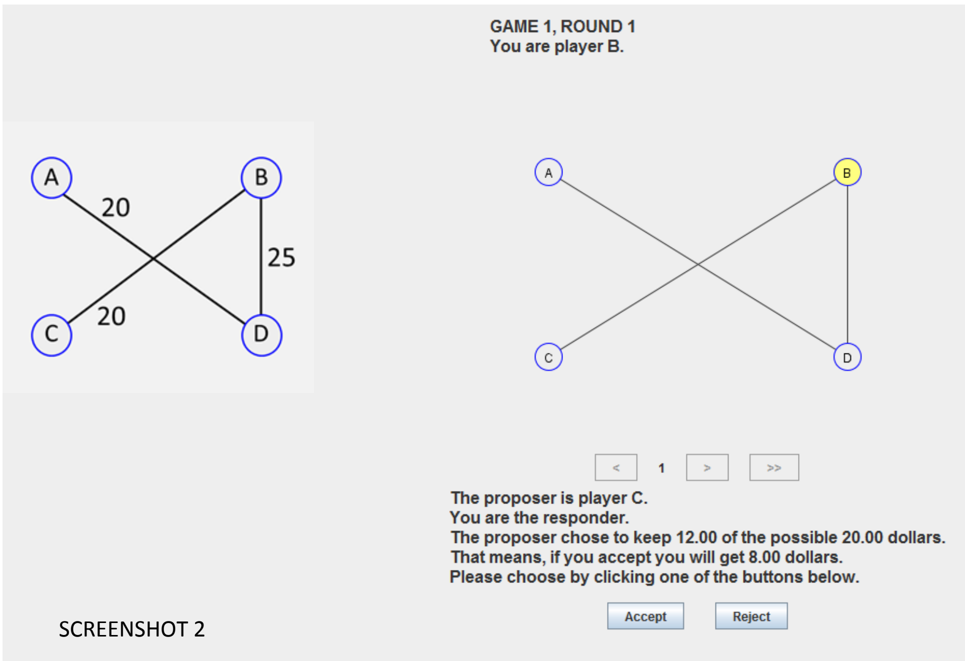


Figure I.22: Screenshot 2 (Experiment I)

This is the screenshot of the same player B at the end of Round 1 of the first game. Player B accepted the offer made by player C.

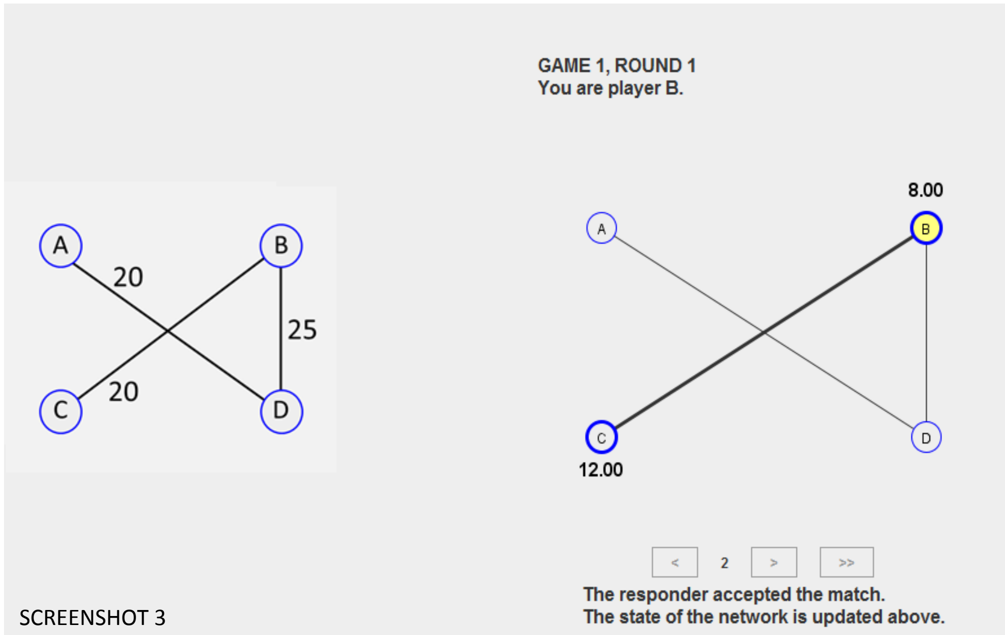


Figure I.23: Screenshot 3 (Experiment I)

I.3: Quiz for Experiment I Game 25

Screen 1

Question 1: Take a look at Screenshot 1 depicted in Figure ??. Suppose that in round 1 player B makes an offer to D in which B keeps 3 dollars. Suppose this offer is selected. How many dollars each player would get if D accepted the offer and then the game ended?

(1) A gets \$0, B gets \$22, C gets \$0, and D gets \$3

(2) A gets \$0, B gets \$3, C gets \$0, and D gets \$22

(3) A gets \$0, B gets \$3, C gets \$20, and D gets \$22

(4) A gets \$20, B gets \$3, C gets \$0, and D gets \$22

Correct answer is (2).

