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In-Group Versus Out-Group Preferences in Intergroup Conflict: An Experiment

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ABSTRACT

In group conflicts, individuals often have diverse preferences, such as maximizing personal payoff, maximizing the group's payoff, or defeating rivals. When these preferences coexist, isolating their impact on conflict outcomes becomes challenging. To disentangle in-group and out-group preferences, we conduct a group contest experiment in which human in-group or out-group players are replaced with historical subjects to maintain strategic similarity. Our study aims to explore (i) the variation in effort in group conflicts due to in-group and out-group preferences and group cohesion, and (ii) how the impact of these preferences changes when the two groups have explicitly different categorical identities. Surprisingly, our results indicate an absence of overall treatment effects on effort levels. However, the presence of in-groups has heightened concerns about individual payoffs. When out-groups are introduced, these concerns are moderated by an additional focus on the group's payoffs. The negative effect of the in-group preferences and the positive effect of the out-group preferences are weaker when group members have a common categorical identity.

JEL Classification: C91, C92, D74, D91

1 | Introduction

Intergroup conflicts are a widespread phenomenon, encompassing a wide array of situations such as civil wars, ethnic tensions, elections, group lobbying, and sports rivalries. Given their prevalence, scholars from various social science disciplines, and predominantly from social psychology and behavioral decision theory, aim to understand the underlying causes and motivations behind the extent of individuals' involvement in these conflicts. The primary behavioral factors explaining behavior in group conflicts (Sheremeta 2015) include an individual's preferences for their own group members in contrast to their preferences for the opponent group members. In the present study, we aim to disentangle the impact of in-group vis-a-vis out-group preferences on group conflict, and we do so both in the presence and absence of a minimal categorical identity created in the experimental laboratory.

Preference for in-group members are usually characterized in the positive domain, e.g., cooperation, while preference about out-group members are usually characterized in the negative domain, e.g., aggressive competition (Buhl 1999; Hewstone et al. 2002; Halevy et al. 2008). Since positivity towards in-group and negativity towards out-group can jointly guide behavior under the simultaneous presence of both in-group and out-group members, studies in the experimental literature try to distinguish between the two (Halevy et al. 2008; Yamagishi and Mifune 2009; Halevy et al. 2012; Abbink et al. 2012; Buttelmann and Böhm 2014; Weisel and Böhm 2015; Weisel and Zultan 2016; Abbink and Harris 2019).

Most of these studies use the minimal identity paradigm to assign different categorical identities to the groups and distinguish between in-group and out-group preferences in intergroup prisoner's dilemma or resource distribution games (Chowdhury 2021). A minimal identity paradigm (Sherif et al. 1961) classifies the participants into groups with artificial identities created specifically in the context of the experiment. Fewer studies (Sherif et al. 1961; Abbink et al. 2012; Chowdhury et al. 2016; Chakravarty et al. 2016; Huang et al. 2021) look at Intergroup preferences in contest games, some of which use artificial identities (Sherif et al. 1961; Abbink et al. 2012; Chowdhury et al. 2016) and some use real identities (Chowdhury et al. 2016; Chakravarty et al. 2016; Huang et al. 2021). These studies investigate how contest effort responds to the contesting groups having different identities, but they do not aim to understand any distinctive effects that in-group players and out-group players may have on conflict.

Contests are commonly used to represent conflicts where players invest costly and irreversible resources to obtain a reward (Garfinkel and Skaperdas 2007). Group conflicts are often modeled as group contests where multiple individuals in a group jointly contest against one or several other groups for a reward. We consider a simple bilateral intergroup contest over a public-good reward (Katz et al. 1990). Players belonging to a group in such a contest independently decide their efforts towards the group contest which are then added up to determine the "group effort". The competing groups' efforts are then entered into a lottery such that the group with the higher group effort has the higher chance of winning (Tullock 1980). The reward is a public good, so all the members of the winning group equally share the spoils of the conflict, but their final payoffs depend on their respective effort decisions.[1] This creates a strategic incentive for individuals to free ride on their group members (Bornstein and Ben-Yossef 1994).[2]

It is crucial to note, however, that an individual's effort in a group contest can be influenced by both the strategic and affective aspects of the game. Despite the incentive for within-group free-riding, experimental studies deploying bilateral Intergroup contests over public-good rewards often report that observed group effort exceeds twice the predicted equilibrium (Abbink et al. 2010; Ahn et al. 2011; Sheremeta 2011; Eisenkopf 2014; Chowdhury et al. 2016; Majerczyk et al. 2019). There are various explanations for this behavior. An individual's final payoff may consist of both material and nonmaterial elements. Apart from judgmental errors, preferences related to the group and the psychological significance of winning or losing may also lead the final payoffs to deviate from the material gains (Sheremeta 2015). However, in our study, we focus on the role of group-related preferences in explaining contest effort.

