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Does Payoff Equity Facilitate Coordination? A test of Schelling's Conjecture

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Does Payoff Equity Facilitate Coordination? A test of Schelling's Conjecture

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Abstract

Starting from Schelling (1960), several game theorists have conjectured that payoff equity might facilitate coordination in normal-form games with multiple equilibria –the more equitable equilibrium might be selected either because fairness makes it focal or because many individuals dislike payoff inequities, as abundant experimental evidence suggests. In this line, we propose a selection principle called Equity (EQ), which selects the equilibrium in pure strategies minimizing the difference between the highest and smallest payoff, if only one such equilibrium exists. Using a within-subjects experimental design, furthermore, we study the relative performance of the equity principle in six simple 2x2 coordination games. Overall, we find that Equity explains individual behavior better than a large range of alternative theories, including theories of bounded rationality and several other equilibrium selection principles. Further, a classification analysis suggests the existence of two main groups of players: (i) players who tend to play as Equity predicts, and (ii) a miscellaneous group of players who either go for the risk dominant equilibrium or act in a boundedly rational manner. This heterogeneity seems to be behind most of the coordination failures that we observe.

Keywords: Coordination; equity; experiments; inequity aversion; level-k thinking; risk dominance.

JEL Classiffication: C72; C91; D03; D63

A kifizetésbeli méltányosság elősegíti a koordinációt? A Shelling-feltevés kísérleti vizsgálata

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Összefoglaló

Shelling (1960) óta számos játékelmélettel foglalkozó kutató élt azzal a feltevéssel, hogy a kifizetésbeli méltányosság elősegítheti a koordinációt olyan normál formájú játékokban, amelyeknek több egyensúlya van. A méltányosabb egyensúlyt azért választhatják, mert vagy a méltányosság miatt kelti fel a figyelmet vagy pedig azért, mert több egyén nem szereti a kifizetésbeli különbségeket, ahogy azt számos kísérleti tanulmány dokumentálta már. Ezen gondolatot követve javasoljuk a méltányosságot, mint egyensúlyválasztási elvet, amely a tiszta stratégiájú egyensúlyok közül azt választja ki, amelyik minimalizálja a legnagyobb és a legkisebb kifizetés közötti különbséget (amennyiben csak egy ilyen egyensúly létezik). Egy kísérlet segítségével vizsgáljuk, hogyan teljesít a méltányossági elv hat egyszerű 2x2-es koordinációs játékban. Azt találjuk, hogy a méltányosság jobban magyarázza a döntéseket, mint számos alternatív elmélet (köztük az egyensúly-választási kritériumok és a korlátozott racionalitással kapcsolatos elméletek). Osztályozási elemzésünk azt sugallja, hogy a kísérleti alanyokat két nagy csoportba lehet sorolni: i) játékosok, akik a méltányossági elvnek megfelelően döntenek, és ii) egy vegyes csoport tagjai, akik vagy a kockázatdomináns egyensúlyt választják, vagy pedig korlátozott racionalitással jellemezhető leginkább a döntésük. Ez a heterogenitás magyarázza, hogy miért figyelhetünk meg koordinációs kudarcokat.

Tárgyszavak: koordináció, méltányosság, kísérlet, egyenlőtlenségkerülés, k-szintű gondolkodás, kockázati dominancia

JEL kódok: C72; C91; D03; D63

1. INTRODUCTION

Coordination characterizes strategic interaction in many fields of economics and everyday life, and indeed becomes crucial when a group of agents shares a common goal and there are different ways to achieve it. Examples of such type of situations include the choice of an industry standard, deciding where and when to meet somebody, choosing a fast route in the city traffic, or organizing teamwork and division of labor –see Schelling (1960) for additional examples.

A rich experimental literature has found several factors that affect coordination.[1] For instance, pre-play talk often facilitates coordination on Pareto efficient equilibria, especially under certain communication protocols (Cooper et al., 1989 and 1992; Van Huyck et al., 1992; Blume and Ortmann, 2007). Another example is repeated play, in particular when playing with the same partner (Palfrey and Rosenthal, 1994; Brandts and Cooper, 2006). Our paper contributes to this literature, exploring the role of one factor that has not received so much attention, that is, payoff equity.

More precisely, we propose and test experimentally a simple selection principle called Equity, or EQ, which selects the equilibrium in pure strategies minimizing the difference between the highest and smallest payoff, if only one such equilibrium exists. This principle is partially based on a conjecture by Schelling (1960, p 61) that agents find focal or salient an equilibrium if it is fair. More precisely, Schelling considers a bargaining game in which two players simultaneously make claims over $100; each player getting his claim if the two claims add to no more than $100, and zero otherwise. Schelling claims that the 50-50 equilibrium is salient, and provides data from an informal sample showing that almost all subjects achieve coordination on that outcome. EQ generalizes in a simple manner Schelling's conjecture that fairness can facilitate coordination, a point which can be illustrated again using the game below, where we depict monetary payoffs. Note that the game has two equilibria in pure strategies –i.e., (R1, C1) and (R2, C2) – if we posit that all players are selfish and hence care only about their own pecuniary payoff. Thus, a coordination problem exists in the typical game-theoretical sense.

	C1	**C2**
R1	75, 140	75, 75
R2	70, 70	110, 110

[1] See Crawford (1997), Camerer (2003), and Devetag and Ortmann (2007) for reviews of some of this literature.

EQ predicts that both players will act according to equilibrium (R2, C2), as the difference between the maximum and minimal payoff is the smallest among all existing equilibria in pure strategies. We find the EQ prediction intuitive for several reasons. To start, players might find the EQ equilibrium focal simply because it is fair and equitable, as Schelling suggested. In this line, Myerson (1997, p. 112) noted that "welfare properties of *equity* and *efficiency* may determine the focal equilibrium in a game" (in italics in the original). A more subtle, alternative argument is based on the idea that some people may have preferences such that they dislike inequity.[2] In this case, the EQ equilibrium of the original game with selfish players might be *sometimes* the only one that survives a process of iterated deletion of dominated strategies provided that the distribution of types is the convenient one. This is the case for equilibrium (R2, C2) in the game above if the probability that Row is sufficiently inequity averse is high enough: Since such a player would always play R2 whatever Column chooses, Column would find C2 a best response in expected terms if she believes that Row is very likely so inequity averse.

While the influence of payoff equity on coordination has been suggested by several theorists, the issue has not received much attention from experimental economists. Often, the analyzed coordination games are games with several equilibria where all players get the same payoff (Stag Hunt, Weak-Link, etc.), or games like the Battle of the Sexes with (pure-strategy) equilibria outcomes which are inequitable but just a permutation of each other. Payoff equity cannot facilitate coordination in these games because they do not have a unique equitable equilibrium. In contrast, our experimental design includes six *asymmetric*, 2x2 normal-form games where EQ makes a *unique prediction*. Our choice of games allows us to explore whether subjects play as predicted by EQ, and to compare its performance with a large range of alternative theories (to be formally defined later), thus assessing the relative explanatory power of EQ. These theories include alternative equilibrium selection principle like *efficiency* and *risk dominance* (Harsanyi and Selten, 1988), but also theories of bounded rationality such as *level-k theory* (Stahl and Wilson, 1995), *maximum payoff* (called 'optimistic' rule in Haruvy et al., 1999), and the *security (or maximin)* rule. Several of them have received much attention in the experimental literature on coordination.

[2] Influential articles like Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) have shown that this hypothesis can organize key experimental phenomena like cooperation in social dilemmas and costly punishment in the ultimatum game.

Since all subjects play our six games (i.e., we use a within-subjects design), we can also evaluate heterogeneity –e.g., assuming that some agents act as EQ predicts, while others play as risk-dominance predicts.[3] For this we use the classification procedure by El-Gamal and Grether (1995), comparing a large range of models. Given our research goal, this is important for two reasons. First, if we can show that EQ is important to explain the behavior of a substantial fraction of agents, even allowing for heterogeneity, we gain reassurance that it plays a significant role in this kind of games. Second, even if EQ explains the behavior of many subjects, it is likely that it cannot explain the totality of our data, and hence it seems natural to ask what other forces account for the rest. The heterogeneity analysis can shed light on this.