Question 2: Suppose that in round 1 player A makes an offer to D in which A keeps 7 dollars. Suppose this offer is selected. How many dollars each player would get if D rejected the offer and then the game ended?

(1) A gets \$7, B gets \$0, C gets \$0 and D gets \$18

(2) A gets \$18, B gets \$0, C gets \$0 and D gets \$7

(3) All players get 0

(4) Not enough information is given to work it out

Correct answer is (3).

Question 3: Does the group assignment stays fixed between games and between rounds of the same game?

(1) Participants are reshuffled into new groups in each game and in each round

(2) Group assignments do not change between rounds and between games

(3) Group assignments are fixed throughout the game but vary between games

Correct answer is (3).

Screen 2

Question 1: Take a look at Screenshot 3 depicted in Figure **??**. This screenshot shows what has happened in round 1 of the game. Which player are you?

(1) A

(2) B

(3) C

(4) D

Correct answer is (2).

Question 2: Which players are currently matched?

(1) A and D as well as B and C

(2) A and C as well as B and D

(3) A and D

(4) B and C

Correct answer is (4).

Question 3: In round 2, players B and C chose DO NOTHING, while players A and D proposed matches. Will the game continue to the next round?

(1) No because A and D cannot form a match with each other

(2) Yes because A and D can form a match with each other

Correct answer is (2).

Appendix J: Experiment II Instructions

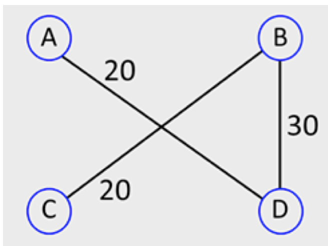
J.1: Instructions for Experiment II Game 30 treatment

Welcome. You are about to participate in an experiment on decision-making and you will be paid for your participation in cash privately at the end of the session. Please turn off all electronic devices, especially phones. During the experiment you are not allowed to open or use any other applications on these laboratory computers, except for the interface of the experiment.

Structure of the experiment. The experiment consists of 10 games. Before the beginning of each game, you will be randomly divided into groups of 4 people and assigned an ID letter (A, B, C or D). Your group assignment and your ID letter will be the same during the same game, but will vary from game to game. In other words, at the end of each game, you will be randomly divided into new groups and you will be assigned new ID letters. The game number and your ID letter will be clearly displayed on the top of the screen. To determine your payment, at the end of the experiment, the computer will select one game from the 10 games played. Each game is equally likely to be chosen for payment. Your earnings will be equal to your earnings in this randomly selected game. In addition, you will receive $15 participation fee. All the payoffs on the computer screen are in dollars.

What happens in each game. In each game you will engage in anonymous bargaining. A network describes who can reach agreements with whom and how many dollars different pairs of players have to split between them when trying to reach an agreement. Throughout the game, there will be opportunities for pairs to become matched and reach agreement on how to split the amount of dollars the match will generate. Each person can be matched with at most one other person. We will explain below in details what it means to be matched with another person.

In today's experiment, the structure of the network will be the same in all 10 games (see diagram below).



This is a 4-person network with each person identified by the letters A, B, C and D. Different people in the network have different numbers of connections. For instance, B is connected to C and to D, while A is only connected to D. The number next to the line connecting two people represents the surplus available to that pair (the number of dollars) that pair would generate by matching with each other. For example, if A matched to D, A and D will receive a combined total of $20.

The screen has three main parts: the top-left part depicts the diagram of a network, the bottom-left part of the screen keeps track of all matches established in your group and the right part of the screen is where you will be making your decisions. We will describe now in details each of these parts and the game. At the beginning of each game all members of your group are unmatched.

At any point during the game, each member of the group can make an offer to another member with whom he or she has a connection (indicated by the thin line connecting two players). An offer is the proposal of how to divide the surplus between the two players. For example, player B can make an offer to player D and to player C. If B makes an offer to player C, then he/she proposes how to split $20 between the two of them. If B makes an offer to player D, then he/she proposes how to split $30 between the two of them. Player A, however, can only make an offer to player D since this is the only player she has a connection to. An offer between player A and player D specifies a proposal of how to split $20 between the two of them.

To make an offer, click on circle with ID letter of the player to whom you would like to make an offer on the right-hand side of the screen in the column called OFFERS YOU PROPOSED. At this point the blank field will appear in which you need to type an amount that you want to keep for yourself. The remaining portion of the total surplus will be proposed to player to whom you are making an offer. Once you type in a number, click SUBMIT button. At this moment your offer will appear in the OFFERS PROPOSED BY OTHERS column on the screen of all other members of your group.

At any point you can withdraw any of your current offers. To do that click on WITHDRAW button next to the offer in OFFERS YOU PROPOSED column. If you want to modify your offer to a player you already proposed an offer, you can always withdraw the current offer and make a new one. In the column OFFERS PROPOSED BY OTHERS you will see at any point in time all currently standing offers made by other people. If another player withdrew her proposal, it will disappear from OFFERS PROPOSED BY OTHERS column. In the column OFFERS YOU PROPOSED you will see all currently standing offers that you have proposed.

