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Envy Freeness in Experimental Fair Division Problems

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Abstract: Envy is sometimes suggested as an underlying motive in the assessment of different economic allocations. In the theoretical literature on fair division, following Foley (1967), the term "envy" refers to an *intra*personal comparison of different consumption bundles. By contrast, in its everyday use "envy" involves *inter*personal comparisons of well-being. We present and discuss results from free-form bargaining experiments on fair division problems in which inter- and intrapersonal criteria can be distinguished. We find that interpersonal comparisons play the dominant role. The effect of the intrapersonal criterion of envy-freeness is limited to situations in which other fairness criteria are not applicable.

Keywords: Fairness, Envy Freeness, Social Preferences, Bargaining

JEL Classification: A13, C78, C91, D63

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1. Introduction

Interpersonal utility comparisons are commonly held to lack solid conceptual foundations. There are obvious problems in verifying (or even understanding) statements such as "I would be happier if I received good *A* than you would be if you received it," or "I would suffer more in situation *B* than you in situation *C*." The difficulties in making interpersonal utility comparisons have led economists to suggest sophisticated fairness criteria that do not rely on such comparisons. One such criterion is Foley's (1967) *envy freeness*.[1] A person is envy free if he or she does not prefer another person's bundle of goods; an allocation is envy free if everybody is envy free, i.e. if nobody would be better off with someone else's bundle. No interpersonal utility comparisons are necessary; each individual compares bundles only with respect to his or her own preferences. Envy in this sense has to be distinguished from the more casual use of the term in everyday language which refers to a feeling as expressed in "I am envious since you are better off than I am" – an interpersonal comparison. By contrast, envy according to Foley refers to a statement like "I am envious because I would be better off with what you have than with my own bundle" – an intrapersonal comparison.

The purpose of the present paper is to test the empirical relevance of envy freeness as an intrapersonal fairness criterion. Although there is a large experimental literature on fairness (see e.g. Fehr and Schmidt 2002 for an overview), the existing laboratory experiments do not allow to discriminate between interpersonal and intrapersonal fairness criteria.[2] The reason is that in laboratory experiments social states are typically described in monetary terms, i.e. all relevant information is contained in the distribution of money among the participants (either in real terms or in experimental currency). Since all individuals are assumed to prefer more money to less, the two notions of envy mentioned above cannot be distinguished: someone else is better off than I am if and only if he or she owns something that I would prefer as well (namely, more money). To break this nexus we need to impose different preferences for different individuals. In our experiments, we endow individuals with different preferences by

[1] Another example is Pazner and Schmeidler's *egalitarian equivalence* (see Pazner/Schmeidler,1974).
[2] There is a tradition, following Yaari/Bar-Hillel (1984), of trying to elicit social preferences by questionnaires (see e.g. Konow 2003 and Gaertner 2006, Chapter 9). In this context, it is common to ask subjects to (hypothetically) distribute goods among individuals with different preferences. However, envy freeness has not been addressed in this literature either.

assigning different individual values to the same objects. We can thus distinguish criteria that are based on interpersonal comparisons, such as maximizing the welfare level of the worst off individual (the “maximin principle”), or minimizing the payoff difference (“inequality aversion”), from intrapersonal criteria such as envy freeness. To illustrate this, consider the following example (cf. 3PERS-1-R1 in Section 3 below). There are three indivisible goods A, B, C, and a fixed amount of 5 units of money to be distributed among three individuals 1, 2 and 3. Suppose that individual 1 considers goods A, B and C to be worth 45, 35, and 20 units of money, respectively. Similarly, individual 2 considers goods A, B and C to be worth 35, 40 and 25 money units, respectively; finally, individual 3 considers goods A, B and C to be worth 50, 5 and 45 units of money, respectively. The following table summarizes these values.

	A	B	C
1	45	35	20
2	35	40	25
3	50	5	45

Money M=5

In this situation, the perfectly egalitartian payoff distribution (45,45,45) can be created by giving good A to individual 1, good B and the 5 money units to individual 2, and good C to individual 3. However, individual 3 is envious since he/she would be better off with good A which is given to individual 1. On the other hand, envy-freeness can be achieved by implementing the same allocation of goods but giving the 5 units of money to individual 3 with a resulting (unequal) payoff distribution of (45,40,50). In this example, envy freeness thus makes a different recommendation than either payoff equalization or maximizing the payoff of the worst-off individual.

A potential difficulty with our approach stems from the fact that the “goods” to be distributed are not really consumed by the particpants but serve only as a temporary substitute for money. Indeed, any allocation of objects translates into a distribution of money in experimental currency and subjects are ultimately paid according to the total amounts earned during the experiment. It could therefore be argued that the distributions of our virtual goods are only an intermediate framing device for the different money amounts ultimately consumed. This observation may weaken the role of envy freeness in our context since envy in the sense of Foley can only exist in the intermediate stage before participants are paid according to their accumulated earnings. Nevertheless, this does not render envy freeness irrelevant in our setting. In particular, different allocations of goods may induce the same payoff distribution while some of these allocations are envy free and others are not. The following example with five indivisible goods illustrates this point (see Herreiner 2007).

	A	B	C	D	E
1	40	2	3	25	30
2	14	26	8	26	26
3	10	26	26	12	26

The allocation in which individual 1 receives good A, individual 2 receives goods B and D, and individual 3 receives goods C and E results in the payoff distribution (40,52,52). The same payoff distribution also results from the allocation in which individual 1 receives good A, individual 2 receives goods D and E, and individual 3 receives good B and C. The difference between the two allocations is that the first is envy free while at the second allocation individual 1 would prefer individual 2's bundle of goods to his/her own bundle. The example illustrates that properties of allocations such as envy freeness cannot be captured by a distributional preference approach that is solely based on the induced distribution of money. In Section 3 below, we provide evidence that in some cases there are indeed significant differences in the choice frequencies of different allocations that induce the *same* payoff distribution. Some of these differences can be attributed to envy freeness.[3]

Overall, however, we find that envy freeness plays a much lesser role than interpersonal fairness criteria. Our experimental results suggest that inequality aversion (i.e. a preference for more equal distributions of money) is the most important criterion

[3] This example (and similar ones) has been tested using a questionnaire method in Herreiner (2007) (see also Herreiner/Puppe (2007)). In our context with indivisible goods, there is no simpler structurally comparable example of two payoff-equivalent allocations of which only one is envy free.

that, together with Pareto optimality, characterizes most choices of allocations.[4] The main conclusion from our study is, that, while interpersonal fairness criteria are dominant, envy freeness plays a role as a *secondary criterion* in situations in which Pareto optimality and inequality aversion are not sufficient to determine a fair allocation.

2. Experiments and General Results

Our results are based on free-form bargaining experiments in which individuals had to agree on an allocation of several objects within a given time period. The experiments were conducted at the experimental lab of the University of Bonn between May 2001 and November 2002. The experiments took place in an anonymous lab setting with participants communicating exclusively via networked computers. Experiments lasted on average 75 minutes (including the initial instructions). Partipants were paid based on the allocations they agreed upon; the average payoff was €9. Participants were recruited by posting notices on campus. The majority of participants were economics, business, and law students. 50% of our participants were male/female. Each of our 204 participants attended one session only.

We ran two different kinds of experiments: 2-person bargainging games and 3-person bargaining games of which we did two different treatments in six sessions each. We will refer to them as 2PERS-1, 2PERS-2, 3PERS-1, and 3PERS-2 respectively. The 2-person bargaining games ran over five rounds with individuals matched pairwise. We had six sessions with 8 participants each – a total of 2*6*8=96 individuals in the two treatments of 2PERS. The 3-person bargaining games had four rounds with individuals matched in groups of three. Each of the six sessions had 9 particpants – a total of 2*6*9=108 individuals in the two treatments of 3PERS. Participants were rematched in every round[5] and never interacted with the same individual(s) twice.

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[4] Our results also provide some evidence about the trade-off between Pareto optimality and inequality aversion, a subject that has received some attention recently (see, among others, Charness/Rabin (2002), Engelmann/Strobel (2004 and 2006), Bolton and Ockenfels (2006), Fehr et. Al. (2006), Herreiner/Puppe (2006) and Kritikos/Bolle (2001)).

[5] See Appendix V for the matching. – Some bargaining problems were presented in identical form in different rounds of the same treatment and also in different treatments. We did not see any statistically significant differences in behavior in those different instances of the same game. For example, rounds 2 and 4 in 2PERS-2 have the same ordinal rankings and also the same cardinal rankings but for payoff differences of ±1: the same choice was made 22 (of 23) and 23 (of 24) times respectively – not a significant difference. The same applies when comparing either of these rounds to round 5 of 2PERS-1 – 21 (of 23) pairs chose

In each round, the task for the matched group of players was to agree on an allocation of objects within a given time limit (10 minutes in 2PERS and 12 minutes in 3PERS). The relevant allocation problem was presented to the players of the same group on their respective computer screens that also allowed them to select alloctions and exchange messages. On the left-hand side of the screen individuals found information about their own payoff and that of their matching partner(s), and about proposals.[6] The right-hand side of the screen showed a box corresponding to each object; by clicking on the appropriate boxes individuals could distribute objects between themselves and their matched partner(s). A selected allocation could be sent as a proposal to the matched partner(s) by clicking on a "send" button. The right-hand side of the screen also provided a chat window, where individuals could exchange messages.[7] All proposals and all sent messages were saved in a log file.

