Abstract

I collect data from a modified ultimatum game designed to enable the estimation of fairness, altruism and learning. In the standard ultimatum game, if the receiver of the ultimatum rejects, both players get zero. In this modified game, if the receiver rejects, the receiver gets a positive alternative payoff, while the sender still gets zero. The receiver's alternative payoff is drawn from a common knowledge distribution. The draw is unknown to the sender when the ultimatum is given, but known to the receiver before the accept/reject decision is made. While the receiver still has a dominant strategy in the modified game (take whichever is bigger – the ultimatum payoff or the alternative payoff), it is not true that the receiver should always accept the ultimatum. Hence receivers are observed making decisions both when they should accept and when they should reject. I model the receiver's accept/reject decision and control for warm glow, altruism, fairness and learning. All of these variables are statistically significant. The main determinant of the receiver's accept/reject decision is difference between the ultimatum payoff and the alternative payoff, but these other concerns play an important role. The other players, the senders, are observed choosing ultimatums. I use the first order condition of their utility maximization problem to construct a regression equation with independent variables that control for altruism, fairness and learning. I found that the senders are somewhat spiteful, but more importantly, they care about an un-fair outcome. In other words, they want to win. However, over time this desire is tempered and the senders become more generous.

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Fairness in Ultimatum Games with Heterogeneous Receivers

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1 Introduction

Because of its clear individual incentives and zero sum nature, the Ultimatum Game is an excellent environment for studying the concepts of fairness and altruism. The game is a representation of the last round of a bilateral bargaining process. By the last round all possible compromises have been made and one side, the sender, issues an ultimatum to the other side, the receiver. The ultimatum is a demand to either reach an agreement and split the gains in a specified way, or to declare an impasse and stop bargaining.

If you assume that the sender can commit to follow through on the ultimatum, and that the players are rational and maximize their own utility, then game theory makes very strong predictions about what should happen. The receiver should accept any offer made by the sender that gives him more utility than he would get from his best alternative payoff. In turn, the sender should make an offer that gives the receiver only slightly more than his best alternative.

For example, if the joint gains from making an agreement were A and the best alternative to an agreement for both players was to gain zero, the sender should demand an agreement with a split of $A - u$ for himself and u for the receiver, where $u > 0$ is as small as possible. The receiver then, faced with a choice between u and zero, would accept the ultimatum and earn u. The sender would earn $A - u$.

Guth, Schmittberger and Schwarze (1982) were the first to examine this basic Ultimatum Game in an experimental setting. They were interested in determining whether or not the game theoretic prediction for behavior was accurate. In fact, they observed ultimatums that were far better for the receiver than the theory predicts. In one of their treatments, the senders, on average, offered forty-five percent of the gains to the receiver. This was far better for the receiver than his outside option of zero. In the same treatment, the receivers on average rejected offers of less than thirty-six percent, again far above zero. Guth, *et al.* conclude that players are interested in balanced payoffs, even at a cost, and that "...the rational solution is not considered as socially acceptable or fair."[1]

Binmore, Shaked and Sutton (1985) continued the study of Ultimatum Games in a more complex setting based on the Stahl/Rubenstein bargaining model. In the Binmore, *et al.* design, the game continued an additional round if the ultimatum was initially rejected. In the second round, the joint gains to reaching an agreement were reduced and the players reversed roles. For example, if an offer to split the joint gains of A was rejected by the receiver in the first round, the receiver would take the role of the sender in the second round and demand a split of δA, where δ is a discount rate. The solution of the game based on the Stahl/Rubenstein model is similar to the solution of the basic Ultimatum Game. In equilibrium, the sender demands $A - (u + v)$ in the first period, with u small and v the value to the receiver of continued bargaining, and the receiver accepts.[2]

[1] Guth, *et al.* (1982), page 382.

[2] The alternative payoff I institute in these experiments is conceptually similar to v here.

Binmore, *et al.* found that, although senders initially demanded only about half of the gains, more experienced senders demanded about three fourths of the gains – the equilibrium demand given their parameters. Unlike Guth, *et al.* , Binmore, *et al.* concluded that, with experience, players behaved more like *gamesmen* than like *fairmen*.

At the core of Binmore, *et al.*'s conclusion is the assumption that players are learning according to some process like trial-by-error learning. The non-equilibrium demands must be made by inexperienced players as part of a process undertaken to learn which demand leads to the highest payoff and that eventually the number of non-equilibrium demands will fall. They do not attempt to model this process explicitly.

A number of papers followed in the wake of these two projects and their contradictory conclusions. Guth and Teitz (1988) replicated the experiments of Binmore, *et al.* and found many *fairmen* and no evidence of learning; Neelin, Sonnenschein, and Spiegle (1988) examined games with different finite horizons, they also found no learning; Ochs and Roth (1989) added heterogeneous discount rates and finite horizons, they found no aggregate experience effects; and Weg, Rapoport and Felsenthal (1990) examined heterogeneous discount rates and infinite horizon games and found no learning effects.[3] Bolton (1991), a paper which argues for the inclusion of a term related to the player's relative payoffs in each individual's utility function, includes a list of the common observations about Ultimatum Game experiments:

- The sender, on average, gets more than half of the joint gains;
- the demands are closer to an equal division of the gains than to the equilibrium division;
- demands leading to positive gains for the receiver are rejected;
- some receivers reject demands and in the next round make demands as senders that give them a lower payoff than what they just rejected; and,
- the discount rate influences the outcome.