At any point during the game, each group member can accept any of the currently standing offers made to her. If you accept the offer then the match is formed and the offer you accepted determines your payment in this game. In other words, since each player can be matched with at most one other player in the group, a player that accepts an offer has no other moves in this game. When this happens, offers that involve players in a formed match will be grayed out on the right-hand side of the screen.

In addition, formed matches are displayed on the diagram on the bottom left part of the screen using thick lines. Numbers next to players IDs show the agreed surplus split between players in the formed match. Note that one of the circles in this diagram is highlighted by red color. This circle indicates your position in a network.

When does the game end. There are two ways in which a game will come to an end. The first possibility is the one in which there are no new matches that can be formed between any two members of the group who are not matched yet. The second possibility involves chance. There is 1% chance that the game ends at the end of each 30-second interval. At the end of each game, you will observe the message that indicates why this game ended.

Your payment. When the game ends, each person receives the amount of dollars according to accepted offer. These amounts are indicated on the bottom-left part of the screen next to the circle that indicates each player. If a person is unmatched when the game ends, that participant receives zero dollars.

At the end of the experiment, the computer will randomly choose one of the 10 games that you just played and the number of dollars that you earned in this game will be paid to you together with the participation fee. Each game is equally likely to be selected for payment.

Are there any questions?

J.2: Screenshots for Experiment II Game 30 treatment

This is the screenshot of player B at the beginning of the game. No offers has been made yet. The network position of player B is indicated by the filled red circle in the left bottom diagram.

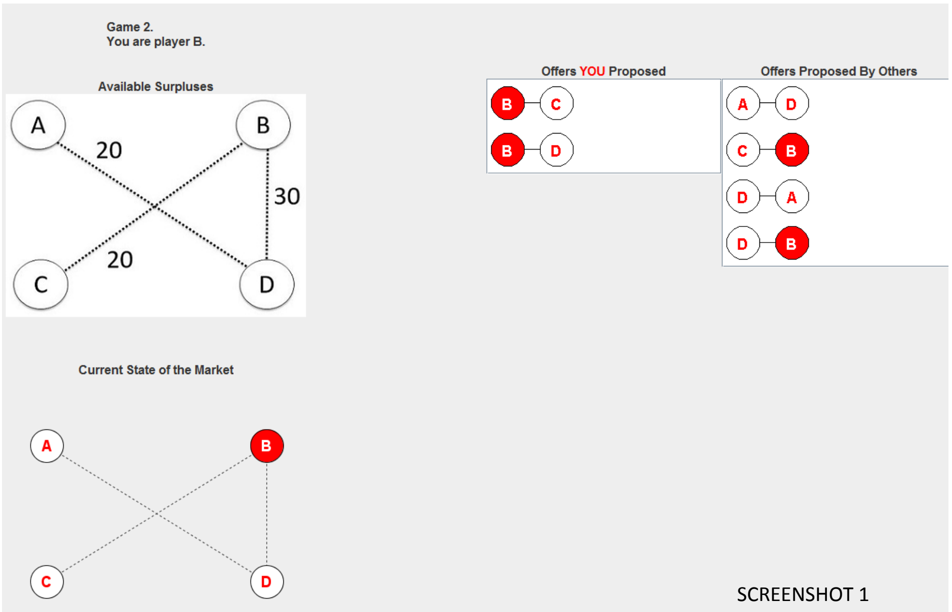


Figure J.21: Screenshot 1 (Experiment II)

This is the screenshot of the same player B some time into the game. There are 3 standing offers: offer from player B to player C, offer from player B to player D and offer from player C to player B.

At the moment depicted in the screenshot, no offers has been accepted yet and all four players are active.

At the moment depicted in the screenshot, player B can do one of the three things: she can withdraw any of the offers he has made so far by clicking WITHDRAW button next to the offer she made, and she can also accept the offer made to her by player C by pressing ACCEPT button next to this offer.

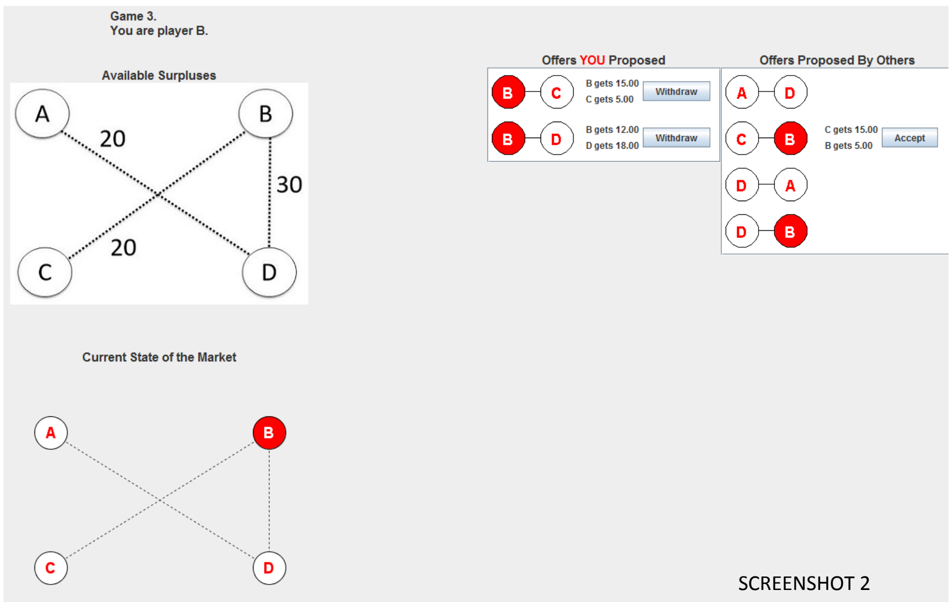


Figure J.22: Screenshot 2 (Experiment II)

This is the screenshot of the same player B at the end of the current game. The current game finished in an inefficient match in which players B and D matched and split the surplus equally between them (each earned $15).