Once the sent proposals of the group of matched players coincided, players were asked to confirm their choices. If all players accepted the given allocation, then the round was over for that group of players; otherwise the group returned to further bargaining via proposals and messages until they agreed or time was up. If the allotted time expired without an agreement, then individuals received a zero payoff for that round. If individuals settled on an allocation before the round's time was up, they had to wait[8] until all other groups had also finished. Payoffs of all four/five rounds were added up and paid out to participants at the end of the experiment. Experimental payoffs were given in Talers with an exchange rate of 12 Talers for DM1 in 2 PERS and 16 Talers for €1 in 3PERS.

Our experiments differ from others in the fast growing literature on fairness and models of distributional preferences not only in the kind of division problems we consider but also in that we assign different payoff rankings to individuals at the beginning of each round. Only by assuming different preferences for different individuals can we distinguish envy freeness in the Foley sense from other notions of fairness. All distributional preference criteria discussed in other studies can be evaluated in our

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the same allocation which again is not signficantly different. We therefore analyze rounds as independent observations.

[6] See the instructions in Appendix III and IV for detailed screenplots.

[7] The communication was monitored to prevent any identifiable messages from being sent.

[8] We provided magazines for the possible waiting period.

experiments, too. Here, we focus on the relationship between envy freeness (EF), inequality aversion (IA) and Pareto optimality (PO).

In the 2-person bargaining games the two matched players had to distribute four indivisible objects between themselves. The two players had different preferences over the 16 possible bundles. We imposed monotonicity, i.e. subsets of bundles were worth less, supersets were worth more. In 2PERS-1 the payoff information in the first two rounds was only ordinal – individuals saw their own and their matched partner's ranking of bundles but did not know the monetary values of the bundles. They knew that getting everything was worth 100 Talers (the experimental currency) and getting nothing was worth 0 Talers. In all other rounds of 2PERS-1 and 2PERS-2 the payoff information was cardinal, i.e. individuals knew both players' rankings *and* the Taler values of the different bundles.[9] The specific rankings and payoffs used in 2PERS-1 and 2PERS-2 and the frequency and properties of the chosen allocations are shown in Appendix I. The general nature of the chosen allocations in the two 2PERS treatments can be summarized[10] as

PO	EF	PO+EF	IA
85%	51%	39%	70%

In the 3-person bargaining games the three matched players had to distribute three indivisible objects and some Taler amount between themselves. In both 3PERS treatments all objects had to be allocated. In 3PERS-1 money could be split into any integer amounts and money could also be thrown away; in 3PERS-2 all money had to be distributed and the amount was not divisible. Payoffs for bundles (and money) were additive in the individual objects. The preferences imposed in 3PERS-1 and 3PERS-2 and the allocation choices are shown in Appendix II. Analogous to the 2-person bargaining games the general nature of the chosen allocations in the 3-person bargaining games can be summarized[11] as

[9] Choices are not significantly different between comparable allocations whether cardinal information was available in the first two rounds or not – see footnote 5.
[10] The calculation for IA is based on rounds 3-5 of 2PERS-1 and rounds 1-5 of 2PERS-2 in which the cardinal rankings were known. See Herreiner/Puppe (2006) for an analysis of distributional preferences in the context of purely ordinal rankings.
[11] EF counts all allocations that are either envy free or in which money is used exclusively to reduce envy. IA counts all allocations where the payoff difference between the richest and the poorest is the smallest possible.

PO	EF	PO+EF	IA
92%	31%	27%	70%

It is obvious that Pareto optimality plays an important role. It is also clear that inequality aversion matters in many of the division problems. Envy freeness seems to be less important at first glance, but envy freeness does play a role on its own right. As the percentages in the tables above show, envy free allocations are also chosen if they are not Pareto optimal. In the next section, we focus on the role of envy freeness in our analysis in order evaluate its importance and also limitations.

3. The Role of Envy Freeness

To compare outcomes in different rounds in order to isolate the effect of envy freeness, we rely on division problems with comparable characteristics. Rounds 4 and 5 of 2PERS-1 and rounds 1, 2, 4, and 5 of 2PERS-2 consist of such problems. In each of those six division problems there are two focal allocations, both at the same ranks in the ordering with the higher ranked bundle two ranks above the lower ranked bundle. One of these two allocations is Pareto optimal and not envy free while the other is Pareto optimal and envy free. [12] The respective allocations in the different rounds are listed in the following table.

2PERS-1-R4	2PERS-2-R1	2PERS-2-R5	2PERS-1-R5	2PERS-2-R2	2PERS-2-R4
(AC,BD) (CD,AB)	(AB,CD) (AD,BC)	(AB,CD) (AD,BC)	(AB,CD) (AD,BC)	(AB,CD) (AD,BC)	(AB,CD) (AD,BC)
PO + EF ↔ large payoff difference PO ↔ small payoff difference			PO + EF ↔ small payoff difference PO ↔ large payoff difference		

In 2PERS-1-R4, 2PERS-2-R1, and 2PERS-2-R5 the PO (and not EF) allocation is also the one where payoff differences are minimized at 1. In those three cases, the PO and EF allocation on the other hand is one where the payoff differences are fairly large at 17. In

[12] The alloctions shown in the second row of the above table are both PO and EF; the allocations shown in the third row are only PO. For all these allocations, one of the two bundles is ranked 7 and the other is ranked 9. The cardinal payoffs are almost identical. See Appendix I.

the other three cases (2PERS-1-R5, 2PERS-2-R2, 2PERS-2-R4), the situation is reversed: the PO and EF allocation is the one where payoff differences are minimized at 1, and the PO allocation that is not EF has a payoff difference of 17. We illustrate the situation below for the rankings of 2PERS-1-R4 on the left and 2PERS-2-R4 on the right. In the left situation the allocation that minimizes payoff differences is PO but not EF (allocation (CD,AB) at which individual 1 is envious). In the right situation the allocation that minimizes payoff differences is PO and EF (allocation (AB,CD)).

		1		2	
		100	ABCD	ABCD	100
		95	ABC	ABD	98
1	PO	92	BCD	ACD	95
		89	ABD	ABC	87
		82	ACD	BCD	84
1		60	AB	AD	64
4	PO+EF	55	AC	AB	47
1		50	BD	BC	43
62	PO	46	CD	BD	38
1		35	AD	AC	30
		28	BC	CD	27
		15	B	A	17
		12	C	D	11
		7	A	B	5
		5	D	C	4
		0	-	-	0
70					

		1		2	
		100	ABCD	ABCD	100
		97	ABC	BCD	95
		95	ACD	ABD	91
		93	BCD	ABC	86
		87	ABD	ACD	82
1		60	BC	BD	64
66	PO+EF	47	AB	BC	52
2		42	CD	AC	51
0	PO	35	AD	CD	46
		33	BD	AB	32
		29	AC	AD	28
1		9	C	B	18
		7	A	D	17
		6	B	C	11
		3	D	A	6
		0	-	-	0
70					

The numbers to the left of the bundles of person 1 indicate the number of times an allocation (of the adjacent bundle for person 1 and the complementary bundle for person 2) was chosen by the 72 matched pairs[13] considered.

The comparison of these two situations allows us to abstract from the role of inequality aversion. It is obvious that inequality aversion is the primary force behind the choices made here. If envy freeness did not play a role, then in both situations the allocation with the minimal payoff difference should be chosen equally frequently – our null hypothesis. It is rejected based on a χ^2-test with a p-value of 0.0423. We thus observe a significant difference between the two situations: the envy free allocation is chosen

[13] A total of 6*4=24 pairs per round with 3 rounds are considered for each situation; in both situations 2 pairs did not reach an agreement.

significantly more often. Despite the preponderance of inequality aversion, the effect of envy freeness can be isolated: Envy freeness matters as it helps to discriminate between Pareto optimal allocations,

A similar conclusion can be drawn from the 3-person bargaining games. To test for envy freeness in this context, the fair division problems are constructed in such a way that money can be used to compensate envy or inequality. As noted above, inequality aversion is the dominant selection criterion here as well but envy freeness also plays a role in this context. The kind of division problems considered can be illustrated by the following example (3PERS-1-R1)

	A	B	C
1	45	35	20
2	35	40	25
3	50	5	45

Money m=8

One focal allocation here is along the main diagonal – person 1 receives good A, person 2 receives good B, and person 3 receives good C. However, that allocation of goods induces envy: person 3 prefers the good given to person 1 (good A) over his/her own good (good C). Focusing only on this allocation of goods along the diagonal, the distribution of money indicates what fairness criteria matter. The money (8 units) can be used to either compensate the inequality by giving at least 5 units to person 2, or to compensate the envy by giving at least 5 units to person 3.