Yet, whether or not the above observations are drawn from the actions of fairmen or from the actions of gamesmen is still an unsettled question. None of the papers attempt to model decision error, none attempt to see if the decision error changes over time. At least within the basic Ultimatum Game, it's impossible to do so because the receiver always has an incentive to reject the ultimatum. The basic Ultimatum Game cannot differentiate between a receiver who rejects an ultimatum out of concerns for fairness, for example, and a receiver who rejects because of error. The researcher only observes the rejection, the receiver's motivation is necessarily supposition.

However, a simple modification of the game allows the measurement of error rates. By endowing the receiver with a positive outside option drawn from a common knowledge

[3]The history of this literature is surveyed in Thaler (1988), Ochs and Roth (1989), and Guth and Teitz (1990).

distribution, with the actual draw known only to the receiver, it's possible to observe decisions made when there is both an incentive to accept and an incentive to reject. Receivers learning by trial-and-error will make errors in both situations and thereby reveal their error rates. Controlling for errors makes it possible to measure the degree to which fairness, altruism, and learning effect the receiver's decision. Once the receivers' decision functions are known, it is also possible to determine the senders' decision functions and test for the same types of behavior.

In this paper, I report on the decisions of players in an Ultimatum Game where the receiver is endowed with an alternative payoff. I compute both the receiver's and sender's decision functions and see if those decision functions contain concerns about fairness or altruism, and see if they change over time.[4]

2 The Game

Let A be the joint gains that are possible if an agreement is reached between the sender and the receiver. Let zero and v be, respectively, the sender's and receiver's alternative payoff if an agreement is not reached. Assume that the receiver knows the value of both outside alternatives, but that the sender only knows the value of his own outside alternative and the distribution from which the value of the receiver's outside alternative is drawn.

The first move of the game belongs to the sender who must deliver an ultimatum to the receiver. The ultimatum is a number $u \in [0, A]$ implying payoffs of $A - u$ for the sender and u for the receiver. As the second move, the receiver must either accept the ultimatum and its implied payoffs or reject the ultimatum in favor of the alternative payoffs.

Assume that the players maximize a utility function that is risk neutral and depends only upon their own monetary payoffs. Then the receiver's problem is to pick the larger, u or v. If u is larger, the receiver accepts, if v is larger, the receiver rejects. Or, you could think of the receiver's decision rule as:

$$d_r = \begin{cases} \textit{accept} & \text{if } (u - v) > 0 \\ \textit{reject} & \text{if otherwise.} \end{cases}$$

This decision rule can be modified to encompass players that are not as self motivated. Additional terms can represent a gain from the act of accepting (a *warm glow*), a gain associated with altruism, a gain associated with fairness, and a stochastic error. For example, the receiver's decision function might be:

$$d_r = \begin{cases} \textit{accept} & \text{if } (u - v) + w_r + a_r(A - u) + k_r(\frac{A}{2} - u)^2 + \varepsilon_r > 0 \\ \textit{reject} & \text{if otherwise,} \end{cases}$$

[4]A similar methodology is used in Palfrey and Prisbrey (1993a, 1993b) to study the effects of altruism in public goods provision with the voluntary contribution mechanism.

with w_r, a_r, k_r, and ε the warm glow, altruism, fairness and error terms (respectively). In this case, how fair an outcome is is determined by a penalty function that gets larger as u gets further away from half of the joint gains. Depending on the signs and magnitudes of each of the additional terms, the receiver is either more or less likely to accept any given ultimatum. If you assume that ε_r is drawn from a Normal distribution, the receiver's decision follows the Probit model.

The sender's problem is to maximize expected utility. In other words,

$$\max_{u \in [0,A]} \ (A-u)G(u) + w_s + a_s u + k_s(\frac{A}{2} - u)^2 + \varepsilon_s(u),$$

where $G(\cdot)$ is the probability that the receiver will accept the ultimatum u. The terms w_s, a_s, k_s, and ε_s are the warm glow, altruism, fairness, and error terms (respectively) for the sender. Note that I have made the sender's error a function of the ultimatum u. The reason for this is obvious once you consider the first order condition:

$$-((A-u)G'(u) - G(u)) = a_s - k_s(\frac{A}{2} - u) + \varepsilon_s'.$$

My strategy is as follows:

1. Estimate the parameters of the receivers' decision functions using the above Probit specification.

2. Based on the results of the Probit estimations, determine $G(\cdot)$, the probability that an ultimatum will be accepted.

3. Estimate the parameters of the senders' decision functions.

3 The Experimental Environment

The experiments that generated the data reported here were run via computers in the experimental laboratory (LeeX) at the Universitat Pompeu Fabra in Barcelona, Spain. The subjects were first year undergraduate students recruited from the Law, Economics, and Business schools. There were four experimental sessions, the first three with sixteen subjects each and the fourth with fourteen subjects.

Each session started with the students entering the lab and sitting at a computer of their choice. A master computer then randomly selected half of the subjects to be senders for the entire session.

Next, a set of instructions were read to the subjects. The instructions explained the particular details and specific parameters of the experiment, which were as follows:

- The possible joint gains $A = 100$, which meant that each sender had to choose $u \in \{0, 100\}$. Only integer choices were possible.

- The value of each receiver's outside alternative was randomly drawn from a triangular distribution on the integers in the interval $[0, 80]$, with the probability of drawing a low value greater than the probability of drawing a high value. The cumulative distribution function for a triangular distribution with a continuous support is
$$F(x) = \frac{2lx - x^2}{l^2},$$
where l is the upper bound of the support. In this case $l = 81$ and, in order to limit the distribution to integers, each draw was rounded down to the closest integer. The subjects were shown a graph of both the probability density and cumulative distribution functions and were shown how to read each.