We find that in five of our six games, EQ explains significantly more choices than any other theory making different predictions. If we allow for heterogeneity, the models that account best for our data always include a substantial fraction of subjects acting as EQ predicts. This is true when we consider models with two, three, or four theories describing subjects' choices. For instance, more than 40% of the subjects are best described by EQ even if we consider models with four theories. Another signal of the relevance of the EQ principle is that even the *worst model with EQ* performs better than the *best model without EQ*, whatever the number of theories considered. In addition, the classification analysis suggests the existence of two main groups of players: (i) players who act according to EQ, and (ii) a diverse group of players, including some who play the risk dominant equilibrium, or others whose behavior is better described by some non-equilibrium theory. However, although allowing for heterogeneity significantly increases accuracy, the penalized log-likelihood criterion proposed by El-Gamal and Grether (1995) suggests that the improvement in accuracy does not compensate the additional complexity involved. In other words, if parsimony is our main goal, a model assuming that all players act according to EQ is the optimal one. We find also that the play of EQ is not related to many personal or game characteristics, but players' degree of risk aversion is highly correlated with it. Finally, while our results indicate that EQ is a relevant force affecting coordination in our games, they also suggest some limitations, like the failure to explain most choices in one of our games. When equity clashes with payoff dominance, it seems that the latter principle triumphs, particularly if the payoff dominant equilibrium yields considerably higher payoffs to the players and is not very unequal. The relevance of EQ apparently depends on the payoff structure of the game; a point that should be addressed by further research.

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[3] Abundant experimental evidence shows that individuals are heterogeneous in many aspects, like their reasoning abilities or their other-regarding preferences (Camerer, 2003 provides numerous illustrations).

The rest of the paper is organized as follows. The next section reviews some related experimental literature on coordination and discusses how our results contribute to the understanding of several results of this literature, whereas Section 3 presents in detail the EQ principle and the other theories that we consider in this paper, and section 4 describes and motivates the experimental design. Section 5 presents our results, and section 6 concludes.

2. RELATED LITERATURE

Our paper complements a large experimental literature on coordination that analyzes the performance of selection principles like payoff dominance, risk dominance, and security (Cooper et al., 1990; Van Huyck et al., 1990; Straub, 1995; and Schmidt et al., 2003). In this regard, our results indicate that subjects often fail to coordinate on the risk dominant equilibria or play the secure strategy when EQ predicts otherwise. We also complement a growing literature (Haruvy and Stahl, 2007; Crawford and Iriberri, 2007a) that considers as well theories of non-equilibrium behavior. In our simple games, most subjects do not act as these theories forecast if EQ makes a different prediction. Yet our classification analysis indicates that the behavior of a minority of subjects can be best explained by some of these theories. In this respect, our study is closely related to Haruvy and Stahl (2007), as both compare the relative performance of several models with heterogeneous agents. In line with our results, Haruvy and Stahl (2007) show that heterogeneous models can explain play in coordination games significantly better than models of homogeneous players. When comparing their results to ours, yet, one has to keep in mind that Haruvy and Stahl (2007) only consider symmetric games and that they study 3x3 games while our focus is on simpler 2x2 games.[4] In a related line, Costa-Gomes et al (2001) also investigate strategic sophistication, assuming different types of strategic and non-strategic players. Four of the 7 theories that we use here appear in their study as well. Their results suggest that a considerable share of players behaves according to a non-equilibrium prediction. However, they do not study the effect of payoff equity on coordination, our main goal in this paper.

Two papers have analyzed how payoff equity affects coordination. Chmura et al. (2005) investigate several 2x2 games with two equilibria. One of them is payoff dominant (or at least efficient, in the sense employed in our study), whereas the other gives the same payoff (225 points) to both players. The authors find that coordination on the first, efficient

[4] This seems important. Crawford and Iriberri (2007b) note that sophistication among subjects depends on the game played. In our games, the fraction of subjects who play in a boundedly rational manner might be smaller than in more complex 3x3 games. Further, the results from Ho and Weigelt (1996) in extensive-form games suggest, that an equilibrium is played less often if it is more complex to compute than others, even if it has low payoff disparity.

equilibrium becomes more complicated when the distance in the players' payoffs in that equilibrium increases. Still, the majority of the subjects play the efficient equilibrium in most games. This is consistent with our finding that payoff dominance trumps equity when both principles clash. In contrast to Chmura et al. (2005), we do not only study games with a payoff dominant equilibrium, and moreover compare its relative performance to alternative theories like risk dominance and security. Our results suggest that EQ is the best predictor in games where payoff dominance and equity do not contradict each other.

On the other hand, Crawford et al. (2008) study how salient strategy labels help to achieve coordination, showing that the effect of labels is much reduced in games with even minutely asymmetric payoffs, and suggesting an explanation based on level-k thinking and "team reasoning". It is worth to clarify that Crawford et al. (2008) study games akin to the Battle of the Sexes without a unique equitable equilibrium, so that EQ has no bite then. Yet our paper complements and qualifies their claim in the title that "even minute payoff asymmetry may yield large coordination failures". In effect, EQ indicates how the existence of an equitable equilibrium (i.e., one where there are small or null payoff *asymmetries*) may facilitate coordination, and we provide evidence in this line.

3. THEORIES

In this section we present the EQ principle and six additional theories to explain behavior in one-shot coordination games. We focus for simplicity on two-player, normal-form games, although extensions to n-player games are often direct. For simplicity, we assume that all players are selfish and risk neutral; their utility equals their monetary payoff. For expositional purposes, we keep using the names 'Row' and 'Column' to refer to the players.

Let E denote the set of equilibria in pure strategies of the game. We say that equilibrium $e \in E$ is selected by the EQ selection principle if the difference between the highest and the smallest *monetary* payoff of e is minimal among all equilibria of E. To clarify matters, consider the games below, both with two equilibria in pure strategies: (R1, C1) and (R2, C2). EQ clearly predicts play of (R2, C2) in both.[5]

	C1	**C2**
R1	75, 140	75, 75
R2	70, 70	110, 110

	C1	**C2**
R1	90, 100	0, 20
R2	20, 0	40, 40

[5] As we mentioned in the introduction, play of EQ could be argued on the grounds that some individuals are inequity averse and find strictly dominant to choose the EQ equilibrium strategy. Appendix B illustrates this point in more detail by using the model by Fehr and Schmidt and discussing the conditions required for a player to have a dominant strategy in these two games and others.

Besides the EQ principle, we consider two other equilibrium selection principles, defined as follows:

i. *(Social) efficiency (EF): selects the equilibrium that maximizes the sum of the players' payoffs.*

   This seems a natural extension of payoff dominance, which selects equilibrium *s* if players receive strictly higher payoffs at *s* than at any other equilibrium. We focus on efficiency because payoff dominance often selects no equilibrium (e.g., left-hand game above). Note anyway that the efficient equilibrium coincides with the payoff-dominant one if it exists.

   Example: efficiency selects equilibrium (R2, C2) in the left-hand game above and (R1, C1) in the right-hand game.

ii. *Risk dominance (RD): selects the equilibrium maximizing the product of players' losses from unilateral deviations.*[6]

   Example: (R2, C2) and (R1, C1) are risk-dominant in the left-hand and right-hand games above, respectively.

The remaining theories to be considered here relax the assumption of equilibrium play even in static games like ours.

iii. *Level-k: level-0 agents choose with uniform probability between their available strategies, while level-k agents best respond to a level-(k-1) strategy.*[7]

   Thus, level-1 agents play a best response to a level-0 strategy, level-2 agents play a best response to a level-1 strategy, and so on. Given previous evidence (see Haruvy et al., 1999), we only consider *level-1 (L1)* and *level-2 (L2)* agents.

   Example: level-1 predicts outcome (R2, C1) in the left-hand game above and (R1, C1) in the right-hand game; while level-2 predicts (R1, C2) in the left-hand game and (R1, C1) in the right-hand game.

iv. *Maximum payoff (MP): each player chooses the action that potentially gives her the highest monetary payoff in the game.*

   Haruvy et al. (1999) refer to this as the "optimistic" rule. An analogous "pessimistic" rule could be easily defined, but we abstain from that as Haruvy et al. (1999) and Costa-Gomes et al. (2001) found little evidence for it.

   Example: Maximum payoff predicts outcome (R2, C1) in the left-hand game above and (R1, C1) in the right-hand game.