Group-related preferences can be interpreted as a composite construct possibly involving cooperation, adversity, positive synergy, reciprocation, and retaliation preferences that may arise in an Intergroup setting. Research on group psychology focuses on "in-group love" and "out-group hate" (e.g., Allport 1954; Sherif 1966; Brewer 1999). Behavioral economics, on the other hand, studies the impact of such considerations on individual decision-making under the umbrella term of "other-regarding preferences" (Cooper and Kagel 2016).

In a bilateral group contest for a public-good prize, conflicting interests arise both within a group and between groups; an individual can increase their group's chance of winning by exerting more effort, but they may also want to spend less effort in comparison to other in-group players. For this reason, we refrain from using terms such as "in-group love" and "out-group hate". Instead, we call preferences relating to other stakeholders in the same group as "in-group preferences" and preferences relating to stakeholders in the opponent group as "out-group preferences". Accordingly, in the context of our study, we assume that the existence of in-group preferences is synonymous with the presence of other in-group players who make effort decisions and bear the consequences of the contest outcome whereas existence of out-group preferences is synonymous to the presence of out-group players who also decide their effort and bear the consequences of contest outcomes. Our experimental design is built on this assumption. To disentangle in-group preferences from out-group preferences, we also draw a distinction between group identity and social or categorical identity. To do so, we look at some interconnected concepts from social psychology and behavioral economics.

One such concept is group cohesion, which is defined as "a dynamic process reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs" (Carron et al. 2002, p. 213), can play a significant role in directing behavior. A group of people functioning in some collective interest have the same group identity regardless of whether they share the same categorical identity or not. Two definitions from identity theory emphasize this. One is *role identity,* which refers to the expectation that being part of a group involves contributing in specific ways (Charng et al. 1988; Charness and Chen 2020). Another is *common fate identity* (Campbell 1958; Gaertner and Dovidio 2011) arising from the shared consequences faced by individuals on the same side in a conflict—if their group wins, everyone wins; if their group loses, they all lose. Both role identity and common fate identity are anticipated to enhance group cohesion, thereby strengthening incentives for higher effort. Similarly, a perceived threat from competing groups typically increases effort (Weisel and Zultan 2016). Parochial altruism, where individuals strive for their own group's benefit over the opposing group, can also spur effort (Abbink et al. 2012). There is also experimental evidence that intergroup competition improves collective efficiency and coordination within a group (Bornstein et al. 2002; Ai et al. 2023).

On the other hand, the possibility that payoffs to group members can still be different depending on their individual efforts may inspire considerations for within-group fairness and equality (Fehr and Schmidt 1999; Bolton and Ockenfels 2000; Riechmann 2007). A significant concern for relative payoffs within their own group may compromise effort.

Apart from group identity on its own, social or categorical identity is also relevant for a group conflict as in most real-life intergroup conflicts, the conflicting parties also bear different social or categorical identities (ethnic, political, racial, etc.), which provides the basic premise for belonging to or siding with one specific party in a conflict and may significantly intensify conflict engagement, as documented theoretically by Sen (1985; 2007), experimentally by Sherif et al. (1961), Chowdhury et al. (2016), and from field data by Esteban et al. (2021a; 2012b) among others (see Chowdhury 2021 for a survey).

To summarize, effort provision in a group conflict is a function of the material payoffs and group-related preferences. In this study, we focus on group-related preferences which we have interpreted as composite preferences arising out of the presence of other stakeholders in one's own or rival group. While the general structure of any bilateral or multilateral group conflict is sufficient for the generation of group-related preferences, the simultaneous presence of categorical identities can have further impact on the salience of such preferences.

We aim to (1) study the exclusive effect of the presence of in-group and out-group players on effort provision in a group contest, (2) whether individuals behave less selfishly due to the presence of other in-group players, (3) how satisfaction regarding the group relates to effort decisions, and finally (4) how the answers to these questions vary when the groups are formed based on a salient minimal categorical identity (Tajfel, 1979).