  The choice of a triangular distribution may seem odd at first, a more natural choice would have been a uniform distribution. However, the sender's decision is rather uninteresting given a uniform distribution and only self-interested players. The sender's problem would be:
$$\max_{u \in [0,A]} (A - u)F(u)$$
where
$$F(u) = \begin{cases} u/\bar{v} & \text{if } u < \bar{v} \\ 1 & \text{otherwise} \end{cases},$$
is the cumulative uniform distribution with $\bar{v}$ equal to the upper end of the support. The solution to this problem is to pick $u = \bar{v}$ if $\bar{v} < \frac{A}{2}$, else pick $u = \frac{A}{2}$. If I choose a uniform distribution and $\bar{v} > 50$, then completely fair sender behavior would be the same as completely selfish sender behavior. Furthermore, if $\bar{v} < 50$ and senders acted optimally, then receivers would get no offers they should reject. Optimal sender behavior would return us to the type of data collect in the basic ultimatum game.

  The triangular distribution, while more complicated, avoids these problems. I chose the support so that there would be some separation between the perfectly fair outcome of $u = 50$ and the perfectly self interested outcome, which in this case is $u = 40$. I also hoped to observe a number of situations where the self interested receiver would reject.

- Each experiment was to continue sixty rounds, with subjects being randomly reassigned into pairs between each round.[5] The reassignment was such that no two subjects were ever in the same pair in consecutive rounds. Each receiver's outside option was also redrawn and revealed to the receiver between each round. Thus, the experiment simulated a series of one time encounters and enabled the observation

[5] Due to accounting errors on the part of the author, the first experiment ran for only fifty-nine rounds and the second experiment ran for sixty-one rounds. Even so, in each experiment the subjects knew which was the final round at least five rounds prior to it.

of a particular receiver's decisions for different values of the outside option. At no time was a sender ever informed of a receiver's outside option.

- The experiment was intentionally stopped and restarted three times in order to divide the rounds into quarters.[6] This was done only to emphasize the passing of the rounds and to enable a logical coding of an experience variable. The identity of the senders and the parameters of the experiment were identical in each of the four quarters.

- Each computer stored a history for each individual. At any time, a subject could recall all the decisions that he had been involved in in that quarter. Receivers could also recall their past outside options.

- The possible joint gains $A = 100$ *points* or 50 pesetas for each round. After all the rounds were completed, each subject was paid in private. The average subject earned 1257 pesetas during the experiment plus 500 pesetas as a participation fee.

4 Receiver Decisions

The senders sent the receivers almost every possible ultimatum. They ranged from 1 to 100, with a mean of 41.36 and a standard deviation of 9.53. The receivers accepted 69.89 percent of the ultimatums.

For illustration, Figure 1 shows the frequency at which the receivers accepted the ultimatums given their monetary payoff $(u - v)$. The figure also shows a non-parametric regression or kernel smooth of the data. The value of the kernel smooth at a particular $(u - v)$ is a weighted average of the decisions made in an interval around that $(u - v)$, with decisions further away having less weight.[7]

For a rough estimate of receivers' behavior in these experiments, consider the value of $(u - v)$ that corresponds to an acceptance rate of fifty percent. That value represents the point where the average receiver is indifferent between accepting and rejecting an ultimatum. According to the kernel smooth, that value is approximately 2.5. The average

[6] An undiscovered incompatibility between the experimental software and other network software running concurrently caused some delays as the experimental software occasionally had to be reset. From the subject's point of view, the reset just added some time between two rounds, the experiments did not have to be restarted. Resetting the software takes less than one minute – the experiments were not jeopardized by long delays. The need to reset did lead to the accounting problem mentioned in the previous footnote. The problem was solved in the end by unloading the other network.

[7] The weights are determined by the particular kernel that is used. The estimation shown here was generated with the Epanechnikov or quadratic kernel and a bandwidth of 5. For a particular $(u - v)$, every observation with $(u - v)$ within 5 units away was given a weight of $0.75(1 - x^2)$, where x was the distance divided by the bandwidth. For information about non-parametric regression see Manski (1991) and especially Härdle (1989). Note that, in this case, the simple frequency distribution is a kernel smooth with a bandwidth less than 1.

receiver is, on average, indifferent between his outside option and an ultimatum with a payoff that is 2.5 points higher.

In order for indifference to be rational, there must be some hidden benefit that comes from accepting the outside alternative or, possibly, from rejecting the ultimatum. The extra benefit will be measured by the variables w_r, a_r, and k_r.

One surprising result that can be seen in this Figure is that the receivers never accepted an ultimatum when $(u - v) < 0$. There were 425 such cases, the ultimatums involved ranged from 1 to 63 with a mean of 37.44 and a standard deviation of 8.56. In some of these cases, when $u = 50$ for example, you would expect receivers who cared about fairness or were altruistic to accept. They did not. In some of these cases, you would expect that there would be some acceptances due to mistakes. There were not.

However, the receivers were not so decisive when $(u-v) \geq 0$. Apparently the receivers make a two part decision. If $(u - v) < 0$, then they reject the ultimatum outright. On the other hand, if $(u - v) \geq 0$, then they think about fairness and altruism and maybe make errors.

Hence, I will estimate a modified receiver decision function:

$$d_r = \begin{cases} \text{if } (u-v) < 0, & \textit{reject} \\ & \\ \qquad \text{else} & \begin{cases} \textit{accept} & \text{if } w_r + a_r u + k_r(100-v)^2 + \varepsilon_r > 0 \\ \textit{reject} & \text{if otherwise.} \end{cases} \end{cases}$$

If we assume that the error term ε has a Normal distribution with variance σ^2, then the above rule implies a binary choice probit model in the $(u-v) \geq 0$ region. Table 1 contains the results of three different probit model estimations, each with different independent variables. Model R1's independent variables are:

1. the constant one, with the coefficient w_r, which represents the warm glow;

2. $100 - u$, with the coefficient a_r, which represents altruism; and

3. $(50 - u)^2$, with the coefficient k_r, which represents fairness.