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[6] This definition stands for 2x2 games with two pure-strategy equilibria, but it can be extended to n-player games (see for instance Haruvy and Stahl, 2007), although this is not necessary for our purposes. See also Harsanyi and Selten (1988, p. 355-357) for a motivation of payoff and risk dominance.

[7] See Stahl and Wilson (1995) for more details.

v. *Security (S) or maximin: players choose the strategy with the largest minimum payoff.*
Note that this behavioral rule leads to equilibrium play if all available strategies are part of at least one equilibrium and the games are symmetric (as in Van Huyck et al., 1990), but it may lead to a non-equilibrium outcome in asymmetric games like ours.
Example: The prediction of security in the left-hand and right-hand games above is respectively (R1, C2) and (R2, C2).

4. EXPERIMENTAL DESIGN AND PROCEDURES

A total of 126 subjects participated in our study, which consisted of 4 sessions run at the Universidad Autónoma de Madrid. No participant attended more than one session. Subjects were undergraduate students with different majors (Economics, Business Administration, or Psychology). They earned on average 7.7 Euros from their decisions, and there was no show-up fee. In every session, which lasted approximately 60 minutes, subjects played six 2x2 normal-form games with the following payoff matrices (payoffs are presented in points at the rate 1 point = 0.1 Euro; we discuss our choice of games later):

Game 1	**C1**	**C2**
R1	75, 140	75, 75
R2	70, 70	110, 110

Game 2	**C1**	**C2**
R1	120, 120	85, 85
R2	80, 80	90, 160

Game 3	**C1**	**C2**
R1	110, 100	0, 90
R2	90, 0	90, 90

Game 4	**C1**	**C2**
R1	120, 105	102, 102
R2	100, 110	115, 115

Game 5	**C1**	**C2**
R1	190, 95	80, 80
R2	120, 90	120, 100

Game 6	**C1**	**C2**
R1	90, 100	0, 20
R2	20, 0	40, 40

Each session was conducted as follows. Before it started, the instructions and the decision sheets (dependent on role) were randomly distributed in conveniently separated seats across the room so as to avoid communication between subjects. The sheets were initially covered and the subjects could freely choose their seat; in that way, subjects were randomly assigned either role ‘A’ (Row) or ‘B’ (Column) for the whole session. Subjects first read the instructions at their own pace and then the experimenter read them aloud so that common knowledge was ensured. Questions were privately clarified.[8]

All six games were presented on the same decision sheet, and subjects were allowed to make their decisions in the order they wanted and revisit their choices at any moment before the experiment ended. As noted in Haruvy and Stahl (2007), this feature theoretically ensures that each subject plays each game in the same conditions, thus preventing potential order effects. Moreover, it increases the robustness of our results, as subjects could make all their choices with the maximum information possible.[9] To control for a potential order effect caused by the listing of the games in the decision sheet, however, the ordering in which the games were presented in the decision sheet was different across sessions (see also Haruvy and Stahl, 2007).

Participants were never told their counterparts' choices in any game, to prevent repeated game effects. After the subjects had made their decisions in the six games, they were asked to answer a brief questionnaire and their decision sheets were collected. Then one game was randomly selected for payment,[10] each subject was anonymously matched with a subject of her opposite role, her payoff was computed for the payment-relevant game, and she was paid in private. All previous features of our design were common knowledge among the participants.

We chose our games to evaluate the extent to which the EQ principle can explain play in coordination games, and how it performs compared with the other theories presented in section 3. Our games offer evidence in this regard because they allow us to discriminate between EQ and the alternative theories. Table 1 shows the strategies predicted by each theory (including EQ) in each of our six games. As the reader can confirm, we have variability in the predictions of each pair of theories. For instance, efficiency and risk dominance predict different actions in games 2, 3, and 4. More precisely, there is a total of 12 predictions (one for Row and Column in each game) and the mean of different predictions across any two theories is 6, the lowest difference being 3 (MP vs. L1, L1 vs. RD, and L2 vs. RD) and the highest 9 (EF vs. S, and MP vs. S).[11]

[8] The instructions for the A players can be found in Appendix A. The instructions for the B player are analogous and are available upon request.
[9] A potential issue when presenting all games at the same time is that subjects might wish to achieve consistency across games. While this factor might affect subjects' behavior, we nevertheless believe that this is immaterial for our research goal, which is evaluating the relative performance of EQ. In particular, it is not clear how a search for consistency could explain that a subject follows EQ and not another selection principle.
[10] If we instead paid multiple games, we could not theoretically treat each game as one-shot.
[11] For comparison, the lowest difference in predictions in Costa-Gomes et al. (2001) is 2 out of 18 games. When considering Row and Column separately, we note that there is no difference between the predictions of RD and L1 (RD and L2) for Row (Column). There is no such problem with EQ, since it differs in at least two predictions (out of 6) from any other theory.

Table 1

Prediction of play by each theory

	Theory						
	EQ	**EF**	**RD**	**L1**	**L2**	**MP**	**S**
Game 1	(R2, C2)	(R2, C2)	(R2, C2)	(R2, C1)	(R1, C2)	(R2, C1)	(R1, C2)
Game 2	(R1, C1)	(R2, C2)	(R1, C1)	(R1, C2)	(R2, C1)	(R1, C2)	(R1, C2)
Game 3	(R2, C2)	(R1, C1)	(R2, C2)	(R2, C2)	(R2, C2)	(R1, C1)	(R2, C2)
Game 4	(R2, C2)	(R2, C2)	(R1, C1)	(R1, C2)	(R2, C1)	(R1, C2)	(R1, C1)
Game 5	(R2, C2)	(R1, C1)	(R1, C1)	(R1, C1)	(R1, C1)	(R1, C2)	(R2, C1)
Game 6	(R2, C2)	(R1, C1)	(R1, C1)	(R1, C1)	(R1, C1)	(R1, C1)	(R2, C2)

We finish with some miscellaneous remarks on our choice of games. First, we have excluded from our design some classical games like the Battle of the Sexes, which do not easily permit discrimination between the theories. Yet note that games 3 and 6 are variations of the well-studied Stag Hunt game (see for instance Cooper *et al.*, 1990). Observe also that our games are very simple 2x2 coordination games, thus helping subjects to understand the decision tasks and the underlying strategic considerations. We remark as well that the payoffs are also chosen so that the average payoff across all games is similar for the row and column player (around 90 points). Finally, we note that our choice of games prevents confounds with motivations like altruism (Andreoni and Miller, 2002; Charness and Rabin, 2002) or pure reciprocity (Rabin, 1993) because these motivations do not predict a *unique* equilibrium in our games. In fact, altruism predicts the same two equilibria as the standard, selfish model in all games: (R1, C1) and (R2, C2). In turn, Rabin (1993) predicts the same equilibria in all games except one (see proposition 3 in Rabin, 1993).[12]

5. EXPERIMENTAL RESULTS

This section is divided in two parts. In 5.1, we present some aggregate results for each game and compare the aggregate performance of each theory across games and sessions. Part 5.2 is devoted to the study of individual behavior using a classification procedure, in order to further analyze the relative performance of the theories and control for heterogeneity among subjects.

[12] The only exception is game 4, where (R1, C2) and (R2, C2) are fairness equilibria, but (R1, C1) is not, at least if the players are sufficiently reciprocal (consult appendix A in Rabin, 1993).

5.1 AGGREGATE RESULTS

We first present the frequency of each outcome in each game. For this, we make use of the recombinant estimation method suggested by Mullin and Reiley (2006). That is, we compute the frequencies considering all possible matchings between row and column players across all sessions. Since 126 subjects participated in the experiment, this means that instead of 63 observations we have 63*63 = 3969 matches in each game. This method increases the number of observations, thus improving the efficiency of the statistical estimates, and alleviates problems caused by a possibly small sample size. Table 2 presents again the payoff matrices of our six games (in bold the outcome predicted by the EQ principle), together with the relative frequency of each outcome (in parenthesis in the corresponding cell), after the recombination of the data from all sessions.