We now present the results of the 3-player bargaining games, 3PERS-1 and 3PERS-2.[14] In 3PERS-1 money (m) was divisible and some or all of it could be thrown away.[15] In 3PERS-2 money (M) could not be discarded, and it was indivisible to force individuals to give the whole amount to one individual which allows a more clear-cut test as to whether envy freeness matters.[16] Each of the two treatments had two rounds with a

[14] Matrices are rearranged here to show all problems in a comparable format.

[15] Some money was thrown away in 4 (of 66) cases – as can be seen in the tables where individual amounts do not add up to the available total. In two cases (3PERS-1-R1) money was only used to compensate payoff inequality but not to provide any additional payoff. In the other two cases (3PERS-1-R1 and 3PERS-1-R3) the same amount of money was given to all three individuals and one additional Taler was given to the individual with the lower payoff.

[16] We are grateful to Gary Charness for suggesting we use indivisbile money for this very reason.

low degree of inequality and envy, and two rounds with a high degree of inequality and envy. The results for the bargaining games with a low degree of inequality and envy are

3PERS-1-R1

	A	B	C
1	45	35	20
2	35	40	25
3	50	5	45

m=8

				16
PO	1	2	3	8
	1	6	1	
	1	2	3	2
	0	5	0	
PO	1	2	3	2
	3	3	2	
PO	1	2	3	1
	3	5	0	
	1	2	3	1
	2	3	2	
PO	1	2	3	1
	2	4	2	
	2	1	3	1
	3	3	2	

3PERS-1-R3

	A	B	C
1	45	35	20
2	35	40	25
3	50	5	45

m=17

				17
PO	1	2	3	12
	4	9	4	
PO	1	2	3	2
	5	7	5	
	1	2	3	1
	5	6	5	
PO	1	2	3	1
	6	6	5	
PO	1	2	3	1
	12	3	2	

3PERS-2-R1

	A	B	C
1	45	25	30
2	30	45	25
3	50	5	45

M=5

				18
PO	1	2	3	6
EF	0	0	5	
PO	1	2	3	6
	0	5	0	
PO	1	2	3	4
	5	0	0	
PO	3	2	1	1
	0	5	0	
	3	1	2	1
	0	5	0	

3PERS-2-R3

	A	B	C
1	45	15	40
2	30	45	25
3	50	5	45

M=5

				17
PO	3	2	1	11
EF	0	0	5	
PO	1	2	3	4
EF	0	0	5	
PO	3	2	1	1
	0	5	0	
PO	1	2	3	1
	0	5	0	

Chosen allocations are described by a goods vector in the first row and a money vector in the second row. The goods vector indicates which individual receives the good of that column (see header of matrix at top); the money vector indicates how much money is associated with the good of the respective column. The numbers to the right of the allocations indicate how frequently they were chosen. To the left of the allocations we specify whether the respective allocations are Pareto optimal (PO) and/or envy free (EF). Thus, for instance, in the first allocation in 3PERS-1-R1 shown in the table, person 1 receives good A and 1 Taler, person 2 receives good B and 6 Talers, and person 3 receives good C and 1 Taler; this allocation was chosen by 8 of 16 groups, and it is Pareto optimal but not envy free. Similarly, the last allocation in 3PERS-1-R1 assigns good A and 3 Talers to person 2, B and 3 Talers to person 1, and C and 2 Talers to person 3; that allocation was chosen only once, and it is neither Pareto optimal nor envy free.

With divisible money (left two cases in the table above), no compensation for envy can be observed; for the goods allocation along the main diagonal, addressing envy would require more money to be given to person 3 (who prefers good A to the received good C) than to the other two individuals – this does not occur. With indivisible money

envy free allocations become the most frequently chosen, although this effect is not statistically significant. In particular, no significant results can be derived for 3PERS-2-R1, even though the envy free allocation is among the most frequently chosen ones.
In the right-most matrix (3PERS-2-R3), the main anti-diagonal allocation (3,2,1) is a Pareto optimal allocation that is also envy free if the money is given to person 1. This allocation and the other envy free allocation along the main diagonal, (1,2,3) with the money given to the third person are chosen much more frequently (11+4=15) than any other allocation. However, conclusions for envy freeness are weakened, in this case, by the fact that the same allocations would also have been chosen on the basis of inequality aversion, Pareto optimality and from a utilitarian perspective.[17] On the other hand, for the allocation along the main diagonal money was assigned to person 3 significantly more often than to either of the other two individuals (trinomial p-value is 0.0247); the envy free alloction was therefore indeed chosen significantly more frequently.

The main anti-diagonal allocation (3,2,1) with all money being given to person 1 seems to be particularly enticing. It is chosen almost three times as frequently as the allocation with the *same* payoffs along the main diagonal, (1,2,3), and all money being given to person 3 – a significant difference with a p-value of 0.0592 for a one-tailed binomial test. It shows very clearly that our set-up with imposed individually different preferences over indivisible objects and bundles is *not* a neutral framing for distributional preferences. It matters which goods are given to which individual and how the money is used, even if the resulting payoff distribution is the same for two different allocations.

Comparing those two allocations with identical payoff vector and analyzing how money is used in relation to the goods vectors allows another possible explanation for the choice of the main anti-diagonal goods allocation. It seems that using money to compensate the worst off individual, while at the same time avoiding envy, is more acceptable than giving money to one of three individuals in an equitable allocation and thereby compensating envy; in other words, money is used to compensate inequalities, not to generate them, although the resulting payoff distributions are identical. This may suggest that procedural aspects matter if subjects perceive the allocation problem in terms of two separate steps of allocating first the goods and then the money.

[17] By definition, a utilitarian allocation maximizes the sum of the payoffs.

The relevance of envy freeness is more obvious when the degree of inequality and envy is larger as is the case in the remaining examples of 3PERS:

3PERS-1-R2

	A	B	C
1	38	31	31
2	33	34	33
3	60	2	38

M=13

				15
PO	1	2	3	10
	3	7	3	
PO	1	2	3	2
	4	5	4	
PO	1	2	3	1
	5	5	3	
PO	1	2	3	1
EC	3	4	6	
	1	2	3	1
	6	7	0	

3PERS-1-R4

	A	B	C
1	38	31	31
2	33	34	33
3	60	2	38

m=7

				18
PO	1	2	3	14
	1	5	1	
PO	1	2	3	2
	2	3	2	
PO	1	2	3	1
EC	0	3	4	
PO	1	2	3	1
EC	1	2	4	

3PERS-2-R2

	A	B	C
1	38	31	31
2	33	34	33
3	60	2	38

M=7

				18
PO	1	2	3	10
	0	7	0	
PO	3	2	1	4
EC	0	0	7	
EC	1	2	3	2
	0	0	7	
PO	1	2	3	2
	7	0	0	

3PERS-2-R4

	A	B	C
1	38	31	31
2	31	38	31
3	60	2	38

M=7

				16
PO	3	2	1	9
EF	0	0	7	
EC	1	2	3	3
	0	0	7	
PO	1	2	3	3
	7	0	0	
PO	1	2	3	1
	0	7	0	

As before, envy freeness is basically not addressed in the left two scenarios where money is divisible. All chosen allocations involved the goods allocation along the main diagonal, i.e. good A is assigned to person 1, good B to person 2 and good C to person 3. At this allocation of goods, person 3 is envious since good A is worth 22 units more than person 3's good C. Note that the 13 respectively 7 units of money are not enough to compensate person 3's envy at this goods allocation. Nevertheless, sometimes the money is used to reduce envy, even if not all of the afflicted person's envy is compensated, or if some but less envy is induced for another person (as in 3PERS-2-R2, see discussion below). This is what we call "envy compensating" (EC in the table). With divisible money this occurred in the three (of 33) allocations along the main diagonal in which person 3 received a larger amount of money than person 1 (and 2). The inequality that would ensue if envy were compensated as much as possible (money vectors (0,0,13) and (0,0,7) for the main diagonal allocation) seems to be too large and therefore unacceptable.

In the third example above (3PERS-2-R2) where money is indivisible, inequality is addressed most frequently, although the level of inequality generated by assigning the money to person 2 is comparable to the one in the goods-only allocation (disposing money was not an option in 3PERS-2); all other allocations exhibit larger payoff differences. In the second and third allocation of 3PERS-2-R2 envy is reduced through the money allocation[18] – however with only six observations envy concerns are clearly less important than inequality concerns.