Model R2 adds a fourth independent variable q, which represents the quarter in which the decision was made. The coefficient of q will be labeled l_r, it represents the change in the decision function due to learning or experience. Models R1 and R2 are representative models, each receiver is assumed to act in the same way. In Model R3, that assumption is relaxed and individual level altruism and fairness terms, a_{ri} and k_{ri} respectively, are estimated. The individual effects are shown in Figures 4 and 5.

First, consider Model R1. Recall that, because this is a probit model, the probability of accepting the ultimatum when $(u - v) \geq 0$ is $\Phi(w_r + a_r(100 - u) + k_r(50 - u)^2)$. At $u = 50$, the perfectly fair outcome, the probability of accepting is 0.96. The probability of accepting the mean offer of $u = 41.36$ is 0.93. If $u = 15$, the probability of accepting is 0.50. Perhaps altruism is a misnomer for the effect of the negative coefficient a_r –

self-interest might be better. The negative coefficient means that as the sender's payoff rises (and because its a zero-sum game, the receiver's payoff falls), the probability that the receiver accepts falls. Surely this is a reasonable finding. The sign of the fairness coefficient k_r is also negative, meaning that as the ultimatum becomes more and more unfair, the probability the receiver accepts falls.

In Model R2, l_r is significant and negative. This means that as the receivers gain experience, the probability that they accept falls. The other coefficients are also larger and, taken together with the results from Model R1, this implies that more experienced receivers value fairness and self-interest more. They are not learning to accept a less fair outcome and Binmore *et. al.* suggested, just the opposite.

Figure 2 shows the probability that a particular u is accepted by the receiver. There are two lines, one is a kernel smooth through the actual data, the other is a acceptance curve constructed from probit Model R1. This curve, labeled probit in the figure, is $G(\cdot)$. It is equal to the probability of accepting times the probability that $(u - v) \geq 0$. The variability at the extreme ends of the kernel smooth is likely due to the small number of observations at those extremes. For example, there are only 7 out of 1860 observations with $u > 80$, that is 0.003 percent of the data. The majority of the observations are in the middle range. The receiver decision model seems to do quite well.

5 The Decisions of Senders

Figure 3 shows the estimated frequency and cumulative frequency of u, the sender's decision. The most common decision is $u = 40$ and the mean decision is $u = 41.36$. Also shown in the figure is a scaled version of the sender's payoff function, $\pi(u) = (100 - u)G(u)/100$. This function shows the expected percentage of A that the sender will receive, given u. The maximum of $\pi(u)$ occurs at $u = 44$. Non-monetary motives made the average receiver reject offers that were slightly above their outside alternative, here non-monetary motives make the average sender offer slightly less than the optimal amount.[8]

Recall that the first order condition for the senders' utility maximization problem was:

$$-((A - u)G'(u) - G(u)) = a_s - k_s(\frac{A}{2} - u) + \varepsilon'_s.$$

If we assume that the error term ε'_s has a Normal distribution with variance σ^2, then, since the left-hand side of the above equation can be computed from the data, we can estimate a_s and k_s using least squares regression. Note however that ε'_s is a function of u, in other words its heteroskedastic. Because of this, the following t-statistics were estimated using White's heteroskedasticity-consistent covariance estimator. Because of potential endogeneity problems, I also present the results of models that do not contain the fairness term k_s. The estimated coefficients are presented in Table 2.

[8]Note however, that 40 is the optimal offer if the receivers act only based on their monetary incentives.

In order to interpret the results, you should recognize that the dependent variable is the slope of the senders' payoff function times -1. This function is shown in Figure 3. A self-interested sender would pick the u so that this slope was equal to zero. The slope is zero at $u = 44$. For $u < 44$, the slope is positive, and for $u > 44$ the slope is negative. In Model S1, the coefficient a_s is negative, implying that altruism causes the senders to pick a more positive slope, or a lower u. According to this model, the senders, like the receivers, are self-interested instead of altruistic.

Model S2 incorporates the fairness term k_s. Its positive value means that senders value an un-fair outcome. The more unfair the outcome is, the higher the senders' utility. Notice the signs in the regression equation. A positive k_s implies that the senders are picking a slope that is more positive (because of the minus in front of k_s.) Hence, they pick a lower u. The senders don't care about fairness, they seem to care about relative payoffs, or winning. Figure 6 shows the individual effects from Model S3. Figures 7 and 8 show individual effects from Model S4.

The coefficients l_s are significant in each model and imply that the senders are offering a higher u as they gain experience.[9] Apparently they are learning of the receivers' desire for a fair outcome and are responding.

5.1 Discussion

And so, what is the answer? Are we observing fairmen or gamesmen? I would argue that we are seeing a bit of both. We are seeing receivers who are interested in getting a fair outcome and they are being very strategic in working for it. The senders are interested in not having a fair outcome (they make more that way) and yet they are responding to the receivers.