Table 2

Frequency of outcomes (in parenthesis) for all possible matchings across sessions

Game 1	**C1**	**C2**
R1	75, 140 *(5%)*	75, 75 *(17%)*
R2	70, 70 *(19%)*	**110, 110** ***(59%)***

Game 2	**C1**	**C2**
R1	**120, 120** ***(68%)***	85, 85 *(18%)*
R2	80, 80 *(11%)*	90, 160 *(3%)*

Game 3	**C1**	**C2**
R1	110, 100 *(16%)*	0, 90 *(22%)*
R2	90, 0 *(27%)*	**90, 90** ***(35%)***

Game 4	**C1**	**C2**
R1	120, 105 *(8%)*	102, 102 *(29%)*
R2	100, 110 *(13%)*	**115, 115** ***(50%)***

Game 5	**C1**	**C2**
R1	190, 95 *(17%)*	80, 80 *(25%)*
R2	120, 90 *(23%)*	**120, 100** ***(35%)***

Game 6	**C1**	**C2**
R1	90, 100 *(39%)*	0, 20 *(24%)*
R2	20, 0 *(23%)*	**40, 40** **(14%)**

The data in Table 2 already suggests that EQ has a significant predictive power in our games, as most people play as it predicts in all games except in game 6. One indication of this is that (R2, C2) is the most frequent outcome in games 1, 3, 4, and 5, and (R1, C1) in game 2; these outcomes coincide with the EQ predictions. In fact, the frequency of the EQ outcome is significantly higher (t-test, p = 0.000) than the frequency of *any other* outcome in any game except game 6, where the opposite is true. However, the frequency of the EQ outcome is significantly different across games, with the following ranking: game 2 > game 1

> game 4 > game 5 = game 3 > game 6 (t-test; p = 0.000).[13] Incidentally, this ranking suggests that the performance of EQ in a game depends on the whole payoff constellation. In particular, the existence of a payoff dominant equilibrium different than the EQ one seems to deter coordination on the equitable equilibrium, as apparently occurs in games 3 and 6.[14] The results from game 6 also hint that coordination on the EQ equilibrium is hindered as the difference in payoffs between the two equilibria grows larger. Although we later provide additional evidence in this line, further research should address this point more carefully.

We now compare the performance of the EQ principle to that of other theories across games. For this, we pool all the data from our sessions and depict in Table 3 the percentage of hits of each theory in each game –i.e., if one participant chooses in a game the strategy predicted by a given theory, we count that as a hit for that theory.[15] In each game, we highlight the statistically best theory (or theories) in bold –note that the percentage of hits coincides in some games for some theories; this is because these theories share predictions in those games. If in a given game the percentage corresponding to the best theory is not significantly higher than that of the next best theory, then both are highlighted in bold, e.g. in game 5. We can see that the behavior of the majority of the subjects is consistent with the best theory in each game, as the highest percentage of hits is significantly above the 50 percent in any game (t-test; p ≤ 0.016 always, see Table 3 in the web appendix for the exact results).

Table 3

Frequency of hits of each theory, for each game and across all games

Game	EQ	EF	RD	L1	L2	MP	S
1	**76.98%**	**76.98%**	**76.98%**	50.79%	49.21%	50.79%	49.21%
2	**82.54%**	17.46%	**82.54%**	53.17%	46.83%	53.17%	53.17%
3	**59.52%**	40.48%	**59.52%**	**59.52%**	**59.52%**	40.48%	**59.52%**
4	**71.43%**	**71.43%**	28.57%	57.94%	42.06%	57.94%	28.57%
5	**59.52%**	40.48%	40.48%	40.48%	40.48%	**50.79%**	**49.21%**
6	37.30%	**62.70%**	**62.70%**	**62.70%**	**62.70%**	**62.70%**	37.30%
All	**64.55%**	51.59%	58.47%	54.10%	50.13%	52.65%	46.16%

Note: 756 observations.

[13] For the exact statistical results and p-values see Table 1 in the web appendix available at [link deleted]. Note to potential referees: The data is also available at the end of this paper.
[14] The performance of EQ in game 5 might be also affected by the fact that equilibrium (R1, C1) is 'almost payoff dominant' in this game.
[15] The hits of each theory separately for row and column players are available in Table 2 in the web appendix.

The most important observation on the performance of EQ is summarized as follows:

Result 1*: EQ performs significantly better than any other theory in aggregate (t-test; $p<0.009$). In any game except game 6, moreover, EQ is empirically more relevant than any alternative theory predicting a different outcome.*

We find that in games 1 to 4 EQ performs significantly better than any other theory that predicts a different outcome (t-test, $p \leq 0.013$).[16] In game 5 EQ is the best theory, although it shows no statistical difference with MP and S at the 5 percent significance level (t-test; $p \leq 0.082$ and 0.051, respectively). Game 5 is of particular interest because the predictions of EQ there differ most from those by the other theories. We find reassuring that EQ performs rather well in this game compared to the alternatives in this game, even though the EQ prediction implies asymmetric payoffs.[17] With respect to game 6, EQ performs here significantly worse than the best theories (t-test; $p = 0.000$ always), again signaling that EQ is empirically less relevant when it conflicts with payoff dominance. Finally, leaving aside game 6, it is noteworthy that the alternative theories to EQ perform best when they share predictions with EQ. Otherwise they are often unable to explain even 50 percent of the choices. All this seems an indication of the relevance of EQ.

For completeness, we can also compare the performance of those theories different than EQ. In this respect, we find that risk dominance outperforms any other theory on aggregate (t-test; $p < 0.012$ always). Yet it performs rather badly if its predictions are different than those of EQ (leaving aside game 6). In game 4, in particular, risk dominance (together with security) is significantly less successful than the other theories (t-test; $p < 0.013$). In turn, security, level-2, and MP hardly explain half of the aggregate choices. The most successful of the non-equilibrium theories is level-1 theory.

In summary, our results suggest that EQ describes behavior in our games better than any other theory (especially if we leave game 6 aside). Yet, considerable uncertainties remain, both because an aggregate analysis might conceal a high level of heterogeneity, and because there is still much evidence that is left unexplained even by the EQ principle. Therefore, after understanding the aggregate tendencies in our data, we move now to thoroughly study individual behavior and subjects' heterogeneity.

[16] Tables 4, 5 and 6 in the web appendix provide detailed statistical results for the comparisons in this and the next paragraph.
[17] This indicates that the driving force behind the good performance of EQ is not just the symmetry of payoffs *per se*.

5.2 INDIVIDUAL ANALYSIS

We offer here an analysis on the *individual level* of the motives behind the players' choices in our coordination games. For this we use the classification procedure from El-Gamal and Grether (1995).[18] This procedure circumvents the multicollinearity problems that would appear in a classical regression analysis if the motives were treated as independent variables and allows appropriate inferences even when testing all possible motives –no matter how similar their predictions are– at the same time. In the application of the procedure, the key concept is that of *behavioral rule*, defined as a vector of strategies for a player, specifying one strategy for each of our six games. We focus on seven behavioral rules based on the homonymous theories presented in section 3 (they are implicitly described in Table 1), as these are the theories that have attracted most of the attention in previous studies. Note that the behavioral rules are not always symmetric, so that we must sometimes distinguish between rules for Row and Column. For example, the level-1 rule for Row is (R2, R1, R2, R1, R1, R1), while the same rule for Column is (C1, C2, C2, C2, C1, C1).

We first consider the case with no heterogeneity, i.e., we posit that all subjects follow the same behavioral rule $\boldsymbol{r}$ in each game. Yet we also assume that each subject may commit an error and deviate from $\boldsymbol{r}$ in a game with some equal probability ε.[19] This probability can be estimated by maximum likelihood –just by finding the frequency of actual choices unexplained by $\boldsymbol{r}$ – and suggests how well $\boldsymbol{r}$ fits our data. Based on this process we can find the best single behavioral rule, which is the one with the minimal error. Table 4 below contains the results of the classification analysis; the first line of this table presents the results of the best single rule, together with its corresponding error rate ε, its log-likelihood (LL) value, and the penalized log-likelihood (PLL).[20] Unsurprisingly, the best single rule (EQ) coincides with the rule with the highest number of aggregate hits (see Table 3).

[18] For a detailed description of the procedure, see the web appendix.

