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Is fairness used instrumentally? Evidence from sequential bargaining

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Abstract

The equal split is a widely observed outcome in experimental studies of two-person bargaining. Until now only joint hypotheses that combine assumptions about preferences with equilibrium concepts have been used to explain the origin of the equal split. This paper reports an experiment that controls for the preferences of subjects and therefore sheds light on the social orientation of those proposers who make fair offers. The data suggest that fair offers are due to players with fair social orientations, but egoists use fairness instrumentally by increasing offers when they anticipate low offers will be rejected. When responding to offers, rather than principled fairmen defending the equal split, the data suggest that competitive individuals are responsible for most rejections.

PsycINFO classification: 3020
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1. Introduction

Experimental studies of two-person bargaining have demonstrated that modal agreements tend to be closer to an equal split than equilibrium concepts based on

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subgame perfection predict. [1] The data generated by these experiments shows that in the ultimatum game, for example, rather than making offers where proposers keep the entire experimental surplus minus the smallest unit of account, proposers offer distributions that are closer to an equal split of the surplus (Camerer & Thaler, 1995; Roth, 1995). Recent studies have yielded two competing theories to explain the modal 50–50 proposal. Gueth and Huck (1997), Kravitz and Gunto (1992) and Rabin (1993) distinguish between these two theories by noticing that the decision to make fair offers can be the result of two possible scenarios: (1) self-interested proposers make fair offers because they fear that uneven offers might be rejected and (2) proposers make fair offers simply because they are motivated by fairness concerns. We will refer to the former as the *expected utility hypothesis* and the latter as the *normative hypothesis*. [2]

Both theories developed to account for fair offers rely on assumptions about individual motivation without ever directly soliciting the preferences of bargainers. The expected utility theory assumes bargainers are individualistic and only value monetary payoffs. The normative theory assumes that bargainers are motivated by concerns for equity and will forgo monetary rewards when outcomes become discordant. To date only joint hypotheses combining assumptions about player preferences with analytically derived equilibria have been tested. Pretesting subjects to solicit their preferences would allow these hypothesis to be separated and would provide a controlled study of what proposer types (i.e. competitive, egoistic, fair and/or altruistic) make fair offers.

To this point, some efforts have been made to separate instrumental and fair-minded reasons for offering an equal split. For example, Forsythe, Horowitz, Savin, and Sefton (1994) and Hoffman, McCabe, Shachat, and Smith (1994) compare two populations of subjects. The first group plays the ultimatum game and the second plays a different game in which responders can not reject offers, i.e. the *dictator game*. In both cases, the authors report that proposers offer less, on average, in the dictator game. While this result supports the idea that egoists use fairness instrumentally to increase the likelihood of an offer being accepted, a stronger, more conclusive case can be made by (1) using a within subject design, [3]

[1] This result holds for a variety of bargaining institutions. See Hoffman and Spitzer (1982) for a study of Coase bargaining, Gueth and Tietz (1988), Ochs and Roth (1989), and Spiegel, Currie, Sonnenschein, and Sen (1990) for studies of sequential bargaining and for a review of the experiments using the ultimatum game institution see Camerer and Thaler (1995) or Roth (1995).

[2] We call the first the expected utility hypothesis because it assumes that agents are self-interested and have some sense of the probability of being paired with someone who rejects smaller offers. Further, assuming that money can be used as a proxy for utility, according to this hypothesis agents make offers with the highest expected value (utility).

[3] As suggested by a referee, our pretesting approach might be extended to out-of-sample designs if social preferences can be predicted by observable demographics. We do not collect enough demographic variables to test this idea, however, our data suggest that, in the absence of other controls, a participant's sex does not predict his or her social preferences.

and (2) using a pretest that provides more information about participant preferences. [4]

The research reported on here was designed to elicit social preferences and to systematically differentiate between the two theories of fair offers. In accordance with the suggestion made in Hoffman, McCabe, and Smith (1996), the first segment of the experiment utilizes a method developed by social psychologists to facilitate the revelation of subjects preferences over final payoff allocations. The data collected on preferences allows bargainers to be categorized by type as either competitive, egoistic, cooperative, or altruistic, prior to bargaining. Another advantage of using the current method to asses social preferences is that, compared to the dictator game which provides only one observation per participant, the current method accumulates 24 observations and generates a measure of the consistency of each participant's overall orientation.

The second segment of the experiment is a study of repeated sequential bargaining using the same subjects who earlier revealed information about their preferences. Combining the data on subject preferences with data on proposals facilitates separating the two theories of fair offers by controlling for participants social preferences.

An overview of the results suggests that egoists mimic cooperators when it is costly to be perceived as greedy but explore more aggressive offers when they expect that low offers might be accepted. Also, rather than confirming the standard theory of sharing norms that states that proposers offer half because they fear rejections by principled fairmen who make fair proposals and reject unfair proposals, we find that most rejections come from competitive and egoistic bargainers. The latter result suggests rethinking how sharing norms are supported. Specifically, the current data suggest that sharing norms are supported as a by-product of competitive agents who tend to leave money on the table rather than lose relative standing.

2. Experimental design

Subjects were given 5 dollars for being on time and were each led to a private computer terminal as they arrived to prevent pre-experiment conversation. Both segments of the experiment (preference elicitation and bargaining) were conducted one after the other. Each session took approximately 90 minutes including instructions and payment. A total of 120 undergraduate students (who maintained the same role for the duration of the experiment) participated and earned, on average, $20.16. Subjects were paid for both segments and for all periods.

Segment one of the experiment measured subjects social value orientation with respect to outcomes for themselves and another anonymous participant. At the

[4] Other researchers have used the dictator game to control for altruistic predispositions when analyzing trusting behavior. Examples include Castillo and Carter (2002) and Cox (2002). In the area of bargaining, Charness (2000) uses the dictator game to classify participants as either generous or not and then shows that, under certain circumstance, when participants have this information about their partners the efficiency of bargaining increases.

end of the value orientation exercise, subjects were asked to predict how similar the responses of the other subjects participating in their session were to their own responses. These expectations give us an idea of the behavior each subject anticipated encountering in the bargaining segment of the experiment. Segment two was a repeated sequential bargaining experiment that gave subjects experience in both a two-round alternating offer game similar to the institution used by Binmore, Shaked, and Sutton (1985) and Neelin, Sonnenschein, and Spiegel (1988) and the subgame of the two-round game. [5]

2.1. Preference revelation

The ring test is an exercise that has been designed by social psychologists to assess the *value orientation* of individuals along a spectrum from altruistic to competitive. [6] In this segment subjects were asked to make binary choices between 24 (own, other) combinations of payoffs. Subjects were told that each (own, other) combination allocates an amount of experimental francs between them and another subject in the room who is anonymous. Further, they were told that the sum of the francs they choose to allocate to themselves, in addition to the francs allocated to them by their partner would be translated into a dollar payoff that they would receive in privacy at the end of the experiment (i.e. after the second segment). In this exercise subjects were paired in threes so that one person's other payments went to a second person whose other payments went to the third (not back to person one). This was done to prevent any reason to act preemptively (i.e. participants might decide to be egoistic if they suspected that their partners were).