In the last example in 3PERS on the right (2-R4), money is indivisible and the main diagonal allocation has much less inequality than the anti-diagonal allocation. The main anti-diagonal allocation is envy free if the money is given to the the first person together with good C, whereas the main diagonal allocation can at best be envy compensating if the money is given to the third person along with good C – the money compensates scarcely ⅓ of person 3’s envy. Whether this is the decisive difference leading to the substantially more frequent choice of the anti-diagonal allocation as compared to 3PERS-2-R2 is not clear. The main anti-diagonal allocation with the money going to the first person is Pareto optimal, envy-free and utilitarian, whereas the main diagonal allocation is not Pareto optimal if the third person receives the money to reduce envy. Indeed, the payoff distribution corresponding to the latter allocation is (38,38,38+7) which is (weakly) dominated by the payoff distribution (31+7,38,60) resulting from the first allocation. Moreover, if the earlier point about the perceived procedural aspects of the allocation applies, then a relevant criterion may be whether or not money reduces or increases the inequality of the goods allocation – improving the worst individual’s lot (from 31 to 38) is clearly better in that case than introducing inequality by helping one individual receive more than the others (45 instead of 38).

4. Conclusion

Envy freeness is a very important criterion in the theoretical fairness literature. We have shown here that it plays a role in indivisible goods bargaining games. However, its role is limited to that of a “secondary” criterion that matters only if other, less sophisticated critera have no discriminatory power. Notwithstanding its elegance and theoretical appeal, envy freeness seems to be too abstract and complicated to be empirically more relevant in our examples.

[18] In both cases good C is allocated together with the 7 money units. Giving them to person 1or 3 as in these cases, induces envy for person 2: 33+7=40 is better than the 34 associated with good B. Moreover, in the third allocation along the main diagonal person 3’s envy cannot be compensated entirely – giving all 7 Talers to person 3 only reduces envy from 22 to 15.

Interpersonal comparisons, on the other hand, seem to be deeply ingrained in human behavior no matter their lack of theoretical foundations. Individuals rely on distributional preferences and interpersonal comparisons even without cardinal payoff information as we have argued in Herreiner/Puppe (2006). Whether the reliance on distributional preferences depends on the specific context and division problem remains an open question. Fehr/Schmidt (1999) contend that distributional preferences can explain many hitherto startling phenomena. Given that envy freeness requires information only about one's own preferences, it could conceivably be a more powerful criterion in situations with incomplete information. It may be worthwhile to explore the role of envy freeness in particular and fairness criteria in general as a function of the information structure of fair division problems.

Although our analysis provides strong evidence in support of inequality aversion as an empirically relevant fairness criterion, it also shows the limitations of the distributional preference approach. Different allocations yielding the same payoff vector are chosen with significantly different frequencies. It thus seems that other criteria, like envy freeness and/or procedural aspects matter. Bereby-Meyer/Niederle (2005) make a related point showing that intentionality and reciprocity matter and that they cannot be accounted for by distributional preferences.

One new and important aspect of our approach here is that we endow individuals with different preferences over objects to make testing for envy freeness possible. The results are overall not encouraging for envy freeness, although we have demonstrated that envy freeness matters if other, simpler criteria are not applicable. We view our study as a first step towards a more comprehensive analysis of interpersonal versus intrapersonal fairness criteria. One aspect that may be relevant in such an analysis is the versatility and pertinence of fairness criteria in different settings. For instance, we suspect that laboratory experiments by design present decision problems in a way that facilitates the use of interpersonal comparisons. Interpersonal comparisons are certainly much more complex and difficult in real-life situations.

Appendix I: 2-Person Bargaining Games

The tables show the goods allocation with their associated Taler payoffs. In 2PERS-1, "n.a." indicates that in those two rounds participants saw only the ordinal rankings of both players, not the Taler payoffs corresponding to the bundles. Choice frequencies are given at the bottom of the tables along with the properties of the respective allocations (the relevant PO and EF allocations are shaded in dark grey, the comparable PO-only allocations are shaded light grey.

Experiment 2PERS-1

R1

n.a.	1	2	n.a.
100	ABCD	ABCD	100
95	ABC	BCD	98
92	ACD	ABD	95
89	BCD	ABC	87
82	ABD	ACD	84
60	BC	BD	64
55	AB	BC	***47***
50	CD	AC	43
46	AD	CD	38
35	BD	AB	30
28	AC	AD	27
15	C	B	17
12	A	D	11
7	B	C	5
5	D	A	4
0	-	-	0

AB	CD	10	PO	EF
AD	BC	6	PO	
BD	AC	2		
AC	BD	2	PO	
CD	AB	1		
ACD	B	1	PO	
ABCD	-	1	PO	
		23		

R2

n.a.	1	2	n.a.
100	ABCD	ABCD	100
98	ABC	BCD	94
96	ACD	ABD	90
92	BCD	ACD	86
88	ABD	ABC	81
60	BD	CD	64
45	AC	BC	53
40	CD	AD	50
36	AB	AC	44
30	AD	BD	***32***
28	BC	AB	26
9	C	D	19
8	A	B	15
5	B	C	10
2	D	A	7
0	-	-	0

AB	CD	10	PO	
BD	AC	8	PO	EF
AD	BC	2		EF
BC	AD	1		
AC	BD	1		
		22		

R3

	1	2	
100	ABCD	ABCD	100
98	ABC	ABC	97
95	ABD	ABD	96
93	CBD	ACD	91
83	ACD	CBD	88
66	AB	BC	75
57	CD	AC	***45***
53	BC	BD	42
46	AD	CD	40
45	BD	AB	28
20	AC	AD	19
9	B	A	8
5	A	B	7
3	C	C	3
1	D	D	2
0	-	-	0

BD	AC	14		EF
AD	BC	7	PO	
AB	CD	2	PO	EF
		23		

R4

	1	2	
100	ABCD	ABCD	100
95	ABC	ABD	98
92	BCD	ACD	95
89	ABD	ABC	87
82	ACD	BCD	84
60	AB	AD	64
55	AC	AB	***47***
50	BD	BC	43
46	CD	BD	38
35	AD	AC	30
28	BC	CD	27
15	B	A	17
12	C	D	11
7	A	B	5
5	D	C	4
0	-	-	0

CD	AB	21	PO	
AC	BD	1	PO	EF
		22		

R5

	1	2	
100	ABCD	ABCD	100
98	ABC	BCD	94
96	ACD	ABD	90
92	BCD	ABC	86
88	ABD	ACD	81
60	BC	BD	64
45	AB	BC	53
40	CD	AC	50
36	AD	CD	***44***
30	BD	AB	32
28	AC	AD	26
9	C	B	19
8	A	D	15
5	B	C	10
2	D	A	7
0	-	-	0

AB	CD	21	PO	EF
CD	AB	1		
C	ABD	1	PO	
		23		

Experiment 2PERS-2

R1

	1	2	
100	ABCD	ABCD	100
95	ABC	BCD	98
92	ACD	ABD	95
89	BCD	ABC	87
82	ABD	ACD	84
60	BC	BD	64
55	AB	BC	***47***
50	CD	AC	43
46	AD	CD	38
35	BD	AB	30
28	AC	AD	27
15	C	B	17
12	A	D	11
7	B	C	5
5	D	A	4
0	-	-	0

AD	BC	19	PO	
AB	CD	2	PO	EF
ACD	B	1	PO	
BD	AC	1		
CD	AB	1		
		24		

R2

	1	2	
100	ABCD	ABCD	100
98	ABC	BCD	94
96	ACD	ABD	90
92	BCD	ACD	86
88	ABD	ABC	81
60	BC	BD	64
45	AB	BC	53
40	CD	AC	50
36	AD	CD	***44***
30	BD	AB	32
28	AC	AD	26
9	C	D	19
8	A	B	15
5	B	C	10
2	D	A	7
0	-	-	0

AB	CD	22	PO	EF
BC	AD	1	PO	
		23		

R3

	1	2	
100	ABCD	ABCD	100
98	ABC	ABC	97
95	ABD	ABD	96
93	CBD	ACD	91
83	ACD	CBD	88
66	AB	BC	75
57	CD	AC	***45***
53	BC	BD	42
46	AD	CD	40
45	BD	AB	28
20	AC	AD	19
9	B	A	8
5	A	B	7
3	C	C	3
1	D	D	2
0	-	-	0

AD	BC	12	PO	
BD	AC	8		EF
		20		

R4

	1	2	
100	ABCD	ABCD	100
97	ABC	BCD	95
95	ACD	ABD	91
93	BCD	ABC	86
87	ABD	ACD	82
60	BC	BD	64
47	AB	BC	52
42	CD	AC	51
35	AD	CD	***46***
33	BD	AB	32
29	AC	AD	28
9	C	B	18
7	A	D	17
6	B	C	11
3	D	A	6
0	-	-	0

AB	CD	23	PO	EF
CD	AB	1		
		24		

R5

	1	2	
100	ABCD	ABCD	100
96	ABC	BCD	97
91	ACD	ABD	93
90	BCD	ABC	88
83	ABD	ACD	86
60	BC	BD	64
56	AB	BC	***46***
52	CD	AC	41
45	AD	CD	39
39	BD	AB	35
31	AC	AD	30
14	C	B	16
13	A	D	14
8	B	C	7
2	D	A	4
0	-	-	0

AD	BC	22	PO	
BC	AD	1	PO	
AB	CD	1	PO	EF
		24		

Appendix II: 3-Person Bargaining Games

The matrices below are rearranged to show the allocations where inequality aversion may play a role along the diagonals. In the experiment the columns and/or rows were arranged differently. The chosen allocations are indicated below the matrices. The first row of each allocation indicates which individual gets the good of the corresponding column; the second row indicates what money amount was added to a good. For instance, in round 1 of 3PERS-1 the first allocation was chosen 8 times. Here person 1 gets good A and 1 Taler, person 2 gets good B and 6 Talers, and person 3 gets good C and 1 Taler. The last allocation was chosen only once; here person 2 gets good A and 3 Talers, person 1 gets good B and 3 Talers, and person 3 gets good C and 2 Talers.