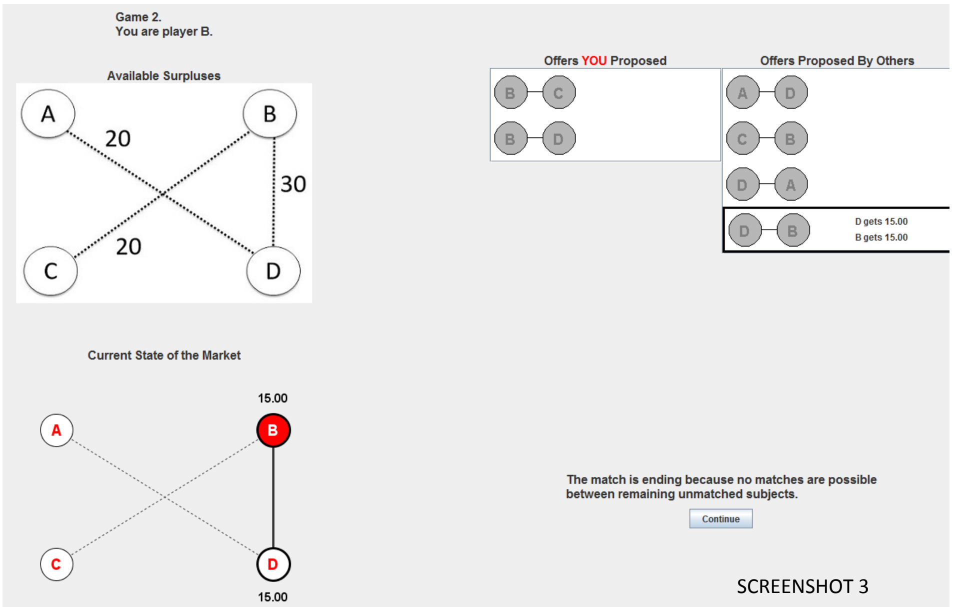


Figure J.23: Screenshot 3 (Experiment II)

J.3: Quiz for Experiment II Game 30 treatment

Screen 1

Question 1: Take a look at Screenshot 1 depicted in Figure ??. Which player are you?

(1) A

(2) B

(3) C

(4) D

Correct answer is (2).

Question 2: How do you make an offer?

(1) Click on the circle corresponding to the person you want to make an offer to in the box Offers YOU proposed

(2) Click on the circle corresponding to the person you want to make an offer to in the box Offers proposed by OTHERS

(3) Click on the circle corresponding to the person you want to make an offer to in the available surpluses picture

(4) Click on the circle corresponding to the person you want to make an offer to in the current state of the market picture

Correct answer is (1).

Question 3: Which of the following could not be an outcome of the game:

(1) A gets \$20, B gets \$0, C gets \$20, D gets \$0

(2) A gets \$0, B gets \$20, C gets \$0, D gets \$20

(3) A gets \$0, B gets \$0, C gets \$20, D gets \$20

(4) A gets \$20, B gets \$0, C gets \$0, D gets \$20

(5) A gets \$0, B gets \$0, C gets \$0, D gets \$30

Correct answer is (4).

Screen 2

Question 1: Take a look at Screenshot 3 depicted in Figure **??**. Which players have already matched and left the market?

(1) No one

(2) A and D

(3) B and C

(4) B and D

(5) Everyone

Correct answer is (4).

Question 2: What payment will player A get?

(1) Can't tell from the information presented
(2) \$0
(3) \$5
(4) \$15
(5) \$20

Correct answer is (2).

Screen 3

Question 1: Take a look at Screenshot 2 depicted in Figure **??**. Which players have already matched and left the market?

(1) No one
(2) A and D
(3) B and C
(4) B and D
(5) Everyone

Correct answer is (1).

Question 2: Which actions are available to player D?

(1) Accept A's offer, Accept B's offer, and Accept C's offer
(2) Accept A's offer, Withdraw offer to C, and Withdraw offer to B
(3) Accept B's offer, Make an offer to A, and Make an offer to B
(4) Make an offer to B and Accept C's offer

Correct answer is (3).

Question 3: If D accepts B's offer, what payment player B receives?

(1) \$18

(2) \$15

(3) \$12

(4) \$5

Correct answer is (3).

Question 4: Suppose that B accepts C's offer, what happens next?