The sum to be allocated is not constant over combinations of own and other payoffs. The 24 pairs of outcomes lie evenly spaced on a circle with radius 15 francs. [7] The center of the circle is the origin of the two-dimensional space where the horizontal axis counts own francs and the vertical axis counts other francs. In other words, $(\text{own})^2 + (\text{other})^2 = 15^2$ is the correspondence from which the outcome pairs are chosen. Each decision, made sequentially, requires the subject to choose between adjacent allocations on this circle. For example, one decision is between (10.6 francs for you and 10.6 francs for other) versus (13 francs for you and 7.5 francs for other).

The data collected from the 24 responses generate a *motivational vector* for each participant. This vector is calculated by adding all the responses to the pairs posed. The vector is then mapped back onto the original circle and is used to characterize the subject into one of four categories. Fig. 1 shows the value orientation circle di-

[5] The instructions for the first segment follow Offerman, Sonnemans, and Schram (1996) and the instructions for the second segment follow Neelin et al. (1988). The only differences were the addition of instructions in the use of the software.

[6] This method has been used recently in a public goods experiment Offerman et al. (1996), and was developed and first used in Griesinger and Livingston (1973), Liebrand (1984) and McClintock and Liebrand (1988).

[7] The currency for the entire experiment was experimental francs. Subjects were informed of the exchange rate between francs and dollars ($1 = 5F) before the value orientation experiment began.

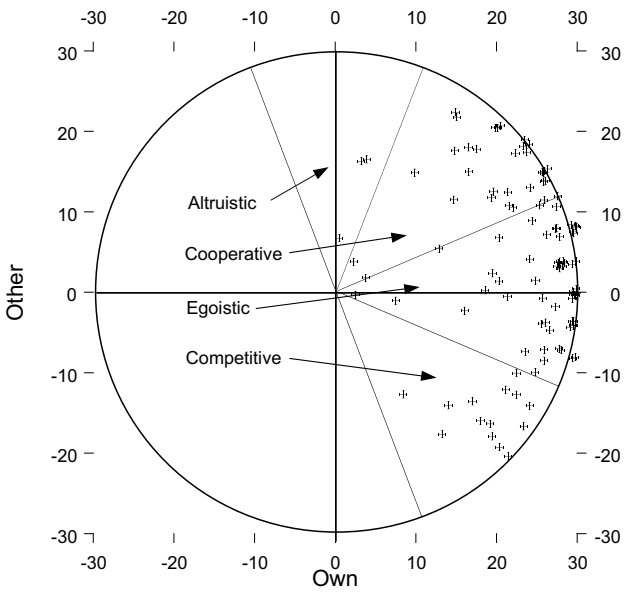

Fig. 1. Social value orientation circle.
(*Note:* Altruists lie between 112.5° and 67.5°, cooperators between 67.5° and 22.5°, egoists between 22.5° and −22.5°, and competitors between −22.5° and −67.5°. Observations have been jittered to reveal those observations that lie on top of each other.)

vided into the four classifications, from most prosocial to least: altruistic, cooperative, egoistic and competitive. [8]

The length of the motivation vector is a measure of the consistency of each subject's series of choices. If, for example, an individual's motivation vector was calculated to be $(15, 0)$ and if when the individual was asked to choose between the combinations $(3.9, 14.5)$ and $(7.5, 13)$ the subject chose $(7.5, 13)$, then the individual would have made a consistent choice because in Fig. 1 $(7.5, 13)$ is closer to $(15, 0)$ than $(3.9, 14.5)$ is. Subjects who choose randomly are expected to have short motivation vectors. If a subject's behavior is completely consistent the resulting vector would have length twice the circle radius (see footnote 8 for an example). For the

[8] Because participants choose outcomes in both gain and loss space, allocations tend to cancel each other out when creating the motivation vector. For example, if a participant is a consistent egoist, i.e. she only seeks to maximize her own payoff, when making her 24 choices she would always pick the allocation closest to the $(15, 0)$ outcome. In the end, she would have chosen the $(15, 0)$ allocation twice (once when comparing $(15, 0)$ to $(14.5, 3.9)$ and once when compared against $(14.5, -3.9)$), she would have never chosen the $(-15, 0)$ allocation, and all the other allocations would cancel with the allocations directly across the circle from them. This leaves the participant with a motivation vector of $(15, 0) + (15, 0)$ or $(30, 0)$. The angle of one's motivation vector is just the inverse tangent of the ratio other/own calculated from one's motivation vector. For classification purposes, social psychologist have settled on the following convention: motivational vectors that fall in the range 112.5°–67.5° are classified as altruistic, between 67.5 and 22.5 as cooperative, between 22.5 and −22.5 as egoistic, and between −22.5 and −67.5 as competitive.

purposes of the analysis to follow, consistency will be measured as each subject's vector length as a fraction of the maximal length.

2.2. The bargaining environment

Table 1 summarizes the repeated sequential bargaining environment that subjects interacted in. The bargaining design is similar to the design used in Harrison and McCabe (1992) to examine the effect of coordinated expectations about subgame play on first round offers in sequential bargaining games.

Subjects were randomly assigned to a role as either player one or player two. There were 10 periods of bargaining. All odd periods consisted of a one-round ultimatum game and all even periods were two-round shrinking pie games. Specifically, in periods 1, 3, 5, 7, 9 player two was asked to propose a division of the experimental surplus 10δ where $0 < \delta < 1$. Once this choice was made, player one then chose to either accept or reject the offer. If the offer was accepted, player one would receive the proposed amount X and player two would receive $10\delta - X$. If the offer was rejected, both players received zero for the period.

In periods 2, 4, 6, 8, 10 it was player one's turn to make an offer. In even periods the size of the pie was initially 10 experimental francs. If player two accepted player one's offer, the division of the surplus was implemented (X for player two and $10 - X$ for player one) and the bargainers moved to the next period. However, if player one's round one offer was rejected, the interaction moved to round two – the subgame – and the size of the pie shrank to 10δ. Here, the subgame was identical to the game played in odd periods with player two making an ultimatum offer to player one. To make sure that subjects understood the structure of the interaction, they were given a worksheet to record offers sent, received, and responses made for each period. The worksheet clearly laid out the structure of bargaining to reinforce the consequences of moving to the subgame and the consequences of rejecting an offer in the subgame.