Experiment 3PERS-1

R1

	A	B	C
1	45	35	20
2	35	40	25
3	50	5	45

m=8

				16
PO	1	2	3	8
	1	6	1	
	1	2	3	2
	0	5	0	
PO	1	2	3	2
	3	3	2	
PO	1	2	3	1
	3	5	0	
	1	2	3	1
	2	3	2	
PO	1	2	3	1
	2	4	2	
	2	1	3	1
	3	3	2	

R2

	A	B	C
1	38	31	31
2	33	34	33
3	60	2	38

m=13

				15
PO	1	2	3	10
	3	7	3	
PO	1	2	3	2
	4	5	4	
PO	1	2	3	1
	5	5	3	
PO	1	2	3	1
EC	3	4	6	
	1	2	3	1
	6	7	0	

R3

	A	B	C
1	45	35	20
2	35	40	25
3	50	5	45

m=17

				17
PO	1	2	3	12
	4	9	4	
PO	1	2	3	2
	5	7	5	
	1	2	3	1
	5	6	5	
PO	1	2	3	1
	6	6	5	
PO	1	2	3	1
	12	3	2	

R4

	A	B	C
1	38	31	31
2	33	34	33
3	60	2	38

m=7

				18
PO	1	2	3	14
	1	5	1	
PO	1	2	3	2
	2	3	2	
PO	1	2	3	1
EC	0	3	4	
PO	1	2	3	1
EC	1	2	4	

Experiment 3PERS-2

R1

	A	B	C
1	45	25	30
2	30	45	25
3	50	5	45

M=5

				18
PO	1	2	3	6
EF	0	0	5	
PO	1	2	3	6
	0	5	0	
PO	1	2	3	4
	5	0	0	
PO	3	2	1	1
	0	5	0	
	3	1	2	1
	0	5	0	

R2

	A	B	C
1	38	31	31
2	33	34	33
3	60	2	38

M=7

				18
PO	1	2	3	10
	0	7	0	
PO	3	2	1	4
EC	0	0	7	
EC	1	2	3	2
	0	0	7	
PO	1	2	3	2
	7	0	0	

R3

	A	B	C
1	45	15	40
2	30	45	25
3	50	5	45

M=5

				17
PO	3	2	1	11
EF	0	0	5	
PO	1	2	3	4
EF	0	0	5	
PO	3	2	1	1
	0	5	0	
PO	1	2	3	1
	0	5	0	

R4

	A	B	C
1	38	31	31
2	31	38	31
3	60	2	38

M=7

				16
PO	3	2	1	9
EF	0	0	7	
EC	1	2	3	3
	0	0	7	
PO	1	2	3	3
	7	0	0	
PO	1	2	3	1
	0	7	0	

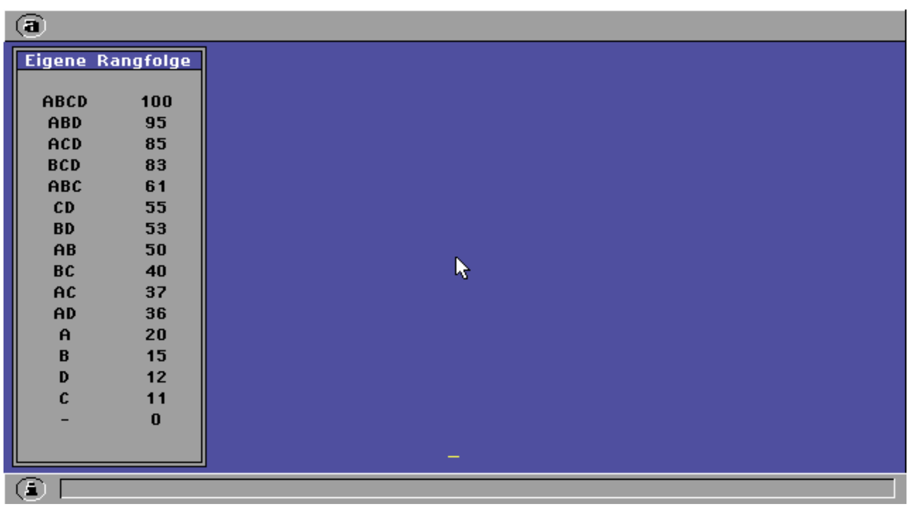
Appendix III: 2-Person Bargaining Games Sample Instructions (2PERS-2) and Screenplots

(The following is a translation of the German instructions – as close as possible to the German original. The original instructions are available upon request from the authors.)

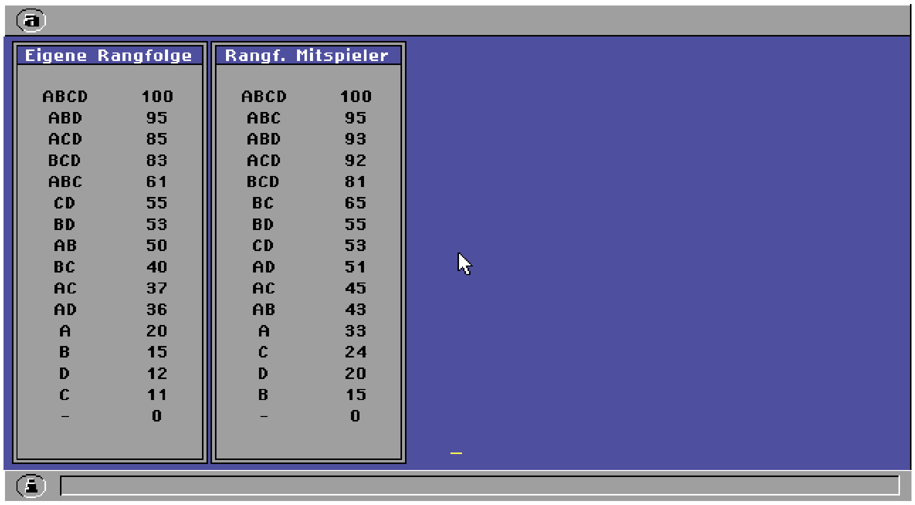
In this experiment you will repeatedly have to distribute several goods between yourself and a partner. The experiment has five independent rounds, each of which you will play with a different partner. In each round you will be given four goods, and you will have to agree with your partner on a distribution of these goods.

There will be four new goods in each round. The goods are referred to as A, B, C and D, respectively. You can think of any kind of object and any kind of division problem. The goods themselves are indivisible, i.e. each good can either be given to you or to your partner. All goods have a positive value. The more goods you receive, the better. However, the value of the goods is different for you and your partner. In each round, we give you a ranking of the bundles of goods in which the values of the bundles are listed in descending order. In each round, you will be given a new ranking. The ranking gives the value of each bundle of goods in Taler (T), our experimental currency. If you agree with your partner on a distribution of goods, you will receive the Taler amount corresponding to your bundle of goods. At the end of the experiment, these Taler amounts will be converted in Deutsche Mark (DM) and paid out to you.

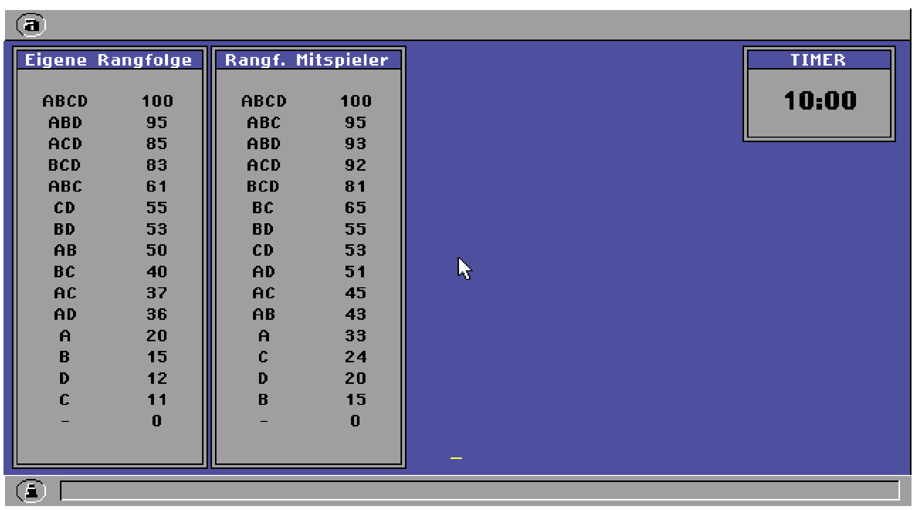
For example, your ranking could look as follows:



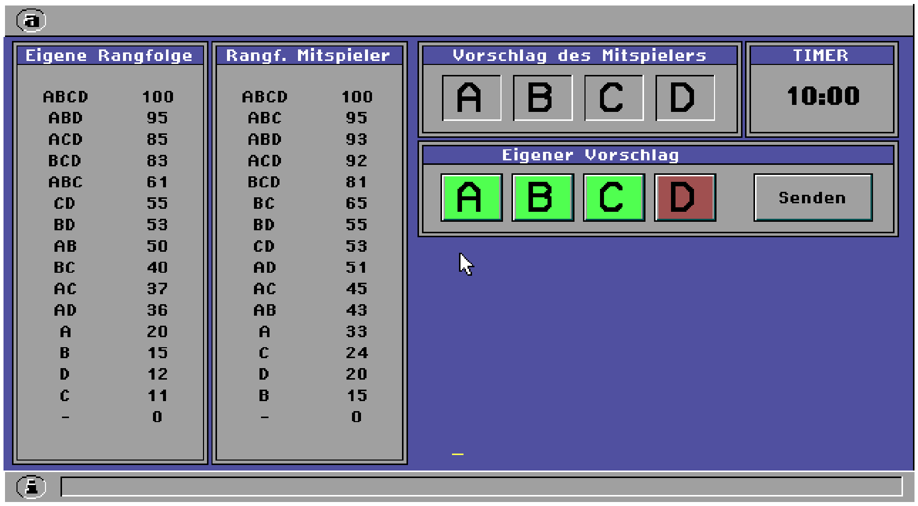
In this case, your most preferred bundle consists of goods A, B, C and D; it is worth T 100. Thus, if you and your partner agreed that he gets nothing and you get all four goods, then you would receive T 100. Your second best bundle is ABD, for which you would receive T 95 if you agreed with your partner that you get ABD and he gets C. Observe that the value of bundles of goods cannot be derived from the values of the single goods. For instance, good C alone is worth T 11 and good D alone is worth T 12, but both goods combined (CD) are worth T 55 to you. It is also possible that a good is worth little when added to another bundle, e.g. the bundle ABD is worth T 95 to you and adding C increases the value of the bundle only to 100 (ABCD), although good C alone is worth 11. In this case, good C does not add much value to the bundle ABD. The goods complement each other in different ways depending on the specific goods with which they are combined. Therefore, for all evaluations in this experiment you have to look at all bundles of goods and not only at the values of single goods. Your partner also gets a ranking of his valuations. On the screen, you will see your partner's ranking next to your own. This may look as follows:



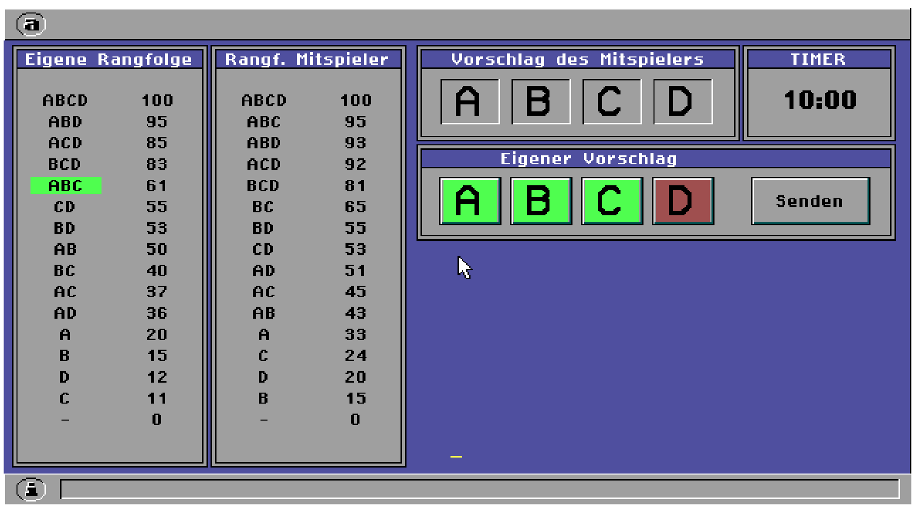
Please start each round by carefully looking at both rankings. The rankings will be different in each round. Each round of this experiment lasts 10 minutes at most. This time is indicated at the top right side of the screen and will be counted down to 0:00 during the round. Within this time span you have to reach an agreement with your partner on who gets which good. If you do not agree within 10 minutes, neither of you will receive anything in this round.



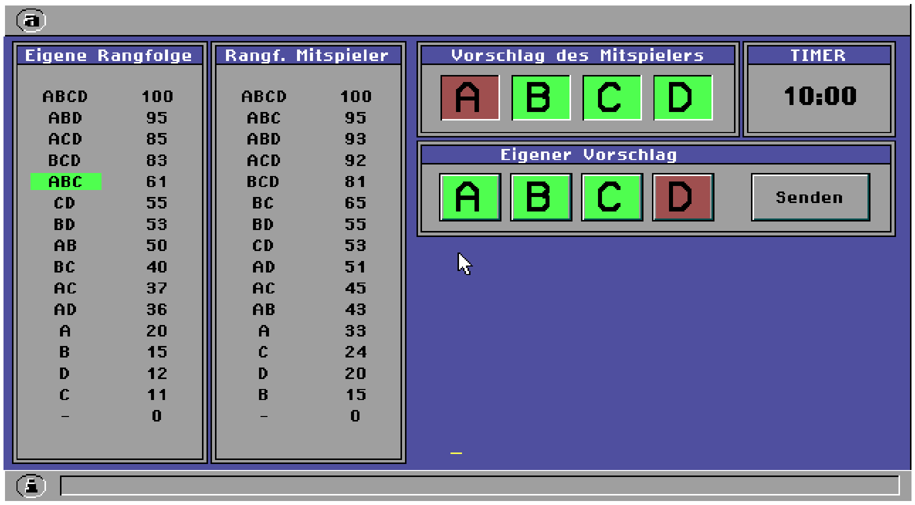
You reach an agreement with your partner by sending him a proposal or by waiting for his proposal. Each of you can make a proposal at the same time. Your partner's proposal appears in the top middle section and your own proposal appears directly beneath. In *both* proposal lines, the goods you get appear in *green*, those received by your partner in *red*. To make a proposal, select the goods you want to receive by clicking on the corresponding buttons, and then send the proposal by clicking on the "send" button.



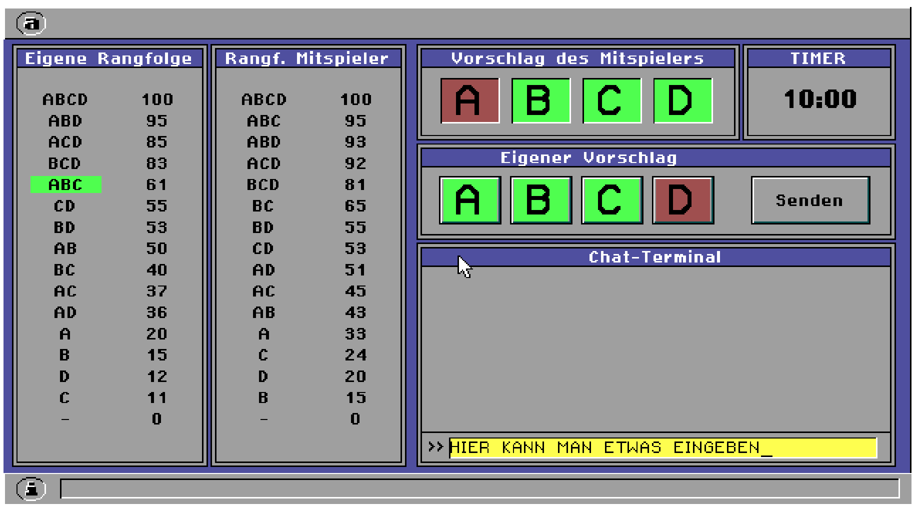
You can change your proposal at any time by clicking on the A, B, C, D buttons. Every click changes the color of the button and therefore moves the good from you (green) to your partner (red) or vice versa. Unless you send your proposal, your partner cannot see your current selection. The most recent proposal you sent can be seen in your ranking on the left – your corresponding bundle is shown in a green box.



