Interpersonal allocation behavior in a household savings experiment

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Abstract

We investigate the intertemporal and interpersonal allocation behavior of spouses with different deterministic life expectations in an experiment. In each period of their life both partners propose a consumption level one of which is then randomly implemented. In spite of the complex dynamics optimal behavior is rather simple and straightforward in the sense of conditional consumption smoothing. A substantial number of participants does not care whether their partner receives any payoff. This selfish behavior is punished by their partners. On average participants stay on egoistic consumption paths, although in later periods their behavior shifts in the direction of consumption paths leading to equal payoffs.

Keywords: experimental economics, considerate attitudes, random dictatorship

JEL-Classification: C73, C91, D91

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I. Introduction

Traditional economic models treat households as a single individual, and do not allow for separate preferences and possible conflicts of interest between the individuals in a partnership. Due to the gender specific differences conflicting interests of spouses are, however, the rule rather than an exception. In fact, wives are typically younger than their husbands, and, women generally live longer. These two facts imply that preferences about saving may differ between wife and husband. There is, indeed, empirical evidence for this hypothesis indicating that wives find saving more important than their husbands [e. g. Euwals et al., 2000] and that individual income is not pooled for all household consumptions [e. g. Phipps and Burton, 1998].

Most theoretical and to the best of our knowledge all [see the survey by Anderhub and Güth, 1999] experimental studies of saving or intertemporal allocation rely on one-person families. Only recently two-person households have been investigated more closely [see, e. g., Browning, 2000, Wirl and Feichtinger, 2002]. The usual tradition in the literature on intra-household allocation [e. g., Chiappori, 1988, Manser and Brown, 1980, McElroy and Horney, 1981] is to assume efficient cooperation, e. g. by imposing the (asymmetric) Nash bargaining solution, rather than specifying a non-cooperative setup with an inefficient solution that is open for Pareto-improvements.

The ways in which couples decide how much to consume and how much to save will mainly depend on who has been, is, or will be the major bread winner [see Browning et al., 1994, Vogler and Pahl, 1994, Ward-Batts, 2000] and who has the higher relative expertise [Meier et al., 1999] what may be justified by some marriage bargaining model [see, for instance, Chen and Woolley, 2001, Lundberg and Pollak, 1996].[1]

In this study, however, we are not mainly interested in household decision making but use the household as a more natural frame to investigate interpersonal allocation behavior. That the allocation task is embedded in a savings decision task should reduce the possible demand effect for 'fair' behavior which might be implicitly implied by standard dictator and ultimatum experiments [see Roth, 1995b, for a discussion of this matter].

1 For a more general survey on decision making within partnerships see Kirchler et al. [2001].

For our experiment we do not want to impose specific rules of bargaining. By assuming periodic random dictatorship we allow both partners to be decisive. Thus they confront the different incentives of both partners and must anticipate the future allocation choices of the other. Dictatorship itself is a rather tough method to resolve interpersonal conflicts. It is surprisingly often used outside the lab because of its obvious procedural fairness when being implemented in the form of random dictators. Emerical examples of random procedures are lotteries to allocate goods and burdens [see Elster, 1988]. Judges, jurors and soldiers are, for instance, frequently selected by a random device. Repeated random dictatorship is not only procedural fair but, as will be rigorously shown, for the experimental game also incentive compatible. By investigating the interpersonal allocation behavior in a more natural context the artificiality of the standard dictator game is reduced. What should strengthen the external validity of our findings. Accordingly, this paper is a contribution in a novel context to the literature on interpersonal allocation behavior.

We basically adopt the scenario of Anderhub et al. [2000]

- by eliminating all uncertainty about life expectation (which is the only uncertain variable in their dynamic optimization task) and
- by considering couples, e. g. a household comprising a wife, who lives for 6 periods, and a husband with only 4 periods to live.

In periods 1 to 4 when both spouses enjoy the same public[2] consumption it is decided independently by chance whether she or he determines how much is spent jointly on consumption in this period. Intertemporal payoffs are simply the products of periodic consumption amounts. It turns out that conditional optimal behavior does not depend on what the other intends to do: Optimal behavior requires perfect consumption smoothing over the own remaining life time where optimality means to maximize one's own intertemporal payoff expectation. Due to repeated random dictatorship consumption sequences are stochastic.

We do not expect that all or most participants in the role of the husband with his shorter "life" will actually leave nothing for their "spouse", when actually becoming the dictator in period 4, their last period. Rather like in other experiments exploring

2 Allowing for private consumption of one or both spouses would have complicated the derivation of the individually optimal consumption trajectories and questioned that spouses would be aware of what is best for them, respectively their partner.

social interaction in small groups [see the surveys by Camerer, 2003, Roth, 1995a] we expect considerate attitudes, e. g. in the sense that the other earns at least something positive or nearly as much as oneself.

The experiment allows for "reincarnation", i. e. participants experience successively two "single" lives and eight "couple" lives without changing their role and their partner. In dynamic allocation tasks it seems utterly necessary to allow for learning [see Anderhub and Güth, 1999]. In actual life there is no "reincarnation" but one may learn from others' experiences like those of parents and other relatives which, in our experiment, are substituted by own experiences.

In section I we introduce the dynamic decision model with the two players F(emale) and M(ale) which is solved for the specific constellation used in the experiment. The experimental design is introduced in section II. After analyzing the results in section III our main conclusions are finally summarized (section IV).

II. The Dynamic Allocation Game

For the two players F and M let f, respectively m denote their life expectations where we realistically assume

$$(1) \quad f > m > 1,$$

i. e. wives live longer, but also males face an intertemporal allocation problem. Except for the difference in life expectations we do not impose gender differences. More specifically, both partners evaluate a pattern $\zeta = (C_1, \ldots, C_T)$ of consumption values C_t in periods $t = 1, \ldots, T(\leq f)$ according to

$$(2) \quad U_F = \prod_{t=1}^{f} C_t,$$

by the wife, respectively by the husband according to

$$(3) \quad U_M = \prod_{t=1}^{m} C_t,$$

since (again for the sake of simplicity) we disregard discounting. Thus partners would choose the same consumption pattern if they would live equally long and were opportunistic maximizers.[3] Note that we easily could have chosen a frame suggesting that such a partnership is beneficial. We also abstract from other regarding concerns [like, for instance, Dufwenberg, 2002] since these are not meant to apply and, if so, are not particularly suited to dynamic games.

How is ζ actually determined? We assume that in every period t both partners F and M submit a proposal y_t and x_t, respectively, how much to spend in period t and that it is then independently and randomly decided (with equal probabilities) in each period $t = 1$ to m which of the two proposals is implemented, i. e. whether $C_t = y_t$ or $C_t = x_t$ applies. Of course, consumption patterns ζ are restricted by the available funds. Let $W_1 (> 0)$ denote the initial wealth which can be used for consumption purposes. Since

$$(4) \quad W_t = W_{t-1} - C_{t-1} \; \forall \, t \geq 2,$$

early consumption restricts later consumption so that

$$(5) \quad 0 \leq x_t \leq W_t, \; 0 \leq y_t \leq W_t \text{ and thus } 0 \leq C_t \leq W_t$$

must hold for all periods $t = 1, 2, \ldots$.

Except for the fact that C_t is randomly dictated by wife or husband this resembles the experimental situation which has already been thoroughly explored for one-person families in a series of studies [Anderhub and Güth, 1999]. Life expectation in these experiments has been highly stochastic what we avoid by assuming given and commonly known parameters f and m. How will husband M cope with the fact that F lives longer than he does? Will he leave enough for her or does he disregard her longer planning horizon, e. g. by arguing that she will take care for the periods after m by herself, say, by her consumption proposals y_t?[4]

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3 Most models of marriage bargaining deny such a consensus in view of gender specific needs which we are neglecting here (for a discussion of such needs and illuminating experimental evidence see Güth et al. [2000]). It is assumed here since we want to focus on the conflicting interests due to different life expectations.

4 As will be shown further, since he would spend everything in period m in case x_m is implemented, the excuse is rather dubious.

Let us discuss the optimal behavior assuming perfectly opportunistic – in the sense of own payoff concerns only – and risk neutral players before introducing the experiment and analyzing its results. We assume risk neutrality since, due to their many "lives", participants should be mainly motivated by what they earn on average [see also Eichberger et al., forthcoming, Rabin, 2000]. Checking the constructive proof (see Appendix) shows that we mainly rely on dominance arguments in the sense of dominant strategies. Thus, unlike in other game theoretic contexts, risk neutrality has not to be commonly known.

For $i = F, M$ a strategy $s_i(\cdot)$ must assign a proposal (y_t, respectively x_t) for the consumption level C_t in period t for all residual wealth levels W_t in t and for all possible periods t. Optimal choices $y_t^\star(W_t)$ and $x_t^\star(W_t)$ will, of course, anticipate rational future decision making. By applying backward induction one can prove

$$(6) \quad y_t^\star(W_t) = \frac{W_t}{f - t + 1} \quad \text{and} \quad x_t^\star(W_t) = \frac{W_t}{m - t + 1},$$

where, of course, $y_t^\star(\cdot)$ applies to periods $t = 1, ..., f$ and $x_t^\star(\cdot)$ only to periods $t = 1, ..., m$.

It is quite surprising that although the partner also influences the actually resulting consumption pattern, both partners behave as if they would live alone and smooth consumption over own life time.[5] Although the decision problem is quite complex, in the sense of a dynamic game, the optimal behavior is obvious and prominent. We do not expect our participants to understand that they cannot do better than simple consumption smoothing. However, proposals may tend to approach consumption smoothing when partners become more experienced. An alternative hypothesis to learning opportunism in this sense is that partners aim at consumption sequences that yield more or less equal or at least positive payoffs for both partners.

5 Intuitively one would have expected this result only for overall random dictatorship in the sense that either F or M determine the consumption level of all periods $t = 1, \ldots, m$ which they jointly experience. This incentive compatibility seems, however, to apply also to repeated random dictatorship.

III. Experimental Design

In the experiment (see Appendix A for instructions) a participant experiences 10 successive "lives", always assuming the same role F or M what should provide better chances for learning. The first two lives are "single lives", whereas lives 3 to 10 are "couple lives". Within the couple lives there is no rematching, the participants are playing 8 lives with the same partner. Thus, "reincarnation" only allows to learn how to "live" with the same partner and not to diversify by playing differently with different partners.

We ran two treatments with different initial endowments. Thus, the potential maximal payoffs of both partners (see Table 1) are either very close – the equal opportunity treatment ([EO], $W_1 = 13$) – or are rather different – the unequal opportunity treatment ([UO], $W_1 = 21$). Whether or not decisions are driven mainly by fairness concerns may thus be explored in a rather straightforward way as a between-subjects measure. A more subtle within-subjects measure is derived later. Payoffs are measured in points, summed up over all "lives", and then transformed into German Mark (DM) by 10 points $=$ DM 0.47 for $W_1 = 13$ and 10 points $=$ DM 0.03 for $W_1 = 21$. In addition to their earnings participants received a show up fee of DM 5.00.

We ran 6 sessions (3 sessions with $W_1 = 21$ and 3 sessions with $W_1 = 13$) each comprising several couples at the Humboldt-University of Berlin. The participants were randomly recruited from a pool of undergraduate students of Economics and Business Administration who stated their general willingness to participate in an experiment before. A session typically lasted about 90 minutes. For the analysis we have altogether 35 couples, 18 couples with $W_1 = 13$ and 17 couples with $W_1 = 21$.

IV. Experimental Results

Average earnings for F and M partitioned for different phases (single live 1 and 2, early couple lives 3 to 6 and late couple lives 7 to 10) are listed in Table 1. Similar to the maxima joint total payoffs of each couple were significantly higher in the equal opportunity [EO] treatment than in the unequal opportunity [UO] treat-

Table 1: Average Earnings

treatment	$W_1 = 13$		$W_1 = 21$	
role	F	M	F	M
all lives (in DM) excl. show-up fee	19.26	27.88	20.06	11.11
$(W_1/t)^t$ with $t \in \{m, f\}$	103.45	111.57	1838.27	759.69
single lives (in points)	84.15	102.82	1348.59	622.01
	(23.316)	(14.477)	(501.431)	(186.417)
early couple lives 3–6 (in points)	27.88	46.52	417.67	288.16
	(19.431)	(19.924)	(217.556)	(135.203)
late couple lives 7–10 (in points)	32.51	50.00	579.71	326.53
	(20.489)	(15.959)	(374.977)	(117.126)
Wilcoxon test (early $<$ late) p-value	0.367	0.209	0.060	0.164
	0.142		0.028	

Note: Numbers in parentheses denote standard deviations. The Wilcoxon test p-values denote the p-values of the single sided paired test on early and late couple lives earnings of the individuals (first row) and households (second row).

ment (Wilcoxon signed rank test[6], $p < 0.001$). Due to the experimental design M's total payoffs are higher than F's payoffs in [EO] ($p = 0.003$) but lower in [UO] ($p < 0.001$). Though the individual average earnings do not change significantly over time household earnings in the [UO] treatment are significantly higher during late couple lives than during early lives ($p = 0.028$). In the following we state a few prominent observations which we then try to justify individually.

Observation 1 *Very few M-players are 'kind' to their F-partner. But, this does not matter for average payoffs of either one.*

If our participants care for each other M's relative total payoff should be higher in the [UO] treatment than in the [EO] treatment and vice versa for F's relative total payoff as a result of counterbalancing the unequal earning opportunities.[7] But, this is not the case. The relative total payoffs do not differ between the two treatments (KS-test, M: $p = 0.513$, F: $p = 0.203$). Another indicator would be the amount left by M-players after the fourth period. In 20 % of all lives the M-player would

6 Throughout the statistical analysis we use the nonparametric Wilcoxon test unless stated otherwise.

7 Whereby the relative life payoffs are calculated as payoff divided by W_1^t with $t \in \{m, f\}$. Total relative payoff is then the average of all relative payoffs over all lives of a couple.

have left exactly two units allowing equal absolute payoffs in this 'life'. Only in 6.7 % of all lives the M-player would have left more than two units leading to a higher payoff for the longer living partner. Henceforth, we will call this kind of behavior, leaving at least two units for the F-partner after one's terminal period of life, 'kind' or 'considerate'.

In no case the M-player showed consistent kind behavior, i. e. at least once during the eight couple lives he completely consumed the endowment in the last period of his life. More than 20 % of all M-players never left anything. There is no significant difference between treatments (two-sample test for equality of proportions, $p = 0.756$). Since there are no differences in relative total payoffs between treatments there is only weak evidence for other regarding preferences in the sense of kind behavior as defined above.

To analyze further considerate behavior, we partition our data into two groups. In the first group we will have all couples with less and equal median frequency of kind behavior in the sense that the M-player left at least two units after his terminal period of life. The second group consists of all couples that showed more than median frequency of kind behavior. Only participants in this group will be called considerate.

Surprisingly, considerate M-players have a total payoff of 0.101 standard deviations above the respective treatment mean even though they propose to consume less. Non-considerate M-players score 0.085 standard deviations below the mean. F-players with a considerate partner have a payoff of 0.032 standard deviations below the mean whereas their counterparts score 0.027 standard deviations above the mean. As a result the joint earnings of households with a considerate husband is 0.026 standard deviations below the respective treatment mean whereas the 'non-considerate' couples score 0.022 standard deviation above the mean.[8] This can be explained by assuming that a non-considerate husband sooner or later faces a non-considerate wife who in period 4 would smooth consumption what increases the joint earnings but decreases what the husband gets.

Finally, there is no significant rank correlation between joint total payoff (measured in standard deviations from the treatment mean) and the number of times the

8 These differences are not significant ($p > 0.2$), though.

Table 2: Random effects probit estimation for consumption proposals of zero by F-players

Dependent Variable: consumption proposals of zero by F-players Method: Maximum Likelihood - Random Effects Binary Probit				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
constant	6.878	2.536	2.712	0.007
treatment dummy	-0.302	0.452	-0.668	0.504
average e_F	-10.331	3.402	-3.037	0.002
Δ_{MF} relative payoff at $l-1$	0.886	0.410	2.160	0.031
$\ln(x_1/x_1^\star)$ if $x_1 = c_1$	2.288	1.240	1.845	0.065
$\ln(x_2/x_2^\star)$ if $x_2 = c_2$	0.587	1.090	0.538	0.590
$\ln(x_3/x_3^\star)$ if $x_3 = c_3$	3.081	0.571	5.390	0.000
Log likelihood	-74.228	Restr. log likelihood		-116.610
Probability(LR stat)	0.000	McFadden R^2		0.363

Note: Current life is denoted by l. The egoistic consumption pattern score e is defined in equation 8.

M-player exhibits kind behavior ($\text{cor} = 0.113, p = 0.259$).

Observation 2 *Participants successfully try to educate their partners by choosing a punishment consumption level of zero. Such a punishment does not hurt an F-player but only her partner. M-players signal their willingness to cooperate by choosing higher than individually optimal savings.*

In 41 (14) out of 280 lives of both treatments F-players (M) chose at least in one period a consumption level of zero and thus may have caused a payoff of zero for both partners in this "life".[9] We estimated a probit model that can significantly explain what triggered the 'punishment' decision of F-players (see Table 2). There is not enough variation in our data to do likewise for the 'punishment' decisions by M-players.

The independent variables are a treatment dummy (0 for [EO], 1 for [UO]), the over all lives averaged egoistic consumption pattern score of the F-player as defined by equation (8) below that varies between 0 and 1 with 1 indicating perfect egoistic conditional consumption smoothing. Further, the difference in the relative

9 "Punishment" may, of course, be the motivation of low consumption choices as well. Since such moderate form of punishment is, however, more difficult to distinguish from "leaving more for the future", it will be neglected.

payoffs in the last life, and the logarithm of the ratios $x_t/x_t^\star$ with $t \in \{1, 2, 3\}$ if the consumption proposal x_t of the M-player is implemented are also included. We include only the first three log-ratios $x_t/x_t^\star$ because the F-player can not observe the fourth consumption proposal before making her own decision.

First, there is no significant treatment effect. Neither is the coefficient of the log-ratio $x_2/x_2^\star$ significant. All other coefficients are significant at least at the 10 % level. The higher the average egoistic consumption pattern score of the F-player the less likely is a consumption proposal of zero. F-players who are mainly concerned about their own payoff engage less likely in trying to educate their partners to be 'kind'. The probability of 'punishment' increases significantly with a higher realized consumption proposal of the M partner in period $t = 1$ and $t = 3$. A clearly non-cooperative signal in the first or third period triggers the punishment decision. Note, that the first period is a very prominent one and that the third period is the last period the F-player can react on such a signal. Finally, the smaller the F-player's relative payoff in the last life in comparison to the M-player's relative payoff the more likely is a consumption proposal of zero. An alternative model using a dummy for zero payoff in the last life instead obtained a lower likelihood. Thus, the model in Table 2 accounts not only for the cases where the M-player leaves nothing for periods 5 and 6 but indeed suggests a more linear relation between obtained payoffs in the last life and the probability of punishing.

After an implemented punishment the egoistic consumption pattern score of M-players decreases significantly in the next life ($p < 0.001$) due to less egoistic consumption level proposals. Thus, at least in the first three periods of the life after a punishment M-players acts as if he intends to leave his F-partner more endowment for consumption after his fourth period of life.

Comparing median total payoffs with and without 'punishment' we find that M-player's total payoff is significantly higher when no punishment occurred ($p = 0.035$ [EO], $p = 0.023$ [UO]) while there is no significant difference in F-player's total payoff ($p = 0.536$ [EO], $p = 0.743$ [UO]). We find no significant differences if we stratify only for punishment decisions of M-players ($p > 0.3$).

A life payoff of zero due to a zero consumption decision does not significantly reduce the total payoff of F-players because they most likely have to endure an M partner who does not leave any or very little endowment for consumption after his

Table 3: Relative to optimal consumption proposal ratios over all couple lives

Period	1	2	3	4	
M-Player	1.080	0.980	0.963	0.858	mean
	0.365	0.283	0.337	0.236	st. deviation
	0.968	0.938	0.949	1.000	median
F-player	1.036	1.043	1.066	1.082	mean
	0.463	0.480	0.449	0.566	st. deviation
	1.000	1.000	1.000	1.000	median

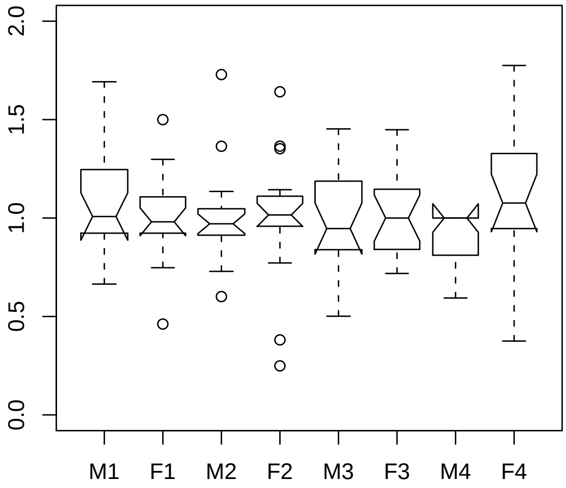
final period of life, anyway. "Wives" seem to accept the burden of educating selfish "husbands" by punishment. Due to the partner design (a pair of participants stays together for all eight couple lives) this can be seen as an attempt of reputation formation.

Reputation formation might also manifest in a specific pattern of consumptions proposals. To further explore this we compute the relative to optimal consumption proposal ratios r defined as

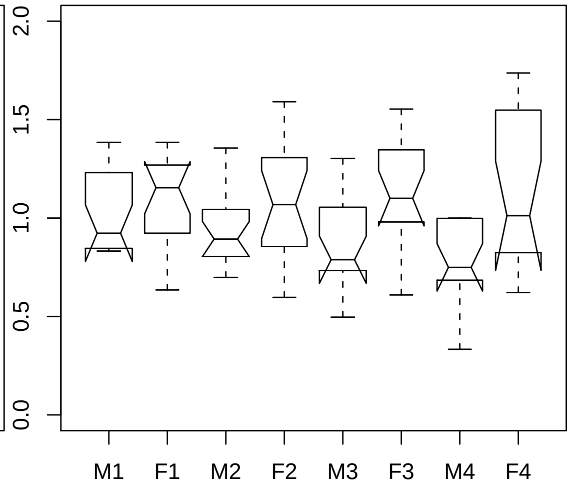
$$(7) \quad r_{M,t} = \frac{x_t(m-t+1)}{W_t} \quad \text{and} \quad r_{F,t} = \frac{y_t(f-t+1)}{W_t}.$$

A ratio of $r = 1$ indicates a conditional optimal consumption proposal. A higher value denotes higher relative (to optimal) consumption, a lower value denotes lower relative (to optimal) consumption. As can be seen in Table 3 both M- and F-players are on average close to the optimal consumption proposal. Averaged over all participants and all lives no pattern different from the optimal behavior is identifiable.

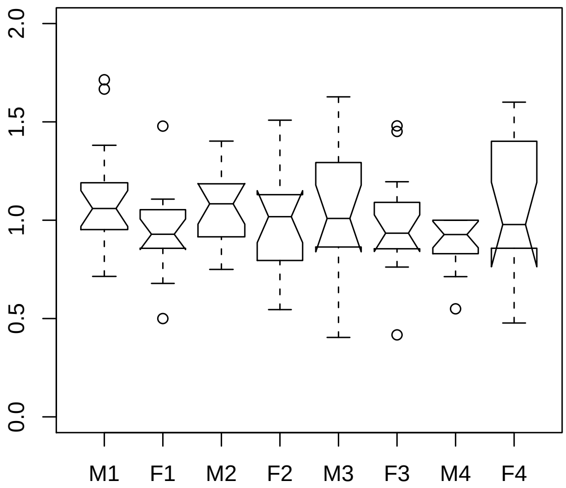
Since learning and reputation formation takes time we partition the data again into 'early' and 'late' couple lives (lives 3–6 and 7–10). Figure 1 shows the box-and-whisker plots of the relative to optimal consumption proposal ratios of all participants for the periods $t = 1, \ldots, 4$ during 'early' and 'late' lives. The two hinges indicate the first and third quartile, the whiskers extend to the most extreme data point which is no more than 1.5 times the interquartile range from the box. The circles denote observations that lie outside of this range. If the notches of two plots do not overlap then the medians are significantly different at the 5 percent level. During early lives the ratios r of M- and F-players are not significantly different from



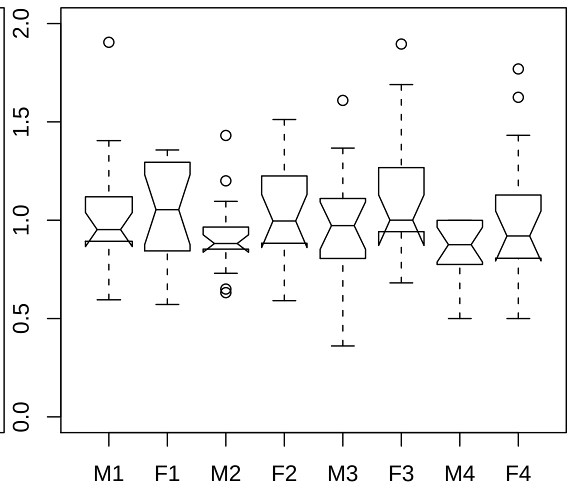
(a) Early couple lives, $W_1 = 13$



(b) Late couple lives, $W_1 = 13$



(c) Early couple lives, $W_1 = 21$



(d) Late couple lives, $W_1 = 21$

Figure 1: Box-plots of the relative to optimal consumption proposal ratios of M- and F-players during 'early' and 'late' lives for the periods 1–4

Table 4: Consumption pattern scores

	pattern	egoistic		equity		joint max	
W_1	player	early lives	late lives	early lives	late lives	early lives	late lives
13	M	0.883	0.850	0.794	0.835	0.698	0.741
	F	0.830	0.797	0.781	0.807	0.679	0.729
21	M	0.865	0.859	0.827	0.845	0.653	0.678
	F	0.826	0.842	0.717	0.738	0.760	0.724

1 in both treatments except for the fourth period in the [UO] treatment in which the median M-player already leaves some endowment for the F-player. During late lives, however, an interesting pattern is observable. M-players consume significantly less then optimal – at least in the [EO] treatment. Conversely, F-players consume more than optimal during the first three periods of their life and then consume the optimal amount in the fourth period. They, thus, seem to reward kind behavior by consuming more what induces higher earnings for their M-partner. This pattern is by far more pronounced in the [EO] than in the [UO] treatment.

It seems that in the [EO] treatment the M-player needs to give a strong signal of cooperation to avoid punishment. In the [UO] treatment the already handicapped M-player does not need such a strong signal. Eventually this may also explain the increase in joint earnings from early to late lives in the [UO] treatment.

Observation 3 *On average both, M and F-players follow more an egoistic consumption path than one leading to equity. They do not maximize joint profits although they slightly care more for equity in later lives.*

For our analysis we introduce three derived measures. Since we are interested in whether and how close our participants approach (conditional) optimality in the sense of conditional consumption smoothing we define first the egoistic consumption pattern score of M-player's consumption proposals per life based on Theil's U-statistic as

$$(8) \quad e_i = 1 - \frac{\sqrt{1/m \sum_{t=1}^{m} (x_{i,t} - x_{i,t}^{\star})^2}}{\sqrt{1/m \sum_{t=1}^{m} x_{i,t}^2} + \sqrt{1/m \sum_{t=1}^{m} {x_{i,t}^{\star}}^2}}$$

and correspondingly for F-players. We calculate the score for both, M and F-players, by using only the first m periods to ensure better comparability. The score e is bounded such that $0 \leq e \leq 1$ with $e = 1$ indicating optimal conditional consumption smoothing. Further, we want to see whether our participants are more likely to follow a consumption pattern that leads to equity or that maximizes the joint payoff of the household. Thus we define the equity consumption pattern score as in (8) by replacing $x^{\star}_{i,t}$ with $\bar{c}_{i,t}$, the consumption proposal that maximizes own payoff under the constraint that the partner will be able to obtain the same life payoff. Finally, the joint payoff maximizing consumption pattern score is defined as in (8) by replacing $x^{\star}_{i,t}$ with $\tilde{c}_{i,t}$, the consumption proposal that maximizes joint payoff.[10] The average consumption pattern scores of our participants stratified for early and late couple lives are tabulated in Table 4.

Over all lives and participants there is a significantly higher egoistic than equity score (M: $p = 0.001$, F: $p = 0.006$) or joint max score indicating that participants behavior is rather driven by individual payoff maximization. We can, however, observe a slight change in the scores over time. Of these changes only the increase in the equity score of M-players in the [UO] treatment is significant at the 5 % level. Regarding the differences between the scores we, however, observe a significant shift towards more joint payoff maximization for M-players in late lives in the [UO] treatment and towards more equity and joint payoff maximization for M and F-players in the [EO] treatment ($\alpha = 0.05$). But the egoistic score is always as least as high as the equity score.

V. Discussion

We have experimentally investigated interpersonal allocation behavior in the context of intertemporal allocation decisions by couples with deterministic life expectations. The F-partner lives longer than her M-partner. The consumption level in each period of a life is determined by random dictatorship. To allow for learning each couple lives eight lives together (no rematching) after two initial single lives. Despite the complex interaction dynamics optimal behavior is rather simple and straightforward in the sense of conditional consumption smoothing over own life time. We ran

10 See the appendix for the derivation of $\bar{c}_{i,t}$ and $\tilde{c}_{i,t}$.

two treatments, one with close maximal potential payoffs and one with very different maximal potential payoffs for each of the player types.

The main effects are: First, in about 20 % of all lives the M-participant intended to induce equity in absolute payoffs and in additional 6.7 % of all lives he would even have granted his partner a higher absolute payoff in the corresponding life. On the other hand, no M-player is persistently generous. Indeed, more than one fifth of all M-participants, regardless of treatment, would leave their partner with a payoff of zero in all eight couple lives. Since considerate behavior is only sporadic it does not matter much for total payoffs. In the end, 'kind' couples are not significantly better off. The above numbers roughly match the empirically observed precentages of dictator offers in the standard dictator game [see Camerer, 2003, chapter 2, for a survey]. This suggests that there is no strong demand effect for fairness in the standard dictator game frame.

Second, participants try to educate their partners by choosing a punishment (consumption level of zero). Such a punishment by F-players is triggered by extreme selfish behavior of her M-partner and does not hurt, on average, an F-player but only her partner. After such a punishment the consumption proposals of the M-player decline. Thus punishment is an effective means of reputation formation. To avoid punishment M-players signal cooperation by choosing less then individually optimal consumption levels. This feature is more pronounced in the equal opportunity treatment.

Finally, even though participants become more concerned about equity over time they continue to be rather opportunistic. They clearly do not try to maximize joint payoffs, i. e. household earnings.

The experiment shows that embedding an abstract decision task like the dictator game in a more natural context allows not only for an analysis of the abstract task but can also help to identify intentions and thus intrinsic motivated and strategic behavior. Additionally, it might reduce a potential demand for specific behavior that is implicitly implied by the abstract decision task. But for all that it can only complement the research on the abstract task and act as a test of robustness of the otherwise observed behavioral regularities. Or else, there is the danger of confounding the effects of the abstract decision task and the context.

Accessorily, this altogether demonstrates that due to intertemporal and interpersonal allocation conflicts household decisions are better analyzed game theoretically rather then being determined by a single decision unit, and that capturing intra-household bargaining, for instance, by the standard Nash [1950] solution and relying on efficiency may not be such a good idea. Even with complete anonymity some participants developed other regarding concerns what supports approaches like the one of Wirl and Feichtinger [2002].

A possible drawback of our experiment could be that we did not explicitly control for the sex of our participants. In addition to gender specific roles there could be gender specific behavior. Common knowledge that a (fe)male participant assumes the $M(F)$-role may be relevant [e. g. Güth et al., 1999]. This is investigated in a follow up study [Büchner and Dittrich, 2003].

Other possible extensions of our theoretical and experimental analysis that shift the focus more on intra-household decision making might

- focus on stochastic life expectations, e. g. like in Anderhub et al. [2000]. Assume, for instance that (fe)male life extends over at least three and at most six periods and that the number of periods is chosen randomly with different probabilities for females and males; or
- substitute repeated random dictatorship by periodic bargaining, e. g. in the sense of Nash [1950] or of ultimatum bargaining [Güth et al., 1982].

The drawback of such generalizations is, of course, that it will be much less obvious what is best for oneself and for one's partner (see Selten and Güth [1982] for an application of repeated Nash bargaining in a dynamic setup) and that personal characteristics of F- and M-participants like risk attitude and analytic skills will become more crucial.

Appendix

A. Instructions (translation)

The instructions for the two treatments differ only in the exchange rate and the initial endowment. Numbers in square brackets are for the [EO] treatment.

The following experiment consists of 10 rounds. A round consists of several periods. In each round, money can be earned in a fictitious currency (points). On completion of the experiment the aggregate of all per-round earnings is paid out in cash, based on the relationship of 10 points = 0.03 [0.47] DM. You will also receive an additional basic amount of 5.00 DM for participating.

In principle, the task of a round is to distribute an initially available money amount S of 21.00 [13.00] points onto several periods.

For greater clarity, the amount of money that is spent by a participant in period 1 will be referred to as x_1, that of period 2 as x_2, etc. Accordingly, you are required to spend a certain amount x_t in any experienced life period t. In the next period you will only have the residual balance $S - x_1 - \ldots - x_t$ available for spending. A round earnings is calculated as the product of all single amounts that were spent in each experienced life period during this round. You should further note: When spending a zero-amount in a period, you will earn nothing in that round (since one of the factors is 0 in this case). There are two different types of participants:

- A-participants for whom a round consists of six periods. (their per-round earnings G are calculated as: $G = x_1x_2x_3x_4x_5x_6$)
- B-participants for whom a round consists of the first four periods. (their per-round earnings G are calculated as: $G = x_1x_2x_3x_4$)

Before round 1 begins, you will be told which type (A or B) you are and, hence, how many periods you live per round.

In rounds 1 and 2 you make your decisions absolutely independent of other participants' decisions.

In round 3 and all subsequent rounds (up to round 10) you will be allotted to some other participant. This other participant (allotted to you) will be of the other type, i. e. if you are a type A participant with six periods to live, your allotted other participant will only live four periods in that same round and vice versa. You remain allotted to the same participant during all eight rounds.

Each pair of participants then decides for each period t simultaneously with, and independently of, the other participant how much he/she wants to spend in a given period. After both participants have made their decision, one of the two decisions is drawn by lot. This drawn-by-lot decision will be valid for both participants, i. e. it becomes the amount of spending x_t for that particular period t and for both participants (A and B). The amount is deducted from the residual budget of the two participants. For the first four periods of every round, decisions are determined in this manner. In periods 5 and 6, the participant who lives through 6 periods, can make his/her autonomous decisions again. Per-round earnings are calculated for both participants as described above. During the entire experiment, a button in the lower left screen corner is available for access to a pocket computer.

Your entries will remain anonymous because we are only able to assign any of your data to your code number - not to your person. If you have any questions regarding the experiment, please, raise your hand. We will then try to answer your questions privately. Please do not speak with your neighbors since any exchange of information would render your data useless for our purposes. In that case we would have to exclude you from the experiment and refrain from paying you any money.

B. Constructive Derivation of Benchmark Solution

We prove that conditional consumption smoothing in the sense of consuming that amount which results from spreading the available funds equally over one's own remaining life time is optimal for player M at any $t \leq m$.

First, let $u^M(W, C)$ denote the log utility of M and $E[\cdot]$ the expectation operator then

$$(9) \qquad E[u^M(W,C)] = \sum_{t=0}^{m} E[f(C_t, t)] \quad \text{with} \quad f(C_t, t) = \log C_t,$$

where C_t is an element of the set of feasible consumption decisions Γ_t, i. e. $C_t \in \Gamma_t = \{0 \leq C_t \leq W_t\}$. C_t is randomly dictated by player M or F. With x_t and y_t

denoting the consumption proposal of M and F respectively we get

$$E[f(C_t(x_t, y_t), t)] = \frac{1}{2}\log x_t + \frac{1}{2}\log y_t \tag{10}$$

and

$$E[T(W_t, C_t(x_t, y_t), t)] = W_t - \left(\frac{1}{2}x_t + \frac{1}{2}y_t\right) = E[W_{t+1}] \tag{11}$$

defining the expected transition of wealth from period t to $t+1$. Assuming a program, x, that maximizes the above expected utility, we can define the following value function at time t as:

$$V^\star(W_t, t) = \max_{x^t=(x_t,\ldots,x_m)} \sum_{\tau=t}^{m} E[f(C_\tau(x_\tau, y_\tau), \tau)] \tag{12}$$

Assume we know that $V^\star(W_{t+1}, t+1) = V(W_{t+1}, t+1)$ and that $x^{t\star} = (x_t^\star, \ldots, x_m^\star)$ is the program that maximizes (12). By the Principle of Optimality we know that if the optimal decision today is $x^{t\star} = (x_t^\star, \ldots, x_m^\star)$, then the sequence $x^{t+1\star} = (x_{t+1}^\star, \ldots, x_m^\star)$ will be optimal starting tomorrow. Thus, we can write:

$$\begin{aligned} V^\star(W_t, t) &= E[f(C_t(x_t^\star, y_t), t)] + V^\star(E[T(W_t, C_t(x_t^\star, y_t), t)], t+1) \\ &= E[f(C_t(x_t^\star, y_t), t)] + V(E[T(W_t, C_t(x_t^\star, y_t), t)], t+1) \end{aligned} \tag{13}$$

If there was a $\hat{x}_t \in \Gamma_t$ such that

$$\begin{aligned} &E[f(C_t(\hat{x}_t, y_t), t)] + V(E[T(W_t, C_t(\hat{x}_t, y_t), t)], t+1) > \\ &\quad E[f(C_t(x_t^\star, y_t), t)] + V(E[T(W_t, C_t(x_t^\star, y_t), t)], t+1) \end{aligned} \tag{14}$$

then there would be a program $\hat{x}^t$ that would result in a higher value for $V^\star$ than $x^{t\star}$, where $\hat{x}^{t+1}$ is the program that maximizes

$$V(E[T(W_t, C_t(\hat{x}_t, y_t), t)], t+1) = V^\star(E[T(W_t, C_t(\hat{x}_t, y_t), t)], t+1). \tag{15}$$

The existence of such a program, however, would contradict the optimality of $x^{t\star}$. Therefore there cannot be such a $\hat{x}_t$ and thus:

$$V^\star(W_t, t) = \max_{x_t \in \Gamma_t} \left[E[f(C_t(x_t, y_t), t)] + V(E[T(W_t, C_t(x_t, y_t), t)], t+1)\right] \tag{16}$$

that leads to $V^\star(W_t, t) = V(W_t, t)$. Note, that by definition $V^\star(W_{m+i}, m+i) = V(W_{m+i}, m+i) = 0 \quad \forall\, i \geq 1$.

By the first order condition for x_t we have for all W and t at the optimum:

$$\begin{aligned} \frac{\partial E[f]}{\partial x_t}(C_t(x_t^\star, y_t), t) + \frac{\partial V}{\partial E[T]}&(E[T(W_t, C_t(x_t^\star, y_t), t)], t+1) \\ &\cdot \frac{\partial E[T]}{\partial x_t}(W_t, C_t(x_t^\star, y_t), t) = 0. \end{aligned} \tag{17}$$

We substitute (17) for $\partial V / \partial E[T]$ into

$$\begin{aligned} \frac{\partial V}{\partial W_t}(W_t, t) = \frac{\partial E[f]}{\partial W_t}(C_t(x_t^\star, y_t), t) + \frac{\partial V}{\partial E[T]}&(E[T(W_t, C_t(x_t^\star, y_t), t)], t+1) \\ &\cdot \frac{\partial E[T]}{\partial W_t}(W_t, C_t(x_t^\star, y_t), t) \end{aligned} \tag{18}$$

and get

$$\frac{\partial V}{\partial W_t}(W_t, t) = \frac{\partial E[f]}{\partial W_t}(C_t(x_t^\star, y_t), t) - \frac{\partial E[f]}{\partial x_t}(C_t(x_t^\star, y_t), t) \frac{\frac{\partial E[T]}{\partial W_t}(W_t, C_t(x_t^\star, y_t), t)}{\frac{\partial E[T]}{\partial x_t}(W_t, C_t(x_t^\star, y_t), t)}. \tag{19}$$

The Euler equation can then be derived with the help of $\partial V / \partial W_{t+1}$:

$$\begin{aligned} &\frac{\partial E[f]}{\partial x_t}(C_t(x_t^\star, y_t), t) + \Bigg(\frac{\partial E[f]}{\partial W_{t+1}}(C_{t+1}(x_t^\star, y_t), t+1) \\ &- \frac{\partial E[f]}{\partial x_{t+1}}(C_{t+1}(x_{t+1}^\star, y_{t+1}), t+1) \cdot \frac{\frac{\partial E[T]}{\partial W_{t+1}}(W_{t+1}, C_{t+1}(x_{t+1}^\star, y_{t+1}), t+1)}{\frac{\partial E[T]}{\partial x_{t+1}}(W_{t+1}, C_{t+1}(x_{t+1}^\star, y_{t+1}), t+1)} \Bigg) \\ &\cdot \frac{\partial E[T]}{\partial x_t}(W_t, C_t(x_t^\star, y_t), t) = 0. \end{aligned} \tag{20}$$

We can now solve for the optimal consumption proposal of player M. The Euler equation reduces finally to

$$(21)\quad \frac{1}{2x_t^\star} + \left(0 + \frac{1}{x_{t+1}^\star}\right)\left(-\frac{1}{2}\right) = 0 \quad \Rightarrow \quad x_t^\star = x_{t+1}^\star$$

Thus the optimal feasible consumption proposal $x_t^\star \in \Gamma_t$ of player M is

$$(22)\quad x_t^\star = \frac{W_t}{m-t+1} \quad \forall\, t \leq m.$$

At any time the choice of the optimal consumption proposal $x_t^\star$ does not depend on present or future choices of F's consumption proposal $y_{t+i}\,\forall\, i \geq 0$ but only on present available funds W_t and the own remaining time to life $m-t+1$.

By the same line of argument it can be shown that the optimal consumption proposal $y_t^\star$ for player F is $y_t^\star = W_t/(f-t+1)\,\forall\, t \leq f$.

Further, we are interested what consumption paths lead to equal payoffs for both, M and F-players. It is obvious that equal payoffs are obtained if after the m-th period $f-m$ units of the endowment are left so that one unit can be consumed in each of the remaining periods resulting in payoffs $U_F = \prod_{t=1}^{m} C_t \prod_{t=m+1}^{f} C_t = \prod_{t=1}^{m} C_t = U_M$. With the help of the above result it is easy to see that the conditional equal payoff maximizing consumption $\bar{c}_i^\star$ in the first m periods is described by

$$(23)\quad \bar{c}_t^\star = \frac{W_t - (f-m)}{m-t+1} \quad \forall\, t \leq m.$$

Finally, we are also interested in consumption paths that lead to conditional household payoff maximization. Household payoff U_H is defined as the sum of individual payoffs

$$(24)\quad U_H = \prod_{t=1}^{m} C_t + \prod_{t=1}^{f} C_t.$$

With the help of the above results it it obvious that the conditional household payoff maximizing consumption $\tilde{c}_t^\star$ fulfills the following conditions:

$$(25)\quad \tilde{c}_t^\star = \tilde{c}_{t+1}^\star \forall\, t \leq m \text{ and } \tilde{c}_t^\star = \tilde{c}_{t+1}^\star \forall\, m < t \leq f.$$

If like in our experiment $m = 4$ and $f = 6$ the maximization of U_H with respect to c_1 then yields

$$(26) \quad \tilde{c}_1^\star = \frac{5W_1 - \sqrt{W_1^2 - 96}}{24}.$$

In all following periods the preceding consumption is already fixed and has to be taken into account. The maximization of U_H with respect to $c_t \forall\, 1 < t \leq f = 6$ thus yields

$$(27) \quad \tilde{c}_2^\star = \frac{4W_1 - 4c_1 - \sqrt{-2W_1c_1 + c_1^2 + W_1^2 - 60}}{15},$$

$$(28) \quad \tilde{c}_3^\star = \frac{3W_1 - 3c_1 - 3c_2 - \sqrt{-2W_1c_1 - 2W_1c_2 + 2c_1c_2 + W_1^2 + c_1^2 + c_2^2 - 32}}{8},$$

$$(29) \quad \tilde{c}_4^\star = \frac{2W_1 - 2c_1 - 2c_2 - 2c_3}{3} - \frac{\sqrt{-2W_1c_1 - 2W_1c_2 - 2W_1c_3 + 2c_1c_2 + c_1c_3 + 2c_2c_3 + W_1^2 + c_1^2 + c_2^2 + c_3^2 - 12}}{3},$$

$$(30) \quad \tilde{c}_5^\star = \frac{W_1 - c_1 - c_2 - c_3 - c_4}{2}, \text{ and}$$

$$(31) \quad \tilde{c}_6^\star = W_1 - c_1 - c_2 - c_3 - c_4 - c_5.$$

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