The subgame perfect equilibrium (SGP) for the bargaining environment is calculated with the help of Table 1. Start with the subgame played in each odd period. Assuming agents with egoistic preferences who only consider their own payoffs, are locally nonsatiated in monetary gains, and have common expectations that everyone else has egoistic preferences, the SGP outcome is where player two offers player one the smallest unit of account, ε, and player one accepts because ε is better than nothing. This is true for each odd period and thus forms the expectation of

Table 1
Game structure and subgame perfect outcomes

Period	Round	Pie size	Payoff if offer X is accepted		Subgame perfect outcomes	
			Player 1	Player 2	Player 1	Player 2
Odd	1	10δ	X	$10\delta - X$	ε	$10\delta - \varepsilon$
Even	1	10	$10 - X$	X	$(1-\delta)10$	10δ
	2	10δ	X	$10\delta - X$	ε	$10\delta - \varepsilon$

what is likely to occur if bargaining in even periods goes to the subgame. Given this expectation about subgame play, in even periods player one does best by offering player two what he or she is expected to receive if bargaining moves to the second round, namely 10δ. [9] Faced with this offer, player two accepts as she cannot possibly do better by rejecting and forcing the interaction to round 2. This scenario is predicted to occur in each period of the game, regardless of how subjects are matched. [10]

The bargaining environment was constructed this way for three reasons. To begin with, stationary replication is valuable because it allows subjects to adjust to and possibly consider the strategic aspects of the environment, whereas the results of one-shot bargaining might be inconsistent with subjects fully understanding the incentive structure (Gale, Binmore, & Samuleson, 1995). Also, stationary replication in the one-round subgame and the two-round game facilitates studying the behavior of bargainer types (as categorized by value orientation) over time. Lastly, given repeated interaction, as in Harrison and McCabe (1992) one might expect that pairs of subjects who always agree in the first round of a sequential game lack experience in the subgame and therefore have no way to update their expectations about what they will receive if the game moves to the second round. With this in mind, the current design forces players through the subgame to determine whether the various bargainer types use this experience differently to form expectations that, in turn, influence their proposing strategies.

2.3. Treatments

We manipulated two treatment variables within the design, the discount factor for the bargaining game, δ, and the rule that matched bargainers at the beginning of each period. For half of the 12 sessions the discount factor was 0.25 favoring player one and for the other half the discount factor was 0.75 favoring player two (see Table 1). Also for half the sessions subjects bargained with the same partner for all 10 periods and for the other half, they were randomly rematched at the beginning of each period. The matching rule was explicitly mentioned in the instructions of the bargaining segment. These two treatment variables constitute a 2 by 2 factorial design. Three sessions (with either 10 or 12 participants) were run for each of the four cells. The twelve sessions yielded 17 bargaining observations per period in the ($\delta = 0.25$, random) and ($\delta = 0.75$, same) treatments, 12 observations in the ($\delta = 0.25$, same) treatment and 15 observations in the ($\delta = 0.75$, random) treatment.

The discount factor was varied to investigate how sensitive different bargainer types are to the cost of rejecting an offer in round one of the even periods. Notice that as δ decreases the implied cost of rejecting an offer and moving to round two

[9] Here we assume that player one offers 10δ rather than $10\delta - \varepsilon$ because the former just makes player two indifferent between accepting and forcing player one into the subgame. If players randomize when indifferent, player one clearly does better by adding ε to her offer.

[10] Notice that even repeated bargaining between players paired with each other for the duration of the game cannot support any other Nash equilibrium without the use of the type of incredible threats that are precluded by subgame perfection.

increases. This cost is measured by the expected payoff to player two from ending up in the subgame which is increasing in δ. Although the assumption of egoistic preferences and common knowledge precludes the possibility of rejections in equilibrium, in practice they occur but should happen less frequently when the cost associated with rejecting increases. The matching rule was used as a treatment to investigate whether, despite the SGP prediction, repeated interaction with the same partner can sustain a sharing norm.

3. Experimental results

3.1. Value orientations

The value orientation segment of the experiment typically took less than half an hour from the time subjects were seated to the time they finished submitting their estimates about the preferences of the group they were to bargain with. Overall, of the 120 subjects who participated 3 were classified as altruistic (2%), 33 were classified as cooperative (26%), 71 were classified as egoistic (59%) and 14 were classified as competitive (12%). [11] The third and sixth columns of data in Table 2 present the population distribution of types by treatment. [12] As noted in Table 2, the average consistency of the choices of participants across treatments is similar and confirms that, as seen in Offerman et al. (1996), paying participants based on their choices raises the level of consistency over the 76% and 80% found in Liebrand (1984).

One might worry about misclassification due to unobserved errors in the value orientation, especially when the value orientation is used to predict bargaining behavior. Superimposed on Fig. 1 are the final motivation vectors of all our participants. Notice that most of the observations are well within the boundaries of a given classification, but a nontrivial number are close to a boundary between classifications. This means that if participants near a boundary make even small errors, they might be misclassified. To asses the magnitude of this problem and correct for it, after we present summary statistics on behavior by value orientation category, we regress behavior on both value orientation type and the motivation vector angle. Not only is the vector angle not subject to misclassification, it is a more precise measure of social orientation.

At the end of the value orientation experiment subjects were asked to estimate how many other subjects responded to the value orientation the same way that they did. Note that gathering this information is necessary for a complete test of the expected utility explanation of fair offers because egoists are thought to decide on a strategy that will maximize their payoff and to do so they must form expectations

[11] This population distribution loosely matches the results of Offerman et al. (1996) who find no altruists, 27% cooperators, 65% egoists and 4% competitors.

[12] Pair-wise tests of the distribution of types (as classified by value orientation final vector angle) show that the allocation of types across treatments does not differ (Kolmogorov–Smirnov tests where the lowest p-value, 0.1333, occurs in the same, $\delta = 0.25$ versus same, $\delta = 0.75$ comparison). Hence, we achieved random assignment to our treatments.

Table 2
Summary of fair offers and rejections by value orientation category

VO type	$\delta = 0.25$			$\delta = 0.75$		
	% of offers $\geqslant$ half	% of rejections	% of population	% of offers $\geqslant$ half	% of rejections	% of population
Same						
Competitor	5	30	13	2	18	9
Egoist	66	50	58	77	72	74
Cooperator	26	20	25	21	10	17
Altruist	3	0	4	0	0	0
Random						
Competitor	14	38	19	8	22	13
Egoist	58	38	47	48	61	57
Cooperator	28	24	34	36	13	27
Altruist	0	0	0	8	4	3

Note: The average consistency of value orientation choices is 85% for ($\delta = 0.25$, same), 92% for ($\delta = 0.75$, same), 86% for ($\delta = 0.25$, random), and 85% for ($\delta = 0.75$, random).

about who they will bargain with. To gather this information, subjects were asked for a cumulative distribution of how representative they felt they were. [13] Subjects were asked three questions: Of the other subjects participating today, how many do you think answered 8 or fewer, between 9 and 16, and between 17 and 24 questions the same way that you did?