To answer these questions, we examine behavior in a bilateral group contest over public-good prize (Katz et al. 1990) in a laboratory experiment. Both in-group and out-group preferences are salient in a bilateral group contest. To disentangle in-group preferences from out-group preferences, we use a between-group treatment variation where we either remove the out-group players to make only the in-group preferences salient or remove both in-group and out-group players to make both in-group and out-group preferences non-salient. The conceptual reason behind this design is to eliminate the in-group and out-group preferences from a standard group contest without changing the strategic aspects of the game. Cox (2017) also used a similar design approach to remove social preferences in a one-on-one contest.

Our results suggest that there is no overall effect of such preferences in our setting. However, compared to a contest where both in-group and out-group players are present simultaneously or one where neither in-group nor out-groups are present, the salient presence of in-group players alone heightens individuals' concerns about their own payoffs. This was reflected in lower satisfaction with the group among those with a higher relative share in the total group effort over the course of the game. The effect of removing the out-group alone was less pronounced when players were made aware that groups were formed based on some common categorical identity and each group contested with another group that had a different identity. Where our study notably differs from most other studies in the group conflict literature is this observation that players are likely to behave more selfishly in the absence of out-group players. This happens due to the specific nature of the group contest game; the public-good aspect dominates the conflict aspect in the absence of concurrently active out-group players.

Our experimental design and results contribute to the literature on in-group out-group preferences in group conflicts in two distinct ways. First, in terms of implementation, we use a novel method for disentangling intertwined group-related preferences[3] by removing in-groups and out-groups from a standard group contest while keeping the strategic elements of the contest largely unaltered. Second, we show that the presence of other in-group players doesn't necessarily foster "in-group love" but may rather intensify players' concerns for equality within their own group. This sheds new light on the complexities of inter-group relationships in contests. Our finding that the presence of in-groups does not induce higher effort, but instead may make individuals more concerned about their own individual payoffs, is a novel result. While this finding is in contrast to the classical claim of the existence of in-group love independently of out-group hate (Brewer 1999), it is consistent with the idea of social comparison. Individuals, in a social situation, are concerned about their own payoff in comparison to others. Hence, they care only about intra-group comparison when only in-groups are present. But when the out-groups are present, they may view their own group as a unit and may partially shift their focus to the inter-group comparison.

The remaining sections of the paper are structured as follows. Section 2 is divided into two subsections: the first subsection provides a detailed explanation of the experimental design, and the second one outlines the implementation details. Section 3 outlines the behavioral hypotheses related to our research questions. The findings of the study are presented in Section 4. Finally, Section 5 provides the conclusion of the paper.

2 | Experimental Design and Procedure

The total payoff in a contest, as pointed out earlier, can consist of material and nonmaterial elements, where nonmaterial elements include altruistic preferences, inequality preferences, joy-of-winning, in-group love, out-group hate, etc. We do not distinguish between all these different nonmaterial elements but assume that all such gains or losses arise only when at least another human being is at the receiving end of the consequences of one's actions. Accordingly, we designed an experiment to completely switch off the payoff consequences of a participant's actions on other participants. We do so by replacing these other participants with computers that copy digitally stored decisions on human subjects from earlier sessions. For example, to remove any material or nonmaterial consequences of a subject's action on the in-groups, we match this subject's decisions with two sets of stored decisions (of two previously active subjects) that together constitute the decision of their group. All participants in the out-group remain concurrently active participants.

When we also want to remove the consequences on out-groups, the out-group decisions comprise three other sets of stored decisions (of three previously active subjects). Subjects from earlier sessions have already been paid for. They do not learn about the present events, and do not face any further payoff consequences thereof. Interaction with such previously active others, as opposed to interaction with concurrently active others, should thus be free of social preferences regarding any potential financial and/or psychological payoffs to others. This should also neutralize the group-related preferences related to contest behavior and outcomes.

Inter-group preferences refer to differentiative social preferences attributed to other members in one's own group vis-à-vis