(1) B exits the game matched with C receiving a payoff of \$15. Offers proposed by player B are automatically cancelled and then A and D continue to play.

(2) B exits the game matched with C receiving a payoff of \$5. Offers proposed by player B are automatically cancelled and then A and D continue to play.

Correct answer is (2).

Appendix H: Experiment III Instructions

H.1: Instructions for Experiment III Game 25 treatment

Welcome. You are about to participate in an experiment on decision-making and you will be paid for your participation in cash privately at the end of the session. Please turn off all electronic devices, especially phones. During the experiment you are not allowed to open or use any other applications on these laboratory computers, except for the interface of the experiment.

Structure of the experiment. The experiment consists of 10 games. Each game consists of several rounds. Before the beginning of each game, you will be randomly divided into groups of 4 people and assigned an ID letter (A, B, C or D). Your group assignment and your ID letter will be the same in all rounds of the same game, but will vary from game to game. In other words, at the end of each game, you will be randomly divided into new groups and you will be assigned new ID letters. The game number, the round number and your ID letter will be clearly displayed on the top of the screen.

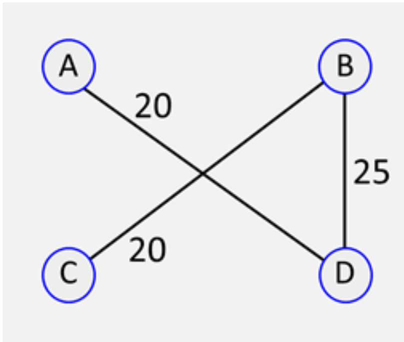
To determine your payment, at the end of the experiment, the computer will select one game from the 10 games played. Each game is equally likely to be chosen for payment. Your earnings will be equal to your earnings in this randomly selected game. In addition you will receive $15 for completing the experiment. All the payoffs on the computer screen are in dollars.

What happens in each game. In each game you will engage in anonymous bargaining. A network describes who is connected to whom and how many dollars pairs of players will receive if they are matched at the end of the game. Throughout the game, there will be opportunities for pairs to become matched and reach agreement on how to split the amount of dollars the match will generate. Each person can be matched with at most one other person in her group. We will explain below in details what it means to be matched with another person.

The screen has three main parts: the top-left part depicts the diagram of a network, the top-right part keeps track of matches established in your group in each round and the bottom-right part is where you will make your decisions. We will describe now in details each of these parts and the game.

In today's experiment, the structure of the network will be the same in all 10 games (see diagram below). This diagram depicts the connections between people and amounts of dollars available for matches between these participants.

This is a 4-person network with each person identified by the letters A, B, C and D. Different people in the network can have different numbers of connections. For instance, A is connected to C and to D, while B is only connected to D. The number

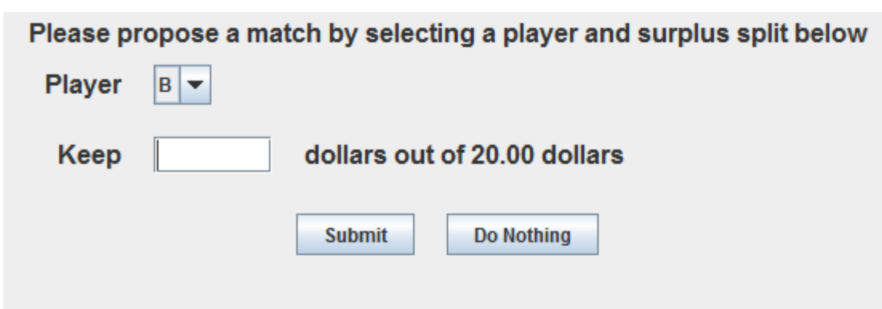


next to the line connecting two people represents the surplus (the number of dollars) that pair would generate by matching with each other. For example, if A matched to C, A and C will receive a combined total of 10 dollars.

Each game will consist of several rounds.

First round. At the beginning of a round, each member of the network can choose one of two actions: 1) propose a match or 2) do nothing. Proposing a match means choosing a person in the network with whom you are connected and proposing how to divide available dollars between the two of you. In other words, a proposal of a match is a suggestion of how many dollars you would receive and how many dollars the other person would receive. To make a proposal, please choose the ID letter of the member you want to propose a split using the drop-down menu. Then underneath that type the number of dollars that you propose to keep to yourself. The remaining dollars will be allocated to the member you chose to propose to if he/she accepts your proposal.