The average response across all treatments was that 27% of the other participants were approximately 1/3 similar, 35% were 2/3 similar and 38% were very similar to the average respondent. This demonstrates that overall, subjects felt that they were representative of the population and therefore, subjects must have expected to meet someone with a similar social orientation in the bargaining segment. The phenomenon that subjects project their view of the world as being representative of the population as a whole is not particular to this experiment and has also been documented in the social dilemma experiments reported on in Dawes and Orbell (1995).

3.2. Proposals

The first thing to notice about proposer behavior in the bargaining segment is the stability of the time path of average offers around an equal split of the surplus for each treatment (pooling VO types). Figs. 2 and 3 present the time paths for average offers in both the first round of the two-round game played in even periods (Fig. 2)

[13] Subjects earnings were not influenced by this portion of the experiment and therefore it might be argued that their responses were not incentive compatible. However, two arguments supported not paying subjects for this exercise. First, presenting subjects with a complicated scoring rule and taking the time to explain it may confuse them more than insure incentive compatibility. Secondly, placing the exercise in the middle of the experiment insures that, at a minimum, the exercise was taken seriously. The second argument was confirmed by the amount of time subjects spent on this portion of the experiment which was considerably more than would be expected if people answered randomly.

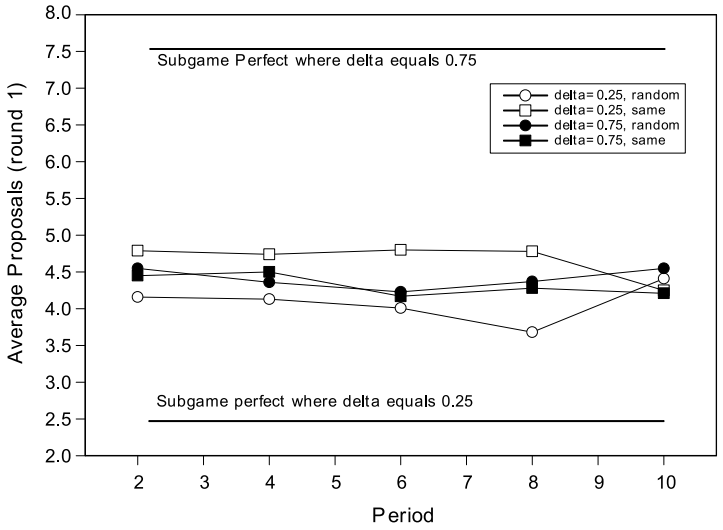

Fig. 2. Average proposals in the first round of the two-round game.

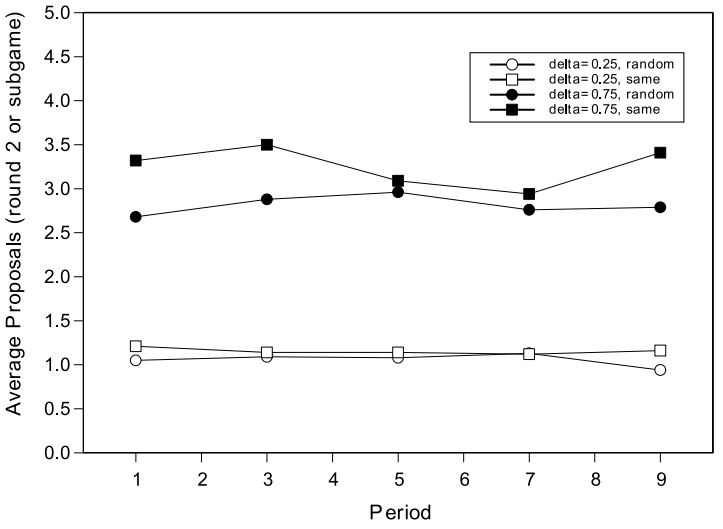

Fig. 3. Average proposals in the second round of the two-round game or in the ultimatum subgame.

and the average offers made in the ultimatum games played in odd periods (Fig. 3). [14] As discussed elsewhere (Carpenter, 2002), one might explain this phenomenon by

[14] *t*-tests show no difference between first period offers and last period offers for any treatment. Further, as we will see, including the time period as a regressor in Table 3 adds nothing to the analysis.

Table 3
The determinants of fair offers (dependant variable = fraction of the pie offered in round one)

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Intercept	0.42***	0.45***	0.41***	0.43***	0.39***	0.42***	0.39***	0.41***
	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)
Altruist	0.13**		0.14**		0.13**		0.13**	
	(0.06)		(0.06)		(0.06)		(0.06)	
Cooperator	0.05*		0.05**		0.05*		0.04*	
	(0.02)		(0.02)		(0.02)		(0.02)	
Egoist	0.03		0.13***		0.12***		0.12***	
	(0.02)		(0.04)		(0.04)		(0.04)	
Angle		0.001***		0.001***		0.001***		0.001***
		(0.0003)		(0.0003)		(0.0003)		(0.0003)
Consistency	−0.03	−0.03	−0.01	0.06	−0.01	0.05	−0.01	0.06
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
ExpectEgo			−0.14***		−0.13***		−0.13***	
			(0.05)		(0.05)		(0.05)	
ExpectOwn				−0.004***		−0.003***		−0.003***
				(0.001)		(0.001)		(0.001)
S25					0.05***	0.05**	0.05***	0.05**
					(0.02)	(0.02)	(0.02)	(0.02)
S75					0.03	0.03	0.03	0.03
					(0.02)	(0.02)	(0.02)	(0.02)
R25					0.01	0.01	0.01	0.01
					(0.02)	(0.02)	(0.02)	(0.02)
Sex							0.01	0.01
							(0.02)	(0.02)
Role							0.01	0.01
							(0.01)	(0.01)
Period							−0.002	−0.002
							(0.002)	(0.002)
R^2	0.04	0.04	0.06	0.06	0.08	0.09	0.09	0.09
N	600	600	600	600	600	600	600	600

Notes: All regressions include individual random effects. * – 90% level, ** – 95% level, and *** – 99% level.

positing that expectations are formed in the initial ultimatum game played in period one about what a proposer and a responder are likely to receive in future periods. Further, rather than forming expectations over absolute payoffs, subjects seem to use the first period ultimatum game to form expectations over relative outcomes. Specifically, player one anticipates that by ending up in the subgame after a rejection by player two, they will receive 45% of the pie and therefore demands 55% in the first round. This interpretation is supported by Fig. 4 which pools round one offers across the two player roles and translates the offers into relative terms. This shows that offers are on average consistently close to 45%.