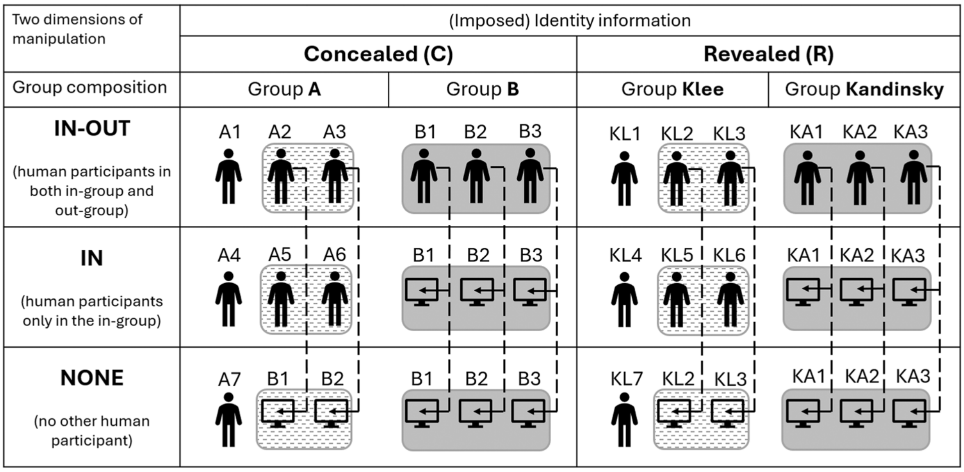

FIGURE 1 | Experimental Design. *Note:* The human figurines indicate concurrently active players and the computers indicate stored decisions from previously active players. In each cell, in-groups and out-groups are indicated only from the first player's perspective; in-groups are marked inside a light dashed rectangle and out-groups are marked inside a solid shaded rectangle.

those in the other group(s). It follows that impersonating the players in one's own group and the other group is an obvious way of eliminating inter-group preferences. We had primarily two design choices towards that end, namely, using decisions made by previously active participants or using some computer program (e.g., AI) to imitate human behavior in group contests. However, the latter would involve heterogeneity in terms of participants' beliefs about how the computer program works and may also not be able to remove motives like joy-of-winning. Neuroscientific evidence shows that the human brain engages with other humans differently than it does with AI (Harris 2024) and that AI cannot trigger experience but may still preserve agency (Harris 2024; Geiselmann et al. 2023). Therefore, to remove the ascription of both agency and experience when we remove in-group or out-group players, we decided to use digitally stored decisions made by previously active participants.

We name the treatments in terms of whether a subject is faced with other concurrently active subjects or not. A subject in the IN-OUT treatments plays with concurrently active others in both in-group and out-group. A subject in the IN treatments plays with concurrently active others only in their own group but faces previously active others in the out-group. A subject in the NONE treatments plays only with previously active others in both in-group and out-group. Hence, group-related preferences should be composed of both in-group and out-group preferences in the IN-OUT treatment, and only of in-group preferences in the IN treatment. The decisions in the NONE treatment should be independent of any group-related preferences.

Referring to the research questions mentioned in Section 1, one can observe that the above design allows us to examine questions (1) and (2), i.e., the exclusive effect of the presence of in-group and out-group players on effort provision and whether individuals behave less selfishly due to the presence of other in-group players. To examine question (3), we used a group satisfaction questionnaire (*a la* Hinkle et al. 1989) to understand how satisfied the participants were with their groups at the end of the game. To examine question (4), i.e., the additional effects of categorical identity on inter-group preferences, we always grouped our subjects into two clusters based on minimal identities assigned to them in the laboratory (Tajfel 1970). Subjects in each cluster are then matched into several 3-person groups. Each group always contests a group from the other cluster. Subjects were aware of this matching in the Revealed (R) condition but unaware of this in the Concealed (C) condition.

2.1 | Structural Design of the Experiment

Figure 1 summarizes the experimental design. With a 3×2 between-subjects design, there are six treatment groups. Each cell shows two groups contesting against each other. A human figurine indicates a concurrently active player, and a computer indicates the stored decisions from previously active players. Each human figurine has a unique number on top of it, while each computer is marked with the same number as a human figurine whose decisions it has copied. Note that computers copy decisions only from IN-OUT players as this is our baseline scenario. The arrows also indicate which previously active players' effort decisions are stored by the computers and where these are used. For this reason, implementing this design required carrying out the IN-OUT treatments first, followed by the IN and the NONE treatments, respectively.[4] The instructions are provided in A.

Contesting groups in the C treatments are simply named as group A or group B, while contesting groups in the R treatments are named after two famous painters Klee and Kandinsky (see the experimental procedures for how these names are assigned). In each cell, the in-group and out-group players are defined from the perspective of the player on the very left; in-group players are inside a light dashed space and out-group players are inside a solid shaded space.

2.2 | Experimental Procedures

The experiment was conducted using the z-Tree software (Fischbacher 2007). There are three different group matching variations—IN-OUT, IN, and NONE; each conducted separately under two identity conditions—C (concealed) and R (revealed). The experiment had two parts. Part I of the experiment consisted of a painting choice task (Tajfel 1970) which is used for assigning subjects with minimal categorical identities, i.e., Klee or Kandinsky. Subjects were then randomly assigned into three-person groups with two other players of the same minimal identity as theirs. Each Klee group was matched with a Kandinsky group for the group contest in Part II; however, this information was only revealed to all the subjects in the R treatments but was concealed from all the subjects in the C treatments.

Part I task: At the beginning of the experiment, in Part I, each subject was shown five pairs of paintings. Subjects were informed that each pair consisted of one painting by Paul Klee and another by Wassily Kandinsky, but they did not know which painting belonged to whom. Subjects were asked to indicate their preferred painting in each pair. The number of Klee paintings chosen for each subject was recorded and those choosing higher than or equal to the median choice were marked as Klee subjects and the rest as Kandinsky subjects. If there were more subjects in the Klee group, a random assignment procedure was followed to transfer half of the excess subjects with the median preference to the Kandinsky group so that both groups could have an equal number of subjects. Subjects were aware of the categorization but not of this exact procedure. In the C treatment, subjects were explicitly told that subsequent parts of the experiment would be completely independent of this choice task. In the R treatment, they were told whether they had been categorized as a Klee subject or a Kandinsky subject. Subjects were paid a lump sum amount of money for completing this task under both the C and R treatments.

Part II task: At the beginning of Part II, subjects from the same identity cluster were randomly matched into groups of three. Each group was then matched with a group from the other identity cluster. The inter-group contest in Part II had two phases: first a one-shot inter-group lottery contest over a public-good prize and then 20 repetitions of the same game in the second phase. Subjects were not aware of the repeated contests at the time of making their decisions in the one-shot contest. This was implemented to collect more observations and to understand if the preferences are different in a one-shot contest versus in a repeated contest where anticipatory learning can play a role. The composition of any given group (i.e., intra-group matching) remained the same throughout and a Klee group always contested a Kandinsky group, but the inter-group matching was randomly reshuffled every period.

Each subject at the beginning of each period of the inter-group contest was endowed with 60 Experimental Currency Units (ECU) which had to be allocated between a private and a group account. Each subject individually and independently decided how much to allocate to which account. Once all subjects had made their decisions, a computerized Tullock lottery was conducted with the total ECUs in the two contesting groups' accounts. Each subject in the winning group was rewarded with 60 ECU. The outcome from each lottery period was shown before the next period began. There were no carryovers from one period to another.

The equilibrium group effort for this contest is 15 ECU (Katz et al. 1990). However, unlike the majority of contest studies, our interest does not lie in deviations from equilibrium. Outcomes or payoffs from any of the previous periods were not observable at any point during the experiment (i.e., no history table was provided on the Z-Tree outcome screen). We also restricted subjects' access to pen and paper in the laboratory. Hence, all tangible memory aids were disabled so as to minimize heterogeneity in the accessibility of contest history. At the end of each period, subjects were shown their own allocation, the total allocation in their group's account, the total allocation in the other group's account, the contest outcome and only their own final payoff in that period.

Besides random assignment to the C and R conditions, subjects were randomly assigned to one of three treatments. In what follows, we explain how the three treatments varied in terms of intra−or intergroup matching.

IN-OUT treatment: All groups in the IN-OUT treatment were comprised of concurrently active individuals. There were two IN-OUT treatments (IN-OUT-C and IN-OUT-R) consisting of 30 subjects each. All 30 subjects participated in the same session, and depending on their identity clusters, each subject was assigned to one of the five KLEE and five KANDINSKY groups. The composition of each group remained unchanged over all lottery periods. However, a given KLEE group was matched against one of the five different KANDINSKY groups in each period. This matching was done according to a preset random order.

IN treatment: In the IN treatment, a group consisting of concurrently active subjects contested a group comprised of only previously active subjects. Subjects from the same identity cluster were randomly matched into three-player groups. Unlike IN-OUT, the KLEE groups in the IN treatment were not matched with any of the KANDINSKY groups playing in that session, and vice versa. Instead, a KLEE group faced the same opponent-group decisions in each period as the corresponding KLEE group from the IN-OUT treatment faced from their opponents. Similarly, a KANDINSKY group in the IN treatment faced decisions from a previously active KLEE group in the IN-OUT treatment. If a group won in the IN treatment, then each subject received 60 ECUs. If they lost, nobody received any reward (including the previously active group from the IN-OUT treatment). Thus, any decision made by any subject in the IN treatment did not have any consequences for any out-group players.