To see my point, consider the type of information that the receivers can send to the senders during the experiment. The receiver can reject the ultimatum, in effect telling the sender it needs to be higher, or the receiver can accept, telling the sender the ultimatum was high enough, perhaps higher than it needed to be. If the sender adjusts his offers up when he sees rejections, and down when he sees acceptances, then the receivers clearly want to reject as much as feasible. Certainly they should reject when there is no cost for them to do so, *i.e.* when $(u - v) < 0$. They do in fact do this. They may even be willing to reject when it costs them something, especially if it reinforces a more fair outcome. Hence the possibility of rejections when $(u - v) \geq 0$ and the outcome is less than fair. Of course, fair offers are almost always accepted if $(u - v) \geq 0$.

The senders, who begin the games making relatively low offers, see the rejections and understand. Although the effect is slow, the offers start to go up.

[9] One- tailed tests, $\alpha = 0.05$.

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Appendix A: Instructions and Quiz

Instructions

This is an experiment in decision making. You will be paid in cash at the end of the experiment. The amount of money you earn will depend upon the decisions you make and on the decisions other people make. We request that you do not talk at all or otherwise attempt to communicate with the other subjects except according to the specific rules of the experiment. If you have a question, feel free to raise your hand. One of us will come over to where you are sitting and answer your question in private.

The session you are participating in is broken down into a sequence of four separate experiments. At the end of the last experiment, you will be paid the total amount you have accumulated during the course of all 4 experiments. Everyone will be paid in private and you are under no obligation to tell others how much you earned. Your earnings are given in *points*. At the end of the last experiment, you will be paid 50 pesetas for every 100 *points* you have accumulated during the course of all four experiments.

Each experiment has 15 separate rounds and then it will end. During each round of the experiment you will be randomly paired with another subject. You will **never** be paired with the same subject for two rounds in a row.

In each pair of subjects, one person will be the Sender and the other will be the Receiver. If you are a Sender, you will be a Sender for all the rounds of all the experiments. If you are a Receiver, you will be a Receiver for all the rounds of all the experiments.

At the beginning of the round, each Receiver is assigned an alternative. This alternative is random and will change from round to round and will vary from person to person randomly. To be more specific, the alternative is taken from a Triangular distribution.

[Show the picture of a Triangular distribution] [Hand out picture and chart]

The lowest possible value for the alternative is 0 points and the highest possible value is 80 points. The chance of getting any specific alternative is higher for a low value than it is for a high value.

The chart shows the chance of getting an alternative less than 10, less than 20, less than 30, and so forth. For example, you can see that 437 times out of 1000, the alternative should be less than 20 and that 937 times out of 1000, the alternative should be less than 60.

There is absolutely no systematic or intentional pattern to the value of the alternatives. The determination of alternatives across rounds and across Receivers is entirely random. Therefore, every Receiver will generally have different a alternative. Furthermore, these alternatives will change from round to round in a random way. You will be informed PRIVATELY what your new alternative is at the beginning of each round and you are not permitted to tell anyone what this amount is.

After the alternatives are given to the Receivers, each Sender is given the chance to divide 100 points between himself and his Receiver. The sender picks a number between 0 and 100, this number is how many points he wants for himself.

Then, once all the Senders have made their choice, the Receivers get to choose to accept the Sender's proposal or to reject it. If the Receiver accepts, then the 100 points is divided between the pair according to the Sender's proposal. If the Receiver does not accept, then the Sender gets 0 points and the Receiver gets his alternative.

What happens in your pair has no effect on the points earned by people in other pairs nor do their actions have an effect on the points you earn.

Are there any questions?

[Begin practice rounds]
[Begin experiment 1.]

Specific instructions for Experiment 2:

Experiment 2 is the same as experiment 1.
[Begin experiment 2.]

Specific instructions for Experiment 3:

Experiment 3 is the same as experiments 1 and 2.
[Begin experiment 3.]

Specific instructions for Experiment 4:

Experiment 4 is the same as experiments 1, 2 and 3.
[Begin experiment 4.]

Directions for the practice rounds:

Please do not push any keys until you are told to do so. We will do two practice rounds so you can see what the computer does, you will not be paid for these rounds.

[wait for the screen]

In the large box on the left is the history table. At the top of this box is listed the round you are in, the alternative for the Receiver, the number of points you would receive if the split is accepted, the decision of the Receiver, and the points you earned in the round. Note that if you are a Sender, you do not actually see the alternative, you just see a question mark.

In the upper right-hand box, you are told the actions that you can take. If you are a Sender, you are told that you may split 100 points. If you are a Receiver, you are told that you may accept the split or take your alternative. You are told what your alternative is worth.

In the box below this, you are told if you are a Sender or a Receiver and exactly what you must do. If you are a Sender, you are told that you must choose a split. If you are a Receiver, you are told that you must Accept or not accept the split.

In the last box you are told your payoffs depending upon what the other player in your pair does. The numbers here will always be the payoff for you.

In the upper left-hand corner is your id number and in the upper right is the round number.

Now, Senders: At the bottom of the main screen, you are asked to make your decision by entering a number between 0 and 100. Please enter the last two digits of your DNI number. You will then have to press S to send the number to the Receiver. The computer will ask you to confirm your decision, so if you make a mistake, you can correct it. Note that your offer has been recorded on the screen in the history box and in the payoff box.

[wait for all the senders]

Now, Receivers: Once you get your offer, it will be recorded in both the history box and in the payoff box. You must then choose to Accept the offer or to Not Accept the offer. Please Accept the offers. The computer will ask you to confirm your decision, so if you make a mistake, you can correct it. Note that your decision has been recorded on the screen in the history box.

The computer then computes your earnings and keeps track of them in the history box.

[do another round]

Notice how the history of the last round is still on the screen for you to see.

Senders, this time please enter 100 - DNI.

[wait for senders]

Receivers this time please choose Not Accept.

[wait for round to end]

Are there any questions?