[19] The assumption that any subject trembles with the same probability in any game merits two clarifications. First, it seems realistic because (i) our games are rather simple and (ii) subjects were given the possibility to revisit their choices at any moment and hence no change of ε through time (due to learning effects) should be expected. Second, the assumption implies that the probability of error is independent across games. In other words, the probability of deviating from $\boldsymbol{r}$ at any game is not conditioned on how the subject behaved in any other game. This seems reasonable in our experiment because, due to reason (ii) above, no order effects due to learning are expected.

[20] The PLL follows El-Gamal and Grether (1995) and other studies (e.g., Shachat and Walker, 2004), introducing a penalty for the use of each extra rule which will help us to decide whether the increased complexity of a model improves substantially the understanding of the data. The web appendix explains in more detail the logic behind the penalty term.

Table 4

Results of the classification analysis with 1, 2, 3, and 4 rules; across all sessions

# of rules	Best Model	% of subjects per rule	ε	LL Value	PLL Value
1	EQ	100%	0.354	-491.54	-494.18
2	EQ; RD	60.3%; 39.7%	0.259	-432.64	-525.26
3	EQ; RD; MP EQ; RD; EF	41.7%; 28.6%; 29.7% 41.2%; 29.4%; 29.4%	0.237	-413.78	-560.12
4	EQ; L1; L2; MP	41.7%; 15.1%; 21%; 22.2%	0.216	-394.10	-579.33

Note: With 3 rules we report two models, as they perform equally well.

To allow for heterogeneity, consider now any combination of our seven rules (a *model*). We can classify subjects by assigning each one to the rule that best fits her behavior among those present in the model.[21] Given this assignment, we can compute the corresponding error in an analogous manner as before, and hence find the model with two, three, etc. rules that best accounts for the data in our games. In this vein, Table 4 reports information for the best model with two, three, and four rules. We also indicate the proportion of subjects assigned to each rule (in the model with just one rule this is obviously 100%). We find that the best model with two rules is composed by EQ and risk dominance, and 60% of the subjects are assigned to EQ. With three rules there are two optimal models, both of them including EQ and RD, plus a third rule. Conclusions change slightly with four rules, the main difference being that RD does not appear in the best model. Yet this result requires some qualification, as in our games level-k theories and RD make different predictions only in a small number of cases (3 out of 12; see Table 1). Since our games do not allow a very neat discrimination between these rules, therefore, the result must be taken with some caution. In any case, EQ maintains its importance both in relative and absolute terms: More than 40% of the subjects are still assigned to EQ, making it the most relevant rule.

We have also performed the classification analysis with the data from every session, Table 1 in Appendix C reports the results. With two rules, EQ is included in the best model of any session, with more than 50 percent of the subjects assigned to it always. The second best rule besides EQ varies across sessions, in sessions 1 and 2 it is risk dominance, while in session 3 is efficiency, and in session 4 the level-1 rule. If we consider models with three rules, EQ is always included among the best model in any session. Furthermore, we also observe a substantial proportion of subjects who are assigned to the RD rule in most

[21] If k rules fit best the behavior of one subject, we assign 1/k 'subjects' to any such rule. Note further that any such model implicitly assumes for tractability that players are actually heterogeneous (i.e., play different rules), but are *not* aware of this heterogeneity.

sessions (except session 4), whereas the rest of the subjects do not follow the same behavioral pattern across sessions. Our most important findings about heterogeneity are summed up as follows:

Result 2*: Subjects are heterogeneous, but the behavior of the largest fraction of them is best explained by the EQ principle whatever the number of rules considered (up to 4). Regarding the remaining subjects, they are best depicted either by risk dominance or by non-equilibrium theories like level-k or MP.*

As an implication of the fact that the largest fraction of the subjects tend to play EQ, those subjects who follow EQ often get a larger monetary payoff than those who do not follow EQ. In fact, playing according to EQ yields the highest *ex post* payoffs (considering the actual play of the opponent players) in games 1-4. In games 5 and 6, however, we note that playing according to EQ does not pay off. In game 5, both row and column players actually lose a small amount of money (0.25 and 3.5 points, respectively, that is, some cents) if they play EQ, while in game 6 the losses are more heavy, amounting on average to 28 and 36 points for the row and column players (which are equivalent to 2.8 and 3.6 Euros, respectively).

Although subjects are clearly heterogeneous, we have to examine whether the increased accuracy of heterogeneous models is worth their increased complexity. Naturally, the models with more rules have lower error rates, but they are also less parsimonious, and we would like to achieve a compromise in this respect. Although there are many criteria to judge whether models with additional rules improve substantially our understanding of the data, one possibility is to introduce a penalty for the use of each extra rule; this is what the PLL does. According to this criterion, the introduction of an additional rule in a model is recommended only if the PLL value grows with the addition of that rule. Our data hence suggests that one rule is enough to provide a parsimonious depiction of the subjects' behavior, pointing again to the importance of EQ in our games.

To infer whether heterogeneous models substantially improve the error rate, we also use maximum-likelihood (ML) tests to compare the best models with 1 and 2 rules, and the best models with 2 and 3 rules, as they are nested.[22] Each of these tests indicates whether the net

[22] We say that the optimal model with k rules is nested if it is a restriction of the model with k+1 rules. Let $\lambda = L_R/L_U$ denote the likelihood ratio, where L_R and L_U are respectively the values of the likelihood function for the restricted model and the more complex model. Since the statistic $-2\cdot\mathrm{Ln}(\lambda)$ is asymptotically distributed as a chi-squared with degrees of freedom equal to the number of restrictions imposed, we reject the restricted model if $-2\cdot\mathrm{Ln}(\lambda)$ is very large, as this indicates in turn very small values of λ. For a final clarification, note that in a model with k rules we must determine for each subject the rule that he/she follows and those that he/she does not follow. This means k parameters per subject, taking value zero (the subject does not follow the corresponding rule) or 1 (the subject follows the rule). Let then $\boldsymbol{r}^*$ denote the rule not present in the model with k rules and n* the number of subjects who are assigned rule $\boldsymbol{r}^*$ in the model with k+1 rules. As we

improvement obtained with the more complex model is significant. In this respect, we observe that the best model with one rule can be rejected when compared with the best model with two rules (degrees of freedom = 50; statistic value = 117.8; p = 0.000), whereas this model with two rules is *not* rejected when compared with the best model with three rules (degrees of freedom = 37; statistic value = 37.7; p > 0.437). According to these tests, therefore, models with more than two rules do not improve accuracy.

Result 3*: If parsimony is our main goal, a model assuming that all players follow the EQ rule is optimal. In terms of accuracy, however, the optimal model with two rules (EQ; RD) is significantly better. Adding a third rule does not produce a significant improvement.*

To reinforce our results on the explanatory relevance of EQ in our games, we have also analyzed how the models without EQ perform compared to the optimal one. We find that when ranking all possible models according to their errors (or, equivalently, their log-likelihood value), the *best* model *without* EQ comes only after the *worst* model including EQ. That is, any model containing EQ performs better than the best model without it. We also note that the differences in the error rates between the best models with and without EQ are always larger than 5 percent. To illustrate this, Table 5 compares error rates and LL-values of the best models with and without EQ.

Table 5

Best models with 1, 2, 3, and 4 rules; with and without EQ

Number of rules	Best model		Error **ε**	LL-value
1	with EQ	EQ	0.354	-491.54
	without EQ	RD	0.415	-513.13
2	with EQ	EQ; RD	0.259	-432.64
	without EQ	RD; MP	0.329	-479.10
3	with EQ	EQ; RD; MP EQ; RD; EF	0.237	-413.78
	without EQ	RD; MP; S	0.306	-465.32
4	with EQ	EQ; MP ; L1; L2	0.216	-394.10
	without EQ	RD; MP; S; EF	0.270	-440.82

move from the optimal model with k+1 rules to that with k rules, we impose n* restrictions, as the parameters corresponding to rule ***r****** are restricted to take value zero for these n* subjects.

We have also performed the classification analysis with the data from games 1, 2, 4, and 5. This is interesting in order to further test the idea that EQ explains behavior better if it does not clash with payoff dominance (provided that there is a payoff dominant equilibrium). In this respect, Table 2 in Appendix C indicates the best models with 1, 2, 3, and 4 rules in the mentioned games and across all sessions, and provides some evidence consistent with the cited idea: (i) whatever the number of rules, EQ is always included in the best model and the majority of the subjects is assigned to it; (ii) the error rate of the best model in games 1, 2, 4, and 5 is always smaller (at least by 6.7%) than the error rate of the same model in games 1 to 6; (iii) we observe that the best model with 3 and 4 rules explains around 85 percent of the subjects' choices in these games. The role of risk dominance seems diminished in these games, as RD never appears in the best models.

