Electronic Supplementary Materials

Endogenous Group Formation and its impact on Cooperation and Surplus Allocation - An Experimental Analysis

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Supplementary Material A:

A behavioral model

In our paper, we have observed that contributions and cooperation rates do not differ on average in ET and RT. We have also seen that in ET agents self select into groups whose life spans differ largely and that receivers´ expectations have a large impact on their cooperation rates. What we are not able to understand from the experimental data is what drives distributors to contribute differently and how individual differences affect group duration. In order to explain the qualitative features of the experimental results, we have developed a behavioral model. To keep the analysis simple, we investigate a variant of the surplus allocation game with one receiver and one distributor forming a group, and with only receivers deciding about cooperation. More specifically, the following 2-stage game is played repeatedly: First, receivers decide whether to cooperate or not (choices "y" or "n"). If a receiver refuses to cooperate, no surplus is produced and both group members earn nothing in that round. In case of cooperation, a surplus of 10 is produced. In the second stage of the game the distributor decides unilaterally about her contribution "c" to the payoff of "her" receiver. The set of feasible contributions is given by C={1,2,..10}. Hence, the earnings of the receivers and distributors, x_r and x_d, in round t are given by

$$x_{rt}(y,c)=c,\ x_{dt}(y,c)=10-c, \text{ and } x_{rt}(n,.)=x_{dt}(n,.)=0.$$

To allow for informed cooperation decisions, each receiver is informed about the previous contribution of "his" distributors, c_p, before the decision about cooperation is taken. Overall, this game is played for T rounds. In the first round, cooperation is enforced, and only the distributor has to decide about the contribution (i.e. the first round is a dictator game). Hence, a c_p exists for every distributor in every round where the receivers make cooperation decisions, i.e. in all t>1.

As in the experiment, we analyse two different matching protocols: In the re-match (RT), from round two onwards, subjects get re-matched every round using independent draws. With endogenous matching (ET) each group stays together until the receiver stops cooperating, in which case the agents get randomly re-matched with other agents unmatched in the respective round. We also look at the case where cooperation is exogenously enforced and agents get re-matched every round (BT).

The model is based on three straightforward behavioural assumptions.

1) Each agent (distributors and receivers) is endowed with an acceptance threshold $\tilde{c}$ that denotes the minimum previous contribution such that the particular agent would cooperate if he played the role of a receiver. This cooperation threshold describes the actual behavior of each receiver - if $c_p \geq \tilde{c}$, the receiver cooperates, otherwise he refuses cooperation (but for the possibility of making mistakes - see point 3 below). A distributor's cooperation threshold impacts her beliefs about the cooperation thresholds of the matched receiver (see point 2 below), which in turn is crucial for the optimal contribution of the distributor.

Agents differ in their acceptance thresholds. More specifically, there exist two types of agents in the population. Both receivers and distributors can be either modest (type m) or seeking (type s). Overall there is a mass of 1 of each receivers and distributors, and a fraction g of both of them is of type m. By definition, $\tilde{c}_s > \tilde{c}_m$, and we assume that $5 \geq \tilde{c}_s > \tilde{c}_m \geq 1$- both types of receivers cooperate with someone who previously contributed half of the surplus.

2) Each distributor wants to make choices that maximize the sum of the earnings of all rounds. Denote by $c^*(\tau,t)$ the optimal choice of a distributor of type τ in round t for given distributor's belief about the receivers' types. To determine $c^*(\tau,t)$, the distributor has to take the impact of her choices on the future cooperation behavior of her receivers into account, which of course depend on the types of the future receivers (see point 1 above).

To model the distributors' beliefs about the receivers' types we start from the observation that humans think that their own types are more present in the general population than they actually are. Because of the evidence cited in the introduction, we assume that in all rounds each contributor believes with certainty that all receivers are of her own type. This assumption is consistent with Bayesian updating when each distributor has the prior belief that all receivers are of her own type, provided that the receivers make mistakes when deciding about cooperation (see point 3 below). Within such a model, any cooperation decision contradicting the distributor's a-priori belief would be regarded as a mistake, leaving the beliefs about the receiver's type unchanged. This assumption is consistent with the experimental result that differences in distributor's choices remained stable during the experiment except for the very last round, implying that indeed little if any belief updating took place during the course of the experiment.

3) Whenever a choice is made, each receiver and each distributor makes a mistake with probability α, $0<\alpha<1/2$. For a type-τ receiver this implies that the likelihood of cooperation is $(1-\alpha)$ if $c_p \geq \tilde{c}_\tau$, and α otherwise.

In case of a mistake, a distributor chooses a contribution according to a probability distribution with full support on the set of feasible contributions. We assume that this probability distribution depends on her intended choice c*. Denote by $p(c|c^*)$ the likelihood that c is chosen in case of a mistake, if the distributor intends c*. The resulting cumulative probability distribution is $P(c|c^*)$, i.e. $P(c|c^*)$ is the likelihood that the actually chosen contribution is weakly below c in case of a mistake, if the distributor intends c*. We assume that the distributor is less likely to pick a small contribution if he intends to choose a relatively high contribution than if he intends a low contribution. Formally, for all c, c*, and c*' with $c^*<c^{*\prime}$ and $c<10$, $P(c|c^*)> P(c|c^{*\prime})$.

Taking into account that mistakes occur with a probability of α, the likelihood that the actual choice c is equal to the intended choice c* is $(1-\alpha)+\alpha p(c^*|c^*)$. The likelihood of a choice $c \neq c^*$ is given by $\alpha p(c|c^*)$. Likewise, the likelihood that the actual choice is weakly below a certain level c is given by $\alpha P(c|c^*)$ if $c< c^*$, and it is $(1-\alpha)+\alpha P(c|c^*)]$ if $c \geq c^*$.

Using this framework, we get the following results (see proofs below):

Proposition 1:

i) In the BT, $c^*(\tau,t)=1$ for both types τ=m,s for all rounds.

ii) If the receiver cooperated in the last round T, the optimal intended contribution $c^*(\tau,T)=1$ for both types τ=m,s in the RT as well as in the ET.

iii) For α small enough and for any round t with t<T it holds: If the receiver cooperated, the optimal intended contribution of the distributor is given by $c^*(\tau,t)=\tilde{c}_\tau$ for both types τ=m,s in the RT as well as in the ET.

Proposition 1 shows that the contribution is lower in BT than in ET and RT, as observed in the experiment. In the ET and RT a distributor, who would be seeking (s-type) in case she were a receiver, contributes more than someone who thinks all agents (including herself) are modest, provided that the mistake probability is small enough. Hence, an s-type distributor appears more generous than m-types, not because of real generosity, but due to the fear that without generosity receivers refrain from cooperating with her.

From now on we assume that the mistake probability is small enough that Proposition 1iii holds. Next we turn to the likelihood of cooperation. Since the likelihood of cooperation depends on the previous contribution of the distributor, and on the type of the receiver, it depends on the group composition. Denote by $prob(y|\tau_d,\tau_r)$ the probability of cooperation when the group is formed of a d-type distributor and a r-type receiver. We get:

Proposition 2: In the ET and the RT it holds that groups consisting of a seeking distributor and a modest receiver have the highest cooperation probabilities, while groups consisting of a modest distributor and a seeking receiver have the lowest cooperation probabilities:

i) $prob(y|\tau_d=s; \tau_r=m) > prob(y|\tau_d=\tau_r=m)$ and $prob(y|\tau_d=s; \tau_r=m) > prob(y|\tau_d=\tau_s=s)$, and

ii) $prob(y|\tau_d=\tau_r=m) > prob(y|\tau_d=m;\tau_r=s)$ and $prob(y|\tau_d=\tau_s=s) > prob(y|\tau_d=m;\tau_r=s)$.

Note that $prob(y|\tau_d=\tau_r=m) > prob(y|\tau_d=m;\tau_r=s)$ and $prob(y|\tau_d=s; \tau_r=m) > prob(y|\tau_d=\tau_r=s)$ - an m-type receiver is more likely to cooperate than an s-type for any given type of distributor he can be matched with. Hence, the expected cooperation rates are larger for m-type than for s-type receivers. Similarly, $prob(y|\tau_d=s; \tau_r=m) > prob(y|\tau_d=\tau_r=m)$ and $prob(y|\tau_d=\tau_r=s) > prob(y|\tau_d=m;\tau_r=s)$ - an s-type distributor experiences more cooperation than an m-type for any given type of receiver she can be matched with. Hence, in expectations the experienced cooperation rates are larger for s-type distributors than for m-type distributors, and for m-type receivers than for s-type receivers. Furthermore, for the ET Proposition 2 implies that groups consisting of a modest receiver and a seeking distributor have the longest expected duration, whereas groups consisting of a seeking receiver and a modest distributor have the shortest expected duration.

Proposition 1 states the intended contributions of the different types of distributors in the ET and the RT provided that the receivers have cooperated. But not all groups cooperate, and for a given group the probability of cooperation depends on the types of the receiver and the distributor, i.e. on the type composition of the respective group (Proposition 2). To calculate the overall cooperation rate in the population, and the average contribution level, we have to take into account how often the four different possible type combinations are present in the population. This leads to the following

Proposition 3: For α converging to zero, the observed cooperation rates and the observed contributions converge to the same level in the ET and the RT treatment. For α=0 the following holds:

i) In both treatments the cooperation rate is 1-g(1-g) in any round but round 1.

ii) In both treatments, a mass of (1-g) distributors choose a contribution of $\tilde{c}_s$, a mass of g^2 distributors chooses $\tilde{c}_m$, and the other distributors do not have to make a contribution choice in any round but round 1 since their receivers do not cooperate.

According to Proposition 3, average observed cooperation and contribution behavior are similar in both treatments as long as the mistake rates are not too large. Furthermore, in the ET there is a large variance in the number of groups an agent belongs to, and the contribution of a distributor as well as the acceptance threshold of a receiver are correlated with the number of groups (s)he belongs to:

Proposition 4: When α converges to zero the following holds:

i) In the ET, a fraction of g(1-g) receivers and distributors are members of T groups, while all other receivers are members of only 1 group.

ii) The average contribution of a multi-group ET distributor is below the average contribution of an RT distributor, while the average contribution of a few-group ET distributor is larger than that of an RT distributor.

iii) The average acceptance threshold of an RT receiver is below the average acceptance threshold of a multi-group ET receiver, and above that of an few-round ET receiver.

Proposition 4 is in accordance with the experimental results. With respect to the payoffs we get the following result:

Proposition 5: For α=0 it holds:

i) The average payoff of the distributors is larger in the BT than in the two other treatments. The average payoff of the receivers is smaller in the BT than in the two other treatments.

ii) The average payoffs of distributors and receivers are the same in the RT and the ET.

iii) Few-group ET agents have higher expected payoff than RT agents, who in turn have higher payoff than multi-group ET agents.

Again, this proposition reflects the results found in the experiment.

To summarize, the model captures the main experimental results very well: In the BT, contributions are smaller than in the other treatments, leading to higher distributors' payoffs and lower receivers' payoffs in the BT than in the other treatments. On average, cooperation rates, contribution levels, and earnings are the same in the ET and the RT. However, in ET group durations differ, and so does the number of groups each particular agent is member of. Multi-group ET receivers cooperate less than RT receivers, while few-group ET receivers cooperate more. And multi-group ET distributors contribute less than RT receivers, while few-group ET distributors contribute more. Furthermore, the resulting payoff structure is in accordance with the experimental results. The model also sheds light on the rationales that drive distributors/receivers to behave in different ways and self-select. Seeking distributors are those who contribute more, not driven by true generosity, but by fear of rejection. The more efficient groups (lasting the longest) are those composed by modest receivers and seeking distributors, while the groups with the shortest life-span are those composed by modest distributors and seeking receivers.

Proof of Proposition 1

i and ii) In the BT, in any round t any increase in the contribution unambiguously decreases the overall payoff of the distributor. The same argument holds for the last round T in the other treatments.

iii) First note that in any round for a given previous contribution the cooperation probability is continuous in α. Furthermore, for given cooperation decision and given intended contribution the expected contribution is continuous in α. Hence, in any given round the expected earnings of this round are continuous in α.

Next we show that in any round $t<T$ with zero mistake probabilities the sum of a type τ-distributor's earnings in all rounds weakly larger than t is strictly larger when he chooses a contribution of $\tilde{c}_\tau$ in round t than when he chooses any other distribution in round t, given his belief that all receivers are also of type τ. Since this holds for any $t<T$ and since earnings are continuous in α, it is optimal to choose $c^*(\tau,t)= \tilde{c}_\tau$ in all rounds but T for small enough α.

Take round T-1 and $\alpha=0$. A distributor of type τ has to distribute a surplus (i.e. her receiver in round T-1 decided to cooperate). We have to distinguish between two sets of choices (since $\alpha=0$, the intended choice equals the actual choice). First, we look at all choices $c<\tilde{c}_\tau$. In this case the distributor's expected earnings of the last two rounds are given by $x_{d(T-1)}+ x_{dT}=10-c$, since the distributor expects that in the last round the receiver will not cooperate. Hence, within the set of choices $c<\tilde{c}_\tau$ the earnings are maximized at c=1, leading to $x_{d(T-1)}+ x_{dT}=9$.

Second, we look at all choices $c\geq\tilde{c}_\tau$. In this case her expected earnings of the last two rounds are given by $x_{d(T-1)}+ x_{dT} =10-c+9$, since the distributor expects that in the last round the receiver will cooperate and she will earn 9 in the last round. Hence, within the set of choices $c\geq\tilde{c}_\tau$ the earnings are maximized at $c= \tilde{c}_\tau$ leading to $x_{d(T-1)}+ x_{dT}=10-\tilde{c}_\tau +9$. Obviously, these earning are strictly larger than the maximum the distributor could earn during the last two rounds with any $c<\tilde{c}_\tau$.

Therefore, the unique earning maximizing choice of the distributor in round T-1 is given by $c^*(\tau,T-1)=\tilde{c}_\tau$, and by continuity of the earning function this holds true for small enough α.

Next, take round T-2 and $\alpha=0$ with a distributor of type τ having to distribute a surplus (i.e. her receiver in round T-2 decided to cooperate). Again, we have to distinguish between two sets of choices (since $\alpha=0$, the intended choice equals the actual choice). First, we look at all choices $c<\tilde{c}_\tau$. In this case the distributor's expected earnings of the last three rounds are given by $x_{d(T-2)}+x_{d(T-1)}+x_{dT}=10-c$, since the distributor expects that in the last 2 rounds the receivers will not cooperate. Hence, within the set of choices $c<\tilde{c}_\tau$ the earnings are maximized at c=1, leading to $x_{d(T-1)}+x_{dT}=9$.

Second, we look at all choices $c\geq\tilde{c}_\tau$. In this case her expected earnings of the last three rounds are given by $x_{d(T-2)}+x_{d(T-1)}+x_{dT}=10-c+(10-\tilde{c}_\tau)+9$, since the distributor expects that in round T-1 the receivers will cooperate and she will chooses $c^*=\tilde{c}_\tau$, leading cooperation in round T. Hence, the distributor will earn $(10-\tilde{c}_\tau)$ and 9, respectively, in the last 2 rounds. Within the set of choices $c\geq\tilde{c}_\tau$ the earnings are maximized at $c=\tilde{c}_\tau$, leading to $x_{d(T-2)}+x_{d(T-1)}+x_{dT}=2(10-\tilde{c}_\tau)+9$.

These earnings are strictly larger than the maximum the distributor could earn during the last three rounds with any $c<\tilde{c}_\tau$. Therefore, the unique earning maximizing choice of the distributor in round T-2 is given by $c^*(\tau,T-2)=\tilde{c}_\tau$, and by continuity of the payoff-function this holds for small enough α.

The same proof goes through for any round t<T-2. Within the set of choices $c<\tilde{c}_\tau$ the earning maximizing choice is 1, implying expected earnings for the last T-t+1 rounds of $\Sigma_{n\geq t}x_{dn}=9$. Within the set of choices $c\geq\tilde{c}_\tau$ the earning maximizing choice is $\tilde{c}_\tau$, implying expected earnings for the last T-t+1 rounds of $\Sigma_{n\geq t}x_{dn}=(T-t)(10-\tilde{c}_\tau)+9$, which is strictly larger than 9. Therefore, for all rounds t<T the earning maximizing contribution is given by $c^*(\tau,t)=\tilde{c}_\tau$ for a small enough mistake probability. Note that this proof also holds for t=1 when cooperation is enforced, i.e when a dictator game is played.

Proof of Proposition 2

Since round 1 is a dictator game, at least one previous round exists where the distributor made a choice. In this previous round, she intended to choose $c^*=\tilde{c}_\tau$, since this is her intention in all rounds but T (obviously, T can never be the previous round). Since the intended previous choice only depends on the type of the distributor, the probability distribution of the actual previous choices depends only on the distributor's type. Since the cooperation decision of the receivers depends only on the previous choice and on the type of the receiver, the likelihood of cooperation depends only on the pair of types. We have groups with 4 different type combinations:

Case a) Receiver and distributor are of type m, i.e. $\tau_r=\tau_d=m$. Because the distributor intended $\tilde{c}_\tau=\tilde{c}_m$ in the previous round, the likelihood of an actual previous choice $c_p<\tilde{c}_m$ is given by $prob(c_p|c<\tilde{c}_m)=\alpha P(\tilde{c}_m-1|\tilde{c}_m)$, while the likelihood that the actual previous choice c_p is weakly larger than $\tilde{c}_m$ is given by $prob(c_p|c\geq\tilde{c}_m)=1-\alpha P(\tilde{c}_m-1|\tilde{c}_m)$. This implies a cooperation probability of

$$prob(y|\tau_d=\tau_r=m) = \alpha^2 P(\tilde{c}_m-1|\tilde{c}_m)+(1-\alpha)[1-\alpha\ P(\tilde{c}_m-1|\tilde{c}_m)]=1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_m-1|\tilde{c}_m).$$

Case b) $\tau_r=\tau_d=s$. This is exactly the same as Case 1, except that $P(\tilde{c}_m-1|\tilde{c}_m)$ has to be replaced by $P(\tilde{c}_s-1|\tilde{c}_s)$. Hence $prob(y|\tau_d=\tau_s=s)=1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_s-1|\tilde{c}_s)$.

Case c) $\tau_d=s$; $\tau_r=m$. Because the distributor intended $\tilde{c}_s$ in the previous round, and because $\tilde{c}_m< \tilde{c}_s$, the likelihood of an actual previous choice $c_p<\tilde{c}_m$ is given by $prob(c_p|c<\tilde{c}_m)=\alpha P(\tilde{c}_m-1|\tilde{c}_s)$, while the likelihood that the actual previous choice c_p is weakly larger than $\tilde{c}_m$ is given by $prob(c_p|c\geq\tilde{c}_m)=1-\alpha P(\tilde{c}_m-1|\tilde{c}_s)$. This implies a cooperation probability of

$$prob(y|\tau_d=s;\ \tau_r=m)= \alpha^2 P(\tilde{c}_m-1|\tilde{c}_s)+(1-\alpha)[1-\alpha P(\tilde{c}_m-1|\tilde{c}_s)]=1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_m-1|\tilde{c}_s).$$

Case d) $\tau_d=m;\tau_r=s$. Because the distributor intended $\tilde{c}_m$ in the previous round, and because $\tilde{c}_m< \tilde{c}_s$ the likelihood of an actual previous choice $c_p <\tilde{c}_s$ is given by $prob(c_p|c<\tilde{c}_s)= (1-\alpha)+\alpha P(\tilde{c}_s-1|\tilde{c}_m)$, while the likelihood that the actual previous choice c_p is weakly larger than $\tilde{c}_f$ is given by $prob(c_p|c\geq\tilde{c}_s)=\alpha[1-P(\tilde{c}_s-1|\tilde{c}_m)]$.This implies a cooperation probability of

$$prob(y|\tau_d=m;\tau_r=s)=\alpha[(1-\alpha)+\alpha P(\tilde{c}_s-1|\tilde{c}_m)]+(1-\alpha)[\alpha[1-P(\tilde{c}_s-1|\tilde{c}_m)]]=2\alpha(1-\alpha)-\alpha(1-2\alpha)P(\tilde{c}_s-1|\tilde{c}_m).$$

Recall that $P(.|\tilde{c}_s)$ and $P(.|\tilde{c}_m)$ are cumulative distributions derived from a full support distributions. Therefore, $P(\tilde{c}_s-1|\tilde{c}_s)>P(\tilde{c}_m-1|\tilde{c}_s)$ and $P(\tilde{c}_s-1|\tilde{c}_m)>P(\tilde{c}_m-1|\tilde{c}_m)$ since $\tilde{c}_s-1>\tilde{c}_m-1$. This implies that

$prob(y|\tau_d=s;\ \tau_r=m)=1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_m-1|\tilde{c}_s) > 1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_s-1|\tilde{c}_s)= prob(y|\tau_d=\tau_s=s)$, and

$prob(y|\tau_d=\tau_r=m)=1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_m-1|\tilde{c}_m) > 2\alpha(1-\alpha)-\alpha(1-2\alpha)P(\tilde{c}_s-1|\tilde{c}_m)= prob(y|\tau_d=m;\tau_r=s)$.

By assumption $P(\tilde{c}_m-1|\tilde{c}_m)>P(\tilde{c}_m-1|\tilde{c}_s)$ and $P(\tilde{c}_s-1|\tilde{c}_m)>P(\tilde{c}_s-1|\tilde{c}_s)$. Hence,

$prob(y|\tau_d=s;\ \tau_r=m)=1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_m-1|\tilde{c}_s) > 1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_m-1|\tilde{c}_m)=prob(y|\tau_d=\tau_r=m)$, and

$prob(y|\tau_d=\tau_s=s)=1-\alpha-\alpha(1-2\alpha)P(\tilde{c}_s-1|\tilde{c}_s) > 2\alpha(1-\alpha)-\alpha(1-2\alpha)P(\tilde{c}_s-1|\tilde{c}_m)= prob(y|\tau_d=m;\tau_r=s)$.

Proof of Proposition 3

First, we look at the ET. In any round for a given previous contribution the cooperation probability is continuous in α. Furthermore, for given cooperation decision and given intended contribution the expected contribution is continuous in α. Hence, the distribution of group compositions in the next round is continuous in α.

Take α=0, and look at the first round. In this round, where cooperation is exogenously enforced, a fraction g of distributors chooses a contribution of $\tilde{c}_m$, and a fraction of (1-g) distributors chooses $\tilde{c}_s$.

In the round 2, we have a fraction of g(1-g) groups that consist of a m-type distributor and a s-type receiver. In these groups the receivers do no cooperate, since their distributors have chosen $\tilde{c}_m$ in round 1 and they require at least a previous contribution of $\tilde{c}_s$ to cooperate. These groups get immediately split up again.

In the round 2, we also have a fraction of (1-g)g groups that consist of a s-type distributor and a m-type receiver. In these groups the receivers cooperate, the distributors contribute $\tilde{c}_s$, and the groups stay together in round 3. For the fraction $(1-g)^2$ groups consisting of $\tau_d=\tau_r=s$ the receivers cooperate, the distributors contribute $\tilde{c}_s$, and the groups stay together in round 3. Similarly, for the fraction g^2 groups consisting of $\tau_d=\tau_r=m$ the receivers cooperate, the distributors contribute $\tilde{c}_m$, and the groups also stay together in round 3.

In round 3, all agents stay with their previous partners except a mass of (1-g)g of s-type distributors and the same mass of m-type receivers. These distributors and receivers - coming from a ($\tau_d=m,\tau_r=s$)-group - get re-matched, but with a partner of the same type as they experienced in round 2. Hence, these receivers will again not cooperate, and these groups will again be split up. All other round-2- groups remain together also in round 3, the receivers cooperate, the distributors contribute according to their types, and the group stay together also in round 4. By applying the same logic to all the following rounds, these groups will stay together for the rest of the game, while the distributors and receivers coming from a split-up ($\tau_d=m,\tau_r=s$)-group will never cooperate again. Hence, the rate of non-cooperation is (1-g)g for all rounds of the ET treatment (except for round 1). Furthermore, in any round but the first one (1-g) distributors choose a contribution of $\tilde{c}_s$, g^2 distributors choose $\tilde{c}_m$, and g(1-g) distributors do not have to make a distribution choice since their receivers do not cooperate.

For the RT, note a group cooperates except if it is composed of $\tau_d=s,\tau_r=m$. Due to law of larger numbers and since groups are composed according by random and independent draws, $\tau_d=s,\tau_r=m$ groups are formed in (1-g)g cases, like in the ET. The rate of non-cooperation in the RT is (1-g)g like in the ET, and the contributions are $\tilde{c}_s$ for (1-g) distributors and $\tilde{c}_m$ for g^2 distributors, again like in the ET.

Proof of Proposition 4

i) It follows immediately from the proof of Proposition 3, a fraction of g(1-g) ET receivers an distributors are members of T groups, while all others ET receivers stay in the same group all the rounds (Recall that in round 1 where cooperation is exogenously enforced).

ii) A multi-round ET distributors choose 0 except for round. The few-round ET distributors consist of a mass of (1-g) agents contributing $\tilde{c}_s$ and g^2 agents contributing $\tilde{c}_m$ in all rounds. Hence, the average contribution of a few-round ET distributor is $[(1-g)\tilde{c}_s+g^2\tilde{c}_m]/[1-g+g^2]$. In the

RT (1-g) distributors contribute $\tilde{c}_s$, g^2 contribute $\tilde{c}_m$, and the rest nothing. Hence, the average contribution in the RT is given by $(1-g)\tilde{c}_s+g^2\tilde{c}_m$.

iii) The average acceptance threshold of an RT receiver is $g\tilde{c}_m+(1-g)\tilde{c}_s$. For multi-round receiver it is $\tilde{c}_s$, while for a few-round ET receiver it is $g\tilde{c}_m+(1-g)^2\tilde{c}_s$.

Proof of Proposition 5

ii) In round 1, when cooperation is enforced, g distributors choose $\tilde{c}_m$ and (1-g) distributors choose $\tilde{c}_s$ in all rounds. As can be seen from the proof of proposition 3, the same groups are formed in all later in both treatments, leading to the same cooperation and contribution behavior. Hence, the average payoffs are the same in both treatments.

i) Since distributors always receive the maximum possible payoff, namely 9, in every round of the BT, and since in the ET and the RT a mass of g(1-g) distributors faces non-cooperation in all rounds, The distributors' payoffs are strictly larger in the BT than in the RT and the ET.

Receivers get an expected payoff of $(1-g)\tilde{c}_s+g^2\tilde{c}_m$ in every round, and since $\tilde{c}_s>\tilde{c}_m\leq 2$ and $1>g>0$, it holds that $(1-g)\tilde{c}_s+g^2\tilde{c}_m>1$, which is the payoff receivers get in the every round of the BT.

iii) Multi-group ET receivers do not cooperate in any round, and multi-group distributors do not experience cooperation but for round 1 when cooperation is exogenously enforced. Hence, the payoffs of these agents are below that of few-round agents who are in groups that always cooperate. Because of i this also implies that the payoffs of RT agents must be in between those of multi-group ET and few-group ET agents.

Supplementary Material B:

Experimental Instructions

Base treatment (BT)

Dear Participant, welcome!

You are about to participate in an experiment on interactive decision-making, conducted by researchers from the Vrije Universiteit Brussel and the Université Libre de Bruxelles, and funded by the Belgian fund for the scientific research (Fonds de la Recherche Scientifique). In this experiment you will earn some money, and the amount will be determined by your choices and by the choices of the other participants.

Your privacy is guaranteed: all results will be used anonymously.

It is very important that you remain silent during the whole experiment, and that you never communicate with the other participants, neither verbally, nor in any other way. For any doubts or problems you may have, please just raise your hand and an experimenter will approach you. If you do not remain silent or if you behave in any way that could potentially disturb the experiment, you will be asked to leave the laboratory, and you will not be paid.

All your earnings during the experiment will be expressed in **Experimental Currency Units** (ECUs), which will be transformed into Euros with a change rate of 10 to 1. At the end of the experiment, a show up fee of 2.5 euros will be added to your earnings.

You will be paid privately and in cash. Other participants will not be informed about your earnings.

Before starting, you will be randomly assigned to the role of Agent 1 or Agent 2, and you will maintain the role for the whole experiment. During the experiment, two Agents 1 and two Agents 2 will form groups of four people.

The experiment consists of 30 rounds. In each round there will be a random re-grouping of Agents 1 and 2. Obviously, as the matching rule is random and as the number of rounds is larger than the number of participants, you will be matched more than once with the same subjects during the experiment. However, you will never know the identity of the participants you are matched with and hence you will not be able to identify your partners. Your partners will also be unable to identify you.

In each round each Agent 1 receives an endowment of 10 ECUs and has to decide how much to give to the two Agents 2 that have been matched with him/her. The minimal amount to give is 1 ECU, the maximal 10 ECUs. The amount will be equally split between the two Agents 2.
Each Agent 1's gain will be what he/she has decided to keep for him/herself, while each Agent 2's gain will be the sum of what the two matched Agents 1 have given, divided by 2 (since he/she has to share with the other Agent 2).
After the choices of the Agents 1 each Agent 2 will be informed about the amounts that have been given to him/her. Agents 2 do not have to make any decision.

Example: At round X, Agent 1a decides to give 1 ECU, Agent 1b decides to give 3 ECUs. In that round, Agent 1a gains 10-1=9 ECUs, Agent 1b gains 10-3=7 ECUs, and each Agent 2 gains (1+3)/2=2ECUs.

Once the experiment is over, you will have to fill a short questionnaire.

After that, your final earnings will be determined. For Agent 1 the final earnings (in ECUs) are the sum of all those amounts he/she did not give to his/her Agents 2 over all the 30 rounds. For Agent 2, the final earnings are the sum of all those earnings he/she received from his/her Agents 1 during all the 30 rounds.
These final earnings are transformed into Euros with 10 ECUs being equal to 1 euro, and a show up fee of 2.5 euros will be added.

You will be asked to fill a short questionnaire and you will be paid 2.5 euros to complete this task.
Your final earning will appear on the screen and the experimenters will explain the modality of payment.

Thank you for your participation!

Re-match Treatment (RT)

Dear Participant, welcome!

You are about to participate in an experiment on interactive decision-making, conducted by researchers from the Vrije Universiteit Brussel and the Université Libre de Bruxelles, and funded by the Belgian fund for the scientific research (Fonds de la Recherche Scientifique). In this experiment you will earn some money, and the amount will be determined by your choices and by the choices of the other participants.
Your privacy is guaranteed: all results will be used anonymously.
It is very important that you remain silent during the whole experiment, and that you never communicate with the other participants, neither verbally, nor in any other way. For any doubts or problems you may have, please just raise your hand and an experimenter will approach you. If you do not remain silent or if you behave in any way that could potentially disturb the experiment, you will be asked to leave the laboratory, and you will not be paid.

All your earnings during the experiment will be expressed in **Experimental Currency Units** (ECUs), which will be transformed into Euros with a change rate of 10 to 1. At the end of the experiment, a show up fee of 5 euros will be added to your earnings.
You will be paid privately and in cash. Other participants will not be informed about your earnings.

Before starting, you will be randomly assigned to the role of Agent 1 or Agent 2, and you will maintain the role for the whole experiment. During the experiment, two Agents 1 and two Agents 2 will form groups of four people.

The experiment is divided in two parts with a total of 30 rounds. In each round there will be a random re-matching of Agents 1 and 2. Obviously, as the matching rule is random and as the number of rounds is larger than the number of participants, you will be matched more than once with the same subjects during the experiment. However, you will never know the identity of the participants you are matched with and hence you will not be able to identify your partners. Your partners will also be unable to identify you.

PART 1

The first part of the experiment consists of 3 rounds. In each round, each Agent 1 receives an endowment of 10 ECUs and has to decide how much to give to the Agents 2 that have been matched with him/her. The minimal amount to give to Agents 2 is 1 ECU, the maximal 10 ECUs. After the choice, the amount will be split equally between the two Agents 2 and each of them will be informed about the amount that has been given to him/her. Agents 2 do not have to make any decision.

Example: At round X, Agent 1a decides to give 1 ECU, Agent 1b decides to give 3 ECUs. In that round, Agent 1a gains 10-1=9 ECUs, Agent 1b gains 10-3=7 ECUs, and each Agent 2 gains (1+3)/2=2 ECUs.

PART 2

The second part of the experiment consists of 27 rounds (from round 4 to round 30). At the beginning of each round, two Agents 1 and two Agents 2 are matched and form a group. All members of the group see a screenshot that shows what the matched Agents 1 gave in the three

last rounds he/she played. Then all agents (both Agents 1 and 2) have to choose whether he/she wants to interact with the group he/she has been matched with, or not.
IF NOT, i.e. if at least one agent refuses to interact, the group is dissolved. All agents of this group skip this round and go directly to the following one, where they will be matched with new partners. When an interaction is refused, each agent of the group will gain 0 ECUs for that round. Refusals are not shown in the screenshot that summarizes the three previous rounds.

IF YES, i.e. if all agents of a group accept to interact, the group stays together during this round. In this case, both Agents 1 receive 10 ECUs and chooses how much to give to Agents 2, with a minimum of 1 and a maximum of 10 ECUs. After the choice, each Agent 2 will be informed about the amount that has been given to him/her.

As already explained, at the beginning of each round a screenshot informs each agent what the randomly matched Agents 1 gave in the three last rounds he/she played. Agents will not see if in the previous rounds any agent refused to interact with a specific Agent 1.

Once the experiment is over, you will have to fill a short questionnaire.

After that, your final earnings will be determined. For Agent 1 the final earnings (in ECUs) are the sum of all those amounts he/she did not give to his/her Agents 2 over all the 30 rounds. For Agent 2, the final earnings are the sum of all those earnings he/she received from his/her Agents 1 during all the 30 rounds.
These final earnings are transformed into Euros with 10 ECUs being equal to 1 euro, and a show up fee of 5 euros will be added.
Your final earning will appear on the screen and the experimenters will explain the modality of payment.

Thank you for your participation!

Endogenous-match Treatment (ET)

Dear Participant, welcome!

You are about to participate in an experiment on interactive decision-making, conducted by researchers from the Vrije Universiteit Brussel and the Université Libre de Bruxelles, and funded by the Belgian fund for the scientific research (Fonds de la Recherche Scientifique). In this experiment you will earn some money, and the amount will be determined by your choices and by the choices of the other participants.

Your privacy is guaranteed: all results will be used anonymously.

It is very important that you remain silent during the whole experiment, and that you never communicate with the other participants, neither verbally, nor in any other way. For any doubts or problems you may have, please just raise your hand and an experimenter will approach you. If you do not remain silent or if you behave in any way that could potentially disturb the experiment, you will be asked to leave the laboratory, and you will not be paid.

All your earnings during the experiment will be expressed in **Experimental Currency Units** (ECUs), which will be transformed into Euros with a change rate of 10 to 1. At the end of the experiment, a show up fee of 5 euros will be added to your earnings.

You will be paid privately and in cash. Other participants will not be informed about your earnings.

Before starting, you will be randomly assigned to the role of Agent 1 or Agent 2, and you will maintain the role for the whole experiment. During the experiment, two Agents 1 and two Agents 2 will form groups of four people.

The experiment is divided in two parts with a total of 30 rounds. You will never know the identity of the participants you are matched with in the different rounds - you will not be able to identify your partners. Your partners will also be unable to identify you.

PART 1

The first part of the experiment consists of 3 rounds. During these three rounds, you will be matched with the same agents - the composition of your group will not change. In each round, each Agent 1 receives an endowment of 10 ECUs and has to decide how much to give to the Agents 2 that have been matched with him/her. The minimal amount to give to Agents 2 is 1 ECU, the maximal 10 ECUs. After the choice, the amount will be split equally between the two Agents 2 and each of them will be informed about the amount that has been given to him/her Agents 2 do not have to make any decision.

Example: At round X, Agent 1a decides to give 1 ECU, Agent 1b decides to give 3 ECUs. In that round, gent 1a gains 10-1=9 ECUs, Agent 1b gains 10-3=7 ECUs, and each Agent 2 gains (1+3)/2=2 ECUs.

PART 2

The second part of the experiment consists of 27 rounds (from round 4 to round 30).
At the beginning of round 4 of this part of the experiment, each agent (both Agents 1 and 2) will have to choose whether he/she wants to maintain the group he/she has interacted with in the previous round, or not. To reach a decision, all members of the group see a screenshot that shows what the matched Agents 1 gave in the three last rounds he/she played.

IF NOT, i.e. if at least one agent does not want to maintain the group, it is dissolved. All agents of this group skip this round and go directly to the following one, where they will be matched with new partners. When the group is dissolved, each agent of the group will gain 0 ECUs for that round. Refusals are not shown in the screenshot that summarizes the three previous rounds.

IF YES, i.e. if all agents of the group want to maintain it, the group stays together during this round. In this case, both Agents 1 receive 10 ECUs and chooses how much to give to Agents 2, with a minimum of 1 and a maximum of 10 ECUs. After the choice, each Agent 2 will be informed about the amount that has been given to him/her.

From round 5 to round 30, at the beginning of each round each agent will have to choose whether he/she accepts to interact with the proposed group, or whether he/she prefers to be matched with new partners.

If in the previous round your group has been dissolved, then you will be matched randomly with the available agents.

If in the previous round your group was not dissolved, each group member has to choose again whether he/she wants to maintain the group in this round, or not. If it is dissolved in this round, every group member earn 0 ECUs in this round, and a new matching takes place in the next round. If the group is again maintained, each Agent 1 has to decide about the split of his 10 ECUs as described before.

As already explained, at the beginning of each round a screenshot informs each agent the Agents 1 he/she is matched with gave in the three last rounds the respective Agent 1 played. Agents will not see if in the previous rounds any agent refused to interact with a specific Agents 1.

Please keep in mind that if your group is dissolved, in the next round you will be randomly re-matched. But if all the other groups have been maintained, your group will be re-formed with the same agents.

Once the experiment is over, you will have to fill a short questionnaire.

After that, your final earnings will be determined. For Agent 1 the final earnings (in ECUs) are the sum of all those amounts he/she did not give to his/her Agents 2 over all the 30 rounds. For Agent 2, the final earnings are the sum of all those earnings he/she received from his/her Agents 1 during all the 30 rounds.

These final earnings are transformed into Euros with 10 ECUs being equal to 1 euro, and a show up fee of 5 euros will be added.

Your final earning will appear on the screen and the experimenters will explain the modality of payment.

Thank you for your participation!

QUESTIONNAIRE

Dear Participant,

the following questionnaire is anonymous and has the sole purpose of verifying your understanding of the rules of this experiment.

We ask you to answer to the following questions. If you are uncertain about how to respond, please consult the instructions sheet or the experimenter.

Once you have finished, please raise your hand and an experimenter will come and check your answers.

If Agent 1a decides to give 3 ECUs, and Agent 1b decides to give 5 ECUs, how many ECUs will each of the four agents of the group in that round?

Agent 1a………... Agent 1b…………

Agent 2a........... Agent 2b…………

If Agent 1a decides to give 4ECUs, and Agent 1b decides to give 2 ECUs, how many ECUswill each of the four agents of the group in that round?

Agent 1a……….. Agent 1b…………

Agent 2a........... Agent 2b…………

In the second part of the experiment, will the group be dissolved if one of the agents decides so?

YES NO

In the second part of the experiment, will the groups be randomly re-matched at each round?

YES NO

In the second part of the experiment, if one agent decides not to maintain the randomly selected group, how many ECUs will each group member earn in that round? …………