[hand out quiz]

Quiz

1. How many experiments will there be?

2. How many subjects are in a group?

3. How many rounds will each experiment last?

4. If someone is in my group in round 1 of an experiment, it is:

    i. Certain

    ii. Very Likely

    iii. Very Unlikely

    iv. Impossible

    that s/he will be in my group in round 2 of the experiment.

5. If someone is in my group in this experiment, it is:

   i. Certain

   ii. Very Likely

   iii. Very Unlikely

   iv. Impossible

   that s/he will be in my group in the next experiment.

6. What is the probability that a Receiver has an Alternative equal to or less than 30? 40?

7. If you are a Sender in the first experiment, what will you be in the second experiment?

8. If a proposal is not accepted, how much does the Sender earn? How much does the Receiver earn?

9. If I earn 50 points, how many pesetas will I get?

Receiver Models

Dependent variable: accept/reject decision when $u > v$

Coef.	Model R1	Model R2	Model R3
w_r	2.54453	3.36310	3.58084
	(8.94403)	(7.97471)	(4.66527)
a_r	-1.65210e-002	-1.72007e-002	see
	(-3.47208)	(-3.54327)	Fig. 4
k_r	-9.32156e-004	-9.83262e-004	see
	(-5.95048)	(-6.18047)	Fig. 5
l_r		-0.20591	-0.21091
		(-2.74199)	(-1.45755)
log lkhd	-368.29	-363.92	-231.15
psuedoR^2	0.67634	0.68018	0.79686
n	1407	1407	1407

Table 1: These are the results of the probit estimation for the three receiver models. The numbers in parentheses are t-statistics. The psuedoR^2 is 1 minus the ratio of the model's log likelihood to a baseline model's log likelihood. In the baseline model, the probability of accepting is equal to the number of acceptances divided by the number of chances.

Tables and Figures

Sender Models

Dependent variable: $-((A-u)\cdot G'(u)-G(u))$

Coef.	Model S1	Model S2	Model S3	Model S4
a_s	-0.41057	0.14396	see	see
	(-6.60673)	(4.40544)	Fig 6	Fig 7
k_s		9.91702e-002		see
		(28.63597)		Fig 8
l_s	4.75951e-002	1.28997e-002	7.85358e-002	1.24448e-002
	(2.91063)	(1.75774)	(4.78846)	(1.75302)
R^2	6.60283e-003	0.87354	0.47321	0.94488
$\sum e^2$	4.74208e+002	60.36887	2.51468e+002	26.31184
n	1860	1860	1860	1860

Table 2: These are the results of the least squares regressions for the four sender models. The numbers in parentheses are t-statistics that were computed using White's heteroscedasticity-consistent covariance estimator.

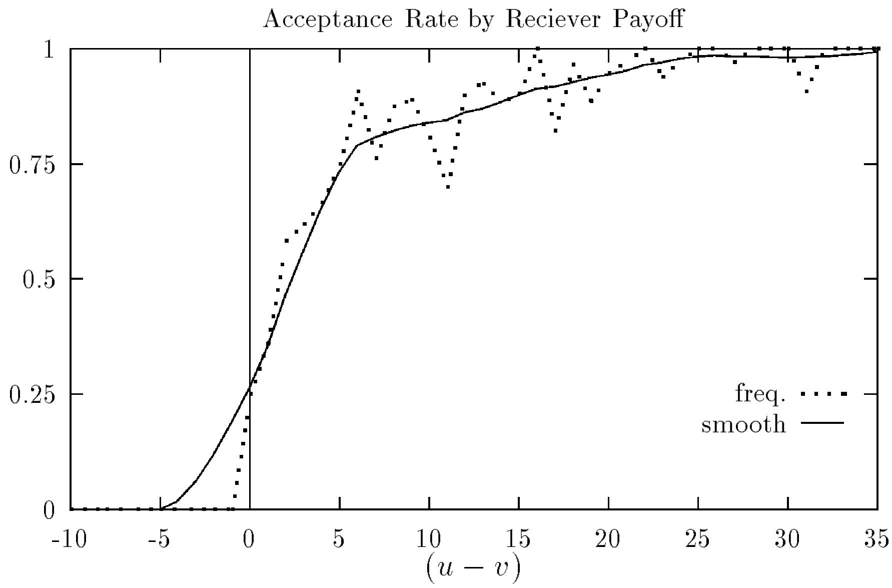

Figure 1:

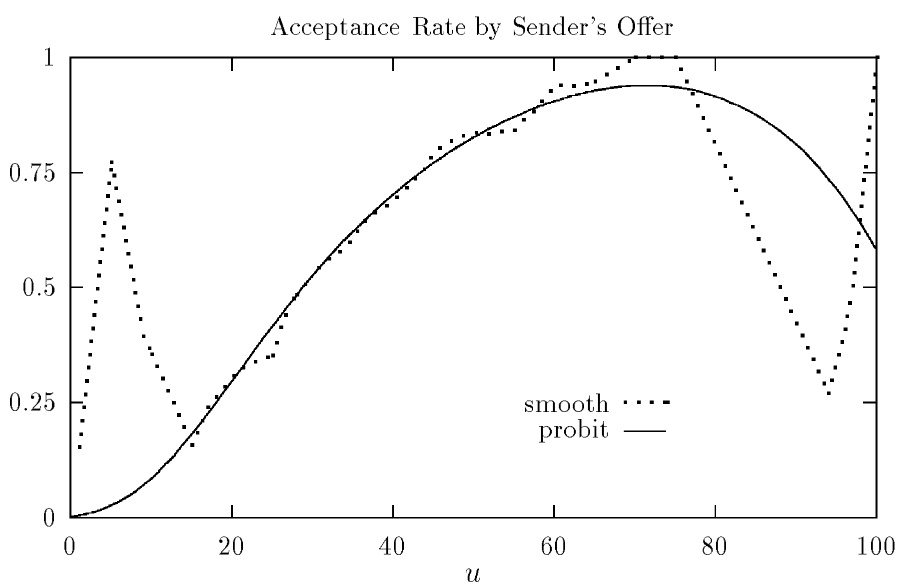

Figure 2:

