Cooperative versus competitive interactions and in-group bias

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Abstract

We study the effect of interpersonal but impersonal interactions on in-group bias in allocational choices. Before the elicitation of the choices, individuals either engage in a cooperative or competitive interaction, or in no interaction at all. We find that a cooperative interaction eliminates any in-group bias as compared to the case where there is no interaction, and even introduces relatively more pro-sociality with respect to out-group. A competitive interaction reduces pro-sociality in general, irrespective of whether others are in- or out-group.

Keywords: in-group bias, interactions, allocational choices, laboratory experiment

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1 Introduction

People tend to act less socially when their decisions affect others who do not share the same identity. This behavior has been referred to as *in-group bias* and is observed even when identity is artificially induced (Tajfel, Billig, Bundy, and Flament, 1971). For example, individuals tend to be relatively more inequality averse when it comes to distributing money between oneself and an *out-group* other than when it comes to distributing money between oneself and an *in-group* other (Chen and Li, 2009; Currarini and Mengel, 2016). It is also shown that when induced group memberships are made salient, individuals are less inclined to cooperate or coordinate with out-group members than with in-group members in strategic environments (Charness, Rigotti, and Rustichini, 2007; Chen and Chen, 2011). Balliet, Wu, and De Dreu (2014) show in a meta-study that such effects are found for artificially induced and natural groups.

In daily life, however, interactions are often not as neutral as implemented in the lab, and their nature is either competitive or cooperative. Think for example of competition for a job or for college admission as opposed to cooperation between colleagues within organizations or between college students, or of competition between sports players or teams as opposed to cooperation within sports teams. This paper studies whether the nature of interactions has an effect on in-group bias. Suppose for example that a local competes with an immigrant for a job position. Will this lead her to behave in a relatively more hostile way towards immigrants in general than toward other locals? Suppose that the local and the immigrant instead both engage in the same charity activity, will this lead the local to treat immigrants more favorably so that (possible initial) prejudice is removed?

Interactions with out-group can occur even when there is no direct personal contact. In the above-mentioned example of a local competing with an immigrant for a job the applicants are not necessarily in personal contact with each other. Other examples relate to people from different communities who (know that they) donated to the same charity, people with different ethnic backgrounds who both bid for a precious DVD on eBay, or teenagers from different countries who play against each other in an online video game. Although we know that *physical* social distance has an impact on reciprocity and partner choice in online interactions (see Charness, Haruvy, and Sonsino, 2007; Fiedler, Haruvy, and Li, 2011), it is not all that clear whether the nature of the interaction will have an effect on in-group bias in the case of such *impersonal* interactions. According to intergroup contact theory, which is a long-standing theory in social psychology, cooperative interactions with out-group reduce prejudice against out-group only if there is direct personal contact (Allport, 1954). In the studies included in the survey by Paluck, Green, and Green (2019), that provides empirical support for intergroup contact theory, participants at least get a chance to know the person they interact with, and can often talk to this person (see also Pettigrew and Tropp, 2006).[1] We design an experiment that allows to study whether the nature of interaction with out-

[1]Contacts range from temporary and structured conversations or activities in a lab setting, to sustained interventions (e.g. discussions on a specific topic or a joint trip) or encounters (e.g. interracial college roommates) in naturalistic environment.

group members by itself has an effect on in-group bias, even if the interaction is impersonal and only involves economic interdependence.

In the experiment participants are randomly assigned to either a *Red* group or a *Blue* group and make distributional choices after having engaged in an interaction with an out-group member. The interaction involves a real-effort task and we manipulate the nature of this interaction by imposing different payment structures. In the *Neutral* condition, participants are paid on a piece rate basis. In the *Competitive* condition, only the best performer earns money with the task. In the *Cooperative* condition, there are effort externalities among the participants. The incentives are set up such that the expected earnings are the same in the three conditions for risk neutral players. After the real-effort task, participants make a series of allocational choices (inspired by Chen and Li, 2009; Currarini and Mengel, 2016), where they distribute money between themselves and another in-group *or* out-group participant. The choices are chosen in a way that allows to disentangle charity concerns from envy (Fehr and Schmidt, 1999; Charness and Rabin, 2002). We use the aggregate difference between the charity concerns or envy of participants matched to an in-group other and the charity concerns or envy of participants matched to an out-group other as a measure of in-group bias. The key question is whether this difference depends on the nature of the real-effort interaction.

The results indicate that the nature of the real-effort interaction has an effect on in-group bias in charity concerns. In particular, whereas participants attach a higher weight to the earnings of an in-group other than of an an out-group other in the *Neutral* and *Competitive* conditions, the opposite holds in the *Cooperative* condition. Envy of individuals, however, is not affected by the nature of the preceding interaction.

A number of studies have explored the effect of the nature of interactions on self-reported attitudes toward out-group. In general, cooperative contacts tend to reduce prejudice toward out-groups. Van Oudenhoven, Groenewoud, and Hewstone (1996) find that when the ethnic background of Turkish participants is made salient, the attitude of Dutch participants toward Turkish people is more favorable after they cooperated with Turkish participants on some tasks. Brown, Vivian, and Hewstone (1999) show that after cooperative contact with German participants, British participants view Germans more positively (i.e. as more hardworking and efficient). Adachi, Hodson, Willoughby, Blank, and Ha (2016) demonstrate that after players played cooperatively with out-group players from another university in violent video games, their attitudes towards out-group are improved. Instead, negative contacts tend to lead to a more hostile attitude toward out-groups. Labianca, Brass, and Gray (1998) find that negative (interpersonal) relationships between employees from different departments of a company are positively correlated with higher perceived intergroup conflicts between departments. Brown, Maras, Masser, Vivian, and Hewstone (2001) ask British participants to describe a specific French person they know and to assess the nature of contact with this person. They find that if the contact is rated as conflictual, participants report more aggressive attitudes toward French in general. Our study contributes to this literature by providing behavioral evidence and by comparing a cooperative interaction to a competitive interaction under *ceteris paribus* conditions.