NONE treatment: In the NONE treatment, an active subject grouped with two previously active subjects from the same identity cluster contested against a previously active group from the other identity cluster. The way it was implemented needs detailed clarification: each subject was randomly assigned to role-play as one player of a particular group from the same identity cluster in the corresponding IN-OUT treatment. Their group effort consisted of their own effort decision and the effort decisions from the previously active group members. This group effort was then matched with the group effort from the previously active opponent group's effort. Given this, if the active subject's group won in the NONE treatment, then this subject received 60 ECUs. If they lost, nobody received any rewards. Thus, any decisions made by any subject in the NONE treatment did not have any consequences for any in-group or out-group players. A close look at Figure 1 should help in comprehending the intra-group and intergroup matches across different treatment sessions.

Example: We demonstrate the above technologies with an example. Suppose Klee-1 group in the IN-OUT-C treatment is matched with Kand-3 group in the one-shot contest and Klee-2 group is matched with Kand-5. All these groups comprise subjects who are concurrently active and all their effort decisions are stored by the computer.

In the IN-C session, group Klee-1 has three concurrently active subjects whose effort decisions are matched with an out-group effort equal to the total effort from the Kand-3 group in the IN-OUT-C treatment. Kand-3 group in IN-OUT-C also had three concurrently active subjects who encountered an out-group effort equal to the total effort of the Klee-1 group from the IN-OUT-C session. Similarly, there are concurrently active players in the Klee-2 and Kand-5 groups in IN-C but they are not contesting against each other. Instead, the Klee-2 group in IN-C contests against an out-group effort equal to the total effort of the Kand-5 group from IN-OUT-C and Kand-5 group contests against an out-group effort which is equal to the total effort exerted by the Klee-2 group in IN-OUT-C.

In the NONE-C session, one subject role-played as player 1 in the Klee-1 group. This subject's effort was matched with stored efforts from players 2 and 3 in the Klee-1 group of the IN-OUT-C treatment. That total was then entered into a contest against an out-group effort equal to the total effort from Kand-3 group in IN-OUT-C. Similarly, another subject in the NONE-C session is role-played as player 2 in the Klee-1 group. This subject's effort was matched with the stored efforts from players 1 and 3 of the Klee-1 group in IN-OUT-C. This total was then put through a lottery with an out-group effort equal to the total effort from the Kand-3 group in IN-OUT-C. Similarly, some other subject role-played as player 3 in Klee-1 group. Yet another subject in NONE-C role-played as player 1 of the Kand-3 group, whose effort was added up to the stored effort decisions of players 2 and 3 in the Kand-3 group from the IN-OUT-C and the resulting total was put into a lottery with an out-group effort equal to the total effort of the Klee-1 group from IN-OUT-C. Similarly, for players 2 and 3 of the Kand-3 group. The same procedure is followed for all groups and individuals in each period of the repeated contest as well. At the end of the experiment, 4 out of the 20 lottery periods were randomly chosen for payment. Subjects were also paid for the one-shot contest. Subjects also answered a questionnaire about perceived group satisfaction, a questionnaire about the reason behind their decisions, an incentivized risk-elicitation task, an incentivized ambiguity elicitation task, an incentivized cognitive reflection test (CRT), and a demographic questionnaire.

The group satisfaction questionnaire was adapted from Hinkle et al. (1989) and Insko et al. (2013), which asks the subjects how much they liked belonging to the group, to what extent they thought the group worked well together or held them back, whether the group was important to them, and whether they thought the other members behaved selfishly or not. We chose to use this questionnaire instead of a standard dictator game or allocation game because we wanted to know how subjects reflected cohesion based on their play experience. The use of CRT was motivated by Cox (2017) and Sheremeta (2020), who reported a significant negative correlation between CRT score and effort in one-shot contests. Although Sheremeta (2011) and Shupp et al. (2013) report that attitudes towards risk and ambiguity do not explain contest expenditure, we still verified our results controlling for both of these attributes (not reported).

3 | Hypotheses

Here we state the four testable hypotheses that align with our four original research questions. Our experimental design rests on the assumption that eliminating human in-group players removes all in-group-related preferences, and likewise, removing human out-group players removes all out-group-related preferences.

The IN-OUT treatments allow for the simultaneous presence of all in-group and out-group related preferences. Removing the out-group players in the IN treatments renders all out-group related preferences irrelevant. The further absence of in-group players in the NONE treatment should also deactivate any in-group related preferences such as group-synergy or within-group inequality aversion. Building on this design principle of eliminating group-related preferences through the removal of out-group and in-group players, we formulate the following hypotheses.

First, regardless of whether the lab-generated minimal identities are revealed or not, we expect average effort in IN to be higher than average effort in NONE due to the presence of other active in-group players in the IN treatment, which is likely to induce "a cooperative motivation to help the in-group" (Halevy et al. 2012; Sheremeta 2015). We further expect effort in IN-OUT to be higher than effort in IN due to the additional presence of active out-group players which may induce an 'aggressive or competitive motivation' to win over the out-group (Halevy et al. 2012; Sheremeta 2015).

Hypothesis 1. *Average effort is highest in the IN-OUT condition, followed by the IN and the NONE conditions, respectively.*

We build all our hypotheses and results at the individual level rather than at the group level. This is because individuals within a group may have different and potentially contrasting preferences, which may obscure the effect of group-related preferences on individual effort choices. Hence, looking at individual effort is important to understand the distinctive impact of the presence or absence of in-group and out-group players.

Note that there is a continuum of individual equilibria in an inter-group public-good contest. In the absence of a unique equilibrium effort at the individual level, we consider an equal split of the equilibrium group effort as a critical benchmark; in groups of size 3, individual efforts lower than one-third of the equilibrium effort is labeled as selfish effort decisions.

Hypothesis 2. *Selfish effort decisions characterized by disproportionately lower efforts at the individual level are most frequent in the NONE treatment, followed by the IN and the IN-OUT treatments.*

Like our first hypothesis, the current hypothesis also follows from group synergy and parochial altruism: that is, more people exhibit selfish effort decisions in the complete absence of any in-group or out-group players in the NONE treatment; additional presence of in-groups in the IN treatment increases the perceived final payoff from winning and reduces selfish effort decisions; while the presence of out-groups in the IN-OUT treatment further increases the perceived final payoff as reflected in even lower selfish effort decisions compared to IN. In our statistical analysis, we take IN-OUT as the baseline for comparing efforts and accordingly, expect the number of selfish decisions in IN to be higher compared to the baseline and the number of selfish decisions in the NONE treatments to be the highest.

The last two hypotheses rank effort levels under the different treatment variations based on the assumption that the presence of other in-group stakeholders inspires positive synergy among the players, thereby enhancing their perceived final payoff from winning, which should translate into higher effort. We do not measure group synergy in our experiment, but we asked subjects about their perceived group satisfaction at the end of the experiment. Our third hypothesis tests if playing the contest with other concurrently active in-group and/or out-group players can be linked to perceived group satisfaction.

First of all, as subjects only interact with historical subjects in the NONE treatment, evolution of "group concept" is unlikely in that treatment. Note also that subjects were explicitly informed that they would be role-playing for participants from previously active groups, making it unclear whether a "group concept" formed in their minds in the treatments. Their responses on the group satisfaction questionnaire likely reflect their perceptions of how those prior participants actually made effort decisions.

Since the group satisfaction questionnaire was implemented at the very end, after all effort decisions were made, and the questions were related to how the subjects felt about being a part of their group, we cannot simply expect the group satisfaction scores to be higher for subjects in the IN treatments compared to those in the NONE treatments, or higher for subjects in the IN-OUT treatments compared to those in the IN treatments. This is because group satisfaction at the end of the game will depend on the realized play experience. Although common wisdom from literature tells us that group cohesion is higher in the presence of out-groups, an individual facing greedy or selfish in-group players in IN-OUT may feel less satisfied about their group compared to another individual facing cooperative in-group players in IN. So, group satisfaction as measured at the end of the contest game cannot tell if the mere presence of in-groups (and/or outgroups) leads to higher group satisfaction or not. Instead, it can give us a clue about whether group satisfaction is correlated to effort and, if it is, whether there is any observed effect of the treatment manipulations on that correlation.

Hypothesis 3. *Individual share of group effort is positively correlated with group satisfaction in IN and IN-OUT, and unrelated in NONE.*

With this hypothesis, we want to establish a mechanism of how our treatment manipulations may have affected the group-related preferences. Individuals were asked about their satisfaction with their group only after they participated in the contest. Therefore, we are unable to observe how the effort dynamics changed their satisfaction with their group, which in turn may have affected the subsequent effort choices. Instead, we look at their average contest effort over the course of the game and see if it correlates to the level of satisfaction with their own group as revealed through their responses to the group satisfaction questionnaire.