Result 4*: EQ explains individual behavior particularly well when we focus on those games where EQ and payoff dominance do not conflict (games 1, 2, 4, and 5). Risk dominance, in contrast, performs relatively poorly in this class of games.*

Finally, we have also performed a regression analysis that investigates several potential determinants of compliance with EQ (such as the subject's role, the order of the games on the decision sheet, demographic differences, or the subject's degree of risk aversion based on Holt and Laury, 2002). Our dependent variable is the number of times (*hits*) that one subject chooses according to the EQ principle in all our games. We have run two types of regressions for this count data: OLS and negative binomial.[23] The marginal effects for two different specifications of the negative binomial model and the results of the OLS model are shown in Table 3 in Appendix C. We find that demographic characteristics are not significant, and with respect to potential effects of the subject's role or the order of display of the games in the decision sheet, the regressions reassuringly show no systematic effect on EQ play. In both regressions we find a highly significant effect of risk aversion on the play of EQ, a point for which we have no clear explanation yet. The rest of the variables are not significant in any regression.

6. CONCLUSION

We suggest a criterion for equilibrium selection, based on the idea that the existence of a unique equitable equilibrium facilitates coordination, and show that it can explain aggregate behavior in six games better than six alternative theories, some of them well studied in the literature on coordination. Indeed, EQ explains the behavior of a substantial share of the subjects, even if we allow for heterogeneity. In any case, it might be advisable to assume that

[23] There is no over-dispersion in our data, so that the negative binomial model yields quantitatively the same results as the Poisson model.

players are heterogeneous in order to obtain a more accurate explanation of our results (although parsimony recommends otherwise). In addition, we also observe that the explanatory power of EQ is limited in some games, particularly in those where there is an alternative equilibrium that is payoff dominant.

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APPENDIX A: INSTRUCTIONS FOR A PARTICIPANT TYPE A

Thank you for participating in this experiment. Please do not talk during the experiment to any other participant. If you do not follow this rule we will have to exclude you from the experiment. If you have any question raise your hand and we will attend you.

There are two types of participants in this experiment: A and B. **You are a type A participant and you will be randomly and anonymously matched with a type B participant** (in what follows we call her/him B)**.** You will never know the type of any other participant, nor will any other participant get to know your type.

At the end of the experiment you will earn an amount of money which will depend on your decisions and B's decisions. Your decisions and your final payment will be only known to you. In particular, you will not know B's decisions; neither will B know your decisions.

Description of the Experiment

In this experiment you will participate in six different scenarios and get a point score in each of them. In this regard we stress three things:

1. Each scenario is independent of the others; that is, your point score in any scenario does not depend on decisions taken by you or B in other scenarios.
2. You will be paid according to your point score in just one scenario, randomly chosen at the end of the experiment, at the rate 10 points = 1 Euro.
3. All scenarios will be presented simultaneously, and you can make your choices in the order you wish. Moreover, you can always revisit and change your choices at any moment before the time devoted to make your choices finishes.

In each scenario you have to choose between alternatives A1 and A2 and B must choose between alternatives B1 and B2. We recall that your choices will remain private, so that neither you nor B will know what the other has chosen and that your point score depends on your decision but also on B's. As a hypothetical example, your point scores might be those of the following table (the left-hand number in each cell is your point score. and the right-hand number is B's):

	Participant B's decision	
My choice	B1	B2
A1	50, 30	30, 60
A2	20, 40	70, 25

In other words:

• If you choose A1 and B chooses B1, you get 50 points and B gets 30 points.

• If you choose A1 and B chooses B2, you get 30 points and B gets 60 points.

• If you choose A2 and B chooses B1, you get 20 points and B gets 40 points.

• If you choose A2 and B chooses B2, you get 70 points and B gets 25 points.

We will describe each scenario with a table similar to the one above, the only difference between the scenarios being the possible point scores. Once all participants make their decisions in all scenarios, we will distribute a short questionnaire. When all participants have filled in the questions and all forms have been collected, the experimenter will roll a die and the number obtained will determine the payment-relevant scenario. The experiment will be then over, we will compute your point score in the selected scenario, divide it by 10, and then pay the resultant amount out to you in Euros.

If there are no questions, we proceed with the scenarios.

APPENDIX B: PREDICTIONS OF THE EQ PRINCIPLE USING THE UTILITY FUNCTION OF FEHR AND SCHMIDT (1999)

We here illustrate how the EQ equilibrium could be achieved in some games if the players are sufficiently inequity averse. For this, we assume that the preferences of any player depend on his own monetary payoff and the inequity embodied in the allocation of monetary payoffs among the players. While there are many possible manners to formalize this idea and EQ does not rely on any specific one, we simplify the exposition by focusing on the well-known model by Fehr and Schmidt (1999). In two-player games, this model posits that the utility function of player i given a monetary allocation $X = (x_i, x_j)$ has the following form ($i \neq j$):

$$U_i(X) = x_i - \alpha_i \max\{x_j - x_i, 0\} - \beta_i \max\{x_i - x_j, 0\},$$

where $0 \leq \beta_i < 1$ and $\beta_i \leq \alpha_i$. Intuitively, a player suffers a utility loss if the co-player gets either a larger or a smaller monetary payoff, but he dislikes disadvantageous inequity relatively more than advantageous one. Note well that players can differ in their parameters α_i and β_i –the case of a selfish player corresponds to $\alpha_i = \beta_i = 0$. In this respect, we refer to a player's preferences over allocations as his 'type', which in this model is completely specified by his parameters α_i and β_i. Players participate in a game of incomplete information since we assume that they do not know their opponent's type.

Consider first game 1. Clearly, strategy R2 is strictly dominant for Row if her parameter α is larger than $5/65 \approx 0.08$, and whatever her β.[24] For some distribution of types in the population, therefore, the EQ equilibrium (R2, C2) will be the only one that survives a process of iterated elimination of strictly dominated strategies. To prove this, let ρ denote the frequency of types with $\alpha_i > 0.08$. Since strategy R2 is strictly dominant if $\alpha_i > 0.08$, it is clear that at least ρ percent of the types should play R2 when playing as Row. *Even* if the remaining proportion $(1- \rho)$ of types with $\alpha_i < 0.08$ were expected to play R1, any type playing as Column (even a selfish one) would find strategy C2 optimal if ρ is large enough, as the expected utility of playing C2 is larger than that of playing C1 if the following holds: $(1- \rho)\cdot 75 + \rho\cdot 110 > (1- \rho)\cdot 140 + \rho\cdot 70 \Leftrightarrow \rho > 65/105$. If Column plays C2, however, it is clear that any type choosing as Row should play R2 as well, thus leading to the unique prediction (R2, C2) in game 1.

[24] For further clarification: in the well-known ultimatum game, a responder with $\alpha = 0.08$ would reject only offers *smaller* than 7 percent of the stake. In this respect, we know from previous studies that rejections of offers equal or larger than one third of the stake are not unusual, thus suggesting the existence of types with a much higher α (see Camerer, 2003 for a survey).

A similar analysis can be performed in games 2 to 6. For simplicity, we just indicate the corresponding values of α and β for which a strategy is strictly dominant. In game 2, strategy R1 is strictly dominant simply if α_i is larger than 0.07. In game 3, in turn, strategy C2 is strictly dominant if $\alpha_i > 1 + 9\beta_i$; for instance, if $\alpha_i > 1$ and $\beta_i = 0$. In games 4 and 5, strategy C2 is strictly dominant if α_i is larger than 0.2 and 0.16, respectively. In game 6, finally, strategy R2 is strictly dominant if $\alpha_i > 7 + 2\beta_i$; for instance, if $\alpha_i > 7$ and $\beta_i = 0$.

APPENDIX C:

Table 1

Results of the classification analysis with 1, 2, 3 and 4 rules per session and across all sessions

Session	# of rules	Best Rules	% of subjects per rule	ε	LL Value	PLL Value
1	1	RD	100	0.375	-158.78	-161.41
2	1	EQ	100	0.319	-172.77	-175.41
3	1	EQ	100	0.417	-65.20	-67.84
4	1	EQ	100	0.333	-91.66	-94.30
All	1	**EQ**	**100**	**0.354**	**-491.54**	**-494.18**
1	2	EQ; RD	52.5; 47.5	0.254	-136.05	-169.05
2	2	EQ; RD	65.2; 34.8	0.232	-149.47	-186.63
3	2	EQ; EF	56.3; 43.7	0.292	-57.95	-74.32
4	2	EQ; L1	68.8; 31.2	0.257	-82.06	-103.97
All	**2**	**EQ; RD**	**60.3; 39.7**	**0.259**	**-432.64**	**-525.26**
1	3	EQ; EF; RD	33.8; 33.8; 32.4	0.221	-126.71	-178.57
2	3	EQ; MP; RD EQ; RD; S	45.7; 26.1; 28.2 53.3; 32.6; 14.1	0.221	-145.78	-204.23
3	3	EQ; EF; RD	34.4; 40.6; 25	0.237	-53.98	-79.48
4	3	EQ; L1; L2	56.3; 29.2; 14.5	0.222	-76.28	-110.56
All	**3**	**EQ; EF; RD EQ; MP; RD**	**41.2; 29.4; 29.4 41.7; 29.8; 28.5**	**0.237**	**-413.78**	**-560.12**
1	4	EQ; EF; RD; MP	34.6; 18.3; 30.0; 17.1	0.200	-120.10	-186.10
2	4	EQ; RD; MP; S	41.3; 23.9; 20.7; 14.1	0.199	-137.83	-212.16
3	4	EQ; EF; L1; S	21.9; 31.2; 25.0; 21.9	0.229	-51.67	-84.41
4	4	EQ; L1; L2; MP	46.5; 17.4; 14.6; 21.5	0.208	-73.69	-117.52
All	**4**	**EQ; L1; L2; MP**	**41.7; 15.1; 21.0; 22.2**	**0.216**	**-394.10**	**-579.33**

Note: In some cases we report two models, as they perform equally well.

Table 2

Results of the classification analysis across sessions for games 1, 2, 4, and 5

# of rules	Best Model	% of subjects to rule	ε	LL Value	PLL Value
1	EQ	100	0.274	-295.85	-298.49
2	EQ; L1	71.8; 28.2	0.192	-246.84	-339.46
3	EQ; L2; MP	52.8; 19; 28.2	0.157	-218.85	-365.20
4	EQ; L2; MP; S	51.6; 17.9; 22.2; 8.3	0.139	-203.08	-388.31

Regression analysis: Our dependent variable is the number of times (*hits*) that one subject chooses according to the EQ principle in all our games. Among the independent variables, we first consider several dummies which refer to aspects of the experimental design like (i) the subject's role (Row vs. Column), and (ii) the order in which a given game appeared on the subjects' decision sheet. With respect to this latter factor, we recall that the order of presentation differed across sessions. More precisely, the six games were presented to the subjects in the following order: games 1, 2, 3, 4, 5, and 6 in session 1; games 6, 5, 4, 3, 2, and 1 in sessions 2 and 3; games 2, 6, 4, 5, 3, 1 in session 4. For this reason, we consider a dummy 'order1' taking value one if the subject participated in session 1, and another dummy 'order23' taking value 1 if the subjects participated in session 2 or 3. As the reader can observe, each dummy represents a different order of play. We also study the effect of the sessions by including session dummies in some of the regressions, session x taking value 1 if the subject participated in session x. Since the order and session dummies are correlated, we use them in different regressions.

Additional independent variables aim to check the effect of individual characteristics like gender, age, field of study (Economics or Business student vs. other field), exposure to game theory, and political ideology –we measured this latter variable on a scale from 1 (extreme left) to 10 (extreme right). Subjects provided these data in the questionnaire that they completed at the end of each session. Furthermore, subjects also indicated their choice in several hypothetical decision problems. In four of them, the subject must anonymously choose between two allocations of Euros. More precisely, the [own, other] allocations available in each problem were (1) [7.2, 8] vs. [7, 7]; (2) [8, 7.2] vs. [7, 7]; (3) [6, 10] vs. [6, 6]; and (4) [6, 10] vs. [8, 0]. While EQ predicts that any type of player should go for the EQ equilibrium (i.e., whatever her social preferences), it is possible that some types of players are more likely to act in that manner. With this in mind and based on these hypothetical choices, we construct two dummy variables: (i) variable 'selfish' takes value 1 if the subject chooses always the allocation maximizing her own payoff (note that in decision problem (3) both allocations are optimal in this sense) and zero otherwise; (ii) variable 'moderate inequity aversion (IA)' takes value 1 only if a subject chooses the equitable allocations in problems (1) and (3), and the payoff-maximizing allocation in the other problems. Finally, we also include a risk-aversion (RA) variable based on Holt and Laury (2002). More precisely, subjects faced 10 decision problems where they had to choose between two monetary lotteries. The consequences in the first lottery are always 2 and 1.6 Euros, whereas in the second lottery they are always 3.85 and 0.1 Euros. The decision problems only differ in the probabilities associated, which are respectively 0.1 and 0.9 for each consequence of each lottery in the first problem, 0.2 and 0.8 in the second problem, and so on. Variable RA equals the number of times that a subject chooses the first, safer lottery.

Table 3

Results of regression analysis

Dependent Variable: EQ hits for each subject				
Independent variables	**OLS**	**OLS**	**Negative Binomial (marginal effects reported)**	**Negative Binomial (marginal effects reported)**
Order 15	-0.300 (0.390)	-	-0.296 (0.355)	-
Order 23	0.678 (0.454)	-	0.711 (0.476)	-
Session 2	-	1.131** (0.512)	-	1.229** (0.561)
Session 3	-	0.466 (0.558)	-	0.520 (0.621)
Session 4	-	0.281 (0.382)	-	0.284 (0.373)
Role	-0.037 (0.234)	-0.048 (0.234)	-0.041 (0.223)	-0.055 (0.222)
Age	-0.016 (0.017)	-0.022 (0.016)	-0.016 (0.017)	-0.023 (0.016)
Male dummy	-0.018 (0.311)	-0.004 (0.298)	-0.018 (0.297)	-0.007 (0.281)
B&E dummy	0.786 (0.510)	0.791* (0.464)	0.812 (0.521)	0.834* (0.472)
GT dummy	0.111 (0.313)	0.151 (0.291)	0.113 (0.302)	0.157 (0.282)
RA	0.168** (0.069)	0.179*** (0.067)	0.167** (0.065)	0.178*** (0.063)
Selfish	-0.173 (0.245)	-0.161 (0.244)	-0.168 (0.234)	-0.157 (0.232)
Moderate IA	0.398 (0.281)	0.481* (0.264)	0.410 (0.275)	0.495* (0.257)
Constant	2.364*** (0.637)	2.256*** (0.638)	-	-
R-squared	0.078	0.105	-	-
N	122	122	122	122

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors clustered on individual level in parenthesis. Notation: B&E = Student of Business or Economics; GT = The subject has some knowledge of Game Theory; RA = Index of risk aversion

WEB APPENDIX ***NOT TO BE PUBLISHED***

Table 1

Comparison of the frequency of the equilibrium predicted by EQ across games

(*t-test, p-value reported*)

Ho: Gi=Gj H1: Gi>Gj	Game 1	Game 2	Game 3	Game 4	Game 5	Game 6
Game 1	-	-	-	-	-	-
Game 2	0.000	-	-	-	-	-
Game 3	1.000	1.000	-	-	-	-
Game 4	1.000	1.000	0.000	-	-	-
Game 5	1.000	1.000	0.079	1.000	-	-
Game 6	1.000	1.000	1.000	1.000	1.000	-