Our paper is also related to Goette, Huffman, Meier, and Sutter (2012) who employ a two-stage game consisting of a simultaneous prisoner's dilemma (PD) in the first stage and a third-party punishment game in the second stage. In a condition of intergroup competition a bonus is offered to each member of the group that got the highest total payoff in the PD. The main result is that in-group favoritism in both the PD game and the punishment game is increased by intergroup competition. Given that the marginal benefit of favoring in-group members is higher with intergroup competition than without, it is difficult to identify whether the effect comes from an increase in competition or from a change in marginal incentives. In our study, we can be more confident that effects — if any — are due to the nature of interaction because we separate the stage of interaction and the stage of eliciting the in-group out-group difference. There is no difference in the marginal benefit of favoring in-group in the stage of elicitation of in-group out-group differences between the competitive, cooperative and neutral condition. In addition, Bettencourt, Brewer, Croak, and Miller (1992) let participants from two minimal groups work together on a task in either an intergroup competitive condition or an intergroup cooperative condition, and ask participants afterwards to rate each person's contribution and friendliness in the task. Their results indicate that teams in the competitive condition exhibit a higher level of in-group favoritism than teams in the cooperative condition. Our study focuses on a somewhat different question, namely whether the nature of interaction between two people of different groups (rather than between two groups) has an effect on how these people treat (rather than feel about) someone from the other group.

2 The experiment

2.1 Design

In the experiment, subjects who are randomly divided into groups *Red* and *Blue* make a series of choices concerning the allocation of money to oneself and another subject. The other subject is either from the same group as the decision-maker (in-group) or from the out-group. We adopt a minimal-group paradigm because it is better in picking up in-group bias than a design based on natural groups, perhaps because it is less sensitive to experimenter demand effects (see Lane, 2016). Also, our paradigm is in some sense "more minimal" than in other studies (e.g. Tajfel, Billig, Bundy, and Flament, 1971; Chen and Li, 2009) since the groups are randomly determined and subjects in the same group do not interact with each other before making their distributional choices. We did not include a group enhancement phase because if such a phase is included, it is impossible to identify whether the formation of group identity is due to allocation of group labels or to the joy of doing a joint activity. The results of, for example, Billig and Tajfel (1973) and Currarini and Mengel (2016) gave us confidence that a group enhancement phase is not necessary to generate in-group bias.

The crux of our experiment is that before making the allocational choices some subjects do not engage in any interaction and other subjects engage in an interaction with an out-group subject, and that, in the case of interaction, there is treatment variation in the nature of the interaction. In particular, the interaction is either cooperative or competitive. We describe the procedures in more detail in what follows.

After being informed about the assigned group (*Red* or *Blue*) subjects are asked to make a series of calculations within one minute. For each calculation, a subject sees four single-digit numbers of which two are shown in red color and two in blue color.[2] The task was to sum up the two numbers in the same color as one's own group. The treatments differ in the way that the earnings for the calculation task are computed. In the treatment without interaction with an out-group subject (labeled *Neutral*) subjects earn 40 tokens for every correct answer, and half of the subjects are randomly drawn for payment of the tokens. In the interactive treatments the task was exactly the same but subjects were matched with an out-group subject for payment. In the *Cooperative* treatment, subjects earn 20 tokens for every correct answer they enter themselves and another 20 tokens for every correct answer entered by the matched subject, and half of the subjects are randomly drawn for payment of the tokens.[3] In the *Competitive* treatment earnings depend on whether the subject wins against the matched out-group member: the winner earns 40 tokens for every correct answer and the loser earns nothing. Information regarding performance and earnings in the calculation task were revealed only at the end of the experiment to avoid any influence on the allocational choices.

After the calculation task, subjects proceed to a second part, in which they make a number of choices on allocations of tokens between herself and another subject. For half of the participants, the other subject is an in-group other and for the other half she is an out-group other. In the cooperative and competitive treatments, subjects are matched to a subject different from the interaction partner in the calculation task. Subjects make three sets of seven allocational choices in which they choose option X or option Y. Each option defines how many tokens they and the matched subject will get if they choose that option. The sets of allocational choices are set up having in mind the utility function of Charness and Rabin (2002), which is flexible in that it allows for a range of pro- and anti-social preferences and has been helpful when thinking about in-group bias (see Chen and Li, 2009; Currarini and Mengel, 2016).[4]

The Charness-Rabin utility function is given as follows in the context of our experiment, where π_i and π_j are the payoffs of subjects i and j respectively and with $g \in$

[2]The color of the numbers can serve as a priming tool to let subjects perceive their color-relevant group membership more saliently.

[3]One could argue that whether this treatment is perceived as a cooperative interaction by subjects may depend on the beliefs about the effort of the matched subject. Subjects with pessimistic beliefs may perceive the treatment as less cooperative than treatment Neutral. Nevertheless, in monetary terms, making as much effort as possible is the dominant strategy as long as the personal cost of doing a calculation is lower than 20 tokens, like in treatment Neutral.

[4]Currarini and Mengel (2016) use variants of some of the games described in Charness and Rabin (2002), but they do not directly estimate parameters of the Charness-Rabin utility.

{in-group, out-group} and $n \in \{Neutral, Cooperative, Competitive\}$:

$$u_i(\cdot|g,n) = \begin{cases} \rho_{g,n}\pi_j + (1-\rho_{g,n})\pi_i & \text{if } \pi_i \geq \pi_j \\ \sigma_{g,n}\pi_j + (1-\sigma_{g,n})\pi_i & \text{if } \pi_i < \pi_j \end{cases} \quad (1)$$

Parameters $\rho < 1$ and $\sigma < 1$ capture the weight a person i puts on the payoff of person j if i earns more and less than j respectively. A person with a high ρ has relatively high charity concerns and a person with a high σ is relatively envious.[5] The first set of seven choices helps to elicit σ and the second set helps to elicit ρ. The third set of choices gives further information for both ρ and σ.[6] Table 1 shows the three sets of allocational choices.

2.2 Hypotheses

As discussed in the introduction, it is typically found that a cooperative interaction with out-group brings about more favorable out-group attitudes, whereas more conflictual contact leads to more aggressive or hostile out-group attitudes. In our experiment the impersonal nature of the interaction may reduce the chance that cooperation leads subjects to develop positive emotions (e.g. empathy) or even friendships, as is for instance the case in Batson et al. (1997) and Finlay and Stephan (2000). Moreover, uncontrolled negative feelings (e.g. anxiety) may also be less likely to occur as a result of negative or even competitive contact (see Pettigrew, 1998; Dovidio, Gaertner, and Kawakami, 2003). Given that impersonal interactions are most likely less intense than personal contact, we formulate weak hypotheses on the effect of the nature of the interaction on possible in-group out-group differences in social preferences.

To test the effect of cooperative or competitive interactions on in-group out-group differences, we test whether there are differences in ρ or σ between subjects who are matched with an in-group and subjects who are matched with an out-group. We hypothesize that a competitive (cooperative) interaction with an out-group weakly increases (decreases) in-group out-group differences in social preferences as compared to the case where there is no interaction. We summarize the hypotheses in terms of the parameters of the utility function expressed in equation 1 as follows:

Hypothesis 1 *On the effect of a competitive interaction*
(a) In-group bias in charity concerns is stronger with a competitive interaction than with no interaction: $\rho_{in,Neutral} - \rho_{out,Neutral} \leq \rho_{in,Competitive} - \rho_{out,Competitive}$
(b) In-group bias in envy is stronger with a competitive interaction than with no interaction: $\sigma_{in,Neutral} - \sigma_{out,Neutral} \leq \sigma_{in,Competitive} - \sigma_{out,Competitive}$

[5] A person with $\rho = \sigma = 0$ implies that she only cares about her own payoff; $\rho > 0$ and $\sigma < 0$ implies the person is averse to inequality in payoff; $\sigma < \rho < 0$ implies the person has a competitive preference; and $\rho > \sigma > 0$ implies the person is an efficiency maximizer.

[6] Designs similar in spirit to elicit social preference parameters are employed in Chen and Li (2009) and Blanco, Engelmann, and Normann (2011).

Table 1: Choice problems

	Option X		Option Y	
Problem	Your earnings	Other's earnings	Your earnings	Other's earnings
Set 1				
1	400	400	200	750
2	400	400	250	750
3	400	400	300	750
4	400	400	350	750
5	400	400	400	750
6	400	400	450	750
7	400	400	500	750
Set 2				
1	600	600	500	200
2	600	600	600	200
3	600	600	700	200
4	600	600	700	300
5	600	600	700	400
6	600	600	700	500
7	600	600	700	600
Set 3				
1	600	300	500	550
2	600	300	500	600
3	600	300	500	650
4	600	300	500	700
5	600	300	500	750
6	600	300	500	800
7	600	300	500	850

Notes: The table shows the three sets of seven choice problems implemented in the experiments. Participants were asked to choose between option X and option Y for each problem.

Hypothesis 2 *On the effect of a cooperative interaction*
(a) In-group bias in charity concerns is weaker with a cooperative interaction than with no interaction: $\rho_{in,Neutral} - \rho_{out,Neutral} \geq \rho_{in,Cooperative} - \rho_{out,Cooperative}$
(b) In-group bias in envy is weaker with a cooperative interaction than with no interaction: $\sigma_{in,Neutral} - \sigma_{out,Neutral} \geq \sigma_{in,Cooperative} - \sigma_{out,Cooperative}$

2.3 Procedures

The experiment was run in May 2017 at CentERlab, Tilburg University and it was computerized using the z-Tree software package (Fischbacher, 2007). The subjects were students recruited via an online system. Upon arrival, subjects were assigned to computers by randomly choosing one card from a pile of numbered cards. Once subjects were seated in the lab they received printed copies of general instructions and instructions for part 1 (the calculation task). After they finished reading the instructions, the experiment started. Subjects received instructions for part 2 (the allocational choices) right after part 1 had ended. The experiment included another part (part 3) on which we elaborate in Section Appendix C of the Appendix. Instructions for this last part were handed out after part 2 had ended.

In total, 12 sessions were run and 160 subjects participated in the experiment. The number of subjects in each session was either 12 or 16. Sessions lasted between 20 and 30 minutes. Subjects earned 9.28 euro on average, with a minimum of 4.06 euro and a maximum of 16.81 euro. The numbers of subjects by treatment are displayed in Table 2.

After subjects finished all parts they filled in a questionnaire, including questions about age, gender, major of study, level of education, experience in experiments, and they were also asked to guess their own and the average number of correct answers in part 1. The guesses can be viewed as a proxy of the subjects' belief of how much they earned in part 1, which may have had an income effect on their subsequent decisions.

To illustrate that the treatments are balanced, Table 2 includes the means and standard deviations (in parentheses) of subjects' characteristics in the different treatments. None of the relevant pairwise comparisons conducted using rank-sum tests gives a difference that is statistically significant at 5% level. Therefore, we conclude that the treatments are balanced in terms of the observables. Nevertheless, to avoid possible confounding effects, we control for individual characteristics in the analyses later.

3 Results

We assume that the utility function of participants is represented by equation 1 and estimate a separate ρ and σ for each treatment. The estimations are based on maximum simulated likelihood in a logit model with individual-level random effects (see Appendix B for details). Figure 1 shows the estimated ρ by treatment and Figure 2 shows the estimated σ by treatment.

Figure 1 shows that the estimated ρ is higher if the matched person is in-group than if (s)he is out-group ($p = 0.053$ without controls; $p = 0.022$ with controls), which replicates earlier-mentioned experimental evidence that there is an in-group bias. The in-group bias implies that charity concerns for an out-group partner are 22 percent lower than for an in-group partner. The figure also shows that ρ is generally lower in the interactive treatments than in the neutral treatment. This could indicate that on average participants dislike that their payment depends on the effort of someone else, which is why they are less keen on giving money to another person at their own expense.

Our main results, however, build upon difference-in-difference analyses. That is, we test whether the competitiveness of the interaction that precedes the distributional choices has an effect on the difference in ρ between in-group and out-group matches. To do so we do pairwise comparisons between the treatments of the in-group out-group difference in ρ. The statistical significance of the comparisons is indicated in Figure 1. A first result is that a cooperative interaction with an out-group person removes the in-group bias that exists if there is no interaction. In *Cooperative*, the out-group ρ is even larger than the in-group ρ (statistically not significant). The dif-in-dif comparison is significant at the 1% level. A second result is that interacting in a competition does not have a significant effect on in-

Table 2: Subjects' characteristics

Group:	*Competitive* In	*Competitive* Out	*Neutral* In	*Neutral* Out	*Cooperative* In	*Cooperative* Out
Age	23.28	23.67	24.17	24.04	23.82	22.71
	(3.91)	(4.90)	(4.15)	(4.43)	(3.40)	(2.87)
Female	0.44	0.38	0.54	0.50	0.68	0.46
	(0.50)	(0.49)	(0.51)	(0.51)	(0.48)	(0.51)
Major in economics/management	0.69	0.83	0.79	0.89	0.82	0.79
	(0.47)	(0.38)	(0.41)	(0.31)	(0.39)	(0.41)
Bachelor	0.38	0.38	0.46	0.43	0.32	0.38
	(0.49)	(0.49)	(0.51)	(0.50)	(0.48)	(0.49)
Experience in experiments	0.97	0.92	0.96	0.93	0.96	1.00
	(0.18)	(0.28)	(0.20)	(0.26)	(0.19)	(0.00)
Nr. of correct answers	22.28	24.17	22.58	22.57	22.32	23.13
	(6.59)	(6.92)	(6.32)	(5.55)	(6.93)	(4.59)
Nr. of own answers guessed correct	13.22	12.87	11.42	12.32	13.46	12.54
	(8.10)	(3.53)	(5.29)	(3.70)	(4.20)	(4.40)
Nr. of answers guessed correct	13.59	11.70	12.00	13.14	13.07	12.04
	(7.60)	(3.08)	(4.37)	(3.63)	(3.56)	(4.53)
Confidence	-0.38	1.17	-0.58	-0.82	0.39	0.50
	(2.27)	(2.06)	(3.99)	(2.84)	(3.24)	(1.35)
N	32	24	24	28	28	24

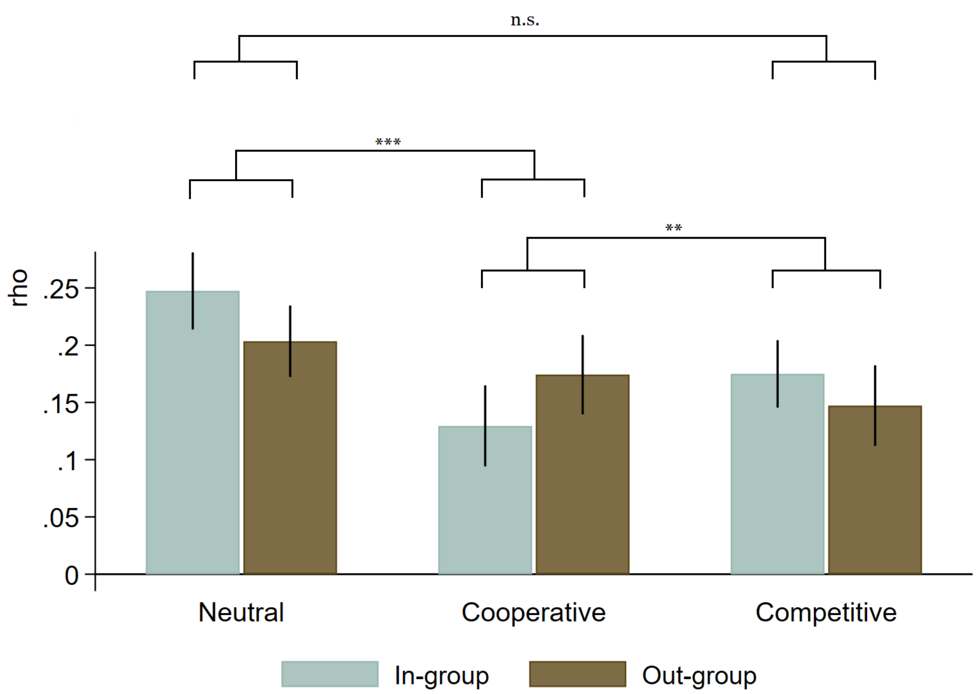
Notes: Female, Major in economics/management, Bachelor, and Experience in experiments are dummy variables. Confidence is defined as the guessed number of correct own answers minus the guessed number of correct answers on average. The data of one subject in *Competitive*, who reported extremely large numbers on the guesses (400 and 450) is excluded for these two variables.

group bias. Third, the dif-in-dif comparison between *Cooperative* and *Competitive* goes in the same direction as that between *Cooperative* and *Neutral*, and is significant at the 5% level. The results lend support to Hypotheses 2(a) and not so to Hypothesis 1(a).

We now turn to the estimated σ, shown in Figure 2. For σ, the estimations are much noisier, and conclusions are quite different. The result is simple: we do not obtain any treatment effect for Figure 2. There is no indication of in-group bias in *Neutral*, and although the effect of *Cooperative* on σ is qualitatively similar to that of *Cooperative* on ρ, it is far from significant. We therefore conclude that none of our hypotheses concerning σ are supported.[7]

[7]One may be concerned that these estimates lack statistical power which affects both the probability of detecting true effects and the likelihood of false positives. Chen and Li (2009) use maximum likelihood estimation in almost the same way as we do, with fewer observations. They report significant in-group effects for both ρ and σ and the effects have comparable significance levels. There is little reason to expect that our estimates have saliently lower statistical power than their estimates do.

Figure 1: Estimated ρ by treatment



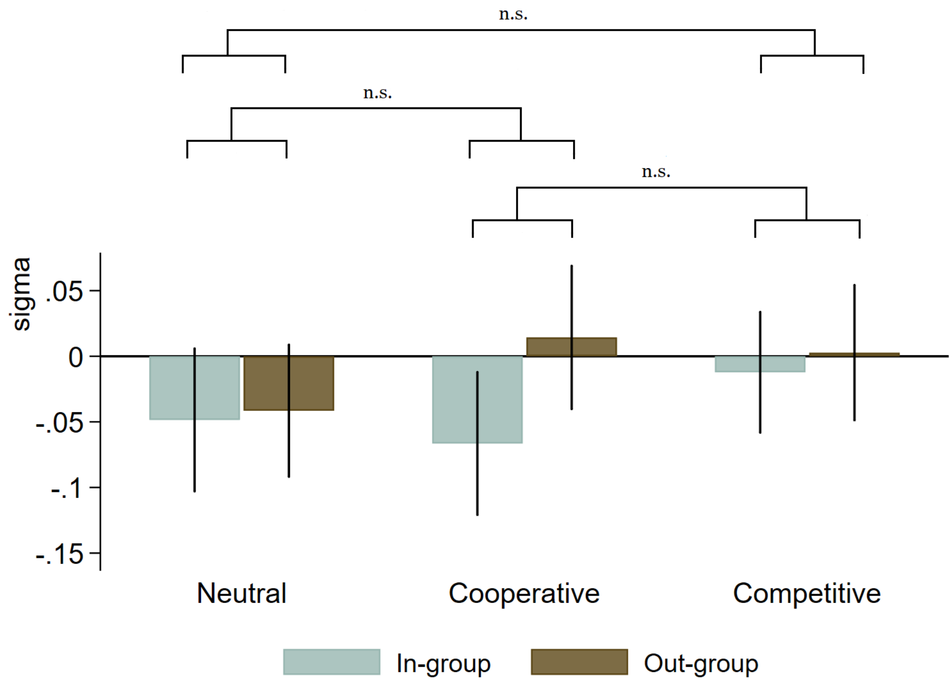
Notes: The figure shows the estimated ρ and its confidence interval by treatment assuming utility function 1. Estimations are based on maximum simulated likelihood in a logit model with individual-level random effects. Details about the method and full estimation results for specifications without and with controls are in Appendix B. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

4 Summary and discussion

This paper uses a minimal-group paradigm to study whether cooperative and competitive interactions with out-group members matter for in-group out-group differences in allocational choices. We first confirm the existence of an in-group out-group difference in social preferences. We show that when subjects receive higher earnings than their matched player, they put a higher weight on the payoff of an in-group partner than on the payoff of an out-group partner; charity concerns are about 22% higher with in-group matching than with out-group matching. Although this is a lower difference than the 47% difference reported by Chen and Li (2009), and we do not find an in-group bias in envy, the result indicates that group identities were formed successfully. The weaker effects may be due to the lack of a group enhancement phase, or to the fact that we use a different choice setting to elicit behavior.[8]

[8] Chen and Li (2009) use data from both the dictator games and the second stage of the sequential games for the estimates of in-group out-group differences in distributional preferences, whereas we use simple allocational choices. Currarini and Mengel (2016) also use dictator games to elicit in-group out-group differences in social preferences. But since they do not distinguish between charity concerns

Figure 2: Estimated σ by treatment



Notes: The figure shows the estimated σ and its confidence interval by treatment assuming utility function 1. Estimations are based on maximum simulated likelihood in a logit model with individual-level random effects. Details about the method and full estimation results for specifications without and with controls are in Appendix B. ***p <0.01, **p <0.05, *p <0.1.

The main result of our experiment is that a cooperative interaction with an out-group member decreases the in-group bias in charity concerns, whereas a competitive interaction does not have much an effect on in-group bias. This suggests that merely having a common goal can reduce prejudice with respect to out-group individuals, even if interactions are impersonal. This is relevant for policy makers who aim at eliminating discrimination against out-group individuals. Creating cooperative economic interdependence between in- and out-group can be sufficient for an elimination or reduction in in-group bias.

One may argue that artificial group identity is as easy to replace as to create. Therefore, it remains an open question whether cooperative economic interdependence also has an effect if the groups are natural instead of artificial. Recent evidence indicates that in the case of personal interaction there seems to be a positive effect as well. Specifically, Lowe (2020) finds that in cricket, cooperative interdependence between caste members increases efficiency in cross-caste trade and reduces own-caste favoritism. Understanding the effect of cooperative economic interdependence on impersonal interactions between natural groups (for example, online trade) would be an interesting topic for future research.

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and envy, it is difficult to compare our treatment effects with theirs.

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Appendix A Instructions

Sample Instructions (for Red group)

General

Welcome to the experiment. Please follow the instructions carefully.

Please be quiet during the entire experiment and do not talk to other participants. If you have a question, raise your hand. An experimenter will then come to your computer to answer the question privately.

The experiment consists of three parts and an additional questionnaire. You will receive instructions for Part 2 and Part 3 right after the preceding part has ended.

Your earnings depend on your decisions and performance, the decisions and performance of other participants, and chance. In all parts of the experiment your earnings are expressed in tokens. The exchange rate is 160 tokens = 1 Euro.

At the end of the experiment, you will be informed about the outcomes of all parts and about how much you earned in each part. Please follow the instructions of the experimenter then, and wait until your seat number is called before leaving the lab. You will receive your final earnings by bank transfer within three working days after the experiment.

Assignment to a group

At the beginning of the experiment, participants will be divided into two groups: a **Red** group and a **Blue** group. The computer will randomly assign half of the participants to the **Red** group and the other half to the **Blue** group. The group to which you are assigned will be shown on the computer screen before Part 1 starts. In all parts, all participants get the same tasks and earnings are calculated in the same way.

Part 1

[Intergroup Neutral Treatment]

Task

You are asked to make a series of calculations during one minute. For each calculation, you will see four single-digit numbers. Two of them are in **Red** color and the other two in **Blue** color. You are asked to sum up the two numbers in **Red** color. The computer quietly keeps track of the number of correct answers.

Example:

3 0 7 2

Your answer: ______

Submit

If and only if you type in 10 and click the "Submit" button, your answer counts as correct.

You can see the time left in seconds at the upper right-hand corner of the screen.

Earnings

Your earnings are calculated as follows:

Earnings = 40 tokens × your number of correct answers.

At the end of the experiment, half of the participants will be randomly chosen by the computer to actually get paid their earnings for this task. Also, at the end of the experiment, you will be informed about your number of correct answers and your earnings in Part 1.

[Intergroup Competition Treatment]

Task

You are asked to make a series of calculations during one minute. For each calculation, you will see four single-digit numbers. Two of them are in **Red** color and the other two in **Blue** color. You are asked to sum up the two numbers in **Red** color. The computer quietly keeps track of the number of correct answers.

Example:

3 0 7 2

Your answer: ______

Submit

If and only if you type in 10 and click the "Submit" button, your answer counts as correct.

You can see the time left in seconds at the upper right-hand corner of the screen.

Earnings

You will be matched with a participant from the **Blue** Group, and your earnings depend on whether you win against this participant. You win if you have more correct answers than the participant from the **Blue** group, and you lose if you have fewer correct answers than the participant from the **Blue** group. If both of you have the same number of correct answers, the winner will be determined randomly.

If you lose, your earnings are equal to 0 tokens. If you win, your earnings are calculated as follows:

Earnings = 40 tokens × number of correct answers.

You will be informed about your and the matched participant's numbers of correct answers and your earnings in Part 1 at the end of the experiment.

[Intergroup Cooperation Treatment]

Task

You are asked to make a series of calculations during one minute. For each calculation, you will see four single-digit numbers. Two of them are in **Red** color and the other two in **Blue** color. You are asked to sum up the two numbers in **Red** color. The computer quietly keeps track of the number of correct answers.

Example:

3 0 7 2

Your answer: ______

Submit

If and only if you type in 10 and click the "Submit" button, your answer counts as correct.

You can see the time left in seconds at the upper right-hand corner of the screen.

Earnings

You will be matched with a participant from the **Blue** group. Your earnings are calculated as follows:

Earnings = 20 tokens × total number of correct answers by you and participant from the **Blue** Group.

At the end of the experiment, half of the participants will be randomly chosen by the computer to actually get paid their earnings for this task. Also, at the end of the experiment, you will be informed about your and the matched participant's number of correct calculations and your earnings in Part 1 at the end of the experiment.

Part 2 [Ingroup Matching]

Task

You are asked to make a number of choices on allocations of tokens between yourself and another randomly selected participant of the **Red** group. That is, you will get to see 21 choice problems as follows, spread over three screens, that each has an option X and an option Y. For each of these problems, you are asked to choose option X or option Y. Each option defines how many tokens you and the other participant from the **Red** Group will get if you choose that option.

Table 1

	Option X		Option Y		Your Decision
Problem	Your earnings	Other's earnings	Your earnings	Other's earnings	
1	400	400	200	750	
2	400	400	250	750	
3	400	400	300	750	
4	400	400	350	750	
5	400	400	400	750	
6	400	400	450	750	
7	400	400	500	750	

Table 2

	Option X		Option Y		Your Decision
Problem	Your earnings	Other's earnings	Your earnings	Other's earnings	
1	600	600	500	200	
2	600	600	600	200	
3	600	600	700	200	
4	600	600	700	300	
5	600	600	700	400	
6	600	600	700	500	
7	600	600	700	600	

Table 3

	Option X		Option Y		Your Decision
Problem	Your earnings	Other's earnings	Your earnings	Other's earnings	
1	600	300	500	550	
2	600	300	500	600	
3	600	300	500	650	
4	600	300	500	700	
5	600	300	500	750	
6	600	300	500	800	
7	600	300	500	850	

For example, for Table 1 Problem 1, you and the matched participant both get 400 tokens if you choose option X, and you get 200 tokens and the matched participant gets 750 tokens if you choose option Y.

The other participant performs the same task.

Earnings

At the end of the experiment, the computer randomly picks one choice problem that counts for payment and randomly determines whether your decision or the matched participant's decision counts for payment.

You will be informed about the results and your earnings in Part 2 at the end of the experiment.

Part 3

In Part 3 the task and calculation of earnings are exactly the same as in Part 2 except that now the other participant is a randomly selected participant of the **Blue** group.

[Notice that the participant to whom you are matched now is different from the participant to whom you were matched in Part 1.]

Appendix B Maximum likelihood estimation

To examine the treatment effects of interactions, we use maximum simulated likelihood estimations and a logit specification with random individual effects. The individual effects are added in the utilities of choosing option Y. Thus the probabilities of option X and Y being chosen can be expressed as below.

$$Prob(X) = \frac{e^{\gamma u(X)}}{e^{\gamma u(X)}+e^{\gamma u(Y)}}$$
$$Prob(Y) = \frac{e^{\gamma u(Y)}}{e^{\gamma u(X)}+e^{\gamma u(Y)}}$$

Take option X as an example. Suppose option X allocates x_i to subject i and x_j to subject j who is matched with subject i. $u_i(X|g,n)$ can be given by

$$u_i(X|g,n) = \begin{cases} \rho_{g,n}x_j + (1-\rho_{g,n})x_i & \text{if } x_i \geq x_j \\ \sigma_{g,n}x_j + (1-\sigma_{g,n})x_i & \text{if } x_i < x_j, \end{cases}$$

where $g(j)$ captures the group identity of subject j and t stands for the treatment (nature of interactions). $\rho_{g,n}$ and $\sigma_{g,n}$ are assumed to be linear functions of the exogenous variables below. In-group is the dummy variable for whether the subject is matched with an in-group member (= 1) or an out-group member (= 0). Competitive (Cooperative) is the dummy variable for whether the subject interacted with an out-group member in a competitive (cooperative) way (= 1) or not (= 0).[9] The treatment effects of competitive and cooperative interactions on in-group-out-group differences are captured by the coefficients of In-group × Competitive and In-group × Cooperative, respectively.

γ captures the sensitivity of subjects' decisions to $u(Y) - u(X)$. If γ is equal to zero, this model is equivalent to a random choice model with equal probability; when γ is infinitely large, the probability of choosing either option with higher utility approaches to one (McFadden, 1981).

[9]So if a subject is involved in the neutral treatment, Cooperative = 0 and Competitive = 0.

Table A1: Maximum simulated likelihood estimates of determinants of ρ and σ

	(1)		(2)	
Dependent variable	ρ	σ	ρ	σ
In-group	0.044*	-0.012	0.052**	-0.008
	(0.023)	(0.037)	(0.023)	(0.037)
In-group × Competitive	-0.016	0.005	-0.030	0.007
	(0.032)	(0.051)	(0.032)	(0.051)
In-group × Cooperative	-0.089***	-0.075	-0.111***	-0.029
	(0.033)	(0.054)	(0.034)	(0.054)
Competitive	-0.056**	0.058	-0.053**	0.012
	(0.023)	(0.037)	(0.024)	(0.037)
Cooperative	-0.029	0.058	-0.036	0.012
	(0.023)	(0.037)	(0.024)	(0.038)
Constant	0.203***	-0.039	0.288***	0.318**
	(0.016)	(0.026)	(0.078)	(0.125)
Controls	No	No	Yes	Yes
γ				
Constant	0.030***		0.031***	
	(0.001)		(0.001)	
Individual Effect				
Std.	33.225***		29.304***	
	(2.993)		(2.878)	
Observations	3360		3360	
Log-likelihood	-1354.05		-1310.58	

Notes: Controls stand for the characteristics of the subject, including age, gender, level of education, experiences in experiments, major of study, race, confidence, and the number of correct answers in the calculation task. Columns (1) display the estimates when characteristics of subjects are not controlled for. Columns (2) display the estimates when characteristics of subjects are controlled for. Standard errors are in parentheses. ***p <0.01, **p <0.05, *p <0.1.

Appendix C On experimenter demand effects

After having made the allocational choices, participants went through a third part in the experiment. Participants were not aware of the instructions for this third part before they had ended the second part. In the third part subjects make decisions for the same 21 choice problems as in part 2 but now in another condition than in part 2. That is, if in part 2 a subject was matched with someone from her own group, she is now matched with someone from the other group, and *vice versa*. Subjects are now likely to be aware of being part in an experiment on in-group out-group behavior. Notice that they do not go through another calculation task.

In experimental studies on in-group out-group behavior it has been a concern that awareness of being part of such experiment may lead to experimenter demand effects.[10] In our experiment, demand effects may work in two different ways. First, subjects who do not like to appear as discriminating prefer to hide in-group out-group differences they possibly exhibit in their daily life. Although this concern holds in particular if groups are formed on the basis of a sensitive characteristic (such as ethnicity, see for example Barr, Lane, and Nosenzo, 2018), it may still hold if groups are formed artificially (albeit to a lesser extent). If such an effect would be present in our experiment, the implication would be that subjects make the same choices as in part 2. A between-subjects analysis based on part 3 would then give the opposite results to what is reported in Section 3: subjects would treat out-group subjects *better* than in-group subjects in treatment *Neutral* and *worse* in treatment *Cooperative*. The second possible demand effect relates to subjects being more aware now of the group of the matched partner, which may lead to strengthened in-group out-group differences. If demand effects work differently for different subjects, then treatment effects are possibly washed out.

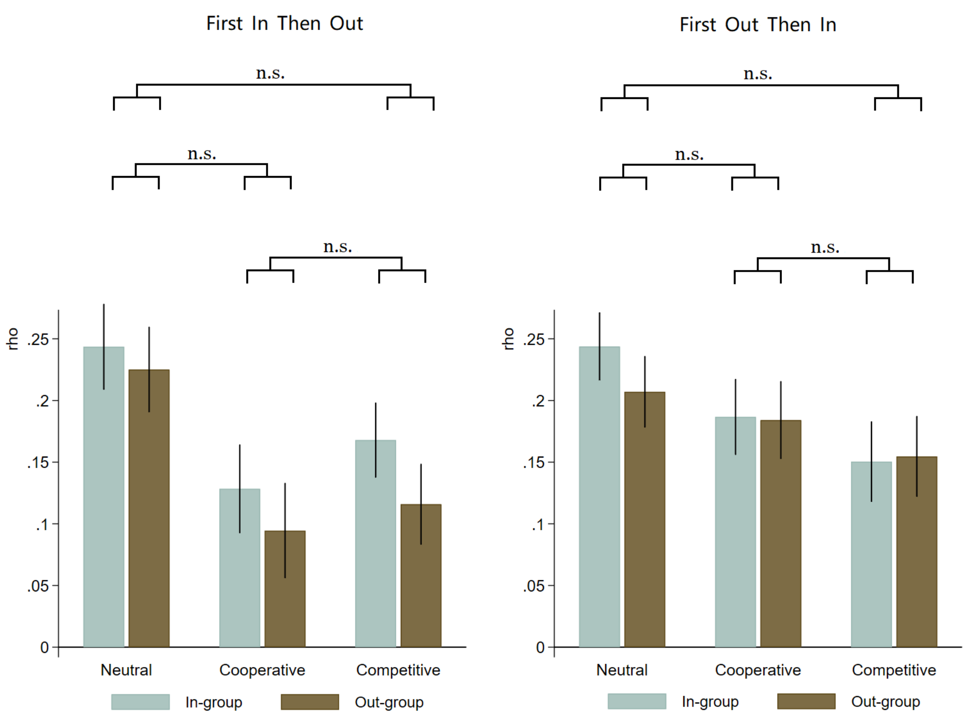
The results for part 3 are easy to summarize: none of the dif-in-dif effects are statistically significant, which makes it difficult to interpret what is going on. Figure A1 and Figure A2 present the estimated ρ and σ separately for subjects who are first matched with in-group then out-group members and those who are matched in the other way around. We find that neither cooperative nor competitive interactions have a salient impact on the in-group out-group difference in neither of the two cases.