The second thing to note is the distance between the subgame perfect predictions for each value of δ and average behavior. The null hypothesis that first round offers pooled across even periods and ultimatum offers in odd periods are equal to

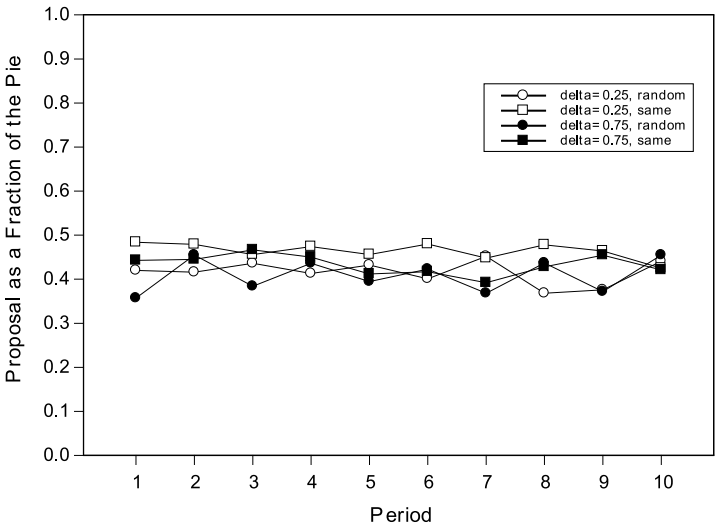

Fig. 4. Average proposals as a fraction of the pie in all periods.

the subgame perfect prediction is rejected at any conventional significance level. [15] These results support the idea that subjects in this environment disregard purely strategic incentives and use the first period subgame to coordinate expectations about what they will receive in later periods.

As for the two treatment variables, the matching rule seems to matter, but the effect of the discount factor seems contradictory. Return to Figs. 2 and 3 to see the effect of the matching rule. Fig. 2 shows that the two treatments where subjects were permanently matched are on par with or exhibit higher absolute offers in the first round of even periods than their random matching counterparts. This pattern persists until all the treatments converge on offers of 4.5 francs in period 10. Fig. 3 demonstrates the same effect of the matching rule on the offers made in odd periods. These results demonstrate that repeated interaction contributes to sharing norms. [16]

The impact of varying the discount factor is a different story. A second look at Fig. 2 reveals that the time path of (same, $\delta = 0.75$) is always below (same, $\delta = 0.25$), however (random, $\delta = 0.75$) is always above (random, $\delta = 0.25$). Therefore, the effect of the discount factor is inconsistent. This result is confirmed statis-

[15] For example, using the treatment ($\delta = 0.25$, same), the null hypothesis that the average first round offer equaled 2.5 was tested using the Wilcoxon signed ranks test against the alternative that it was not equal to 2.5. The null was rejected ($z = 7.96$, $p < 0.01$). This case is representative of all treatments.

[16] However these results need to be tempered by the results of the Wilcoxon rank sum tests which considers the full distribution of offers. The strongest effect of the matching rule is in the $\delta = 0.25$ case. Here the test statistic for odd periods is ($z = -3.47$, $p < 0.01$) and for even periods ($z = -4.12$, $p < 0.01$). The effect weakens for the $\delta = 0.75$ treatment however. Here the statistic for odd periods is ($z = -1.91$, $p = 0.05$) and for even periods ($z = 0.48$, $p = 0.63$). The dampening of the matching treatment effect for the $\delta = 0.75$ case is attributed to higher variance in the behavior in this treatment.

tically by the fact that for both matching rules, the null hypothesis that the first round offers are drawn from the same sample cannot be rejected (Kolmogorov–Smirnov two-tailed test). [17] These facts support the idea that strategic incentives are displaced by the 45/55 rule established early in bargaining.

Our proposal results largely replicate other sequential bargaining experiments. For example, Ochs and Roth (1989) design an experiment in which δ is either 0.40 or 0.60 and find that offers converge on the subgame perfect prediction in only one of the eight treatments. In the other seven treatments the time path of proposals generally hover just below the equal split (i.e. near the 45% convention we find) and in all eight treatments offers are typically within two standard errors of the equal split from the start of the game. Similarly, Gueth and Tietz (1990) find that none of the structural factors (i.e. size of the pie, δ, experience, or procedures) have a statistically significant influence on proposals.

3.3. Value orientations and proposing behavior

Comparing the first numerical column of Table 2 to the third and the fourth to the sixth allows one to see the fraction of fair offers made by each value orientation type compared to how representative the type was in the population. If we take as the counterfactual that each type is equally likely to make a fair offer, we would, for example, expect competitors to account for 13% of the fair offers in the $\delta = 0.25$, same treatment. In fact, we see that in each treatment competitors make fewer fair offers than would be expected given their numbers, and the other types make fair offers roughly in proportion to their shares of the population.

We see that competitors are less fair regardless of the treatment. At the same time, egoists seem to react to the value of the discount factor. When the pie shrinks less (i.e. $\delta = 0.75$) egoists make relatively fewer fair offers. Further, in the $\delta = 0.75$, random treatment, both egoists and competitors generate fewer fair offers than might be expected. When the cost of having an offer rejected is low (i.e. δ is large) and the chance of bargaining with the same person again is low (i.e. so reputations do not matter) egoists make fewer fair offers.

To be more rigorous in our hypothesis testing, we will discuss the results of a regression analysis of the data. [18] Eight regressions are reported in Table 3 using various combinations of explanatory variables, most of which are self-explanatory, however we will briefly describe each regressor. *Other* and *Own* are just the raw value orientation scores given to each individual at the end of stage one (see Fig. 1). Recall, as Own increases from zero to a maximum of thirty, the proposer becomes more egoistic, and as Other increases within the same bounds, the proposer becomes more altruistic. The variables *Altruist*, *Cooperator*, and *Egoist* are dummy variables that

[17] Here the test statistics are: for the comparison of same pairing, δ from 0.25 to 0.75 (ks = 0.1542, $p = 0.32$) and for the comparison of random pairing, δ from 0.25 to 0.75 (ks = 0.2196, $p = 0.03$). The latter is significant only at the 95% level.

[18] We treat the data as a panel by adding the time period as an explanatory variable and by using random effects to control for individual heterogeneity.

indicate a participant's value orientation (hence, competitor behavior is the baseline). *Angle* is the angle generated from a participant's motivation vector, and *Consistency* is measured as a participant's motivation vector length as a fraction of the maximum vector length.