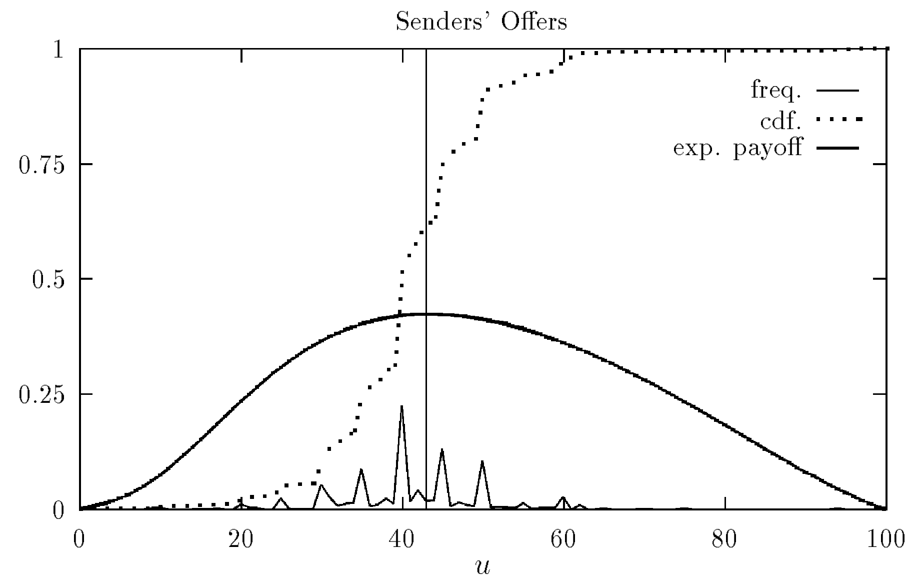

Figure 3:

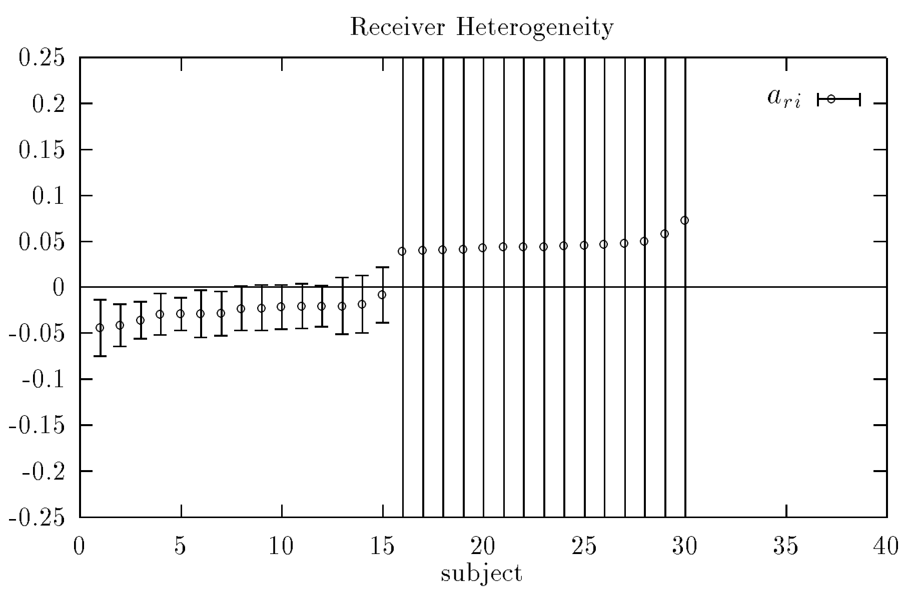

Figure 4:

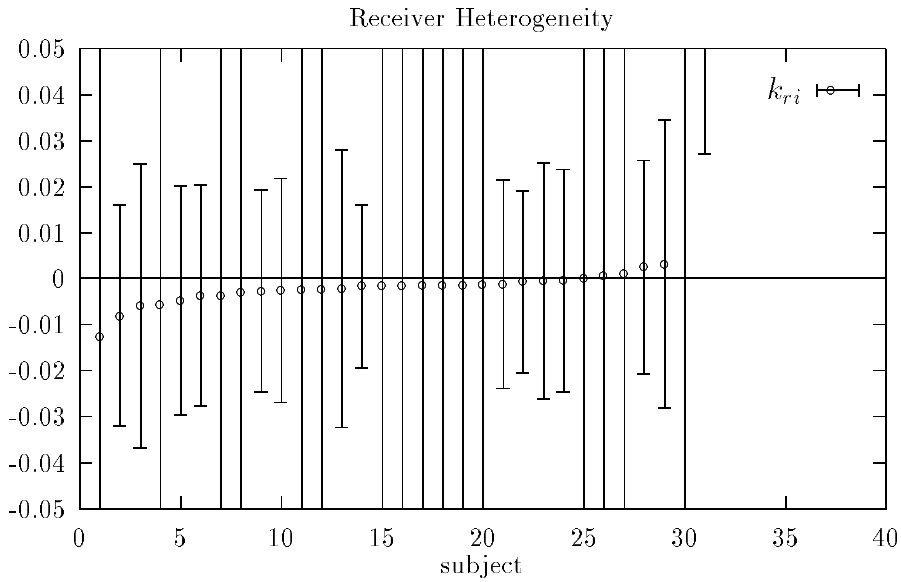

Figure 5:

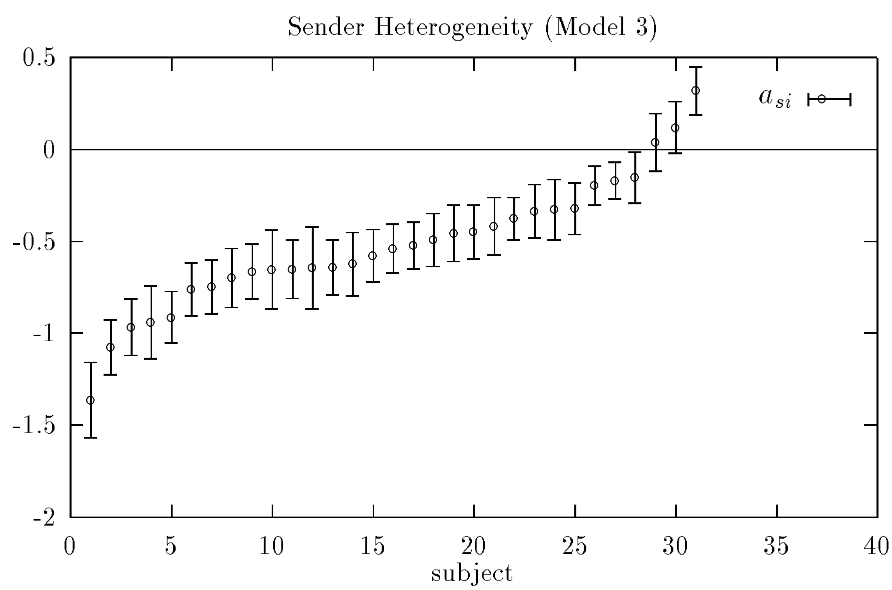

Figure 6:

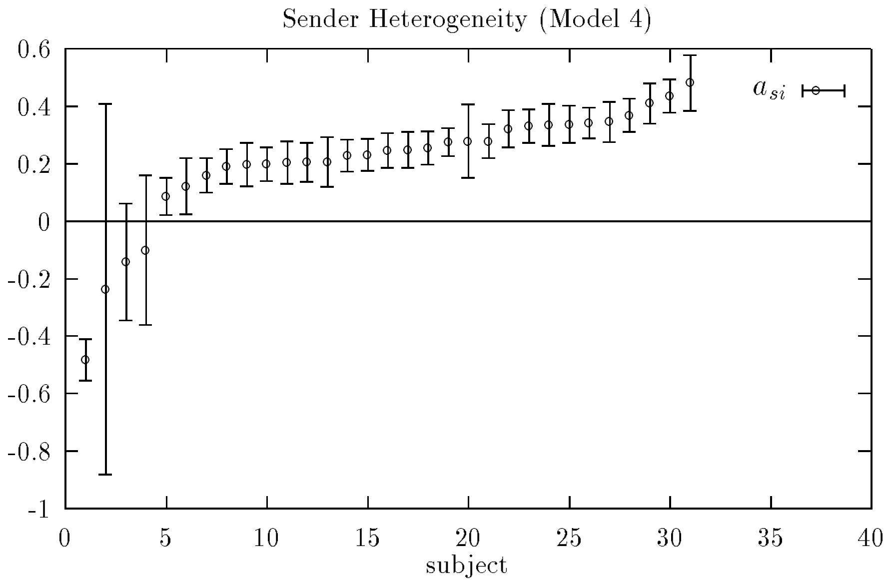

Figure 7:

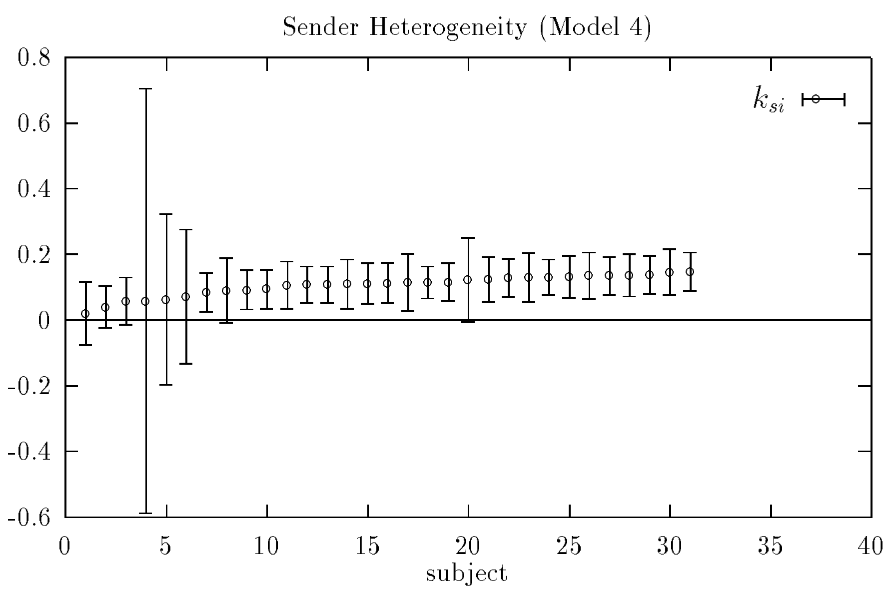

Figure 8: