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Cooperation in Partnerships: The Role of Breakups and Reputation

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Cooperation in Partnerships – The Role of Breakups and Reputation

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[1]The idea to this study and some first experimental sessions originate from a Masters/PhD course in Behavioural and Experimental Economics I taught at the University of Adelaide. I want to thank the participants Suraja Abdul Halim, Lachlan Deer, Mark Dodd, David Hoey, Michael Lebbon, Niti Rathod, and Stefanie Schulte for their input and great work. Mickey Chan's invaluable research assistance is gratefully acknowledged. Mickey implemented the Stable Mariage Mechanism in Z-Tree, which was quite tricky.

Abstract

We investigate experimentally if endogenous partnership formation can improve efficiency in social dilemma situations. Subjects play multiple two-player public goods games, where they can break up with their current partner after every fourth game. Subjects without a partner provide rankings of the available other singles regarding their preferred subject to be matched with. A stable marriage mechanism determines the new matches. We vary the information subjects have when they express their preferences for their future matches and also if staying in a partnership leads to a cost or a bonus. We find that endogenous group formation can increase efficiency. Both the provision of contribution history at the time of re-matching and bonuses for staying in a partnership have positive effects. At least one of the two positive factors has to be present for an efficiency improvement. The presence of both leads to the best results.

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"*It is rare to find a business partner who is selfless. If you are lucky it happens once in a lifetime.*" Michael Eisner, CEO of The Walt Disney Company

1 Introduction

Many real-world situations have the structure of social dilemmas. In social dilemmas individual incentives prevent rational and purely self-interested group members from achieving a socially optimal allocation. The underlying driving force are externalities that are not internalised. For example, the hard work of a member of a team may benefit all team members while the effort cost is borne privately. The benefit of catching a fish accrues privately, while all local fishermen bear the cost of reduced stock. The cleaning effort of a family member makes for a nicer home for the whole family but only the cleaner's back hurts. Traditionally, economists have sought after mechanisms, incentive contracts and government intervention that can overcome these problems. Examples are the Clarke-Groves mechanism, performance based bonus contracts or the public provision of public goods financed by taxes. Moreover, Folk theorems show that in infinitely repeated games equilibria exist where players cooperate. Our question here is if partnerships can help achieve efficiency, when mechanisms, contracts, the government and infinite time horizons are absent.

Experimental studies have shown that under certain circumstances humans can overcome free-riding incentives in social dilemma situations. Typically, humans are able to cooperate to some extent and sustain cooperation for some time in finitely repeated social dilemma situations (e.g. public goods games). Initial cooperation erodes over time though (Ledyard 1995). Some institutional arrangements, such as the availability of costly punishment, have been shown to prevent cooperation from decaying (Fehr and Gächter 2000). Punishment works better when the group composition is fixed than when groups are reformed randomly after each period. The evidence is mixed on whether partners or strangers cooperate more if punishment opportunities are absent (Andreoni and Croson 2008).

This paper explores if endogenous partnership formation, where partnerships can be broken and matches can be influenced by subjects, has the capability of improving cooperation. Our interest in this question is motivated by both applied and more fundamental methodological questions. Firstly, working partnerships are generally seen as something very desirable. This is true in the business world – as our leading quote shows – but also in the private sphere. Just think of a good marriage. Moreover, working partnerships with coauthors play an important role in our academic lives.[1] In this article we want to tackle some questions related to partnerships. What makes a good partnership? Is a long-lasting, stable partnership necessarily more efficient? What role does reputation play when partnership formation is endogenous? And finally, how do the specifics of partnership situations such as breakup and maintenance costs influence partnership formation and efficiency?

Parnerships arise from mutual agreement and can be broken by an individual (potentially by incurring a cost). Hence, partnership formation in real life is en-

[1] It is only due to a coincidence that this paper is single authored.

dogenous and not exogenously determined by some matching protocol like in most experimental studies. The natural question arising is if endogenous parnership formation increases or decreases the efficiency level of partnerships. Intuitively, one can think of different behaviour arising from endogenous partnership formation. Return to our leading quote for instance. Suppose someone has found one of the rare selfless business partners. What will this person do? One natural reaction would be to behave very cooperatively and please the business partner with the aim to prevent the selfless partner to walk away from the partnership. Such a scenario indicates that the threat of breaking a partnership might be beneficial in the sense that it provides incentives for cooperation and hence yields more efficient partnerships. However, there is another possible behaviour: hit-and-run. Some people might initially take maximum advantage of the selfless business partner by free-riding as much as possible. Subsequently, breaking up with the selfless partner allows to escape the potentially angry reaction (i.e. reduced contributions due to negative reciprocity). Such a hit-and-run strategy is the more profitable the higher the likelihood to find another selfless sucker later on. Based on these two scenarios it seems unclear a priori if endogenous partnership formation has a positive or negative impact on efficiency.

We design a set of experimental treatments to investigate the impact of partnership formation on efficiency. Subjects play multiple two-player public goods games, where partnership formation is endogenous. After each phase of four games subjects can decide to break up or not. In the case of a separation, subjects are re-matched according to their stated preferences for a new partner (using a stable marriage mechanism). We introduce treatment variations in two dimensions. Along one dimension the financial consequences of the break-up decision differ. Breaking up is either financially beneficial or costly relative to staying in a partnership. Along the second dimension, the information subjects have on potential matches, we vary if a subject knows the contribution history of potential matches or only sees some characteristics when preferences for future partners are expressed. This design is complemented by three control treatments, which are random re-matching with and without information on the history of the partner and a traditional partner matching.

This design provides – beyond our applied interest – answers to some methodological questions. The existing literature on the effect of endogenous group formation on contributions in public goods games contains mixed evidence. In some studies and treatments contributions have increased, in some others they have not. Typically, unilateral re-matching (Coricelli, Fehr, and Fellner 2004) in constant-sized groups or restricted entry to variable-sized groups (Ahn, Isaak, and Salmon 2008) increase contributions. Restricted entry is beneficial in congested public goods games (Ahn, Isaac, and Salmon 2009). Preference based re-matching with information on past contributions, where re-matching is compulsory is shown to increase contributions by Page, Putterman, and Unel (2005). Almost full efficiency is reached in Cinyabuguma, Page, and Putterman (2005), where subjects can by majority vote permanently expel others to a group of losers with lower endowments and a smaller number of people. Automatic regrouping according to contribution-level strata adds an equilibrium to the standard free-riding equilibrium, which is near-efficient and is typically played in experiments (Gunnthorsdottir, Vragov, Seifert, and McCabe

2010). In other studies bilateral matching fails to have a positive effect on efficiency (Hauk and Nagel 2001; Coricelli, Fehr, and Fellner 2004).

We provide the first study with a fixed group size, different information environments, a simple, stable matching mechanism, voluntary breakups and (dis)incentives to breakup. This design allows for a clean separation of the effects of voluntary breakups with re-matching and the influence of breakup cost and history. Our design holds many factors that varied in other studies across treatments (e.g. group-size or the re-matching procedure) constant in the four partnership treatments. Furthermore, this study is the first that investigates the role of reputation in the matching process and its impact on contributions.

We find that endogenous group formation can increase efficiency. Both the provision of contribution history at the time of re-matching and bonuses for staying in a partnership have positive effects. At least one of the two positive factors has to be present for an efficiency improvement. The presence of both leads to the best results. Deeper analysis shows that information on past contributions is beneficial for efficiency due to two different effects: a level effect and a dynamic effect. We identify an anticipation effect, where subjects that know that their contribution will be seen by future potential partners, conjecture that a higher contribution will improve their changes of getting good partners. This effect increases the level of contributions in treatments with history. The dynamic effect works as follows: subjects, who are broken up with unilaterally, do not reduce their contributions in the next period if history is provided, while they significantly reduce contributions if history is absent. This works for victims of hit-and-run attacks (i.e. a partner took advantage and then broke up to avoid negative reciprocity) but also for subjects who were broken up with because they contributed too little.

The positive effect of small bonuses for staying together in a partnership has to do with the lower breakup rate it creates. We find that long-lasting partnerships lead to the same high contributions in all treatments. Partnerships, where staying together per se is beneficial because of a small bonus payment, lead to lower rates of separation and hence produce more long-lasting partnerships, which per se induce higher contributions.

The remainder of the paper is structured as follows. The next section lays out our experimental design. Section 3 details the predictions made by standard game theory and provides some alternative hypotheses. Subsequently, Section 4 provides a first look at the results by establishing differences in contribution levels and breakup fractions across treatments. Section 5 investigates what determines the breakup decisions, while Section 6 discusses the effects long-lasting partnerships have on contributions. In order to establish some results on the dynamics of contributions, Section 7 investigates the impact of breakups on subsequent contributions. Finally, Section 8 summarises our results and concludes.

2 Experimental Design

We briefly outline our experimental design below. All our treatments have in common that all subjects played 24 two-player public goods games. The differences across treatments lie in different matching procedures and information environments.

We start by explaining the underlying public goods game.

2.1 Underlying public goods game

The underlying two-player public goods game we use is as follows: each of the two partners is endowed with $e = 100$ points. Player i can decide on an amount $C_i \in [0, 100]$ to invest in a group project. Each unit of the endowment kept by player i generates one point of payoff. Each point invested generates 0.8 points of return for each of the two group members. The profit from the group project for player i is calculated as $0.8(C_i + C_j)$ points.[2] Payoffs are symmetrical. Partners decide simultaneously on their investment. Therefore, the payoff of player i is:

$$\Pi_i(C_i, C_j) := 100 - C_i + 0.8(C_i + C_j),\ i, j \in \{1, 2\}, i \neq j.$$

This payoff structure generates a social dilemma, as the net return of one unit of investment for a player is negative (-0.20), while the net social return per unit of investment is positive (0.6). It is a dominant strategy (and therefore Nash) for a purely selfish player to invest nothing in the group project, while social welfare is maximised when both players invest all their endowment. Note that the social welfare W increases linearly with the average group investment $\bar{C}$, as

$$\begin{aligned} W &= 200 + 0.6(C_i + C_j) \\ &= 200 + 1.2\bar{C}. \end{aligned}$$

For this reason the average group contribution can be used as an indicator for the degree to which a group is able to resolve the social dilemma situation.

2.2 Timing and re-matching

A session consists of 24 periods with six phases of four periods each. In each period a partnership plays the two-player public goods game outlined above. After each phase (except in the partner treatment) re-matching takes place. In the random matching treatments all subjects are randomly re-matched with a new partner. In the choice treatments there are two types of subjects. Only subjects with different types can be in a partnership.[3] After each phase, subjects have to decide to stay with their partner or to break up the partnership. A partnership ends if at least one of the two subjects in a partnership decides to break up. All subjects who are without a partner due to a partnership ending are re-matched according to the stable marriage mechanism proposed by Gale and Shapley (1962). For this, subjects are shown some information about the available subjects of the other type. The information given depends on the treatment. Subjects then rank the available potential partners with regard to how much they would like to be matched to these "singles". Using these preference orderings a matching algorithm produces a stable

[2] Our underlying game differs from that used by Coricelli, Fehr, and Fellner (2004) only with respect to the endowment (100 vs. 25).

[3] In real-world terms the types could be male vs. female, worker vs. employer, seller vs. buyer, R&D department vs. Sales department, etc.

new matching. A stable matching is such that any two not matched subjects do not both prefer to be matched to each other over the match they have been assigned by the algorithm.[4] Subsequently, the newly formed partnerships play four public goods games followed by the next break-up and re-matching stage. This is repeated until all six phases of four public goods games are completed.

The underlying stable-marriage matching mechanism is quite complex. For this reason we decided not to fully explain to the participants how the algorithm works, as this could have produced some confusion resulting in very noisy behaviour. In the instructions we described the working of the algorithm as follows: "The computer will collect the rankings from every 'single' and re-match all 'singles' according to these rankings. The partner you are matched with is determined by your preferences and the preferences of all other 'singles'. The computer is programmed to give you the best partner available." The omission of detail on the matching algorithm seems justified, as we are not primarily interested in the working of the mechanism. In a later section, we will briefly investigate how our matching mechanism performed with respect to subjects giving the highest preferences to subjects with the highest past contributions.

2.3 Treatments

In total, we have seven treatments. We employ a $2x2$ design for endogenous partnership formation and add three control treatments. We vary whether remaining in a partnership (i.e. not breaking up with or being broken with) is costly or beneficial. We implemented this by either paying a reward of 10 points (*beneficial* treatments) or deducting 10 points (*costly* treatments) whenever a subject decided not to break up. Note that this reward or cost is very small compared to the payoff from the four public goods games in a phase for which subjects play together. If partners play Nash in the public goods game they receive 400 points each, while they earn 640 points if they fully cooperate and play strategies maximising social welfare. By introducing this small cost or benefit for staying together we intend to switch the equilibrium from always breaking up to always staying together without introducing large payoff differences across treatments.

The other dimension we vary is the information subjects have when they express their preferences over potential "singles" in the re-matching process. In one condition (*characteristics*) only the favourite colour and the other subjects' answers to some hypothetical question designed to elicit social preferences are known. In order to maintain control, these characteristics were elicited in all seven treatment prior to the actual experiment in a questionnaire. Subjects did not know that these informations would be displayed to other players later on. The first question on the questionnaire purely reveals a preference over something that should not be relevant

[4] The Gale-Shapley mechanism produces two potentially different sets of stable matches depending on which type has the proposer power. The subjects with the proposer power do better with respect to getting matches they prefer. The match is proposer-optimal in the sense that there is no other stable matching under which the proposer does better. For this reason we randomly determined in each rematching phase which type was given the propser power. This also mittigates the problem of an incentive to misrepresent the preferences for the group without proposer power. See also Alcalde (1996).

for the experiment. "What is your favourite colour?" The possible answers (tick boxes next to a box filled with the actual colours on screen) are: "Red", "Yellow", "Green", "Purple", and "Blue". The intention of providing subjects with the colour preferences of their choice is to allow subjects to choose according to similarity if they want. The second question we ask is supposed to capture social preferences. We provide the subject with a hypothetical scenario: "Suppose you have won the lottery. Your prizes are a house, a luxury car and an overseas trip for two people. Which object(s) are you keeping for yourself and which are you giving to a family member?" Observing what a person would keep allows for an estimate of how selfish a person is (or pretends to be). Subjects who observe what the potential matches indicated to keep for themselves, have the opportunity to either choose the person that is least selfish or the person that is most similar to themselves.

In the *history* treatments subjects are provided with the average investment of potential matches from the previous phase **in addition** to the information provided to subjects in the *characteristics* treatments. Subjects choice can still be based on either similarity or on the perceived degree of social orientation. However, here subjects are able to strategically influence what potential matches know when choosing, as they are aware that potential matches will see their past investment. Furthermore, here signalling a high level of social orientation has payoff consequences and therefore should be more credible than the answers to a question. The *history* treatments add reputation as a factor.

As control treatments we add a classical *partner* treatment, where no re-matching takes place, while the phase structure (i.e. blocks of four games) is retained. In the remaining two control treatments compulsory random re-matching takes place every four periods. Here, as in the endogenous matching treatments we have a *characteristics* and a *history* treatment. In the characteristics treatment subjects receive the characteristics information on their new partner after each re-matching, while in the *random history* treatment also the new partner's contribution history is given.[5] Table 1 summarises our design with the four endogenous partnership formation treatments in the upper half and the three control treatments in the bottom half.

3 Predictions and Hypothesis

The predictions following standard theory (Subgame Perfect Nash Equilibrium with purely selfish rational agents) is straight-forward. In the last public goods game and in any treatment subjects have a dominant strategy not to invest anything. The unique subgame-perfect continuation following any history in any treatment is for both players not to invest. Subjects' foreseeing that play in the penultimate period will be independent from the history have no incentive to invest in the penultimate

[5] In order to keep the information across treatments with different matching protocols constant we also provided the subjects in the endogenous matching treatments with the same information on their new match as in the corresponding random matching treatment (characterisitcs, history) .

	Information available when choosing partner	
	characteristics only	*also contrib. history*
Remaining is *beneficial*	**beneficial, characteristics**	**beneficial, history**
Remaining is *costly*	**costly, characteristics**	**costly, history**
	Information available after re-matching	
	characteristics only	*also contrib. history*
Matching is *random*	**random, characteristics**	**random, history**
Matching is *fixed*	**partner**	

Table 1: The seven experimental treatments

period. For the treatments without choice moving backwards in the game tree and repeatedly applying the argument above leads to the insight that there is a unique subgame perfect Nash equilibrium where no one invests in any of the 24 public goods games. The same logic also extends to the treatments where every four rounds a decision on breaking up or not has to be made.

Suppose a player has to decide to break up or not with one phase to play. A player should anticipate that regardless of the identity of the partner for the last four rounds no investment will occur along the equilibrium path. The breakup decision will not influence the payout from the subsequent public goods games. Break-up decisions therefore should solely be based on whether staying together yields a bonus or is costly. In the case where staying together is beneficial the unique subgame perfect continuation requires both players not to break up, while in any subgame perfect continuation where staying together is costly the players break up. The same logic applies for earlier partnership decisions. Furthermore, in the case of a breakup (on the equilibrium path for the *costly* treatments or off the equilibrium path in the *beneficial* treatment) subjects are indifferent about who they want to be matched with, as all players will never invest anyway.

Summary Standard theory predicts zero investment in all treatments and public goods games. Breakups never occur in the *beneficial* treatments, while they always occur in the *costly* treatments. In the case of being "single" subjects are indifferent between all potential matches.

Given the large body of literature on cooperation in social dilemmas we do not expect subjects to behave the way traditional theory predicts. Typically, behaviour in repeated public goods games is quite heterogeneous. Conditional cooperators coexist with selfish players (Fischbacher and Gächter 2010; Bayer, Renner, and Sausgruber 2009; Fischbacher, Gächter, and Fehr 2001, show this.). Even a fully rational, selfish agent might find it optimal to contribute positive amounts if she anticipates that it is sufficiently likely to be paired with a conditional cooperator. Positive contributions can be beneficial in the long term, since conditional cooperators' contributions are positively correlated with the partners contributions in the past. In general, contribution decisions become strategic as soon as subjects belief (or know) that there exist other subjects that condition their contributions on past behaviour of partners (such as the mentioned conditional cooperators but also

imitators and the like). This is similar for break-up decisions. If there is reason for a subject to expect to be re-matched with a partner who contributes a different amount than the current partner, then the breaking up decision becomes strategic. In such a case the theoretical prediction of only observing breakups in the costly and no breakups at all in the beneficial partnership treatment does not necessarily hold anymore. A player who is matched to a "nice" person, who typically invests some or even all of the endowment, finds it profitable not to break up a partnership that is costly to maintain if she believes that the expected investment of a new match will be much lower. Similarly, a person in the beneficial partnership treatment might in contrast to the prediction break a partnership if he beliefs that the expected future partner will make contributions, which are sufficiently higher to make up for the loss from the breakup. With this in mind we form the following hypothesis.

HYPOTHESIS 1 In the treatments with choice and beneficial partnerships some breakups will occur. Subjects in the costly partnership treatment will not always break up. The breakup frequency is higher than that in the beneficial partnership treatment though.

The option of ending a partnership should impact on investment behaviour if there are types that are not purely selfish or rational. A person who is paired with a kind investor might want to prevent being broken up with by investing more than he otherwise would. Note that these investment incentives are operating in addition to the typical incentives of keeping conditional cooperators investing. A priory it is not clear what one should expect with respect to differences in investment levels across treatments. The relation between the information subjects have on their potential matches and contributions seems clearest. We conjecture the following for the impact of reputation.

HYPOTHESIS 2 Ceteris paribus, investments are higher in the treatments where subjects have information on the history of other singles before they express preferences for who they want to be matched with.

There are (at least) two mechanisms that could lead to increased contributions in the *history* treatments. Firstly, in these treatments, where subjects know the contribution history of the partner one would expect subjects to express preferences for subjects who have contributed more in the past. Then the stable marriage mechanism will lead to some kind of segregation. Higher contributors will be matched with the like, while free riders will end up with free riders. If subjects anticipate this or learn this during the course of the experiment then we would expect that providing the history ceteris paribus increases contributions, as the only way of avoiding to get stuck with a low contributor are higher contributions (i.e. building a reputation). Secondly, a breakup can not only be the result of the wish to get away from a mean partner but can also give subjects the chance to avoid potential negative reciprocity after having exploited their partner. If the contribution history is not known when re-matching takes place, then misbehaving in a partnership, breaking up and moving on to another partner, who can be exploited, is a potentially profitable strategy. Sufficiently many subjects with this strategy will lead to low contributions. In the treatments where the contribution history is known at the re-matching stage such

a hit and run strategy is not profitable, as the stable-marriage mechanism will ensure that the subjects, who practice such a strategy, will be matched with other low contributing singles. Eliminating the hit-and-run strategy should lead to higher contributions.

Looking at the second dimension of our treatment variation (whether opting to stay in a partnership yields a reward or a penalty) does not allow for a clear hypothesis. First, recall that the actual rewards for or costs of a continued partnership are comparatively small but still vary the incentive of breaking up or not considerably. On the one hand it seems plausible that costly partnership maintenance will lead to higher contributions, as higher contributions are necessary to prevent being dumped by the partner. On the other hand, if partnerships are costly to maintain, then the mentioned hit-and-run strategy is more attractive, which hints at lower contributions in the costly partnership treatment.

Further, and not yet discussed, psychological factors could impact on the dynamics of contributions. Suppose for example that subjects build up trust for each other whenever their partnership survives a break-up stage. This trust comes in addition to the typically observed reciprocity in partner treatments. Together trust and reciprocity might be enough to prevent or delay the decline of contributions we observe in standard partner treatments. If this is the case, then the expected lower separation rates in the reward treatment could in later periods lead to higher investment compared to the costly partnership treatments. In summary we have to say that at this point the direction of impact of the monetary consequences of the break-up decision on contributions is not easily predictable. We formulate an unspecific hypothesis for this reason.

HYPOTHESIS 3 Investment levels vary across treatments with different payoff consequences for staying in a partnership.

4 Results – a first look

We conducted 16 sessions with 16 to 20 subjects each using the software z-tree (Fischbacher 2007). Over-all 296 subjects participated. The experiments took place between October 2008 and July 2010 at the Adelaide Laboratory for Experimental Economics (AdLab). A typical session lasted for about half an hour. Subjects were paid one Australian Dollar for every 150 points of profit in the experiments. On average subjects earned about 23 Dollars. Table 2 summarises the demographics of the subjects who participated. In the next sections we will present the main results. We start by giving a general overview over differences in investment and partnership formation in the different treatments. A more detailed investigation highlighting particular aspects that drive the aggregate results follows.

4.1 Cooperation – levels and within-group correlation

Figure 1 shows average investment per period in the different treatments on the top panel and averages over phases in the lower panel. Table 3 contains average

		Frequency	Percent
gender	*Male*	184	62.16
	Female	112	39.84
course	*Com/Fin*	70	23.65
	Engi	62	20.95
	Other	36	12.16
	Sci	29	9.80
	Med	28	9.46
	Arts	26	8.78
	Law	22	7.43
	Econ	21	7.09
	None	2	0.68
age>24	*No*	232	78.38
	Yes	64	21.62
higher maths	*Yes*	228	77.03
	No	68	22.97
subjects	*N*	296	100.00

Table 2: Demographic characteristics of the subjects

investment aggregated over the phases and adds median investment and breakup fractions. Generally, as in most public goods games, we observe that in all treatments average investment is well above the equilibrium prediction of zero. We also observe differences in investment for the different treatments.

Remarkably, in the beneficial partnership treatment with history the median investment in phases three to six is 100, which is the socially efficient full-cooperation investment. Investments in this treatment are higher than in any other treatment. Furthermore, investments are higher in the endogenous partnership treatments than in the corresponding random re-matching treatments if either staying in a partnership is beneficial or the investment history of potential matches is known when re-matching preferences have to be expressed. Investments are highest if both is the case. The opportunity to break up with a partner and being re-matched according to preferences does not increase cooperation compared to the corresponding random re-matching treatment if staying in a partnership is costly and re-matching preferences can only be based on some characteristics (such as the favourite colour and the answer to a hypothetical question related to social preferences).

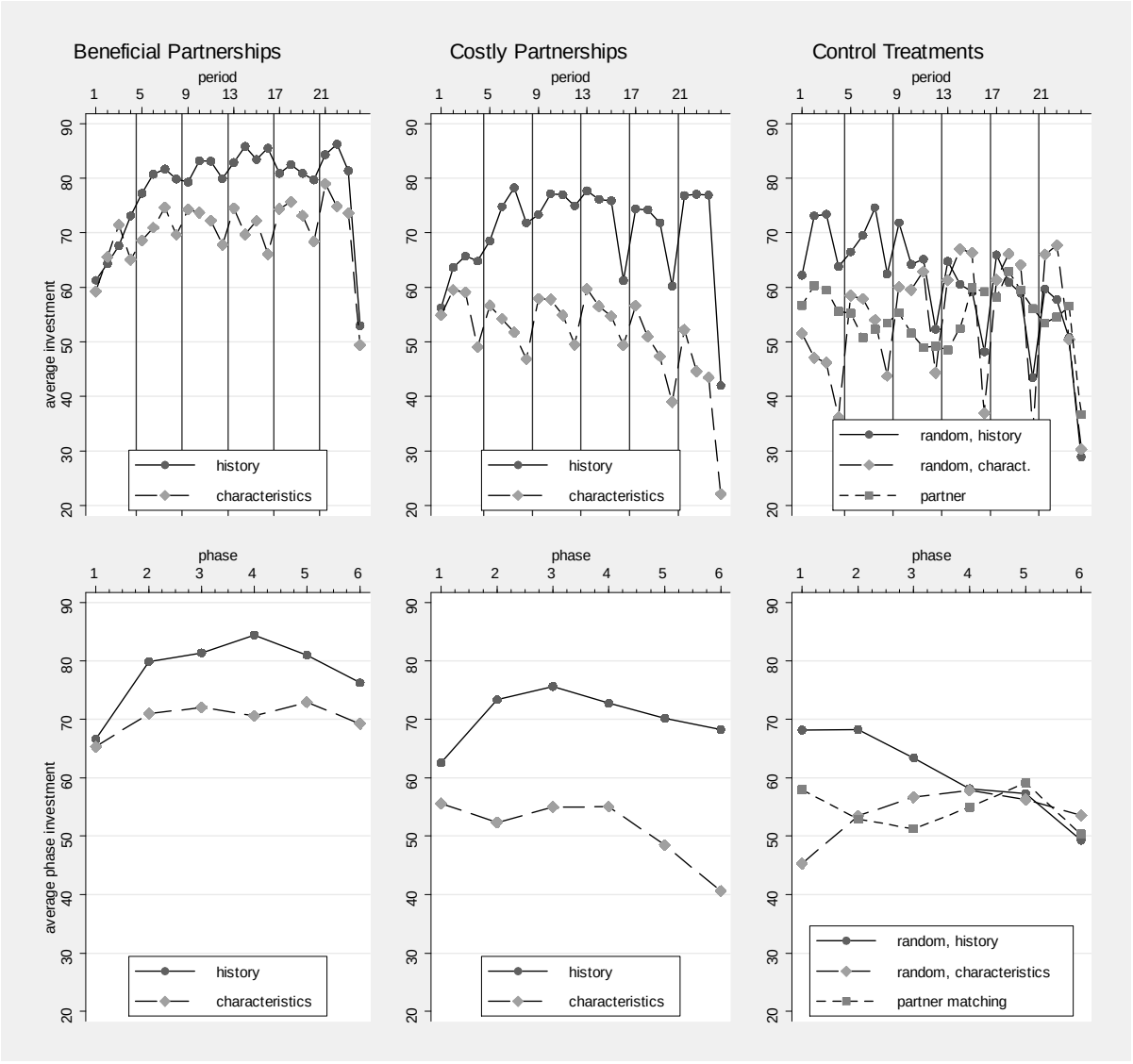


Figure 1: Average investment by treatment

Treatment		Phase 1	2	3	4	5	6	Total*
beneficial history	*mean*	66.59	79.88	81.39	84.41	81.01	76.22	78.25
	median	70.00	99.00	100.00	100.00	100.00	100.00	87.73
	breakup	0.24	0.17	0.44	0.27	0.22	–	0.27
beneficial characteristics	*mean*	65.315	70.94	72.00	70.60	72.89	69.23	70.16
	median	65.00	75.00	80.00	85.00	93.00	88.00	75.52
	breakup	0.16	0.32	0.21	0.26	0.21	–	0.23
costly history	*mean*	62.58	73.34	75.60	72.75	70.15	68.19	70.44
	median	65.00	80.00	90.00	90.00	95.00	87.50	72.08
	breakup	0.63	0.46	0.44	0.51	0.42	–	0.49
costly characteristics	*mean*	55.63	52.38	55.01	55.08	48.48	40.60	51.20
	median	50.00	50.00	62.50	50.00	40.00	32.50	46.86
	breakup	0.75	0.65	0.55	0.55	0.60	–	0.62
random history	*mean*	68.14	68.24	63.38	58.16	57.31	49.29	60.75
	median	80.00	77.50	75.00	60.00	65.00	50.00	63.02
random characteristics	*mean*	45.26	53.52	56.69	57.85	56.31	53.6	53.87
	median	50	60	60	70	65	60	60
partner	*mean*	57.99	52.95	51.29	54.99	59.15	50.30	54.45
	median	55.00	50.00	50.00	60.00	60.00	49.00	57.60

* the median is taken on individual averages over the 24 rounds.

Table 3: Investment and breakup rates by phase and treatment

Rank	Treatment(s)
1	*beneficial, history*
2.5	*beneficial, characteristics & costly, history*
4	*random history*
6	*costly, characteristics & random, characteristics & partner*
differences all significant with $p < 0.01$ or insignificant with $p > 0.1$	

Table 4: Mann-Whitney U-test ranking of treatments with respect to investment

The impact of knowing the history when re-matching takes place is also preserved when re-matching is automatic and random. Investments are higher in the *random history* treatment than in the *random characteristics* treatment. Moreover, forced re-matching with displaying the history leads to more cooperation than a classical partner matching. There the over-all better performance of the re-matching treatment among the control treatments originates from the first three to four phases, while in phases five and six no differences are observed across the control treatments. Mann-Whitney U tests confirm all the observations made above. Table 4 shows the ranking of treatments with respect to the over all level of investment. Treatments where the contributions were not significantly different share the same rank.

If we use individual contributions and pool them then all differences are significant at $p < 0.01$.[6] Aggregating the data on the subject level in order to allow for correlation within a subject, leaves the ranking in tact but by design reduces the significance levels somewhat. We summarise our findings in the following observations.

OBSERVATION 1 When re-matching can occur (forced and randomly or endogenously) than providing the information on past contributions of the new (potential) partner increases over-all cooperation compared to the case where only information on characteristics is provided.

OBSERVATION 2 Endogenous group formation with rewards for staying in a partnership ceteris paribus leads to more cooperation than partnerships that are costly to stay in. Endogenous group formation with costly partnerships, where only characteristics about the potential new partners are known, do not increase cooperation compared to random re-matching where the same information is given.

Beyond the observation that levels differ across treatments, it is also of interest how contribution levels within a partnership are related. One would expect subjects' contributions to be highly correlated if an equity motive or reciprocity is present.[7] Average phase contributions of partners are highly correlated. The correlation coefficients are significantly different from zero in all treatment and range from 0.55 in

[6] The four pairwise comparisons where we do not find significant differences yield p-values of 0.99, 0.58, 0.42 and 0.13.

[7] The study of Croson (2007) shows that such correlation favours reciprocity over altruism and committment as explanations for observed behaviour in public goods games.

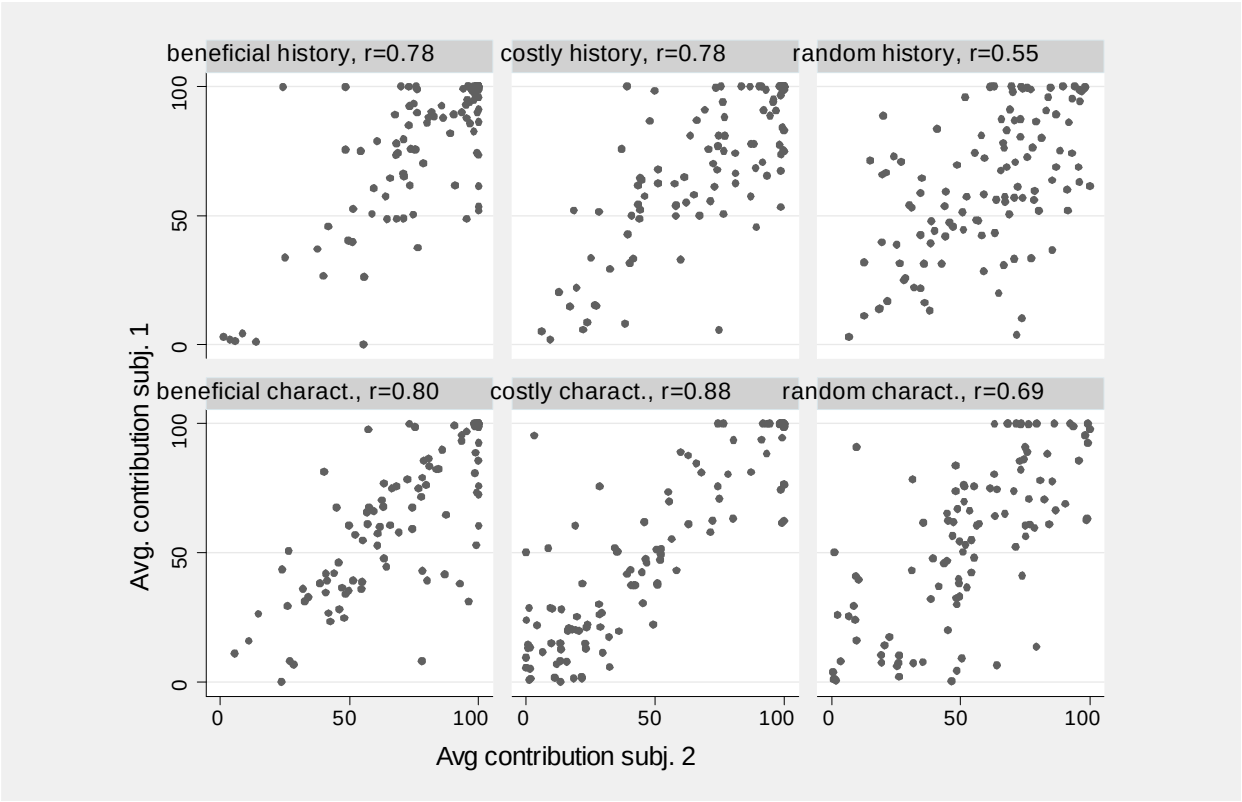


Figure 2: Scatterplot of contributions within a group

the random history treatment to 0.88 in the costly characteristics treatment. For both information conditions the correlation is higher for the two treatments where there is partnership choice than in the random matching treatment.[8] Giving subjects the opportunity to break up a partnership leads to subjects equalising their investment within a phase. The correlation of the within phase contributions in the endogenous group formation treatments is even higher than in the control treatment with partner matching ($\rho = 0.74$). Figure 2 shows scatterplots that visualise the high correlations.

OBSERVATION 3 Average contributions of subjects within partnerships are highly correlated. The correlation is stronger in treatments with partner choice.

More interesting than the well documented fact that contributions within groups are correlated, is the variation in the strength of correlation across treatments. The option of breaking up and the risk of being broken up with seems to add some pressure to contribute similar amounts like the partner in order to prevent being broken up with.

[8] We have correlations of 0.78 in each of the history treatments with choice versus 0.55 in the random history treatment. In the characteristics treatements with choice the correlations are 0.80 and 0.88 versus 0.69 in the random characterstics treatment.

4.2 Breakups

In this section we take a first look at breakup decisions. Figure 3 plots the fractions of breakups in the different treatments by phases. On the left we plot the fraction of individual break-up decisions, while we show the fractions of partnerships that are broken up on the right. A test of proportions – as expected – reveals that the breakup decisions are less frequent in the two treatments where remaining in a partnership pays a small reward than in the treatments where it incurs a small cost ($p < 0.01$ for all pairwise comparisons with pooled data). The stark prediction from standard theory that in the beneficial partnership treatments no breakup occurs, while it should always occur in the costly partnership treatments, is not confirmed though.

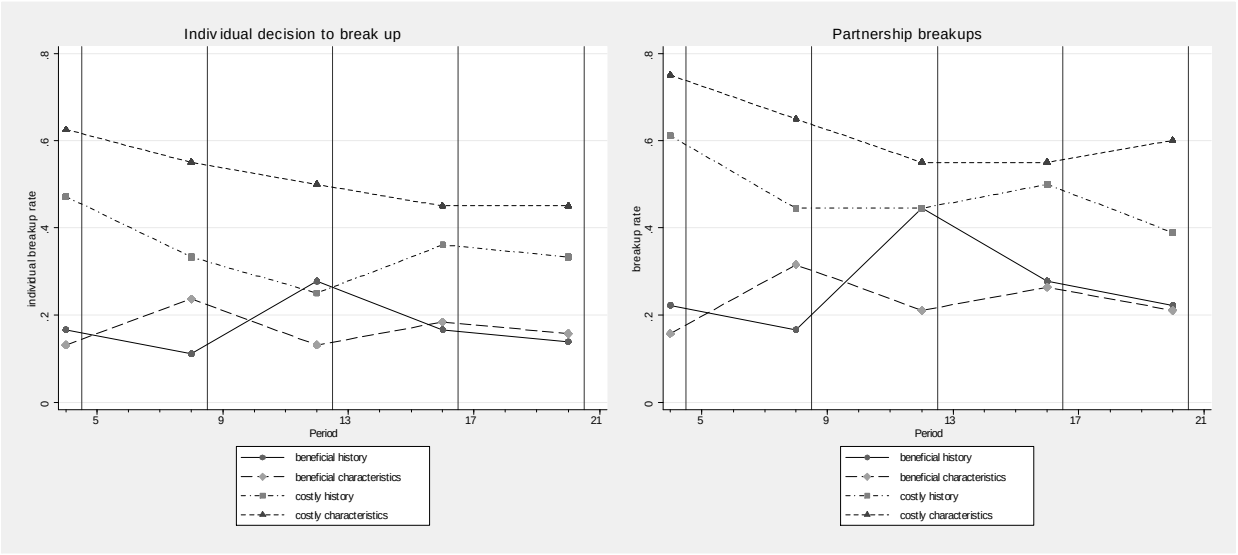


Figure 3: Breakup rates by treatment

The variation of the information about potential future partners a subject receives only leads to significantly different breakup rates if it is costly to stay in a partnership. There the breakup rate is higher when information about past history is not provided ($p < 0.01$). There is no significant difference across the beneficial partnership treatments ($p > 0.92$). In itself the pure breakup rates across treatments are not very informative, since one would expect that contributions are an important factor driving separation decisions. We begin our in-depths analysis with identifying the determinants of breakup decisions.

4.3 Re-matching preferences

It is instructive to investigate how subjects cast their preferences for a new partner, when they are in the pool of singles following a broken partnership. This obviously shows if our design choice of not fully explaining the Gale-Shapley marriage mechanism caused any problems. We will see that this is not the case. More interestingly, this analysis can shed some light on why history has an impact on contributions. Recall that in the history treatments subjects saw the average contribution of all

	ben, hist	*ben, char*	*costly, hist*	*costly, char*
1st pref to highest avg.	0.772	0.475	0.728	0.112
(actual cases / N)	(34/44)	(19/40)	(67/92)	(14/124)
Exp. fraction (random choice)	0.318	0.400	0.196	0.161
(exp. cases / N)	(14/44)	(16/40)	(18/92)	(20/124)
Variance (random choice)	9.167	9.167	14.029	16.71
p-value$^{\$}$	0.015*	0.371	< 0.001*	0.640

$^{\$}H_{alt}$: 1st preference more often for the single with the highest average than under random play

Table 5: Tests on the influence of the history on preferences for partners

potential new partners when they had to rank partners according to their preference for entering a partnership with them. In the characteristics treatments subjects only had some information about a hypothetical question on social preferences and the preferred colours of the potential partners. Conventional theory predicts that in both cases subjects expecting zero contributions in the future are indifferent between all potential partners. Not surprisingly, Table 5 reveals that the fraction of subjects assigning the highest preference to the potential partner with the highest average contribution in the past four rounds is higher in the history treatments.[9] This observation in itself is not very informative yet. Recall that breakup rates varied considerably across treatments. This implies that the number of subjects in the pool of potential partners varied, too. Then a subject who disregards any information about past history or characteristics that might be related to it might choose randomly (just as predicted by conventional theory). In that case the probability that the person with the highest past contributions is chosen decreases with the number of subjects in the pool. In order to clearly identify if subjects systematically chose the partner with the best history we have to take this into account. For this reason we constructed a statistical test for this by treatment, with the null-hypothesis that subjects choose randomly.[10]

The test confirms that the high rates of first preferences for the subjects with the highest past average contribution in the two *history* treatments (approximately 77 and 73 percent) are extremely unlikely to result from random choice. For subjects that are not given any history when they express their preferences we cannot reject the null-hypothesis of random choice.

[9] The numbers exclude cases where subjects had no real choice, as only one potential partner was in the pool of singles.

[10] The test statistic is the number of first preferences for the subject with the highest average contribution. Under the null hypothesis this test statistic is distributed according to a convolution of binomial distributions with different success probabilities and numbers of draws (according to the number of subjects in a particular single pool). We approximate the exact distribution by a normal distribution matching the first two moments, which typically performs well (Butler and Stephens 1993).

OBSERVATION 4 If subjects know the singles' contributions from the last phase, when they express preferences for a new partner, then the first preference goes in about three quarters of the cases to the person where the average past phase contribution was highest. This rate is significantly higher than under random choice.

OBSERVATION 5 If subjects do only know the characteristics of the prospective new partners then they do not significantly more often choose the partner with the highest average phase contribution than randomisation would.

The latter observation seems obvious. If someone does not know the past contributions then he cannot condition his choice on it. However, subjects know how someone has answered a hypothetical decision problem that is related to social preferences. If the answers to the hypothetical decision problems were correlated with actual behaviour then a preference for subjects with the highest self-stated social orientation would lead to first preferences going to high investors. This is not the case. Knowing the stated social orientation is not enough to lead to matching preferences favouring higher contributors. The reason for this is that the answers in the hypothetical decision problem are not correlated with actual contribution behaviour.

The two observations above have an important implication. If subjects know the history at the point of re-matching, then their expressed preferences for the high-contributors lead via the stable marriage mechanism to high contributors being paired together. This means that a higher contribution pays in these treatments, since it makes re-matching with a high-contributor more likely in the case of a breakup. This in turn might lead to high contributors having stronger incentives to break up with low contributors in the *history* treatments. In the characteristics treatments both incentives are absent. The incentive to invest in the history treatments in order to increase the probability of being matched with a subject who invests heavily can nicely explain at least some difference in investment levels between history and characteristics treatments with endogenous group formation. In the next Section we check if actual breakup decision are indeed influenced by the information condition.

5 When do people break partnerships?

From the standpoint of standard theory the decision to break up or not in equilibrium is trivial. Breaking up or staying together does not have any expected future payoff consequences, as anyone contributes zero at all times in equilibrium. So only the immediate payoff impact of the decision matters, which is determined by the assignment to a *beneficial* or *costly* treatment. If assigned to the former a subject should decide to stay in a partnership, while in the latter breaking up is the equilibrium action. Given the observations that a) subjects invest positive amounts and b) that investment levels are heterogenous across subjects, the decision becomes quite complex. A subject might compare the expected future contribution of the current partner to that of a potential new match. There is a further potential consequence of breaking up or not a subject might want to take into account. Deciding to stay in a partnership could be seen as a kind act by the other group member, which then

could trigger positive reciprocity in the form of increased (or at least sustained) investment. In general, the only clear prediction is that the propensity to break up decreases with the contribution of the current partner.

In what follows (in Table 6) we present the results from a random-effects logit regression, where the decision to break up is the dependent variable. We see that the decision to break up is driven by two things: a) how well the partnership worked and b) the information subjects are given when they express their preferences for partners to be re-matched with. We have seen that contributions in a phase and partnership are strongly correlated within but also across subjects. Therefore it is not necessary to include all eight contributions of the two partners in a partnership when predicting if a subject decides to break up or not. We conducted extensive specification tests and concluded that including the maximum and the minimum contribution of both partners is sufficient. Checking for treatment-specific effects of contributions (by introducing interaction terms) revealed that the impact of the maximum own contribution only had an impact in the history treatments.

BREAKUP	Coefficient		Avg. Marginal Effect	
Treatment (base is *beneficial, history)*				
beneficial, character	1.920	(1.017)	0.201	(0.108)
costly, history	1.116*	(0.483)	0.119*	(0.051)
costly, character	3.748**	(0.983)	0.401**	(0.098)
Maximum and minimum contributions of the partner				
min_ other	−0.024**	(0.005)	−0.003**	(0.001)
max_ other	−0.020**	(0.007)	−0.002**	(0.001)
Maximum and minimum of own contribution (max interacted with *history*)				
min_ own	−0.029**	(0.005)	−0.003**	(0.001)
max_ own	0.006	(0.009)	0.001	(0.001)
max_ own x history	0.034**	(0.011)	0.004**	(0.001)
Phase (base is *one)*				
two	0.060	(0.349)	0.006	(0.037)
three	−0.139	(0.356)	−0.015	(0.038)
four	−0.403	(0.369)	−0.043	(0.039)
five	−0.895*	(0.382)	−0.096**	(0.041)
Controls (*age*, *gender*, *color*, *lotto*, *highmaths, course*) coeff. not sign				
Constant	0.375	(1.112)		
ρ	0.29**	(0.077)		
Log $\mathcal{L}$			−278.18	
Observations			750	
Number of subjects			150	

Standard errors in parentheses; $^{**}p < 0.01$, $^{*}p < 0.05$;

Table 6: Tobit panel-regression explaining breakup decisions

The regression results are as follows. Not very surprisingly, subjects' probability to break up decreases with the partners maximum and minimum contribution. Ceteris paribus the probability of a subject breaking up with the partner is about fifty percentage points higher if the partner did not contribute at all than if the partner always contributed in full. The simple rationale for this is the expectation that the lower the contribution of the partner the higher is the likelihood to be re-matched to a better partner after breaking up.

OBSERVATION 6 Subjects are more likely to break up with partners who have lower minimum and maximum investments.

Furthermore, we see that subjects with high minimum contributions are less likely to break up. The magnitude of this effect is about the same size as that of the minimum contribution of the partner. A potential explanation for this has to do with subjects foreseeing others to reciprocate. A low minimum contribution that typically occurs in the last period of a phase, indicates a subject being unkind to the partner by either not contributing much at all over the phase or strategically contributing early to free ride in the last period. A subject doing this might anticipate that staying in the partnership will cause negative reciprocity and low contributions of the partner in the next phase. Then it might be better to look for a new partner (and potentially repeat the same hit-and-run strategy).

OBSERVATION 7 Higher own minimum contributions reduce the likelihood of a subject breaking up.

The maximum own investment in a phase has no significant impact on the breakup decision in all the treatments. However, in the treatments, where the history of a subject is known, when re-matching preferences are expressed, subjects who have made higher maximum investments are – everything else equal – more likely to break up with their partners. This highlights the role of reputation. Subjects who contribute high maximum amounts are confident to have a high likelihood of emerging from the re-matching process with a high contributor when history is provided and therefore are more inclined to break up. Furthermore, the maximum contribution, which typically occurs in the first game of a phase, is an indication for the expectation of what the level of contributions in a working partnership should be. For a given contribution behaviour of the other player it is more likely to be disappointed in these expectations the higher the maximum own contribution is. A disappointed subject can do two things, either adjust the expectations or break up the partnership hoping that the new partner will fulfill the expectations. In the *history* treatments subjects are more confident to find a good partner and rather do the latter, while without information on past contributions the former is the behaviour observed more often.

OBSERVATION 8 Higher own maximum contributions increase the tendency to break up in the history treatments.

The impact of whether staying in a partnership yields a bonus or incurs a cost is as expected. Pairwise Wald tests confirm that in the costly treatments breakup rates are higher ($p < 0.03$ with history and $p < 0.01$ with characteristics).

OBSERVATION 9 Controlling for contribution behaviour breakups are more likely to occur in the treatments where staying in a partnership is costly.

Summing up our findings on breakup decisions, we see that partnerships that work well are more likely to stay together. We also found evidence for hit-and-run behaviour. Information on history during the re-matching process makes high-contribution subjects more confident that the re-matching will lead to a better match. This implies that subjects who want to keep their high-contribution partner will need to contribute more in the history treatments than in the characteristics treatments.

6 The impact of lasting partnerships

In this section we search for the underlying driving force for the differences in contribution levels across treatments with endogenous partnership formation. Figure 4 documents that a stable partnership yields high contributions. Here we plot the average contributions of partnerships that are stable, which we define as having survived two breakup stages, and contrast them with the average contributions of subjects, starting with a new partner (i.e. their old partnership ended just before the phase in question). We see that the contributions of lasting partnerships are very high in all treatments, while the contributions in newly formed groups are significantly lower (Mann-Whitney U-test, $p < 0.01$ in all treatments). The main difference across the treatments appear to be the level and the dynamics of the subjects who are in new groups. The contributions of these subjects are higher in the history treatments if compared to the characteristics treatments (Mann-Whitney U-test, $p < 0.01$). Across the history treatments there is not difference ($p > 0.85$).

In what follows, we estimate a random-effect panel Tobit with individual investments as the dependent variable. We include a set of dummy variables that captures how many phases the partners have played together. This allows us to investigate how partnership formation impacts on contribution levels. We control for common dynamics. For this purpose, we add phase dummies, dummies that capture the period within a phase and a dummy for the final period of the experiment. Further controls for subject characteristics are also added. Finally, dummies for the different treatments are included. These dummies can be interpreted as the remaining differences in contributions that can be attributed to the different treatments, once we control for the common effects resulting from partnership formation. Table 7 reports the coefficients and the marginal effects.[11]

The regression shows that over-all the number of phases played with the same partner is positively related to the investment.[12] Note that this cannot be inter-

[11] We use the marginal effects giving the change in expected investment due to the change of a variable at the population mean taking into account the probability that censoring might occur before or after the change of the dependent variable. See Green (2003)[p 765] for a discussion of different marginal effects in Tobit regressions.

[12] All differences except between partnerships that play in the fifth and in the sixth phase together are significant on at least the one percent level.

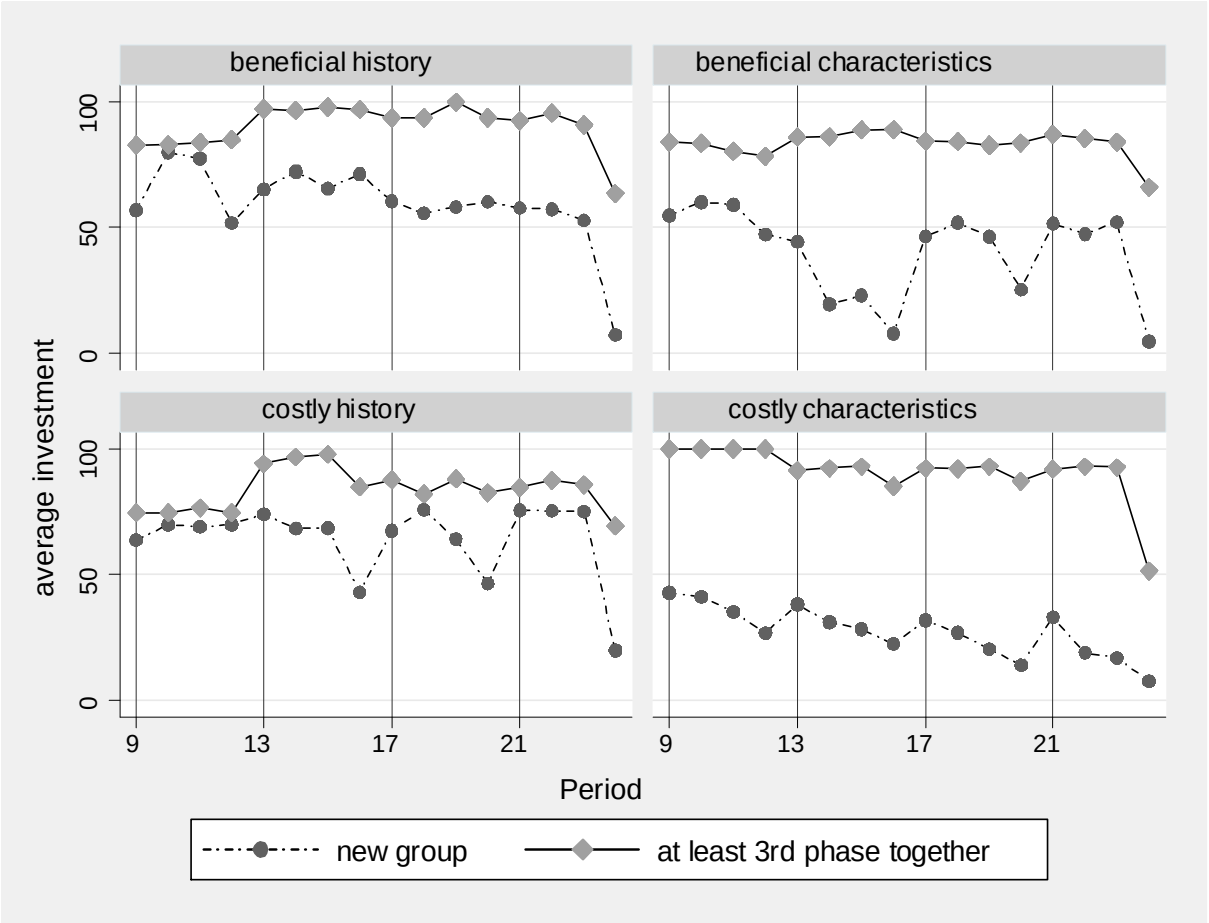


Figure 4: Investment and group stability by treatment

preted as a causal relationship, as subjects who in general contribute more are less likely to be broken up with. For this reason the estimated effect here represents a compound of a selection and a stable-partnership effect. However, there is evidence that the significant coefficients on the periods spent with the same partner are not only the result of selection. Here we exploit the variation across the cost dimension. Observe that after controlling for the number of phases together there is no significant difference in contributions across treatments with different cost within one information condition (history or characteristics) anymore. That means that in general there is no tendency for higher contributions under costly or beneficial partnerships. Over all, contributions are higher in the beneficial partnership treatments though. So where can this difference come from? Having ceteris paribus lower breakup rates in the beneficial treatments tells us that on average there are more long-term partnerships. Together with the observation that per se there are no contribution differences across treatments we can conclude that staying together in a partnership per se increases contributions. This suggests that the good performance of long lasting partnerships is not only the cause of a selection effect. Moreover, the fact that breakup rates are lower in the beneficial condition together with our findings that longer-lasting partnerships do better implies that environments, where staying in a partnership is beneficial per se, are more efficient. It is worth noting that

INVESTMENT	Coefficient		Marginal Effect	
Treatments (base is *beneficial, history)*				
beneficial, characteristics	-19.25^{*}	(9.124)	-12.21^{*}	(5.951)
costly, history	-6.73	(9.213)	-4.17	(5.802)
costly, characteristics	-30.92^{**}	(9.029)	-19.84^{**}	(5.951)
random, history	-12.28	(9.452)	-7.70	(6.059)
random, characteristics	-27.58^{**}	(9.305)	-17.68^{**}	(6.134)
Phases with current partner (base is *first)*				
second	12.93^{**}	(2.155)	7.58^{**}	(1.227)
third	23.65^{**}	(2.829)	13.19^{**}	(1.459)
fourth	39.05^{**}	(3.643)	19.96^{**}	(1.569)
fifth	52.87^{**}	(4.718)	24.67^{**}	(1.651)
sixth	54.92^{**}	(5.007)	25.17^{**}	(1.434)
Phase (base is *one*)				
two	4.65^{*}	(1.991)	2.81^{*}	(1.187
three	3.86	(2.031)	2.34	(1.216)
four	-1.13	(2.051)	0.69	(1.246)
five	-3.55	(2.085)	-2.19	(1.299)
six	-4.56	(2.292)	-2.81^{*}	(1.434)
Period in the phase (base is *one*)				
two	0.98	(1.566)	0.56	(0.953)
three	-0.51	(1.570)	-0.31	(0.961)
four	-12.79^{**}	(1.665)	-7.98^{**}	(1.071)
Final period	-38.75^{**}	(3.528)	-25.37^{**}	(2.337)
Controls (*course*, *gender*, *math, lotto, color, age*) not significant except				
male	13.60^{*}	(5.831)	8.40^{*}	(3.652)
Constant	73.41^{**}	(15.168)		
ρ	0.50^{**}	(0.028)		
Log $\mathcal{L}$		$-16,979$		
Observations		$5,376$		
Number of subjects		224		

Standard errors in parentheses; $^{**}p < 0.01$, $^{*}p < 0.05$;

Table 7: Tobit panel-regression for investment

the average number of periods a partnership is together is higher in the beneficial condition for all phases after the first break-up phase.

OBSERVATION 10 There is a stable partnership effect, i.e. stable partnerships are more efficient. This effect is not purely driven by the fact that subjects who contribute more per se are less likely to be broken up with. Stable partnerships per se are more efficient.

Looking at the coefficients on the treatment dummies, we see that there are some

residual treatment effects even once we control for the effects of group-formation dynamics. Comparing the history treatments to their corresponding characteristics treatment reveals that investment tends to be higher if history is given.[13] Along the matching dimension, we do not find differences across different treatments with the same information condition. This suggests that the better over-all performance of the history treatments cannot solely be explained by group-formation dynamics and welfare enhancing effects of long-term stable partnerships. There must also be a pure level effect.[14] The pure fact that history is provided induces higher investments.

OBSERVATION 11 Beyond effects stemming from different group-formation dynamics and long-term partnership effects in different information conditions, providing history increases contributions through a pure level effect.

7 Treatment-specific effects of breakups

Finally, we investigate if there are treatment specific effects that influence the contribution dynamics. The main question is how subjects adjust their contributions after the end of a phase conditional on the outcome of the breakup stage. As we will show, contribution history has not only a positive level effect on contributions (as shown above) but also prevents erosion of investments after breakups. We estimate an interval regression, where the individual change of average phase investment to the previous phase is the dependent variable. An interval regression is chosen to deal with the truncation occurring on an individual level.[15] In order to identify the effect of breakup decisions on contributions we include dummies for the outcome of the breakup stage before the phase in question. The dummies indicate if a subject has been broken up with unilaterally, i.e. a subject wanted to continue a partnership but the partner broke up, or if a subject chose to breakup herself.[16] A partnership that stayed together is used as the baseline.Treatment-specific effects are obtained by including treatment dummies (with the beneficial, history treatment as the baseline) and their interactions with the partnership decision dummy. Since we have seen in the previous section that lasting partnerships have a treatment independent impact, we include a dummy for partnerships that entered into at least their third phase together. We also include phase dummies to control for time effects. Subject demographics (from a questionnaire after the experiment) and answers in the pre-

[13] The level of significance varies somewhat (beneficial $p < 0.035$, costly $p < 0.01$ and random $p < 0.1$; all two-tailed Wald tests).

[14] Such a pure level effect can be thought of as an anticipation effect, as explained earlier. A subject contributes more, since this increases the chance of better partners if there is information. Alternatively, a social desirability effect could be at work. Subjects behave more cooperatively when they know that other subjects will see their contributions.

[15] To see this, imagine a subject has invested on average $\bar{c}_{t-1}$ in the last phase. Then the change $\Delta\bar{c} \equiv \bar{c}_t - \bar{c}_{t-1}$ is restricted to the inverval $[-\bar{c}_t, 100 - \bar{c}_t]$. Our regression then estimates the effect on an untruncated latent variable. Furthermore, observe that differencing takes out heterogeneity in investment levels, which renders a cross-sectional model adequate. We report robust standard errors though.

[16] Dividing the latter category in subcategories depending on if the other player also chose to separate did not change the results.

experimental questionnaire (favourite color and hypothetical choice after winning the lottery) are also included as controls.

Our main question is the following: How can we explain the differences in dynamics across treatments? We have seen above that there is a composition effect, i.e. partnerships that stay together for longer have higher contributions. The contribution level in these groups are stable over time and similar across treatments regardless of breakup rates. However, the number of long-lasting partnerships is larger in the treatments where staying in the partnerships leads to a small reward (i.e. the beneficial treatments). In addition to these composition effects we found positive anticipation effects in the history treatments. Here we are concerned with the dynamics caused by breakups. How are people reacting to breakups? Are they increasing or decreasing their contribution and are there differences across treatments? By controlling for the common effects of long-term partnerships we can isolate the treatment specific effects of different kinds of breakups. This can shed some light on why average contributions end up being lower in the characteristic treatments than in the corresponding history treatments despite of similar breakup rates and the fact that average contributions in period one are not very different within a matching protocol. Table 8 shows the regression results. We show both the coefficients (, which are identical to the marginal effects on an untruncated latent variable) and the marginal effects on the truncated variable (the actual change in investment) for a subject with an investment at the population average (, which is 68).

The regression reveals that the only significant differences in dynamics across treatments lies in the behaviour of subjects who have been broken up with unilaterally. Subjects, who had this happen to them, react differently depending on whether they are in a history or in a characteristics treatment. Subjects in the history treatments do not significantly alter their average phase contribution. On average subjects in the *beneficial* treatment with *history* tend to increase their contributions. This increase is not significant ($p > 0.15$) though. The effect in the *costly history* treatment is virtually zero. In contrast, subjects who are broken up with unilaterally in the *characteristics* treatments react with significantly lower investment than in the previous phase than subjects in the *history* treatments ($p < 0.023$ for *beneficial* and $p < 0.011$ for *costly*, pairwise Wald tests). The total effect of being unilaterally broken up with (including the treatment specific level effect) results in a reduction of contributions in the characteristics treatments ($p < 0.017$ in the costly and $p < 0.088$ in the beneficial condition). Contributions in all other cases are stable with respect to the reaction to previous break-ups. However there is a time effect. The common baseline changes in contributions from phase to phase are jointly significant ($p < 0.001$, F-test), which indicates that time has an influence. The time effects are negative and become stronger as time progresses (compared to the baseline from phase two).[17]

[17] Individual phase effects are not significantly different from zero in total magnitude though (i.e. once the constant is considered).

CHANGE AVG. INVESTMENT	Coefficient		Marginal Effect*	
Treatments (base is *beneficial, history)*				
beneficial, characteristics	2.04	(1.777)	1.97	(1.711)
costly, history	−0.10	(2.032)	−0.09	(1.966)
costly, characteristics	−1.05	(2.091)	−1.01	(2.026)
Partnership decision before current phase (base is *staying together*)				
been broken up with	6.08	(4.288)	5.80	(4.027)
broken up	0.56	(3.492)	0.55	(3.375)
Interactions Treatment X Partnership Decision				
be,cha X *being broken up with*	−17.09*	(7.359)	−16.86*	(7.323)
be,cha X *broken up*	−1.07	(5.658)	−1.04	(5.495)
co, hi X *being broken up with*	−6.26	(5.631)	−6.12	(5.550)
co, hi X *broken up*	1.79	(4.646)	1.73	(4.451)
co, cha X *being broken up with*	−17.70**	(6.059)	−17.46**	(6.031)
co, cha X *broken up*	−2.69	(4.703)	−2.61	(4.586)
Stable partnership (> 2 phases)	0.95	(1.975)	0.92	(1.909)
Phase (base is *second*)				
third	−4.70	(2.480)	−4.64	(2.427)
fourth	−7.41**	(2.343)	−7.22**	(2.299)
fifth	−9.48**	(2.594)	−9.26**	(2.549)
sixth	−11.54**	(2.381)	−11.26**	(2.344)
Controls (*course*, *gender*, *math, lotto, color, age*) not significant except				
Constant	4.32	(4.833)		
PseudoLog $\mathcal{L}$			−3,177.18	
Observations			750	
Number of subjects			150	

* investment a the population mean; Standard errors in parentheses; $^{**}p < 0.01$, $^{*}p < 0.05$

Table 8: Interval regression for investment dynamics

OBSERVATION 12 After being unilaterally broken up with subjects respond with reducing their contributions in the characteristics treatments, while in the history treatments this effect is absent.

To learn more about the reason for this negative effect of being broken up with we checked the contribution history for those subjects in the *character* and *history* treatments, who were unilaterally broken up with. Looking only at the cases where a subject who had been contributing more than the person who unilaterally broke up with them, shows where the effect comes from. In the *history* treatments on average these subjects reduced their average investment in the next phase by 1.3 units, while subjects in the *characteristics* treatments reduced their contribution by 13.4 units. Subjects who made the disappointing experience of being sacked, even though being more cooperative than the partner, considerable reduce their contribution in the next round when reputation building is impossible, while the

disappointed in history treatments keep their contributions almost constant, as they either got matched with a better partner because of their track record or else still wanted to keep their reputation up. In other words, having been the victim a hit-and-run strategy leads subjects to reduce their contributions if reputation building is not possible.

The picture is similar for cases where the subject who was broken up with unilaterally contributed less than the partner. There in the *history* treatment subjects slightly increased their contribution (+4.8 units) as they wanted to restore some of their reputation, while the free-riders went on to free-ride even more (−8.9 units) in the *characteristics* treatment.

OBSERVATION 13 Behaviour changing effects of re-matching experiences operate through the case of being broken up with unilaterally. Here the pressure of information about past behaviour increases the contributions of free-riders slightly, while in the absence of information free-riders further decrease their investment. The experience of being exploited before being broken up with has a negligible impact on subjects in the history treatment, while it leads to large reductions in contributions if reputation building is not possible.

8 Concluding Remarks

This paper reports on a series of experiments that were designed with the aim to test if endogenous partnership formation enhances cooperation. Endogenous partnership formation was implemented by allowing subjects to break up with their partners. Re-matching of singles was performed with the help of a stable marriage mechanism, where unmatched subjects could express their preferences for potential partners. The underlying social dilemma a partnership faced was a two-player public goods game. We find that under certain circumstances endogenous partnership formation can improve welfare. Two factors prove crucial: the possibility of reputation building and the relative costs and benefits of leaving or remaining in a partnership. Whenever a partnership is costly to maintain and missing information on past behaviour in the pool of potential partners prevents reputation building then the breakup option does not improve cooperation. There cooperation levels are even lower than in the case of forced random re-matching with subjects of known history. In contrast, endogenous partnership formation increases welfare if partnerships provide intrinsic value and if information about the contribution history of potential partners is available when partners are chosen. Cooperation levels are highest when both these conditions are satisfied. Then on average almost 80 percent of the potential surplus is realised.

The behavioural channels, through which information about the past contributions of potential partners works are twofold. Firstly, more cooperative subjects (with a high maximum contribution in an ongoing partnership) are more confident to find a better partner and therefore break up more often with non-cooperative partners. This threat creates an anticipation effect. Secondly, subjects who have been broken up with unilaterally modify their behaviour differently if reputation pressures are present. Subjects who invested less than their partners try to regain

some reputation and modestly increase their investment, while subjects, who were exploited and then dumped, keep their investment roughly constant. In contrast if history is not observable at the point of re-matching then unilaterally sacked free riders free-ride even more in the next partnership. The negative reaction is even stronger for subjects, who were more cooperative than their partners, who broke up with them. Their disappointment translates into a large reduction of contribution in the next partnership when reputation pressures are absent. It remains to mention that self-reported social orientation does not suffice in order to produce these incentives, actual information on past contributions is necessary. Secondly, partnerships with an intrinsic value lead to higher levels of cooperation than partnerships which are costly to maintain. Partnerships with intrinsic value are broken up less easily, which leads to more long-lasting partnerships. Long lasting partnerships are per se more efficient, as emerging trust and reciprocity keep contributions high.

This study highlights how important reputation mechanisms are. In an environment, where there is a choice of partners and reputation building is possible, free riding incentives can be overcome to a large extent. This can explain why online trading platforms (like Ebay) are extremely successful despite of strong free-riding incentives. Our results also provide some rationale for the prominence of reference letters in labour and rental housing markets. For some other areas where partnerships play important roles but reputation building is difficult at least separation cost or an intrinsic value of partnerships might help efficiency. Business partnerships are often costly to resolve. The same is true for cohabitating partnerships, which also (should) have some intrinsic value.

References

Ahn, T., R. M. Isaac, and T. C. Salmon (2009). Coming and going: Experiments on endogenous group sizes for excludable public goods. *Journal of Public Economics 93*(1-2), 336 – 351.

Ahn, T. K., R. M. Isaak, and T. C. Salmon (2008). Endogenous group formation. *Journal of Public Economic Theory 10*(2), 171–194.

Alcalde, J. (1996). Implementation of stable solutions to marriage problems. *Journal of Economic Theory 69*(1), 240 – 254.

Andreoni, J. and R. Croson (2008). Partners versus strangers: Random rematching in public goods experiments. Volume 1 of *Handbook of Experimental Economics Results*, pp. 776 – 783. Elsevier.

Bayer, R.-C., E. Renner, and R. Sausgruber (2009). Confusion and reinforcement learning in experimental public goods games. *NRN Working Paper 2009-22*.

Butler, K. and M. Stephens (1993). The distribution of a sum of binomial random variables. Technical Report 467, Office of Naval Research.

Cinyabuguma, M., T. Page, and L. Putterman (2005). Cooperation under the threat of expulsion in a public goods experiment. *Journal of Public Economics 89*(8), 1421 – 1435.

Coricelli, G., D. Fehr, and G. Fellner (2004). Partner selection in public goods experiments. *The Journal of Conflict Resolution 48*(3), 356–378.

Croson, R. T. A. (2007). Theories of commitment, altruism and reciprocity: Evidence from linear public goods games. *Economic Inquiry 45*(2), 199–216.

Fehr, E. and S. Gächter (2000). Cooperation and punishment in public goods experiments. *American Economic Review 90*, 980–994.

Fischbacher, U. (2007). Z-tree - Zurich toolbox for readymade economic experiments. *Experimental Economics 10*(2), 171–178.

Fischbacher, U. and S. Gächter (2010). Social preferences, beliefs, and the dynamics of free riding in public goods experiments. *American Economic Review 100*(1), 541–56.

Fischbacher, U., S. Gächter, and E. Fehr (2001). Are people conditionally cooperative? evidence from a public goods experiment. *Economics Letters 71*(3), 397 – 404.

Gale, D. and L. S. Shapley (1962). College admissions and the stability of marriage. *The American Mathematical Monthly 69*(1), 9–15.

Green, W. H. (2003). *Econometric Analyis* (5th ed.). Prentice Hall: Pearson Education.

Gunnthorsdottir, A., R. Vragov, S. Seifert, and K. McCabe (2010). Near-efficient equilibria in contribution-based competitive grouping. *Journal of Public Economics 94*(11-12), 987 – 994.

Hauk, E. and R. Nagel (2001). Choice of partners in multiple two-person prisoner's dilemma games: An experimental study. *The Journal of Conflict Resolution 45*(6), 770–793.

Ledyard, J. O. (1995). Public goods: A survey of experimental research. In J. H. Kagel and A. E. Roth (Eds.), *The Handbook of Experimental Economics*. New Jersey: Princeton University Press.

Page, T., L. Putterman, and B. Unel (2005). Voluntary association in public goods experiments: reciprocity, mimicry and efficiency. *The Economic Journal 115*, 1032–1053.

Appendix A: Sample Instructions

A1. Treatments with breakup-choice

Before we start, please read the instructions carefully.

During the experiment, your earnings will be calculated in points rather than dollars. Points are converted to Dollars at the following exchange rate at the end of the session to determine your payment:

150 Points = AUD 1.00

You will be paid in cash immediately after the experiment.

You are not allowed to communicate to other participants during the experiment.

If you have any questions, please raise your hand and we will attend to you individually.

Failure to comply with the outlined rules will result in exclusion from the experiment and you will forfeit your payment.

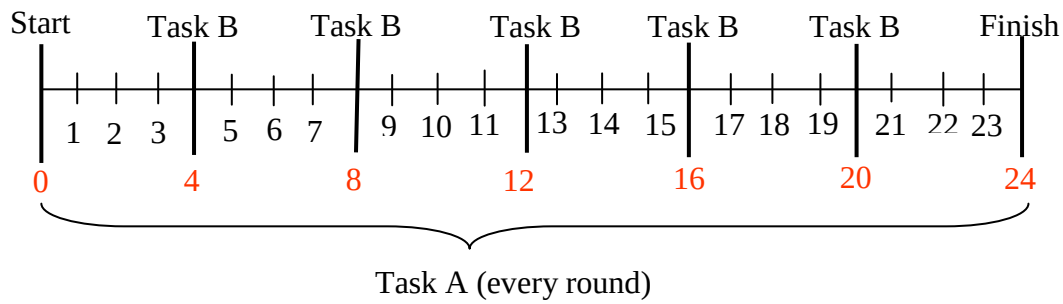
Summary

You will play a game (described in the game section below) for 24 rounds. The game consists of two reoccurring tasks.

Task A: For every round, you will have to decide how to divide 100 points between yourself and an investment project.

Task B: After every four rounds, you will have to make a decision whether you want to stay with your partner or break up.

Timeline of the game:



- You will play this game with a partner. Your initial partner is randomly chosen by a computer.

Details

Task A :

Task A consists of a game for two people. In what follows we will refer to the person you are playing with as your "partner". In each of the 24 rounds, you have to divide your **endowment** (100 points) between what you keep for yourself and what you invest in the project. Your partner chooses her/his investment at the same time.

The total income you earn will be the sum of two parts:

(1) Points that you keep (**endowment** – **investment**)

(2) Your "income from the project".
Income from the project = 0.8 x (**your investment** + **your partner's investment**)

Therefore, your total income is calculated as follows:

Total income = **Points that you keep** + **income from the project**

= (**endowment – investment**) + **0.8 x** (**your investment** + **your partner's investment**)

Your partner's income from the project is calculated the same way.

Task B:

After every four rounds, you will have to decide whether you want to continue the game with your current partner or break the relationship. This option is also available to your partner.

If you decide to stay in the relationship, you will receive 10 extra points.

If either you or your partner decides to break the relationship, the relationship will end and you and your partner will be classified as 'single'. 'Singles' are re-matched according to the following procedure.

Rematching Procedure for 'singles':

- We will display the favourite colour of other 'singles' and their hypothetical lottery scenario answers (please see attachment at the back).
- You will then be asked to rank each 'single' in preference order, i.e. your most favourite candidate should get a ranking of '1'.
- The computer will collect the rankings from every 'single' and rematch all 'singles' according to these rankings. The partner you are matched with is determined by your preferences and the preference of all other 'singles'. The computer is programmed to give you the best partner available (according to your ranking).

After everyone has been matched, the experiment will continue for another four rounds. After these four rounds, you will again be asked to make a decision: stay with your partner or break the relationship. All the same rules apply as outlined previously.

This process will continue until 24 rounds have been played.

After the 24th round your total profit will be recorded and you will be paid in cash.

A2. Random treatments

Before we start, please read the instructions carefully.

During the experiment, your earnings will be calculated in points rather than dollars. Points are converted to Dollars at the following exchange rate at the end of the session to determine your payment:

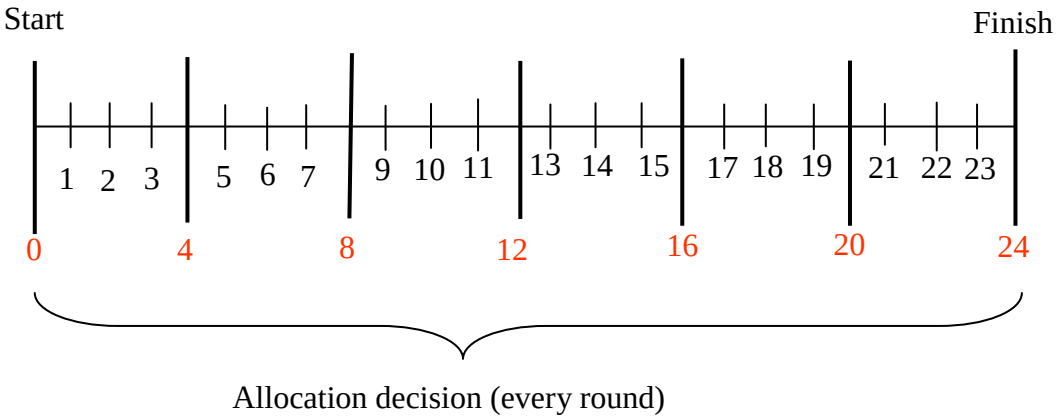
150 Points = AUD 1.00

You will be paid in cash immediately after the experiment.
You are not allowed to communicate to other participants during the experiment.
If you have any questions, please raise your hand and we will attend to you individually.
Failure to comply with the outlined rules will result in exclusion from the experiment and you will forfeit your payment.

Summary

You will play a game (described in the game section below) for 24 rounds.
For every round, you will have to decide how to divide 100 points between yourself and an investment.

Timeline of the game:



- You will play this game with a partner. The initial partner is randomly chosen by a computer. After every four rounds you will randomly be rematch with a new partner.

Details

The game consists of a game for two people. In what follows we will refer to the person you are playing with as your "partner". In each of the 24 rounds, you have to divide your **endowment** (100 points) between what you keep for yourself and what you invest in the project. Your partner chooses her/his investment at the same time.

The total income you earn will be the sum of two parts:

(1) Points that you keep (**endowment** – **investment**)

(2) Your "income from the project".

Income from the project = 0.8 x (**your investment** + **your partner's investment**)

Therefore, your total income is calculated as follows:

Total income = **Points that you keep** + **income from the project**

= (**endowment – investment**) + **0.8 x** (**your investment** + **your partner's investment**)

Your partner's income from the project is calculated the same way.

After every four rounds, you will randomly be re-matched with a new partner.

This process will continue until 24 rounds have been played.

After the 24th round your total profit will be recorded and you will be paid in cash.