Here is how the interface looks like (bottom-right corner of the screen). This picture shows the interface for player C:



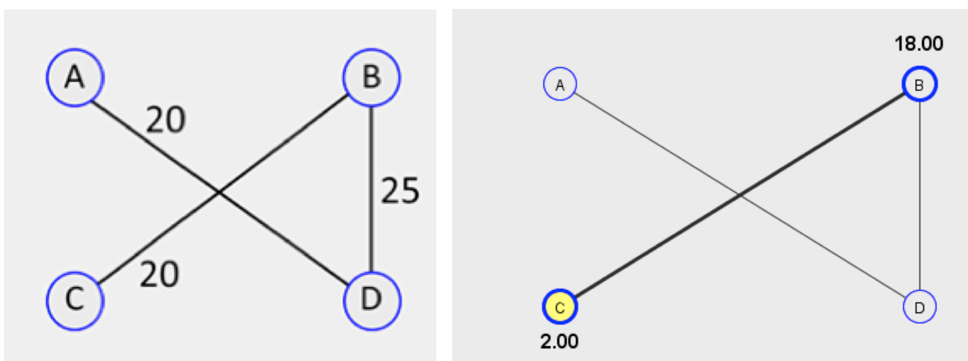
In the example shown in the network diagram above, there are 20 dollars to be divided between players A and D, there are 20 dollars to be divided between players B and C, while there are 25 dollars available for division between players B and D. Therefore, if, for instance, member C makes a proposal to member B and proposes to keep 2 dollars, this means that if member B accepts this proposal she will receive 18 dollars.

Once you finalize your proposal, please click SUBMIT button. At this moment you won't be able to modify your proposal any more in this round. If you do not wish to make a proposal in this round, you can press DO NOTHING button, located to the right of SUBMIT button.

After all members of the group made their moves (submitted a proposal or done nothing), *the computer will select one participant at random*. Each participant is equally likely to be selected.

Only the move of the selected member will be implemented. If selected member chose to do nothing, then the current round will be over and the group will move on to the next round of the same game. If the selected member proposed a match then the person to whom a match was proposed will be prompted to respond to the proposal. This person may choose to accept or to reject the proposal. If a proposal is accepted, the match is formed. If a proposal is rejected, then we move onto the next round without anything changing; both the selected member and the participant proposed to remain unmatched.

If a match is formed, then it will be displayed in subsequent rounds in top-right diagram located on the screen. Here is an example of what a match between B and C would look like:



The diagram on the right mimics the diagram on the left, indicating the connections between people in this network with thin lines. It also indicates your position in the network with the yellow circle. A **thick line** connecting two subjects indicates that a match between these two subjects was formed. The numbers outside the circles indicate the number of dollars each subjects receives according to this agreement. For instance in the example above, in the first round B and C formed a match and agreed to split 20 dollars so that C gets 2 and B gets 18 dollars.

Second and the following rounds. The second, and all the remaining rounds in this game, look very similar to the first round of the except for one feature. At the beginning of each round, all members of the group are asked to choose either to propose a match or to do nothing (just like in the first round). However, while in the very first round all members of the group are unmatched, in the subsequent rounds some members might be matched based on agreements they have reached in the previous rounds.

If a currently matched person is selected by the computer to be the proposer, and makes an offer to a *different player* who decides to accept this new offer, then the proposer will incur a separation cost. In this eventuality, the previous match that has been agreed upon will be dissolved and the new match will be formed in its place. If a matched person's proposal is rejected, the separation cost is ***not*** paid. If a matched person makes a proposal to another participant, but this proposal is not selected by the computer to be implemented, then the separation cost is also ***not*** paid. Finally, if a currently matched person ***receives*** a proposal and decides to accept it, that person must pay the separation cost and the previous match this person was involved in will be dissolved.

The separation cost will be subtracted from the final number of dollars earned in the current game. If a person is responsible for dissolving more than one match, that person will pay the separation cost for each such dissolved match. In today's experiment the separation cost is 10 cents in all games. On the top of the screen you will be able to see how many times you have paid the separation cost up until the current round:

"In the current game, you have paid separation costs −− times

If you have already formed a match in a previous round and wish to keep this match as is, you do not need to re-form it. In other words, if both participants involved in the match reject proposals from other participants if such proposals come along and do not propose new matches to other participants themselves, then the previously formed matches remain intact.

All the remaining details of a round are the same as in the first round.

History. The right-hand side diagram will keep track of the current status of all members of the network in each round. This right-hand side diagram will also allow people to observe how the matches have evolved over the course of the previous rounds for the current game by clicking arrow buttons below the diagram. Notice there is fast-back button. If pressed, this button will show the very first round of the game. There is also a fast-forward button which if pressed will show the current round of the game. The simple arrows are to go back and forth one round at a time. The number between arrows indicates the round number that the diagram is showing.

When does game end and your payment in a game. There are two possibilities for how a game may come to an end. The first possibility involves chance. At the end of each round, the computer randomly chooses an integer number between 1 and 100 (inclusive), with each number being equally likely. If the chosen number is below 100, then game proceeds to the next round. However, if the computer chose the number 100, then current game ends. In other words, there is 1% chance that the current round is the last round in this game and 99% chance game is not over and group proceeds to the next round.

The second possibility is the one in which **players who proposed new matches cannot form matches without players who chose to do nothing.** In other words, there are no possible matches between any two players who are both still proposing. If that is the case, then the current game comes to an end.

When game comes to an end, *each member of the group receives the amount of dollars given by the current agreement (last round agreement) minus the total separation costs each member has incurred.* The dollars each person will receive from the current agreement, not including the separation costs incurred, are shown on the right-hand side diagram of the network for the current round. The number of times each person paid separation cost is indicated on the top of the screen. If a person is unmatched when the game ends, that participant receives zero dollars less the separation costs that participant has incurred.

At the end of each game, you will observe the message that indicates why this game ended.