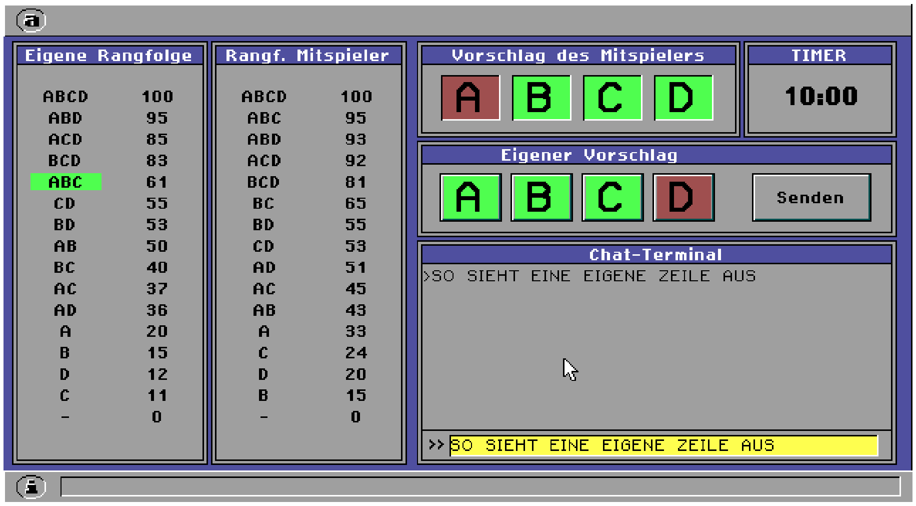
Do not delay sending your proposal because your partner will otherwise not know what you propose. You can change your mind at any time and send a new proposal.



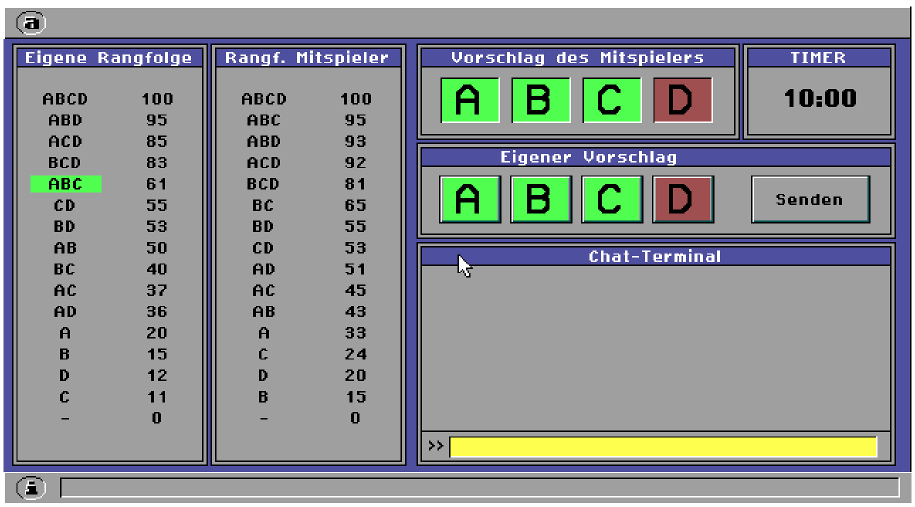
In order to convince a partner to accept your proposal, you can exchange messages in a "chat" window at the bottom right by commenting on your or your partner's proposal. To write in the chat line (max. 80 characters), you have to click on it with the mouse. Press the "enter" key to send a comment. If you want to leave the chat line without writing anything or without sending a comment, you have to press the "Esc" button. If you want to change your proposal after having sent a comment, you will need to leave the chat line first.



Your own comments appear in the chat terminal window with a leading ">" sign; your partner's comments are shown without any additional sign at the beginning.



If the colors of all buttons in your proposal coincide with the colors of the buttons in your partner's proposal, then you have made identical proposals.



You will then be asked whether you want to accept that proposal.

If you and your partner select “Accept” the proposal is accepted and the round is over. If neither or only one of you accepts the proposal, then the round continues, i.e. you can make new proposals or repeat old proposals, and chat. A round is over either if you have both accepted a proposal or if the time limit is reached. If the round has ended before the time limit, you will have to wait until the round is over for all other players – this will be indicated by an acoustic signal. Then, the next round starts for everybody.

At the end of each round you receive the Taler amount corresponding to your bundle of goods. If you did not reach an agreement with your partner you receive no bundle of goods and therefore no Taler amount. The Taler amounts you received will be added over the rounds and converted into DM at the end of the experiment. T 12 equal DM 1.

You will play with a different player in each round of the experiment, hence you *never* play with someone you have already played with. You and your partner *do not know* with whom you play; you will be matched anonymously. What proposals you make, what comments you send, and what bundle of goods you receive in any given round has *no* impact on your or your partner’s ranking of bundles, or on the matching of partners in future rounds.

Please do not mention your name and do not make any comments that could reveal your identity. If you violate this rule you will receive no payment!

All relevant information will appear on the screen. A status line at the bottom of the screen indicates the current state of the experiment. Before starting the experiment, you receive a number that corresponds to your computer terminal and you will be paid at the end based on your number.

Do you have any questions?
Please switch off your cell phones for the duration of the experiment.
Thank you for your cooperation.
Good Luck.

Appendix IV: 3-Person Bargaining Games Sample Instructions (3PERS-1) and Screenplots

(The following is a translation of the German instructions. It is as close as possible to the original. The German instructions are available upon request.)

In each round of this experiment you will have to distribute three goods and a money amount between you and two other players. You will be matched with a different group of players every round and there will be new goods and a new amount of money. The rounds are independent of each other.

The three goods will be labeled A, B, and C; they can stand for any kind of object. The goods are indivisible, i.e. an object has to be given as a whole to one of the three players. You can split the money any way you wish as long as each individual receives an integer amount; you do not need to distribute the whole amount of money.

At the beginning of each round you will learn what your player number is for that round, and how much money and how many objects there are. In the example below, you are player II in the first round.

Each object has a positive value. The individuals you are matched with value objects differently from you. In the top center of the screen you are shown a matrix that indicates how each of you values the different objects. Object values are indicated in Talers – the experimental currency. In the example shown below, you are player II; good A has a value of 50 Talers for you, good B of 20 Talers, and good C of 30 Talers. Player I attaches Taler values of 60, 15, and 25 to goods A, B, and C respectively. For player III goods A and C have a value of 35, whereas good B has a value of 30.
If, for instance, the three of you agree that player 1 receives good B, you, being player II, get good A, and player III gets good C, then player I receives 15 Talers, you have 50 Talers, and player III has 35 Talers. In addition to the three goods there are 5 Talers to be distributed in this round; the amount available in any round is shown at the top right under “Info”. Here, there are 5 Talers available. One possible allocation would be to give each player 1 Taler. If you agree on that division together with the object distribution just described, then player I would have 16, you 51, and player III 36 Talers at the end of round 1.

The Taler amounts received in the four rounds will be added up. At the end of the experiment, the total will be converted into Euros at an exchange rate of 16 Talers = 1 Euro and you will be paid the appropriate amount.

In each round, you receive the agreed-upon amount only if you and your matching partners agree on a division of the objects and money before the available 12 minutes are up. Time is counted down (in minutes and seconds) at the right top of the screen. If the three of you do not agree within the allotted time, then nobody in your group receives anything for that round. Whether you agreed with your partners in earlier rounds and if so, what you agreed upon, has no impact on the division problems in later rounds.

You should start each round by closely inspecting the payoff matrix at the top center. You reach an agreement on an allocation with your matching partners by exchanging proposals. Once your proposals conincide, you will be asked to confirm your choice. The round is over for your group if the three of you all confirm your choices. Otherwise you can continue bargaining with each other until you either agree or time is up.

To select an allocation you have to click on the appropriate buttons in the matrix at the top center under "Mein Vorschlag". The buttons you have selected are shown in green. In the above example you are player II and you assigned good A to player I, good B to yourself, and good C to player III. You can change the allocation by clicking on different buttons. For instance, if you now wanted to allocate good A to yourself, you would need to click on the button labeled "50" in column "A" and row "Spieler II". The "50" button in your row will turn green, the "60" button in player I's row in the same column will turn grey.
To determine the Taler amounts you assign to each player, please move the cursor into the fields in the column "Taler" and type the amount you want to assign to a player. The money has to be split in integer amounts. If you try to assign more money than available, the last entry will be reduced to match the sum of individual amounts to the available total. You exit any field in the "Taler" column by either hitting the "Enter" or the "Esc" key. Hitting "Esc" sets the money amount to zero in that field. If instead you hit "Enter" the number you typed in will be shown. If you use a non-numeric symbol in a Taler amount field, then that field will be set to zero.