Details on data analysis

Table A1 displays MSL estimates based on overall part 2 and part 3 observations and based on part 2 observations only. First of all, in terms of in-group out-group differences in the neutral treatment (the coefficients of *In-group*), there is substantial difference between the overall-data analysis and the between-subject analysis using part 2 data only.Secondly, in the overall-data analysis, cooperative interactions no longer significantly affect the in-group out-group difference in ρ (p-value (In-group $\times$ Cooperative) > 0.1). Interactions decrease ρ for both in- and out-group matches to the same extent (p-value (Cooperative) < 0.01, p-value (Competitive) < 0.01).

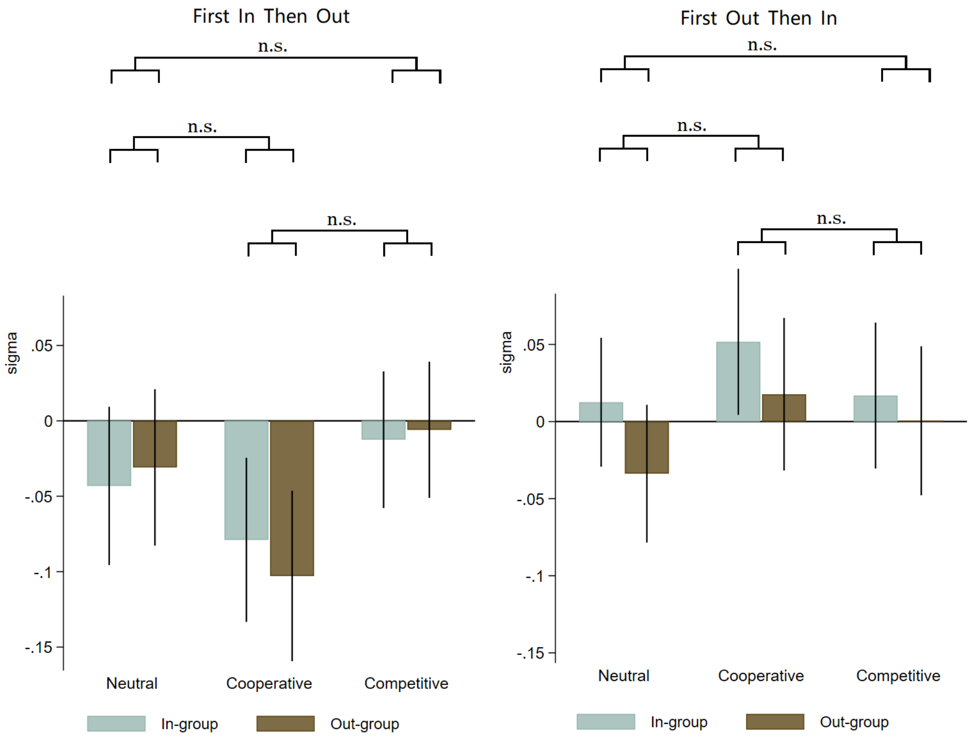
[10] See Charness, Gneezy, and Kuhn (2012) for a discussion.

Figure A1: Estimated ρ by treatment in part 3



Notes: The figure shows the estimated ρ and its confidence interval by treatment assuming utility function 1 using the data of part 3. Estimations are based on maximum simulated likelihood in a logit model with individual-level random effects. $^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.1$.

Figure A2: Estimated σ by treatment in part 3



Notes: The figure shows the estimated σ and its confidence interval by treatment assuming utility function 1 using the data of part 3. Estimations are based on maximum simulated likelihood in a logit model with individual-level random effects. $^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.1$.

Table A2: Comparisons between estimates for overall and part 2 data

	Overall		Part 2	
Dependent variable	ρ	σ	ρ	σ
In-group	0.030*	0.022	0.044*	-0.012
	(0.016)	(0.020)	(0.023)	(0.037)
In-group × Competitive	-0.003	-0.019	-0.016	0.005
	(0.022)	(0.028)	(0.032)	(0.051)
In-group × Cooperative	-0.013	0.007	-0.089***	-0.075
	(0.022)	(0.029)	(0.033)	(0.054)
Competitive	-0.080***	0.031	-0.056**	0.058
	(0.016)	(0.024)	(0.023)	(0.037)
Cooperative	-0.074***	-0.006	-0.029	0.058
	(0.017)	(0.025)	(0.023)	(0.037)
Constant	0.214***	-0.035**	0.203***	-0.039
	(0.011)	(0.017)	(0.016)	(0.026)
γ				
Constant	0.029***		0.030***	
	(0.001)		(0.001)	
Individual Effect				
Std.	32.799***		33.225***	
	(2.565)		(2.993)	
Observations	6720		3360	
Log-likelihood	-2726.50		-1354.05	

Notes: The table reports the maximum simulated likelihood estimates with the same random effect logit model (without controls) to Table A1. The two columns "Overall" present the estimates using both parts 2 and 3 observations; columns "Part 2" re-display the estimates with part 2 observations alone. Standard errors are in parentheses. ***p <0.01, **p <0.05, *p <0.1.