# Subgame Perfection in Ultimatum Bargaining Trees ${ }^{1}$ 

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#### Abstract

In typical experiments on ultimatum bargaining, the game is described verbally and the majority of subjects deviate from subgame-perfect behavior. Proposers typically offer significantly more than the minimum possible and responders reject "unfair" offers. In this work, we show that when the ultimatum bargaining game is presented as an abstract game tree, the vast majority of behavior is consistent with individualistic preferences and subgameperfection. This finding raises doubts about theories that ignore the potential influence of social context and experiments that do not control for social context.


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## 1. Introduction.

In ultimatum bargaining, one party (the Proposer) makes an offer to another party (the Responder), who can accept or reject the offer. If accepted, the parties split a pie according to the agreed terms; otherwise, neither party gets anything. The subgame perfect solution is for the Proposer to offer the minimum feasible amount to the Responder, and for the Responder to accept all positive offers. However, in laboratory experiments most Proposers offer close to an equal split, and most Responders reject offers of less than 30\%. See Guth, Schmittberger and Schwarze (1982) for the original experiment, and Thaler (1988) and Roth (1995) for an overview of ultimatum game experiments. ${ }^{2}$

There are several potential explanations for this deviation from subgame perfect behavior. Subjects may have an intrinsic preference for an equal split (Bolton, 1991; Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002, Stahl and Haruvy, 2002) or they may exhibit envy (Kirchsteiger, 1994). Social preferences may be influenced by culture (Roth et. al., 1991; Slonim and Roth, 1998), by the language in which the game is presented ${ }^{3}$, by the seemingly arbitrary assignment into roles, ${ }^{4}$ or by mood (Capra, 2004). The desire to be judged favorably can also trigger social norms. Even in double-blind experiments ${ }^{5}$, not all subjects may be convinced that the experimenters cannot judge them, and even if convinced, many subjects may believe in a divine being that is always observing and judging their behavior. Subjects may be inexperienced at backward induction in the ultimatum game (e.g. Binmore, et. al., 2002; Johnson, et. al., 2002) and may require learning to do better. Gale, Binmore and Samuelson (1995) argue that learning is especially difficult in the ultimatum game and that subgame perfection may be observed in the very long run (see also Roth and Erev, 1995). Jehiel (2005) proposed an analogy-based approach in which first movers discretize their own action space into analogy classes and offer the lower extreme point of the analogy class that would result in acceptance. The reader, undoubtedly, can add to this list.

[^1]In the current paper we show that a simple game-tree presentation of the ultimatum game without suggestive language such as "dividing a pie" results in substantially more behavior consistent with individualistic preferences and subgame perfection. There is other evidence that extensive-form representation can result in systematically different behavior (e.g., Cooper and Van Huyck, 2003; Deck, 2001; Schotter, Weigelt and Wilson, 1994). ${ }^{6}$

Related findings suggest that games described in terms of the complete set of contingent payoffs to all players may result in less other-regarding behavior. For example, research by Charness, Frechette and Kagel (2004) on the gift exchange shows drastically reduced reciprocal behavior when payoff tables listing both players' payoff for every wage-effort combination are given in addition to the description of the game and the explanation of the game.

The present work is the first to demonstrate that such a presentation effect can result in near subgame perfection in ultimatum bargaining. We describe and report on a series of experiments designed to examine the effect of presenting an ultimatum games as a game tree versus presenting it verbally. We also examine the behavioral effect of the potentially suggestive equal-split option.

Our results do not imply that the game-tree presentation is the only proper experimental design for the ultimatum game. Rather, since presentation definitely affects behavior, the proper design depends on the question being asked. If one is asking how well game theory predicts the behavior in the abstract ultimatum game, then it is vital that the experimenter induce the payoff structure of that game. Our results show that the game-tree presentation significantly reduces the influence of unintended social context. On the other hand, if one is asking how people behave in a socially rich context of dividing a pie that activates social norms and social judgments, then obviously a context-sparse game-tree presentation would be inappropriate.

## 2. Experiments and Results.

Six experiments were conducted at the University of Texas in a Unix computer laboratory. The subjects were third and fourth year undergraduate students and non-economics graduate students with no previous experience with this game. The actual instructions for each experiment are given in Appendices B-E.

The first experiment was a single-task design using the discrete ultimatum game tree shown in Figure 1, which was presented as a hard copy handout. The payoffs points give the percentage chance of winning $\$ 5$. Three sessions were run with 14,22 and 22 participants each.

[^2]Figure 1. The Discrete Ultimatum Game Tree


Each participant received $\$ 5$ to compensate the participant just for showing up. The binary lotteries provided an additional $\$ 0$ or $\$ 5$ for each participant. The second experiment replaced the binary-lottery payoff with an "exchange rate" of 5 cents per point. Thus, the monetary values of the potential offers were $(\$ 4, \$ 1),(\$ 3, \$ 2),(\$ 2, \$ 3)$, and $(\$ 1, \$ 4)$. Two sessions with exchange-rate payoffs were run with 20 and 24 participants each.

Figure 2. Choices by Treatment Aggregated Across Sessions.


The choices by session are given in Appendix A. Figure 2 is a bar chart of the distribution of Proposer choices and the distribution of Responder choices at node A (80:20) aggregated across all sessions of experiments $1 \& 2$. This aggregation is justified by the fact that the Fisher's Exact Test for the difference between the proportion of proposer choices with binary-lottery payoffs and with exchange-rate payoffs has a two-sided p-value of 1.00 (aggregating the B-D choices gives the same result). Similarly, for Responders, the largest treatment difference is for the responder choice following the 20:80 offer, with a p-value of 0.43 . The p-value for the 80:20 offer is 1.00 . Therefore, we cannot reject the hypothesis that the binary-lottery, relative to exchange-rate payoff, makes no significant difference in Proposer or Responder behavior. Summarizing experiments 1 and 2,69\% of Proposers chose the 80:20 branch, and only $4 \%$ of Responders rejected that offer. That $31 \%$ of Proposers made more generous offers does not imply other-regarding preferences, since every Proposer choice can be rationalized by some belief about the Responder. Hence, $96 \%$ of the observed behavior is consistent with individualistic preferences.

This behavior is sharply different from the usual behavior in ultimatum games, but the game is usually presented verbally without a tree ${ }^{7}$. To test whether the behavior in experiments 1 and 2 can be attributed to the tree presentation, we conducted two additional experiments using a typical verbal description without a tree.

The third experiment maintained the singe-task feature, and the exchange-rate payoff feature of the second experiment, but replaced the tree presentation with a typical verbal presentation. The key phrase was: "The First Mover will choose a proposal on how to divide 100 points between him or herself and the Second Mover." Three sessions were run with 18, 18 and 16 participants each. The fourth experiment was identical to the third except that instead of exchange-rate payoffs, the payoffs were given directly in dollar terms: (\$4, \$1), (\$3, \$2), (\$2, $\$ 3)$, and (\$1, \$4). ${ }^{8}$ Two sessions were run with 24 participants each.

Figure 2 displays the distribution of Proposer choices and the distribution of Responder choices at node A (80:20) aggregated across all sessions of experiments $3 \& 4$. This aggregation is justified by the fact that Fisher's Exact Test for the difference between the no-tree Proposer choices with exchange-rate payoffs versus dollar payoffs has a p-value of 0.76 . Further, aggregating the $\mathrm{B}, \mathrm{C}$ and D choices into one category, the Fisher's Exact Test has a p-value of

[^3]0.73. Similarly, for Responders, the largest difference is in the choice following the $80: 20$ branch, but it has a Fisher's Exact Test p-value of 0.41 . Therefore, we cannot reject the hypothesis that the exchange-rate payoff, relative to dollar payoff, in the no-tree treatment makes no significant difference in Proposer or Responder behavior. Summarizing experiments 3 and 4, $23 \%$ of Proposers chose the $80: 20$ branch, and $51 \%$ of Responders rejected that offer.

Comparing the aggregated tree treatments (experiments $1 \& 2$ ) with the aggregated notree verbal treatments (experiments $3 \& 4$ ), while $69 \%$ of Proposers chose the $80: 20$ offer in the tree treatments, only $23 \%$ chose the $80: 20$ offer in the no-tree treatments. This difference is quite apparent in Figure 2 and has a Fisher's Exact Test p-value $<10^{-5}$. While only $4 \%$ of Responders rejected the 80:20 offer in the tree treatments, $51 \%$ rejected in the no-tree treatments, with a Fisher's Exact Test p-value $<10^{-7}$. Therefore, we can strongly reject the hypothesis that the presentation treatment makes no significant difference in Proposer or Responder behavior.

Guth et al. (2001) found evidence that the presence of the equal-split option makes a difference in behavior. In particular, they concluded that fairness concerns may be less pronounced when splitting equally is not possible. ${ }^{9}$ To examine the effect of an equal-split option on the tree versus verbal presentation effects, two additional experiments were run, in which we replaced the 60:40 and 40:60 options with a single 50:50 option. Experiment 5 used the tree presentation of experiments 1 and 2, and experiment 6 used the verbal presentation of experiments 3 and 4. Experiment 5 entailed five sessions with 24, 20, 14, 24 and 20 subjects each, and experiment 6 entailed five sessions with 20, 14, 24, 24 and 22 subjects each. Both experiments used exchange-rate payoffs.

Figure 3 shows a bar chart of the distribution of 80:20 offers by Proposers and the distribution of Responder choices to that offer. For comparison purposes, experiments $1 \& 2$ and experiments $3 \& 4$ are also shown, but with the $\mathrm{B}, \mathrm{C}$ and D proposals lumped together.

[^4]Figure 3. Choice distributions in the experiments.


Under the tree format (experiments $1 \& 2$ versus experiment 5), while there was a higher proportion of egalitarian offers when a 50:50 option was available, the difference in proportions of A choices vs. non-A choices is not statistically significant at the 5\% significance level. Fisher's exact test for equal proportions gives a two-sided p-value of 0.16 , and a one-sided (due to prior findings by Guth et al. 2001) p-value of 0.08 . Similarly, there was higher proportion of Responder rejections of the "A" offer when a $50: 50$ option was available, and this difference has a two-sided Fisher's Exact Test p-value of 0.05. Nonetheless, the rejection rate is still below $20 \%$. Under the verbal format (experiments $3 \& 4$ versus experiment 6), the two-sided Fisher's Exact Test for Proposer and Responder choice proportion differences yielded p-value= 0.45 and $p$-value $=0.69$, respectively. Thus, it appears that the addition of the equal-split had no significant effect under the no-tree verbal treatment.

The differences between the tree versus the no-tree verbal treatments remain dramatic and significant. While $52.9 \%$ of Proposers chose the $80: 20$ branch in the tree treatments, only $15.4 \%$ chose the $80: 20$ offer in the no-tree treatment. The Fisher's Exact Test for this difference yields a p-value of $7 \times 10^{-5}$. While only $17.6 \%$ of Responders rejected the $80: 20$ offer in the tree treatments, $46.2 \%$ rejected in the no-tree treatment. The Fisher's Exact Test for this difference is yields a p-value of 0.003 . Therefore, we can strongly reject the hypothesis that the presentation treatment makes no significant difference in Proposer or Responder behavior even with an exactly equal-split option.

## 3. Discussion.

Our series of experiments demonstrate that when the discrete ultimatum bargaining game, without an exactly equal-split offer, is presented as an abstract game tree using no language
about "dividing" or "allocating" a pie, virtually all the behavior is consistent with individualistic preferences, and the vast majority of behavior is consistent with subgame perfection. Further, the standard ultimatum game results were replicated using the same game but with a standard verbal presentation instead of a tree. ${ }^{10}$ In addition, the equal-split option was shown to nudge behavior in the direction of a more egalitarian split, but the presentation effect remains significant. One might suggest an intermediate design in which a tree would be presented along with the standard non-neutral verbal description to see which one drives the result. We choose not to study this design because such a design could be sensitive to where the emphasis is placed in the instructions, both written and spoken, including tone of voice, position on the page, size, color, etc. However, we refer the interested reader to Bolton and Ockenfels (2005) who accompanied their tree presentation with a verbal description of the game as a "bargaining game" and the Responder branches were labeled Accept and Reject. They find no presentation effect in the ultimatum game between a tree-plus-verbal representation in a mini-ultimatum game and their past studies with verbal descriptions.

It is helpful to compare the behavior in our experiments with other experiments that have used similar discrete ultimatum games. The closest experiment to ours is by Falk, Fehr and Fischbacher (2003). They used a multi-task design with four discrete ultimatum-like games. In the game with feasible divisions of $(8,2)$ and $(5,5), 31 \%$ of the Proposers chose $(8,2)$, while $44 \%$ of the Responders rejected that offer. This contrasts with their game with feasible divisions of $(8,2)$ and $(2,8)$, in which $73 \%$ of Proposers chose $(8,2)$ while only $27 \%$ of Responders rejected that offer. Thus, the absence of an exactly equal-split option leads to more subgame perfect behavior. ${ }^{11}$ Note that our ultimatum game closely resembles the Falk et al. (2003) game, with $(8,2)$ and $(2,8)$ being the extreme points, but with two additional intermediate choices $(6$, $4)$ and $(4,6)$. While we found a similar proportion of selfish behavior on the part of Proposers ( $69 \%$ ), we found significantly less spiteful behavior on the part of Responders ( $4 \%$ vs. Falk et. al.'s $27 \%$ ). The difference could be attributed to the multi-task design used in their experiments, whereas we obtained our results in a single-task design. While Stahl and Haruvy (2005)

[^5]obtained mostly selfish behavior in a multi-task design ${ }^{12}$, Charness, Haruvy and Sonsino (2004) show that a multi-task design may result in more social behavior than standalone games.

Brandts and Sola (2001) also implemented a tree procedure in ultimatum bargaining games. In one game, where the feasible divisions were (80:20) and (25:75), $82 \%$ of proposers made offers of (80:20) and $33 \%$ of responders rejected that offer. In another game with feasible divisions of (80:20) and (50:50), $57 \%$ of proposers made the (80:20) offer and $17 \%$ of responders rejected. As in Falk et al. (2003), the equal split option appears to have made a difference, although not in the same direction for responders. The proposer offers appear to be in line with our results and those of Falk et al. (2003), although a bit on the high side, meaning that proposers appear even more selfish in their experiment. The responders, however, are more spiteful than ours. This could be attributed to the fact that subjects played each game repeatedly for eight rounds, although against different opponents each time ${ }^{13}$ as well to the small sample size ( 16 subjects per game).

An abstract ultimatum game in a laboratory experiment lacks the context of naturally occurring bargaining situations. There is no history that would explain where the pie came from, or legitimize the Proposer's first-mover advantage, nor the Responder's power to commit to a once-and-for-all rejection. In such a contextual vacuum, humans may attempt to recall past situations that resemble this setting and react to the slightest cues to fill in the blanks. Words such as "bargaining," "accept," "reject," "divide" or "allocate" or the presence of an exactly equal-split option could easily create a social context and activate social norms regarding distribution and equity, and participants in experiments may care about how they could be judged by those norms.

The Hoffman et al. (1994) study tested a "neutral" variation which had participants in the role of buyers and sellers engaging in exchange, where sellers made a take-it-or-leave-it offer to the buyer, and compared it to a "divide $\$ 10$ " framing. The framing was studied in a $2 \times 2$ factorial design with variation in entitlement framing. In the no entitlement conditions, the exchange framing resulted in a significant lowering of first mover offers, which is somewhat comparable to our result. However, in the entitlement conditions, the exchange framing made no significant

[^6]effect on first mover choice. Since the Hoffman et al. study did not use the strategy method, there is no way to determine what effect the exchange framing had on second movers' would-be rejections to low offers ${ }^{14}$. Larrick and Blount (1997) studied a relatively neutral social dilemma game with an ultimatum game structure. In that game, two players sequentially made a claim ${ }^{15}$ and each got her claim if the sum did not exceed the pie. They found that second movers were more willing to accept lower amounts, including a zero amount, than in the ultimatum game parallel. However, even in the social dilemma representation nearly half of second movers rejected offers greater than the minimum positive offer. They attributed the framing effect to the greater neutrality of the social dilemma game, particularly perceptions of control and responsibility and the perception of the acceptance-rejection as an expression of approval or disapproval.

Consistent with this conjecture, our results suggest that the verbal-framing of typical ultimatum game experiments introduces a social context which significantly distorts the expected utility payoffs from those assumed by the theory to be tested. In contrast, when the ultimatum game is presented as a game tree with no suggestive language, the vast majority of behavior is consistent with individualistic preferences and subgame perfection ${ }^{16}$.

Other research on framing effects in games may shed additional light on our results. For example, Dufwenberg, Gachter and Hennig-Schmidt (2006) delve deeper into the reasons for framing effects. They propose that such effects can be related to first- and second- order beliefs-- what people expect others to do, and what they believe others expect them to do-- which are influenced by the framing of the game. By altering the labels of the game (linear public good game) and the actions, they show drastic effects in not only actions, but also in first and second order beliefs, which they argue could influence actions through guilt-aversion and reciprocity. In the present ultimatum game framework, we did not extract beliefs, but this is an interesting direction for future research that could shed further light on why behavior is so different across framing treatments.

Finally, we are in no way suggesting that humans are not social or that socially motivated behavior is not economically relevant. Indeed, we applaud the efforts to discover how social

[^7]context and other framing features affect perceived payoffs. Nonetheless, any theory that purports to account for violations of individualistic preferences and subgame perfection must also be able to account for behavior in the settings explored in this work.

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## Appendix A.

Table 1. Choices by Treatment Aggregated Across Sessions.

|  |  | N | A | RA | B | RB | C | RC | D | RD |
| :--- | :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Single-task <br> Binary Lot. | 58 | 20 | 1 | 7 | 1 | 2 | 0 | 0 | 0 |
| 2 | Single-task <br> Exchange Rate | 44 | 15 | 1 | 3 | 0 | 3 | 0 | 1 | 1 |
| Totals for Exp 1 \& 2 | 102 | 35 | 2 | 10 | 1 | 5 | 0 | 1 | 1 |  |
| 3 | No_Tree <br> Exchange Rate | 52 | 5 | 12 | 12 | 2 | 9 | 0 | 0 | 3 |
| 4 | No_Tree <br> Monetary | $48^{17}$ | 6 | 14 | 8 | 2 | 8 | 0 | 0 | 2 |
| Totals for Exp. 3 \& 4 | 100 | 11 | 26 | 20 | 3 | 17 | 0 | 0 | 5 |  |
| 5 | Equal-Split <br> Tree | 102 | 27 | 9 | 23 | 1 | na | na | 1 | 2 |
| 6 | Equal-Split <br> Verbal | 104 | 8 | 24 | 42 | 1 | na | na | 2 | 3 |

[^8]

For experiments $5 \& 6$, "B" denotes the $50: 50$ offer rather than the $60: 40$ offer.

## APPENDIX B. Instructions for Participants (Tree Treatments)

WELCOME [Introduce self and helpers. Say how everyone was recruited."]
This is an experiment about economic decision making. If you follow the instructions carefully you might earn a considerable amount of money. This money will be paid at the end of the experiment in private and in cash. [Wave cash.]

This experiment will last about 1/2 hour. Everyone will receive $\$ 5$ for showing up for this experiment. Additional payments will depend on the decisions that you and other participants make in the experiment; how these payments will be determined will be explained in detail momentarily.

It is important that during the experiment you remain SILENT. If you have any questions, or need assistance of any kind, RAISE YOUR HAND but DO NOT SPEAK. One of the experiment administrators will come to you and you may whisper your question to him. If you talk, laugh, or exclaim out loud, you will be asked to leave and will not be paid. We expect and appreciate your cooperation.

You will be making choices using the computer mouse and keyboard. You may reposition the mouse pad so it is comfortable for you. Your mouse cursor should move when you slide the mouse on the pad. If not, please raise your hand. Do NOT click the mouse buttons or use the keypad until told to do so.
[The screen will be blank until everybody clicks on the begin button - but not yet.]
You will be making one decision, which will be described by a TREE and displayed on the overhead. I will now display an example of a Tree in order to explain what it means. Please look at the overhead while I describe the tree. CAUTION, this is an example and is NOT the Tree for any of your decision tasks.

A Tree consists of nodes and branches. The first (top) node and its branches are Red, while the second (lower) nodes and branches are Blue. Half of the participants in this room (12) will choose among the Red branches and we will call them "First Movers", and the other half of the participants will choose among the Blue branches and we will call them "Second Movers".


In the example Tree displayed, if you are the First Mover, you choose between A, B, and C. If you are the Second Mover, you make three distinct choices: one choice between LA and RA that will be carried out if and only if the First Mover chooses A; one choice between LB and RB that will be carried out if and only if the First Mover chooses; and one choice between LC and RC that will be carried out if and only if the First Mover chooses $C$.

Final payments will be determined as follows. The computer will randomly divide everyone into pairs: one member of each pair will be the First Mover and the other will be the Second Mover. The decisions of each matched pair will determine a unique path in the tree. For example, in the above tree suppose the First Mover chose A; and the Second Mover chose (LA, $R B, R C$ ), the unique path will consist of [show new slide with these branches highlighted]

the A branch, followed by the LA branch, ending in the box with the numbers (20, 35). In this case, the First Mover will receive 20 points and the Second Mover will receive 35 points. Note that the payoffs for the First Mover will always be shown first and in red, while the payoffs for the Second Mover will always be shown second and in blue.

On the other hand, if the Second Mover had chosen ( $R A, L B, R C$ ) the unique path would have been [show new slide with these branches highlighted]

branch A, followed by branch RA, ending in the box with numbers $(40,15)$ In this match, the First Mover would have received 40 points while the Second Mover received 15 points.


Then when matched with a First Mover, if that participant chose A, the path would be (A, LA), ending in $(20,35)$ for (First/Second Mover) respectively; if the First Mover chose B, the path would be $(B, R B)$, ending in $(90,75)$; and if the First Mover chose $C$, the path would be $(C, R C)$, ending in $(30,50)$. Notice that each of the three choices of the Second Mover is important, because A, B or $C$ could be chosen by the First Mover.

At the end of the experiment your point payoff will be converted to dollars in a lottery in which you can win $\$ 5$ or nothing, and the probability of winning is equal to your payoff; in other words, a payoff of 75 points will give you a $75 \%$ chance of winning $\$ 5$. Thus, the higher your payoff for each decision, the greater your chance of winning $\$ 5$. The lotteries for each participant will be separate and independent. That is, if you have a payoff of 75 points and the participant with whom you are paired has a payoff of 25 points, then you get the outcome of a lottery with a $75 \%$ chance of winning $\$ 5$, and the other participant gets the outcome of a separate and independent lottery with a $25 \%$ chance of winning $\$ 5$. [Recall that in addition you will receive $\$ 5$ for showing up.]
[For the monetary payoff treatment, the above paragraph was replaced by the following paragraph.] At the end of the experiment your point payoff will be converted into dollars at the rate of 5 cents per point; in other words, a payoff of 100 points will convert to $\$ 5.00$. [Recall that in addition you will receive $\$ 5$ for showing up.]

Your computer screen will tell you whether you are a First Mover or a Second Mover. Click on Pg Dn now.

You are now looking at the screen that will record your choices for the decision task. If you are a First Mover, there is one row of 4 buttons, labeled $A, B, C$ and D. To make a choice, click on one of these buttons. If you are a Second Mover, there are 4 rows of two buttons each. You must make a choice for each row by clicking on the button of your choice.

You will have 1.5 minutes in which to make your decisions. NO further instructions will be given. If during these 1.5 minutes you want to change a choice you have already made, simply click on a different button. The clock on your screen will display the time remaining. When the clock shows 0:00 and not before, the SUBMIT button will be active, and you should click on it to record your choices.
[Begin passing out hard copies, with a front cover that says DO NOT TURN PAGE UNTIL TOLD TO DO SO. Pause until all hard copies are passed out.]

Enter 555 in the password box at the top of your screen, and click on ENTER PASSWORD. [Pause] You may now turn the page of the handout and begin deciding how to make your choices. [At end], click the SUBMIT button if you have not already done so.

Your screen now displays the Results. Your record screen shows you,, your role, your choice, the choice distribution of the participant with whom you were paired, the number of points you received, and the computer generated random number that determines the lottery outcome. If the points you earned is greater than the random number, then you win $\$ 5$ for that decision; otherwise, $\$ 0$. Your $\$ 5$ show-up payment is added to the lottery outcome and printed at the bottom of this Result screen.
[Pass out the Post-Experiment Questionnaire and Receipt.] We are now passing out a questionnaire that will aid us in improving the design of this and other experiments. First, please fill in your Participant Number (which is at the top of your Screen), and fill in today's date. Also fill out the Receipt. If anyone anticipates earning more than $\$ 450$ in experiments like this over the next year, please raise your hand.

When we ask you to turn in the questionnaire and receipt, we will give you an envelope corresponding to your Participant Number; this envelope will contain your $\$ 5$ participation show-up payment + any other earnings (as indicated on your Record Screen).

Call each participant one at a time to receive their envelope.

## APPENDIX C. Instructions for Participants ("No_Tree" Treatment, Exchange-Rate Payoff)

WELCOME [Introduce self and helpers. Say how everyone was recruited."]
This is an experiment about economic decision making. If you follow the instructions carefully you might earn a considerable amount of money. This money will be paid at the end of the experiment in private and in cash. [Wave cash.]

This experiment will last about 20 minutes. Everyone will receive $\$ 5$ for showing up. Additional payments will depend on the decisions that you and other participants make in the experiment; how these payments will be determined will be explained in detail momentarily.

It is important that during the experiment you remain SILENT. If you have any questions, or need assistance of any kind, RAISE YOUR HAND but DO NOT SPEAK. One of the experiment administrators will come to you and you may whisper your question to him. If you talk, laugh, or exclaim out loud, you will be asked to leave and will not be paid. We expect and appreciate your cooperation.

You will be making choices using the computer mouse. You may reposition the mouse pad so it is comfortable for you. Please click on Pg Dn now. You are now looking at the screen that will record your choices. Beside you is a sheet with written instructions. Please turn over this sheet and follow along as I read these instructions.

The computer has divided everyone into pairs. You will not know with whom you are paired either during or after the experiment. Absolute anonymity and privacy will be maintained.

One member of each pair is designated the First Mover and the other is designated the Second Mover. The First Mover will choose a proposal on how to divide 100 points between him or herself and the Second Mover. A proposal is in the form of the amount offered to the Second Mover. At the end each point will be converted into cash at the rate of 5 cents per point.

If you are a First Mover, there is a line that reads "Your offer", followed by four radio buttons labeled 20, 40, 60 and 80, indicating the number of points you are offering to the Second Mover. To make a choice, click one of the buttons.
$\begin{array}{ll}\text { Your offer: } & \bigcirc 20 \\ \text { Your offer: } & \bigcirc 40 \\ \text { Your offer: } & \bigcirc 60 \\ \text { Your offer: } & \bigcirc 80 \\ \text { If you are a Second Mover, there are } 4 \text { rows, each with two buttons as follows: }\end{array}$
If the First Mover offers 20 points: $\bigcirc$ Accept $\bigcirc$ Reject
If the First Mover offers 40 points: ○ Accept $\bigcirc$ Reject
If the First Mover offers 60 points: $\bigcirc$ Accept $\bigcirc$ Reject
If the First Mover offers 80 points: $\bigcirc$ Accept $\bigcirc$ Reject

Whatever offer the First Mover makes,

- if the Second Mover accepts, then the Second Mover will receive the amount offered and the First Mover will receive 100 points minus the amount offered;
- if the Second Mover rejects, both will receive 0 points.

The Second Mover must choose to Accept or Reject for each of the four possible offers, before knowing which offer is actually made by the First Mover. In other words, you must click one of the buttons on each of the four rows.

At the end of the experiment, points will be converted into cash at the rate of 5 cents per point, and added to the $\$ 5$ for showing up.

You will have 1.5 minutes in which to make your choices. NO further instructions will be given. If during the 1.5 minutes you want to change a choice you have already made, simply click on a different button. The clock on your screen will display the time remaining. When the clock shows 0:00 and not before, the SUBMIT button will be active, and you should click on it to record your choices.

Enter 555 in the password box at the top of your screen, and click on ENTER PASSWORD. [Pause] [At end], click the SUBMIT button if you have not already done so.

Your screen now displays the Results. Your record screen shows you,, your role, your choice, the choice distribution of the participant with whom you were paired, and the number of extra dollars you will receive. Your total earnings are shown at the bottom and include your $\$ 5$ show-up payment.
[Pass out the Post-Experiment Questionnaire and Receipt.] We are now passing out a questionnaire that will aid us in improving the design of this and other experiments. First, please fill in your Participant Number (which is at the top of your Screen), and fill in today's date. Also fill out the Receipt. If anyone anticipates earning more than $\$ 450$ in experiments like this over the next year, please raise your hand.

## APPENDIX D. Instructions for Participants ("No_Tree" Treatment, Dollar Payoff)

WELCOME [Introduce self and helpers. Say how everyone was recruited."]
This is an experiment about economic decision making. If you follow the instructions carefully you might earn a considerable amount of money. This money will be paid at the end of the experiment in private and in cash. [Wave cash.]

This experiment will last about 20 minutes. Everyone will receive $\$ 5$ for showing up. Additional payments will depend on the decisions that you and other participants make in the experiment; how these payments will be determined will be explained in detail momentarily.

It is important that during the experiment you remain SILENT. If you have any questions, or need assistance of any kind, RAISE YOUR HAND but DO NOT SPEAK. One of the experiment administrators will come to you and you may whisper your question to him. If you talk, laugh, or exclaim out loud, you will be asked to leave and will not be paid. We expect and appreciate your cooperation.

You will be making choices using the computer mouse. You may reposition the mouse pad so it is comfortable for you. Please click on Pg Dn now. You are now looking at the screen that will record your choices. Beside you is a sheet with written instructions. Please turn over this sheet and follow along as I read these instructions.

The computer has divided everyone into pairs. You will not know with whom you are paired either during or after the experiment. Absolute anonymity and privacy will be maintained.

One member of each pair is designated the First Mover and the other is designated the Second Mover. The First Mover will choose a proposal on how to divide $\$ 5$ between him or herself and the Second Mover. A proposal is in the form of the amount offered to the Second Mover.

If you are a First Mover, there is a text box labeled "Your offer". To make a choice, click in the text box and type in your offer. Offers are limited to integer amounts from $\$ 1$ to $\$ 4$. [The computer will reject all entries except 1, 2, 3 or 4, and prompt for a correct entry.]


If you are a Second Mover, there are 4 rows, each with two buttons as follows:
If the First Mover offers $\$ 1$ : $\bigcirc$ Accept $\bigcirc$ Reject If the First Mover offers $\$ 2$ : $\bigcirc$ Accept $\bigcirc$ Reject If the First Mover offers $\$ 3$ : $\bigcirc$ Accept $\bigcirc$ Reject If the First Mover offers $\$ 4$ : $\bigcirc$ Accept $\bigcirc$ Reject

Whatever offer the First Mover makes,

- if the Second Mover accepts, then the Second Mover will receive the amount offered and the First Mover will receive $\$ 5$ minus the amount offered;
- if the Second Mover rejects, both will receive $\$ 0$ in additional payments. *

The Second Mover must choose to Accept or Reject each of the four possible offers, before knowing which offer is actually made by the First Mover. In other words, you must click one of the buttons on each of the four rows.

You will have 1 minute in which to make your choices. NO further instructions will be given. If during the 1 minute you want to change a choice you have already made, simply click on a different button. The clock on your screen will display the time remaining. When the clock shows 0:00 and not before, the SUBMIT button will be active, and you should click on it to record your choices.

Enter 555 in the password box at the top of your screen, and click on ENTER PASSWORD. [Pause] [At end], click the SUBMIT button if you have not already done so.

Your screen now displays the Results. Your record screen shows you,, your role, your choice, the choice distribution of the participant with whom you were paired, and the number of extra dollars you will receive. Your total earnings are shown at the bottom and include your $\$ 5$ show-up payment.
[Pass out the Post-Experiment Questionnaire and Receipt.] We are now passing out a questionnaire that will aid us in improving the design of this and other experiments. First, please fill in your Participant Number (which is at the top of your Screen), and fill in today's date. Also fill out the Receipt. If anyone anticipates earning more than $\$ 450$ in experiments like this over the next year, please raise your hand.

When we ask you to turn in the questionnaire and receipt, we will give you an envelope corresponding to your Participant Number; this envelope will contain your total earnings.

Call each participant one at a time to receive their envelope.

[^9]
# APPENDIX E. Instructions for Participants ("No_Tree" Treatment, Exchange-Rate Payoff) 

## WELCOME

[Introduce self and helpers. Say how everyone was recruited."]
This is an experiment about economic decision making. If you follow the instructions carefully you might earn a considerable amount of money. This money will be paid at the end of the experiment in private and in cash. [Wave cash.]

This experiment will last about 20 minutes. Everyone will receive $\$ 5$ for showing up. Additional payments will depend on the decisions that you and other participants make in the experiment; how these payments will be determined will be explained in detail momentarily.

It is important that during the experiment you remain SILENT. If you have any questions, or need assistance of any kind, RAISE YOUR HAND but DO NOT SPEAK. One of the experiment administrators will come to you and you may whisper your question to him. If you talk, laugh, or exclaim out loud, you will be asked to leave and will not be paid. We expect and appreciate your cooperation.

You will be making choices using the computer mouse. You may reposition the mouse pad so it is comfortable for you. Please click on Pg Dn now. You are now looking at the screen that will record your choices. Beside you is a sheet with written instructions. Please turn over this sheet and follow along as I read these instructions.

The computer has divided everyone into pairs. You will not know with whom you are paired either during or after the experiment. Absolute anonymity and privacy will be maintained.

One member of each pair is designated the First Mover and the other is designated the Second Mover. The First Mover will choose a proposal on how to divide 100 points between him or herself and the Second Mover. A proposal is in the form of the amount offered to the Second Mover. At the end each point will be converted into cash at the rate of 5 cents per point.

If you are a First Mover, there is a line that reads "Your offer", followed by four radio buttons labeled 20, 40, 60 and 80, indicating the number of points you are offering to the Second Mover. To make a choice, click one of the buttons.

Your offer: ○ 20
Your offer: $\bigcirc 40$
Your offer: $\bigcirc 60$
Your offer: $\bigcirc 80$
If you are a Second Mover, there are 4 rows, each with two buttons as follows:
If the First Mover offers 20 points: $\bigcirc$ Accept $\bigcirc$ Reject
If the First Mover offers 40 points: $\bigcirc$ Accept $\bigcirc$ Reject
If the First Mover offers 60 points: $\bigcirc$ Accept $\bigcirc$ Reject
If the First Mover offers 80 points: ○ Accept $\bigcirc$ Reject

Whatever offer the First Mover makes,

- if the Second Mover accepts, then the Second Mover will receive the amount offered and the First Mover will receive 100 points minus the amount offered;
- if the Second Mover rejects, both will receive 0 points.

The Second Mover must choose to Accept or Reject for each of the four possible offers, before knowing which offer is actually made by the First Mover. In other words, you must click one of the buttons on each of the four rows.

At the end of the experiment, points will be converted into cash at the rate of 5 cents per point, and added to the $\$ 5$ for showing up.

You will have 1.5 minutes in which to make your choices. NO further instructions will be given. If during the 1.5 minutes you want to change a choice you have already made, simply click on a different button. The clock on your screen will display the time remaining. When the clock shows 0:00 and not before, the SUBMIT button will be active, and you should click on it to record your choices.

Enter 555 in the password box at the top of your screen, and click on ENTER PASSWORD. [Pause] [At end], click the SUBMIT button if you have not already done so.

Your screen now displays the Results. Your record screen shows you,, your role, your choice, the choice distribution of the participant with whom you were paired, and the number of extra dollars you will receive. Your total earnings are shown at the bottom and include your $\$ 5$ show-up payment.
[Pass out the Post-Experiment Questionnaire and Receipt.] We are now passing out a questionnaire that will aid us in improving the design of this and other experiments. First, please fill in your Participant Number (which is at the top of your Screen), and fill in today's date. Also fill out the Receipt. If anyone anticipates earning more than $\$ 450$ in experiments like this over the next year, please raise your hand.

When we ask you to turn in the questionnaire and receipt, we will give you an envelope corresponding to your Participant Number; this envelope will contain your total earnings.


[^0]:    ${ }^{1}$ We are grateful to Gary Bolton, Colin Camerer, Jim Cox, David Cooper, Catherine Eckel, Dan Friedman, Al Roth, Larry Samuelson, and Vernon Smith for helpful comments.

[^1]:    ${ }^{2}$ Experiments with sequential bargaining, such as Rapoport, Erev and Zwick, 1995 and Zwick and Chen, 1999, find similar results-subjects behave in a manner consistent with a taste for fairness.
    ${ }^{3}$ For example, in the Binmore, Shaked and Sutton (1985) paper, the subjects were told "You will be doing us a favor if you simply set out to maximize your winnings."
    ${ }^{4}$ When adding a second stage (with subjects not being told until after the completion of the first stage), in which players reversed roles, Binmore, Shaked and Sutton (1985) found that the second stage (which is an ultimatum game) offers are in line with subgame perfection. Hoffman and Spitzer (1985) and Hoffman, McCabe, Shachat and Smith (1994) found that subjects who were told they had earned (by winning a simple game) the right to be the Proposer offered significantly smaller amounts.
    ${ }^{5}$ Bolton and Zwick (1995) report that double-blind anonymity raises equilibrium play from $30 \%$ to $46 \%$. They conclude this effect is small and explains only $23 \%$ of non-equilibrium play.

[^2]:    ${ }^{6}$ Consistent with our hypothesis, Schotter, Weigelt and Wilson (1994) find that subjects are far less susceptible to incredible threats in the extensive form relative to normal form representation of a particular $2 \times 2$ game.

[^3]:    ${ }^{7}$ When we refer to a pure tree format we allow for a verbal description of how to read tree payoffs but we do not allow any bargaining-related or division-related terms.
    ${ }^{8}$ Boles and Messick (1990, pp. 375-389) found that when responders physically saw dollar bills, low offers were accepted more readily. As such, there is a possibility that presenting payoffs as dollars can have an effect.

[^4]:    ${ }^{9}$ Brandts and Sola (2001) presented related evidence for what they termed "menu dependence." That is, the payoff associated with alternative outcomes in the ultimatum game presented "reference points" which affected utility and choice.

[^5]:    ${ }^{10}$ Deck (2001) found that a tree presentation of a simple trust game, without any verbal description of the game other than describing how to read the tree payoffs, resulted in second movers mostly behaving selfishly-in contrast to previously published results and in contrast to the normal form presentation studied in the same work. Cox and Deck (2005) find similar presentation effects.
    ${ }^{11}$ Guth, Huck and Muller (2001) reported similar effects for sequential play of a discrete ultimatum game in a single-task design. They also ran a small experiment using the strategy method for Responders and found similar results (although their small sample size limits the power of statistical tests).

[^6]:    ${ }^{12}$ Stahl and Haruvy (2003) conducted multi-task experiments in which one of the games was the discrete ultimatum game of Figure 1. Using a similar University of Texas subject pool, the observed behavior was not statistically significantly different from the tree treatments reported here. It could be that a multi-task design creates the perception of a "level playing field," which relieves the participants of responsibility for others since competition on a level playing field is commonly presumed to be fair a priori (Barron and Yechiam, 2002; Darley and Latane, 1968; Fleishman, 1980). However, experiments 1 and 2 in the present work demonstrate that the tree presentation rather than the multi-task design is the driving force.
    ${ }^{13}$ In most sessions and games, the number of rejections rose in the beginning and fell at the end, suggesting that if these games were one-shot, the result would have been different.

[^7]:    ${ }^{14}$ That is, since most offers were at or above $3 / 10$, one cannot determine if a responder would have rejected an offer of 1 or 2 . In our design, a responder states his entire strategy profile and so such determination can be made.
    ${ }^{15}$ Bardsley (2005) studied an expanded dictator game where dictators may claim some of their counterparts' endowments. He found that dictator game giving disappeared entirely and dictators began taking money instead of giving it.
    ${ }^{16}$ The few deviations from subgame perfect behavior in our setting are not inconsistent with purely selfish behavior. The Proposer deviations are easily rationalized by beliefs that Responders might be spiteful. The $4 \%$ of Responder deviations could be attributed to mistakes and are not unusual for laboratory experiments. .

[^8]:    ${ }^{17}$ Due to a computer network malfunction, two Proposer observations were lost; hence, there are 22 Proposer observations and 24 Responder observations.

[^9]:    * These amounts will be added to the $\$ 5$ for showing up.