The variable *Expect* is created from the data gathered at the end of stage one. This variable measures how representative the proposer feels his or her preferences are with respect to the population of other subjects. Expect for proposer i is created by calculating what we call the *expected likeness* of the population for the proposer which is just,

$$\text{Expect}_i = \sum_{j=1}^{3} (p_{ij}) \frac{j}{3}$$

where p_{ij} is the fraction of people reported to be either one-third like the proposer (p_{i1}), two-thirds like the proposer (p_{i2}), or exactly like the proposer (p_{i3}). This means that Expect is bounded from below by $1/3$ and from above by 1. Those proposers with Expect values near $1/3$ do not feel representative of the population and those with Expect values near one think everyone has the same social preferences that they do.

S25, *S75*, and *R25* are dummy variables to account for the effect of the treatment variables (e.g. S25 means same pairing, $\delta = 0.25$). The variable *Sex* is an attempt to control for any differences between the inherent bargaining strategies of men versus women (Sex equals one for women), and *Role* is a dummy variable that takes the value one when the proposer is player one and zero when the proposer is player two. Lastly, *Period* ranges from one to five and accounts for learning, experience, or any other residual effects of stationary replication.

There are two sets of regressions. One set, a, accounts for participant value orientations using dummy variables for the categories. The second set, b, controls for any misclassification by substituting the angle of the motivation vector for each decision maker. Regressions one and two are simple tests of the two hypotheses concerning proposals. We see from equation 1a that the proposer's categorization does explain behavior when controlling for the norm established of proposing approximately 45% of the pie (i.e. the intercept value). Compared to competitors, egoists offer $3/100$ more of the pie, cooperators offer $4/100$ more, altruists offer $13/100$ more, and the last two differences are significant. This results supports the normative hypothesis – fair offers come from cooperative and altruistic proposers and *nearly* fair offers come from egoists. Lastly, as we will see throughout our analysis, the consistency of player's value orientation choices does not seem to affect bargaining behavior.

Although equation 1a provides us with an answer to who makes fair offers, we will now test whether a weaker version of the expected utility hypothesis holds. In particular, although egoists do not make exactly fair offers, they may still use fairness instrumentally. A weaker version of the expected utility hypothesis states that egoists increase offers to maximize expected gains conditioned on their expectations of the bargaining environment (i.e. the distribution of types in the population).

The expected utility hypothesis suggests that egoists only propose fair offers if they anticipate being matched with a bargainer who rejects unfair offers. Altruists and cooperators, on the other hand, make fair offer to everyone. To account for the use of expectations by egoists, we interact our Egoist dummy with the expectations captured by the Expect variable. This yields the variable *ExpectEgo*. Equation 2a illustrates the instrumental use of fairness by egoists. [19] After accounting for the expectations of egoists, altruists and cooperators continue to make significantly higher offers than competitors. Interestingly, the net effect of being an egoist on offers is positive for egoists who do not think they are representative (i.e. for them Expect equals a third) and close to zero for egoists who expect to meet other egoists (i.e. for them Expect is close to one). This supports our modified expected utility hypothesis – egoists must expect that other egoists will accept lower offers and therefore reduce offers when expecting to meet another egoist. But, egoists fear rejections from the other types and increase their offers when they expect to meet someone else.

To test the expected utility hypothesis without relying on the value orientation categories we need to create a variable that can discriminate between prosocial types who make fair offers to everyone and egoistic types who make fair offers only when they expect they have to. When one regresses subject Own scores on their expectations, we see a significant positive effect. [20] This implies that the more egoistic a subject is, the more representative they feel. The logic for this phenomenon has been provided by Kelley and Stahelski (1970) who explain that egoists create other egoists because cooperators become more selfish after interacting with egoists. Presented with selfish behavior, cooperators react egoistically and this reinforces the view of egoists that everyone is like them. [21] This also means that nice types feel less representative. With this in mind, we interact subject expectations with their Own score to create a variable that is low for altruists and cooperators who do not expect to meet other nice types and is high for egoists who think they are likely to meet other egoists.

Moving to regression 2b, we see that the ExpectOwn variable is highly significant and the sign is consistent with our prior. The higher a proposer's ExpectOwn score, i.e. the more egoistic she is and the more representative she feels, the more she shaves off the baseline fair offer because the more she anticipates meeting another egoist who should be content with lower offers. This effect is perhaps better appreciated graphically. Fig. 5 plots the fraction offered against the proposer ExpectOwn scores for high and low values of the ExpectOwn variable. The lower panel is where the ExpectOwn variable takes low values and represents the proposals made by cooperators

[19] In the interests of full disclosure, the first pass at this analysis of expectations also included the interactions of altruists and cooperators with their respective expectations. However, the correlations between these interactions and the two value orientation dummies was very high (i.e. >0.9). The resulting multicolinearity assured that nothing was significant except the highly significant effect of egoists. For this reason, we report regression that only use the interaction between egoists and their expectations because this is the specific hypothesis we are testing.

[20] The coefficient on the Own score is 0.0035 and the p-value is 0.0002.

[21] One of the referees pointed out this reference.

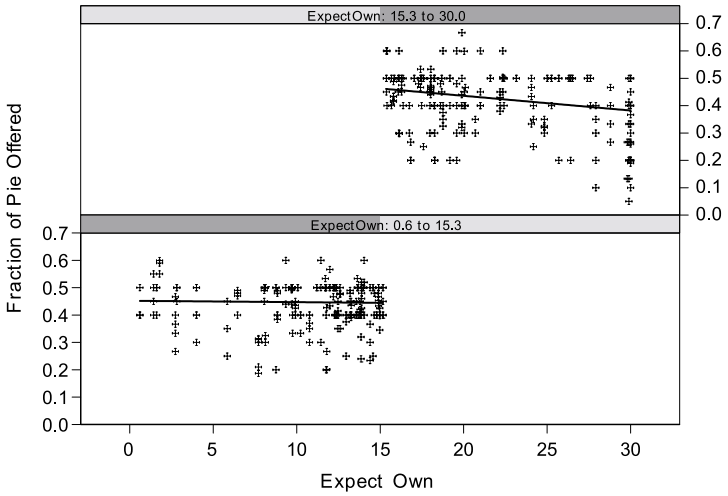

Fig. 5. A plot of the fraction offered as a function of one's expected partner.
(*Note:* ExpectOwn is the interaction of how representative one expects to be of the population and one's own value orientation score. Hence, high ExpectOwn indicates an egoist who feels very representative.)

and altruists. Note, that the relationship in this panel is flat indicating that prosocial types do not discriminate in making fair offers. Compare this with the upper panel where have offers made by egoists who expect to meet other egoists. Here we see the significantly negative relationship that dominates in the pooled data. We conclude that egoists make higher offers when they feel it necessary, but reduce offers when they expect to meet other egoists.