Table 2

Hits of each theory for row and column players

Game	Role	EQ	EF	RD	L1	L2	MP	S
1	Row	77.78%	77.78%	77.78%	77.78%	22.22%	77.78%	22.22%
	Column	76.19%	76.19%	76.19%	23.81%	76.19%	23.81%	76.19%
2	Row	85.71%	14.29%	85.71%	85.71%	14.29%	85.71%	85.71%
	Column	79.37%	20.63%	79.37%	20.63%	79.37%	20.63%	20.63%
3	Row	61.90%	38.10%	61.90%	61.90%	61.90%	38.10%	61.90%
	Column	57.14%	42.86%	57.14%	57.14%	57.14%	42.86%	57.14%
4	Row	63.49%	63.49%	36.51%	36.51%	63.49%	36.51%	36.51%
	Column	79.37%	79.37%	20.63%	79.37%	20.63%	79.37%	20.63%
5	Row	58.73%	41.27%	41.27%	41.27%	41.27%	41.27%	58.73%
	Column	60.32%	39.68%	39.68%	39.68%	39.68%	60.32%	39.68%
6	Row	36.51%	63.49%	63.49%	63.49%	63.49%	63.49%	36.51%
	Column	38.10%	61.90%	61.90%	61.90%	61.90%	61.90%	38.10%
All	Row	64.02%	49.74%	61.11%	61.11%	44.44%	57.14%	50.26%
	Column	65.08%	53.44%	55.82%	47.09%	55.82%	48.15%	42.06%

Table 3

Comparison of hits of rules for each game with 50%

(*t-test, p-value reported*) H_0: theory = 0.5, H_1: theory > 0.5

theory\game	1	2	3	4	5	6	All (1-6)	games 1,2,4,5
EQ	0.000	0.000	0.016	0.000	0.016	0.998	0.000	0.000
EF	0.000	1.000	0.984	0.000	0.984	0.002	0.192	0.238
RD	0.000	0.000	0.016	1.000	0.984	0.002	0.000	0.001
L1	0.430	0.239	0.016	0.037	0.984	0.002	0.012	0.395
L2	0.057	0.761	0.016	0.963	0.984	0.002	0.471	0.992
MP	0.430	0.239	0.984	0.037	0.430	0.002	0.073	0.077
S	0.570	0.239	0.016	1.000	0.570	0.998	0.983	0.987

Table 4

Comparison of frequency of hits of rules for each game: role of EQ

(*t-test, p-value reported;* "-" denotes equal number of hits)

H_0: EQ = other theory, H_1: EQ > other theory

theory\game	1	2	3	4	5	6	All (1-6)	games 1,2,4,5
EF	-	0.000	0.001	-	0.001	1.000	0.000	0.000
RD	-	-	-	0.000	0.001	1.000	0.009	0.000
L1	0.000	0.000	-	0.013	0.001	1.000	0.000	0.000
L2	0.000	0.000	-	0.000	0.001	1.000	0.000	0.000
MP	0.000	0.000	0.001	0.013	0.082	1.000	0.000	0.000
S	0.000	0.000	-	0.000	0.051	-	0.000	0.000

Table 5

Comparison of frequency of hits of rules for each game: role of RD

(*t-test, p-value reported;* "-" denotes equal number of hits)

H_0: RD= other theory, H_1: RD> other theory

theory\game	1	2	3	4	5	6	All (1-6)	games 1,2,4,5
EF	-	0.000	0.001	1.000	-	-	0.004	0.039
L1	0.000	0.000	-	1.000	-	-	0.008	0.008
L2	0.000	0.000	-	0.988	-	-	0.000	0.000
MP	0.000	0.000	0.001	1.000	0.950	-	0.012	0.104
S	0.000	0.000	-	-	0.918	0.000	0.000	0.000

Table 6

Comparison of frequency of hits of rules for each game: bounded rationality

(*t-test, p-value reported;* "-" denotes equal number of hits)

H_0: L1 = other bounded rationality theory

H_1: L1 > other bounded rationality theory

theory\game	1	2	3	4	5	6	total, 1-6	games 1,2,4,5
L2	0.401	0.158	-	0.006	-	-	0.061	0.062
MP	-	-	0.001	-	0.950	-	0.212	0.949
S	0.401	-	-	0.000	0.918	0.000	0.001	0.039

Table 7

Comparison of hits of rules for each session: role of EQ

(*t-test, p-value reported*) H_0: EQ= other theory, H_1: EQ> other theory

theory\session	1	2	3	4	sessions 1-4
EF	0.103	0.000	0.228	0.007	0.000
RD	0.572	0.013	0.283	0.017	0.009
L1	0.156	0.000	0.298	0.040	0.000
L2	0.031	0.000	0.091	0.004	0.000
MP	0.172	0.000	0.228	0.007	0.000
S	0.000	0.000	0.104	0.000	0.000

DESCRIPTION OF THE CLASSIFICATION PROCEDURE

For each subject $i \in I = \{1,..,n\}$ and each decision rule $r \in R = \{EQ, EF, RD, L1, L2, MP, S\}$ we define the variable $x_{i,g}^r$ as follows:

$$x_{i,g}^r = \begin{cases} 1 \;\; if \;\; subject \;\; i's \;\; choice \;\; in \;\; game \;\; g \;\; agrees \;\; with \;\; rule \;\; r \\ 0 \;\; otherwise \end{cases}$$

Further, let X_i^r denote the number of games where subject *i* chooses according to rule *r*:

$$X_i^r = \sum_{g=1}^{6} x_{i,g}^r$$

We posit that each subject follows one of the behavioral rules described in Section 3. In every game, however, there is some probability that the subject commits an error and deviates from the action that her rule prescribes. More precisely, the subject makes a random choice with probability 2ε > 0. That is, if we consider a row player, then she selects R1 and R2 with probability ε. Consequently, the probability that subject *i* deviates from her rule at any game is ε. Since subjects' choices are assumed to be independent (see footnote 19 for a discussion of this point), this data generating process yields the following likelihood function for subject *i* and rule *r*:

$$f_{i,r}(r,\varepsilon,X_i^r) = (1-\varepsilon)^{X_i^r} \times (\varepsilon)^{6-X_i^r} \qquad (1)$$

In a first approach, we assume that all players follow the same decision rule. The resulting likelihood function for the population is

$$F_r = \prod_{i=1}^{n} f_{i,r}(r,\varepsilon,X_i^r) \qquad (2)$$

By applying standard optimization techniques, one can find that the $\hat{\varepsilon}_r$ that maximizes F^r has the following form:

$$\hat{\varepsilon}_r = \frac{2\cdot(6\times n - \sum_i X_i^r)}{6\times n}.$$

By computing $\hat{\varepsilon}_r$ for each rule *r* we can then find the optimal decision rule in the maximum likelihood sense, i.e. that maximizing function (2) given the data. This procedure can be extended to the case where different agents use different rules. Suppose that we want to find the *k* rules that best describe subjects' behavior, maintaining the assumption that each subject follows one rule throughout the six games with some error. Let $\delta_{i,r}$ denote an indicator taking value 1 if subject *i* follows rule *r* and 0 otherwise ($\sum_{r\in R}\delta_{i,r} = 1$). The new likelihood function is consequently

$$F(r,k) = \prod_{i=1}^{n} \prod_{r\in R} (f_{i,r}(r,\varepsilon,X_i^r))^{\delta_{i,r}} \qquad (3)$$

The likelihood maximization can be thought of as the following algorithm. For any possible set of *k* rules, assign each subject to the rule of the set that best explains her behavior (i.e., that one maximizing X_i^r). The set of rules that best describes subjects' choices is the one for which equation (3) reaches the highest value.

Note that the success of our model (measured by how small $\hat{\varepsilon}$ is) increases as the number of rules *k* increases. This is intuitive as the overall likelihood increases as *k* increases. However, our model also becomes more complex and hence it would be desirable to introduce a penalty for allowing “too many” decision rules. Following El-Gamal and Grether (1995), we penalize the introduction of additional rules. The penalty is subtracted from the log-likelihood value, so that the penalized log-likelihood function is

$$PLF(k, \delta_{i,r}, \varepsilon, X_i^r) = \log F(r,k) - k\log(2) - k\log(|r|) - n\log(k),$$

where $|r|$ denotes the total number of rules in *R*. The penalization terms are the Bayesian posteriors that follow from several priors. The penalty term $k\log(2)$ regards the assumption that the probability that the population includes exactly *k* rules is $\left(\frac{1}{2}\right)^k$. The second penalty term refers to the assumption that all possible sets of *k* rules are equally likely (each one having probability $\frac{1}{|r|^k}$). Finally, the last penalty term comes from the assumption that all allocations of rules to subjects are equally likely (probability $\frac{1}{k^n}$).