Payment. At the end of the experiment, the computer will randomly choose one of the 10 games that you just played and the number of dollars that you earned in this game will be paid to you together with the participation fee. Each game is equally likely to be selected for payment. If you made a loss in the game selected, the amount you lost will be subtracted from your participation fee.

Are there any questions?

H.2: Screenshots for Experiment III Game 25 treatment

This is the screenshot of player C at the beginning of Round 1 of the first game in Experiment III Game 25 treatment. The network position of player C is indicated by the filled yellow circle in the right diagram.

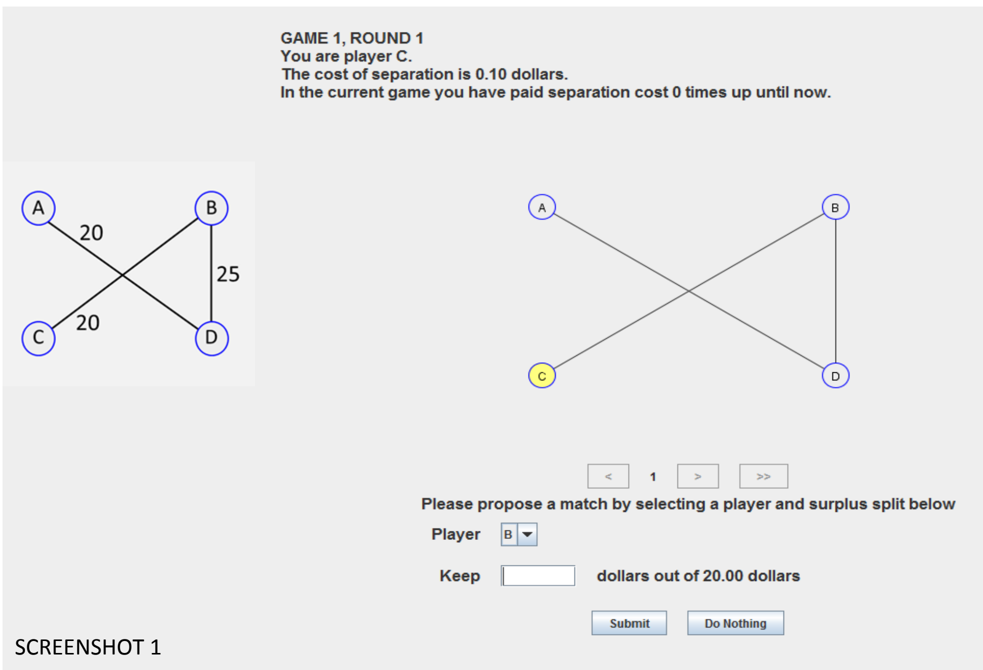


Figure H.21: Screenshot 1 (Experiment III)

This is the screenshot of player B in the middle of Round 1 of the first game in Experiment III Game 25 treatment. At this moment all players made a move (chose to DO NOTHING or proposed a match). The proposal from player C was selected to be implemented. Player C made an offer to player B to keep \$12 out of \$20. At this moment in the game, player B has to choose whether to accept this offer or reject it.

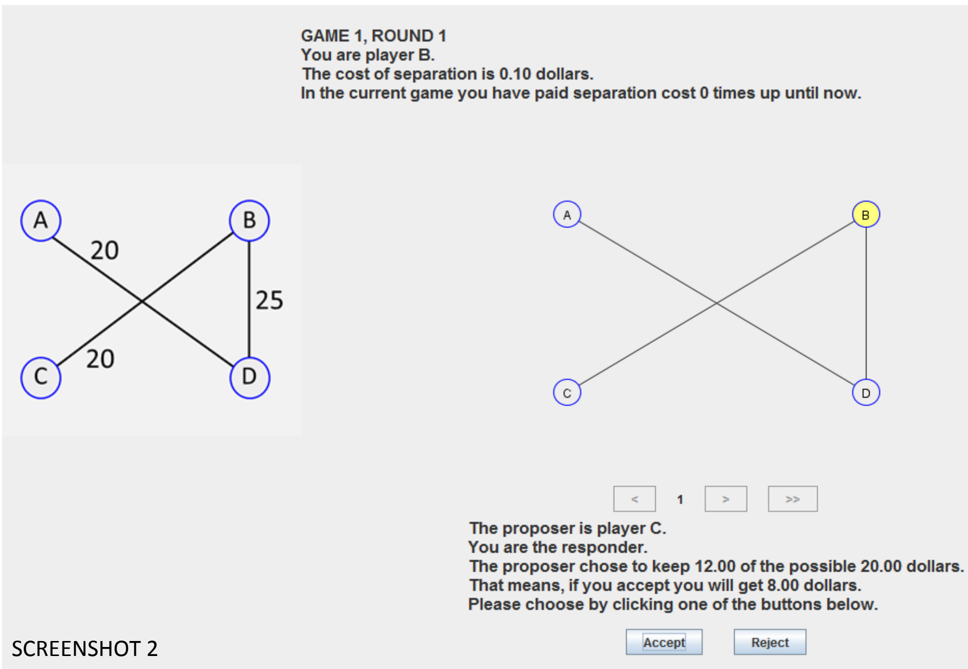


Figure H.22: Screenshot 2 (Experiment III)

This is the screenshot of the same player B at the end of Round 1 of the first game. Player B accepted the offer made by player C.

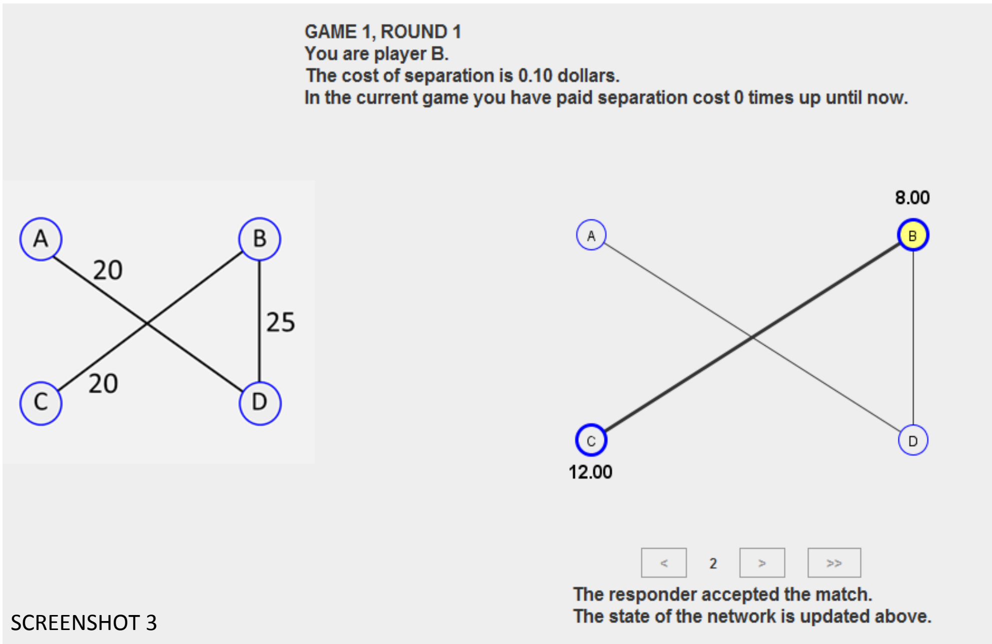


Figure H.23: Screenshot 3 (Experiment III)

H.3: Quiz for Experiment III Game 25 treatment

Screen 1

Question 1: Take a look at Screenshot 1 in Figure ??. Suppose that in round 1 player B makes an offer to D in which B keeps 3 dollars. Suppose this offer is selected. How many dollars each player would get if D accepted the offer and then the game ended?

(1) A gets \$0, B gets \$22, C gets \$0, and D gets \$3

(2) A gets \$0, B gets \$3, C gets \$0, and D gets \$22

(3) A gets \$0, B gets \$3, C gets \$20, and D gets \$22

(4) A gets \$20, B gets \$3, C gets \$0, and D gets \$22

Correct answer is (2).

Question 2: Suppose that in round 1 player A makes an offer to D in which A keeps 7 dollars. Suppose this offer is selected. How many dollars each player would get if D rejected the offer and then the game ended?

(1) A gets \$7, B gets \$0, C gets \$0 and D gets \$18

(2) A gets \$18, B gets \$0, C gets \$0 and D gets \$7

(3) All players get 0

(4) Not enough information is given to work it out

Correct answer is (3).

Question 3: Does the group assignment stays fixed between games and between rounds of the same game?

(1) Participants are reshuffled into new groups in each game and in each round

(2) Group assignments do not change between rounds and between games

(3) Group assignments are fixed throughout the game but vary between games

Correct answer is (3).

Screen 2

Question 1: Take a look at Screenshot 3 in Figure **??**. This screenshot shows what has happened in round 1 of the game. Which player are you?

(1) A

(2) B

(3) C

(4) D

Correct answer is (2).

Question 2: Which players are currently matched?

(1) A and D as well as B and C

(2) A and C as well as B and D

(3) A and D

(4) B and C

Correct answer is (4).

Question 3: In round 2, players B and C chose DO NOTHING, while players A and D proposed matches. Will the game continue to the next round?

(1) No because A and D cannot form a match with each other

(2) Yes because A and D can form a match with each other

Correct answer is (2).

Question 4: Suppose instead in round 2, B and D chose DO NOTHING, A proposed to D and C proposed to B. Will the game continue to the next round?

(1) No because players that proposed matches cannot form any match without players that chose DO NOTHING

(2) Yes because A and D have a link with each other and can form a match

Correct answer is (1).

Question 5: Suppose that in round 2, B proposed to D and D proposed to B. B was selected to implement her proposal and D accepted this new proposal. What will happen?

(1) Players B and D will form a new match and B will pay the separation cost for breaking the previous match she was involved in

(2) Players B and D will form a new match and D will pay the separation cost for breaking the match between B and C

(3) The previous match between B and C remains intact, because B cannot form new matches

(4) Player B will be matched to both player C and player D.

Correct answer is (1).