In regressions 3a and 3b we add dummy variables for the treatment conditions to see if, after controlling for proposer's value orientations and expectations, the different treatments affect offers. Only the $\delta = 0.25$, same treatment differs significantly when compared to the baseline, $\delta = 0.75$, random, treatment. This result illustrates that after controlling for other important factors, only the combined effect of the matching rule and the discount factor increases offers. Notice that the inclusion of the treatment effects does not diminish our main result that egoists use fairness instrumentally and prosocial types use fairness indiscriminately.

We can also look at the effect of other variables that are not at the core of this examination. Regressions 4a and 4b show that proposals do not seem to be determined by sex, or the role of the proposer. This last result confirms the establishment of a proposing norm to offer 45% of the current pie because it shows that the norm is invariant to the role a subject takes on. In addition, we also see that the Period variable which is used to account for changes in proposals over time due to learning or experience has no effect. This last result is not surprise given Figs. 2–4.

The last thing to note is that the methodology we used to account for the social preferences of our proposers does not seem to affect the results. Our results are invariant to whether we specify social preferences by value orientation category or

motivation vector angle. This suggests that misclassification in the current study is not likely to be a large problem for our study of bargaining.

3.4. Responder behavior

Conflict tends to increase as the second round pie increases and as negotiations become more anonymous. [22] Returning to Table 2, we see the somewhat surprising result that competitive types are responsible for most rejections. In each treatment competitors account for more rejections than one would expect if offers are randomly assigned to responders and if value orientation types are equally likely to reject a given offer.

Table 4 summarizes the results of a probit analysis of the likelihood of rejecting an offer based on the responder's value orientation and other right-hand side controls. [23] The dependent variable is one when an offer is rejected and zero when it is accepted. The explanatory variables are the responder's value orientation category (or vector angle), the consistency of the participant's value orientation, the relative size of the offer under consideration, dummy variables for the treatments and the responder's sex, and the time period.

The fact that the size of the offer is highly significant is no surprise, but its inclusion adds legitimacy to the result that responder value orientations matters. Although the Altruist dummy is not significant (probably because altruists make up such a small portion of the population), its sign and magnitude make sense. However, both the Cooperator and the Egoist dummies are significant in any specification and, taken together, the three coefficients indicate that competitors are responsible for most of the rejected offers after controlling for offer size. We come to the counterintuitive conclusion that the 45/55 norm is supported mostly by the disciplining behavior of competitive bargainers. We return to this result in Section 4.

There are two final things to note about our analysis of the responder data. First as see in regressions 2a through 3b, the likelihood of rejecting an offer is independent of the treatment variables, the gender of the responder, and the level of experience. That is, although the rejection rates vary across treatments, this variance is more a function of the mixture of types in a treatment than a result of the treatment variables. Further, women are just as likely to reject an offer as men are after controlling for their social preferences and the size of the offer. Lastly, the insignificant role of the Period variable again illustrates that, in this case, behavior is stable and is not driven by experience. Second, as in our discussion of proposer behavior, we see that our responder results are not affected by how we measure participant value orientations. In each case, substituting the vector angle for the value orientation dummies yields identical results.

[22] The overall rejection rates for each cell are 8.3% for (same, $\delta = 0.25$), 17% for (same, $\delta = 0.75$), 14% for (random, $\delta = 0.25$) and 16% for (random, $\delta = 0.75$).

[23] Again, we include individual random effects.

Table 4
Why do responders reject offers? (dependant variable = 1 for rejection and 0 for acceptance)

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Intercept	3.80***	3.12***	3.76***	3.08***	3.79***	3.14***
	(1.03)	(0.95)	(1.02)	(0.95)	(1.08)	(1.00)
Offer	−9.15***	−9.24***	−9.06***	−9.25***	−9.23***	−9.41***
	(1.74)	(1.78)	(1.70)	(1.77)	(1.78)	(1.84)
Altruist	−1.45		−1.40		−1.44	
	(1.20)		(1.18)		(1.21)	
Cooperator	−1.40***		−1.37***		−1.39***	
	(0.45)		(0.45)		(0.46)	
Egoist	−1.00***		−1.04***		−1.06***	
	(0.38)		(0.39)		(0.39)	
Angle		−0.02***		−0.01***		−0.02***
		(0.005)		(0.005)		(0.005)
Consistency	−0.75	−0.97	−0.89	−1.09	−0.94	−1.17*
	(0.71)	(0.71)	(0.71)	(0.72)	(0.75)	(0.75)
S25			0.06	0.16	0.06	0.16
			(0.41)	(0.43)	(0.42)	(0.43)
S75			0.40	0.32	0.41	0.33
			(0.35)	(0.36)	(0.36)	(0.37)
R25			0.06	0.11	0.05	0.09
			(0.35)	(0.36)	(0.36)	(0.37)
Sex					−0.05	−0.10
					(0.28)	(0.30)
Period					−0.03	−0.03
					(0.06)	(0.06)
Wald Chi-square	28.51	27.51	30.25	28.52	28.78	27.52
p-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N	600	600	600	600	600	600

Notes: All regressions are probits and include individual random effects. * – 90% level, ** – 95% level, and *** – 99% level.

4. Discussion

> Just as people don't write to prove to men that they have a face, there is no need to prove to them that they are egotistical. This egoism is the instrument of our preservation; it resembles the instrument for the perpetuation of the species; we need it, we cherish it, it gives us pleasure, and we must hide it.
>
> Voltaire discussing Mandeville's Fable of the Bees, Dictionnaire Philosophique

Evidence from this experiment suggests that ubiquitous proposals near an equal split of the surplus in experimental bargaining games are the result of both fairness norms and expected utility maximization. Participants with cooperative and altruistic social orientations offer half the available surplus indiscriminately, but egoists use fairness instrumentally in that they increase offers towards an equal split when they

expect to meet equity-minded players. Controlling for the role of players social orientations, we also see weak evidence that less anonymous bargaining environments contribute to the prevalence of fair offers and that players largely ignore structural factors (i.e. the discount factor) which should influence equilibrium proposals.

Perhaps the most unexpected result of the current experiment is responder behavior. The conventional theory of repeated interaction suggests that responders may attempt to discipline proposers early on to increase their share of the surplus in the future. This is not the case here as rejections continue to appear throughout the experiment. One would also expect fewer rejections in the random matching treatment because the expected gain from punishing a greedy proposer is diluted by the small probability that the punisher will be matched with the same partner in the future (i.e. punishment is a public good), but this also does not appear to be the case. Lastly, and most surprisingly, competitive players are considerably more likely to reject offers than egoistic, cooperative, or altruistic players.