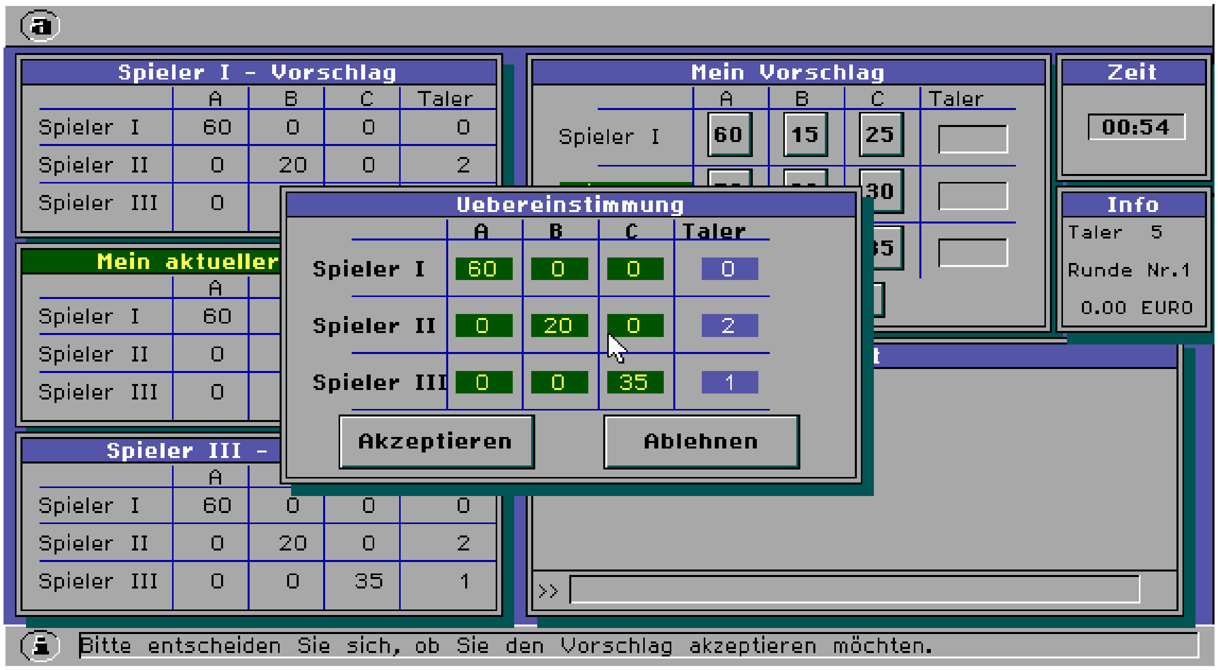
Your matching partners will be able to see your proposals only if you send them. Also, changes you make to your proposal can be seen by the other players only if you send them. To send a proposal you have to click on the "Senden" button at the bottom of the payoff matrix. You can send a proposal only if each good has been assigned to one of the three players.
On the left hand side of the screen you can see all the currently valid proposals. In the example below, player I's current proposal is that player III gets all goods and 1 Taler, whereas player II (you) and player II agree that they want to give good A to player I, good B and 2 Talers to player II, and good C and 1 Taler to player III. If a player has not yet sent a proposal, all entries are zero in the appropriate matrix on the left.

As mentioned before, you have to agree on an allocation within 12 minutes; otherwise you receive no payoff for that round. You can support your proposal and comment on proposals by the other two by sending messages to your matching partners.
To compose a message, move the cursor into the message field at the very bottom underneath the chat window. You can type up to 80 symbols at once. A message is sent once you hit the “Enter” key. If you want to send messages longer than 80 symbols, then compose the message row by row and send each off before composing the next.

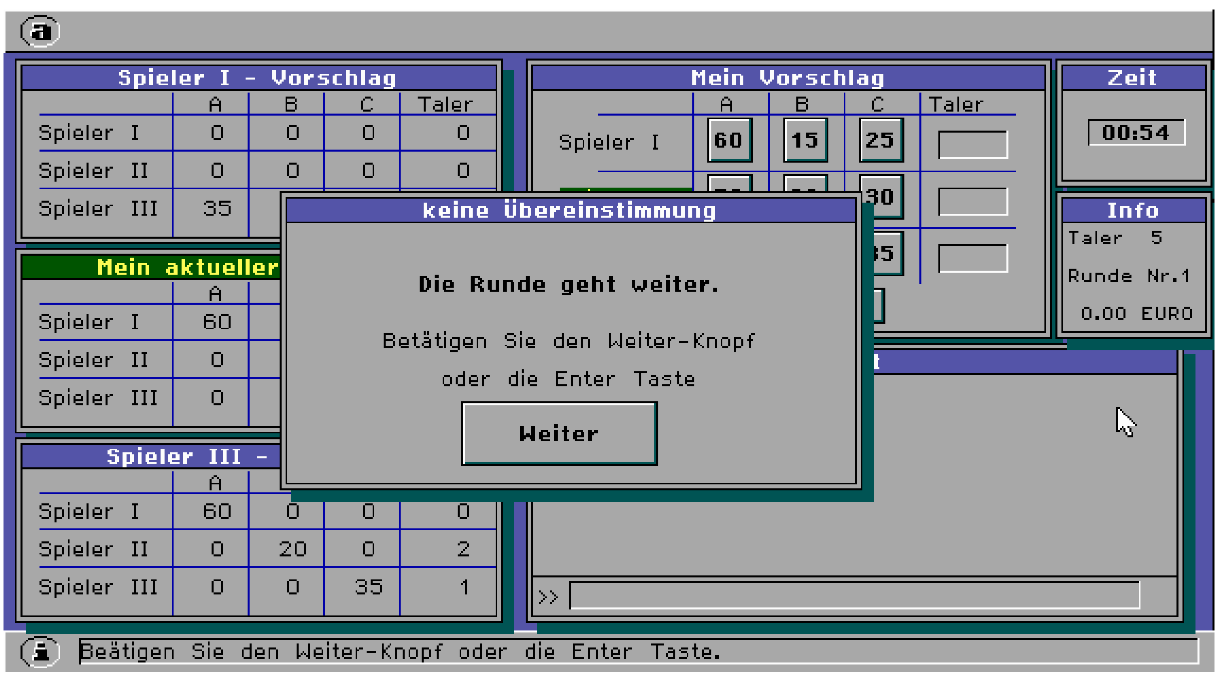
Messages are shown in the chat window above the message field. Each message is preceded by an identifier S1, S2, or S3 indicating the author of the message.
If you do not want to send a message after all, then hit the “Esc” key to leave the message field. You can change your proposal in the matrix at the top only if the cursor is no longer in the message field (use “Esc” or “Enter” to leave the latter).

As soon as all three players have sent a proposal, it will be automatically checked whether they coincide. You will be told if that is not the case. Please confirm the message by clicking on the “Weiter” button, otherwise neither you will be able to make any further proposals. Hitting the “Weiter” button will delete your own proposal from the left matrix on your own screen (not on those of the other players). You will continue to see the proposals your matching partners made until they change them. The matrix at the top will still show your latest proposal, which you can send again by hitting the “Senden” button, or you can change the proposal and then send it off. Alternatively, you can first discuss the proposal with your partners by sending messages. The program will check whether your proposals coincide until all three players have either sent a new proposal or resent the old proposal. You can keep sending new and old proposals at any time, also if your matching partners have not yet sent a proposal or changed their latest proposal. Keep in mind that you have no more than 12 minutes to reach an agreement.

You will be shown a message window with the proposal if you and your matching partners all sent the same proposal. You will be asked to confirm your choice. Choose “Akzeptieren” if you wish to confirm, “Ablehnen” if you do not wish to confirm the proposal.
The proposal is accepted and the round is over if the three of you accept. If, instead, at least one of you rejects the proposal, then you will get a message to that effect; you will have to confirm the message by hitting “Weiter”.



Please do this asap so that you can continue bargaining. Your own last proposal will be deleted on the left hand side, but will still be indicated at the top. The other players' last proposal will still be shown on the left. You can resend your old proposal or come up with a new one. Don't forget to (re)send a proposal. Nothing will happen until each of you has sent a new or old proposal.



A round is over if all groups have settled on an allocation or once time is up. If you agreed on a proposal before the 12 minuters are over, then you may have to wait until all other groups also reach an agreement. Please hit the "Weiter" button immediately once you learn that the round is over for you. You will hear a beep when a new round starts.

In each round you are matched with different individuals; you never meet the same person twice. Matching is anonymous; none of you knows who you are matched with.
Please do not identify yourself in any of your messages and do not provide any other information that may identify you. You will not receive any payoff if you break this rule.

All relevant information will be indicated on the screen during the experiment. You can check at what point the experiment is by following the information at the very bottom of the screen.
You will be assigned a computer by drawing a number. You will have to return that number at the end of the experiment to receive your payoff.

Any questions?

Please turn of your cell phones.
Thank you for your cooperation.
Good luck.

Appendix V: Matching

Experiment 2PERS-1 and 2PERS-2

R1	
1	5
2	6
3	7
4	8

R2	
1	8
2	5
3	6
4	7

R3	
1	2
3	4
5	6
7	8

R4	
7	1
8	2
5	3
6	4

R5	
6	1
7	2
8	3
5	4

Experiment 3PERS-1 and 3PERS-2

R1		
1	2	3
4	5	6
7	8	9

R2		
1	4	7
2	5	8
3	6	9

R3		
1	5	9
2	6	7
3	4	8

R4		
1	6	8
2	4	9
3	5	7

Each participant is represented by a number. Each row corresponds to a matched pair/group. R1 through R4 and R5, respectively, are the rounds of each session.

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