The combination of our proposer and responder results requires us to rethink the basis of sharing norms. The principle of equity present in most societies which states that benefits are split equally among equals is often thought to be supported by the threat of punishment of greedy individuals by fairmen who subscribe to an equity norm. However, the results presented above suggest that sharing norms are also supported by competitive individuals who coordinate their expectations about what they need to receive to maintain or increase their status on the established norm.

Are there theoretical foundations for the type of behavior we see in this experiment? Specifically, can fairmen coexist with egoists and competitors in an equilibrium in which most of the agreements are at or near the equal spit and lower offers are routinely rejected? The answer is yes. What follows is meant only as a brief, stylized, illustration of the sort of evolutionary models that have been used to microfound the stylized facts one typically sees in bargaining data. [24] Consider a simplification of our game where proposers (players 1) offer half the surplus or some low amount, say one. If first round offers are accepted, they are implemented and if they are rejected, the surplus shrinks according to δ and there is a second round of bargaining. In the second round proposers (now players 2) counteroffer half or one and the responders (now players 1) accept or reject. Rejections in the second round lead to both players receiving nothing. The extensive form of this simplification appears as Fig. 6.

A strategy for player 1 has five components. For example the strategy HARAR means offer half initially, accept if offered half after being rejected on the left side of the game, reject if offered the low amount on the left, accept if offered half on the right, and reject if offered the low amount on the right. A strategy for player 2 has four components. The strategy ARHH says player 2 will accept half initially, reject the initial low offer, and always offer half if the interaction makes it to the second stage. The full normal form of this game is huge so, to continue our illustration, we

[24] This is *only* an illustration of more formal models. The interested reader should see Bolton (1997), Carpenter and Matthews (2001), Gale et al. (1995), Morrison (1996), Skyrms (1994), and Young (1993).

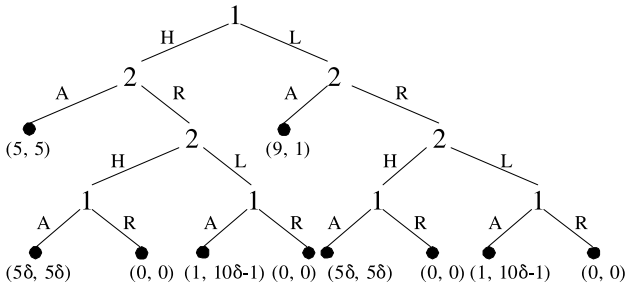

Fig. 6. A simplified version of the game.
(*Note:* H means offer half the surplus, L means make a low offer of one, A means accept and R means reject. δ is 0.25 or 0.75.)

limit our analysis to four strategies for each player that mimic our value orientation categories. For players 1 we have the *altruistic* strategy, HAAAA, who offer half initially and accept all counteroffers, the principled *fairman* strategy, HARAR, that offers half and punishes greedy proposers, the *egoistic* strategy, LAAAA, and the it competitive strategy, LARAR, that rejects offers that reduce relative standing. Modeling players 2 on the behavior of our participants, *altruists* are characterized by AAHH, *fairmen* who reject low offers but always return to the equal split use ARHH, *egoists*, who accept fair offers because they expect rejecting and then being greedy would not be tolerated, use ARLL, and *competitors* use RRLL to try to gain an advantage.

The SGP equilibrium (based on strictly egoistic players) of our simplified four by four game depends on the value of δ. The case where $\delta = 0.25$ is not too interesting because player 1 can prevent player 2 from rejecting by offering half and hence the subgame perfect outcome is the equal split. However, when $\delta = 0.75$ player 1 is indifferent between choosing H or L initially because it is always in player 2's interest to reject and make a low counteroffer. Here the subgame perfect outcome is $(1, 10\delta - 1)$, but other equilbria exist that support the equal split. Notice that the competitor strategy for player 2 is subgame perfect when $\delta = 0.75$ and the egoist strategy is subgame perfect when $\delta = 0.25$. Because the fair outcome is supported by subgame perfect behavior when $\delta = 0.25$, it would be trivial to show the evolution of a fairness norm in this case and therefore from this point on we consider only the more interesting $\delta = 0.75$ case.

To examine whether a population distribution of value orientation types that somewhat resembles what we see in the lab is possible, we use the standard replicator dynamic (Taylor & Jonker, 1978) which simply says that a strategy succeeds to the extent that it does better than average. Fig. 7 illustrates the evolution of strategies in the player 2 population. As the reader can see, there is some set of initial conditions that generates behavior similar to our experiment. In the player 1 population (not shown), most players adopt a strategy that offers half initially and competitors are always driven to extinction so, on average, first round offers are just below half the surplus. As in our value orientation exercise, the largest share of

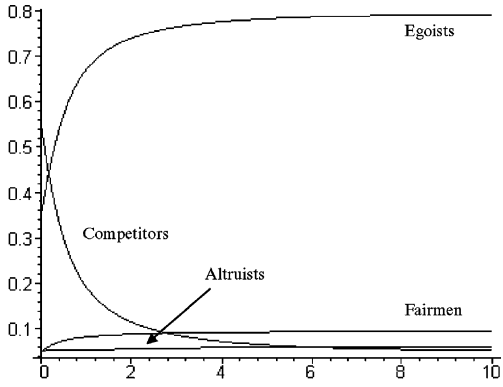

Fig. 7. Evolution of play in the player 2 population.
(*Note:* $\delta = 0.75$, the initial conditions are 0.05 altruists, 0.05 fairmen, 0.35 egoists, and 0.55 competitors.)

players 2 develop into egoists, but competitors and altruists persist in small numbers, and fairmen are approximately twice as frequent as altruists and competitors. While we have said nothing about the size of the basin of attraction for this equilibrium, the point is that we can find initial conditions that lead to a bargaining environment in which fair offers prevail and the fairness norm is supported both by principled fairmen and competitive types who are concerned about relative standing. Further, this equilibrium persists despite the very asymmetric subgame perfect prediction.

Note that this new theory of sharing norms has a strong *Fable of the Bees* aspect to it. [25] That is, much like Adam Smith's view of the market economy which provides a greater social good on the foundation of the selfish motivations of individualistic agents, this research suggests that sharing norms (which might also be thought of as a greater social good) are built and sustained partially by similarly self-interested individuals. On one hand, egoists and competitors refrain from being greedy in anticipation of meeting equity-minded individuals who they expect will not tolerate greediness. But, on the other hand, the same selfish bargainers are responsible for rejecting most low offers. The end result is more fairness in bargaining encounters than can be explained by fairmen alone because selfish proposers strategically make near-fair offers, and because many unfair offers are rejected by competitors due to positional concerns.

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[25] The *Fable of the Bees* refers to the work of Bernard Mandeville (Mandeville, 1714), who, in a general sense, laid the foundation for Adam Smith's notion of the invisible hand.

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