Hypothesis 4. *The three hypotheses above also hold under revealed identity, and effort under all three types of inter-group composition is higher under revealed identity.*

We expect the group-related preferences to be stronger under revealed identity. Under concealed identity individuals are only told that they are matched into groups for the purpose of the contest, whereas in the revealed identity treatments, they know that the groups have been formed based on a minimal categorical identity. This last hypothesis will enable us to conclude if group-related preferences are intensified for groups with salient categorical identities.

The minimal identity paradigm has been widely utilized in social psychology to study group-based preferences and in-group versus out-group biases (Diehl 1988; Diehl 1990; Gagnon and Bourhis 1996; Gaertner and Insko 2000; Yamagishi et al. 2008; Hong and Ratner 2021). However, no study has yet examined how minimal identity affects in-group preferences versus out-group preferences specifically in contests and here we address this gap. While there is ongoing debate over the effectiveness of minimal identity in fostering group behavior in laboratory settings, studies in social psychology support its efficacy, while some economic studies report weaker group-building effects (Chen and Li 2009; Chen and Chen 2011). Despite mixed findings, recent work in experimental economics, such as Chowdhury et al. (2016), who show an increase in effort with real identity, and Hao et al. (2023), who measured participants' neural responses in lottery contests against in-group and out-group opponents, shows renewed interest in this paradigm. Therefore, we employ the minimal identity paradigm to explore whether categorical identity can intensify group preferences and affect effort levels.

4 | Results

We begin our analysis with the summary statistics of the effort provisions. Table 1 summarizes the means and standard errors of individual effort in each treatment, separately for the one-shot contest and the 20 periods of repeated contest. There are 30 individuals matched into 10 distinct groups in each of the IN-OUT and IN treatments. In the NONE treatments, each individual subject role-plays as one particular member of one particular group. We are not interested in deviations from equilibrium group effort. However, it is easy to observe from Table 1 that the average individual effort in the repeated contest almost equals the equilibrium group effort, which is 15 ECU for an inter-group contest with a 60 ECU public-good prize and 3 players in a group. Thus, the average group effort in each treatment, which is simply three times the average individual effort, by far exceeds the equilibrium prediction. Average group effort in all treatments is around four times the equilibrium benchmark in the one-shot game and around three times in the repeated game (the equilibrium group effort is 15).[5]

Table 1 shows that the average effort in all treatments is lower for the repeated contest, which is expected due to learning (see Chowdhury and Marini 2024 for evidence from meta-analysis). Figure 2 shows that average effort decreases over time as subjects become more experienced. Regardless of the group composition and identity information, average effort starts around 20 ECUs in all treatments and ends up between 10 and 15 ECUs by the end.

TABLE 1 | Average Individual Effort in One-Shot and Repeated Contests.

Treatment	One-shot	Repeated (Period 2-21)
IN-OUT-C	21.23 (1.94)	14.90 (0.46)
IN-OUT-R	20.60 (2.33)	15.64 (0.44)
IN-C	19.23 (1.80)	14.36 (0.50)
IN-R	21.40 (2.05)	15.05 (0.50)
NONE-C	19.93 (1.98)	14.83 (0.52)
NONE-R	21.66 (2.39)	15.50 (0.62)
No. of Obs.*	180	3600

Note: Standard errors in parentheses.

Standard non-parametric tests (Kruskal-Wallis test and the Wilcoxon-Mann-Whitney rank-sum test) for comparison between a pair of treatments show no difference on average effort in the one-shot contest. We cannot use non-parametric tests to compare efforts across treatments in the repeated game. This is because in the one-shot game, each subject's decision constitutes an independent observation in all treatments, but that is not the case in the repeated contest.[6]

While one may expect the anticipation of repeated contest to depress effort at the beginning of the repeated contest, we do not find any significant difference between effort decisions in period 1 (one-shot contest) and period 2 (first period of the repeated contest). For the sake of consistency, in the rest of our analysis we use data from the 20 periods of repeated contest. However, including the one-shot contest does not change our results in any significant way.

The following three results correspond to the first three hypotheses from the previous section in the same order. We do not have a separate result corresponding to Hypothesis 4 because the results under revealed identity are discussed along with the results for the concealed identity.

Result 1. *Average effort is similar across treatments.*

Support: Figure 3 shows the distribution of efforts across our six treatments. In view of the positively skewed distribution of efforts with a high mass on zero effort, we report the results from a Tobit regression in Table 2. We do not find any significant effect of either group composition or identity information on individual efforts. Effort exhibits significant autocorrelation within individual participants, and effort falls as participants become more experienced in the game. A higher total effort in the opponent group in the previous period increases the current effort amount except for in the NONE. ■

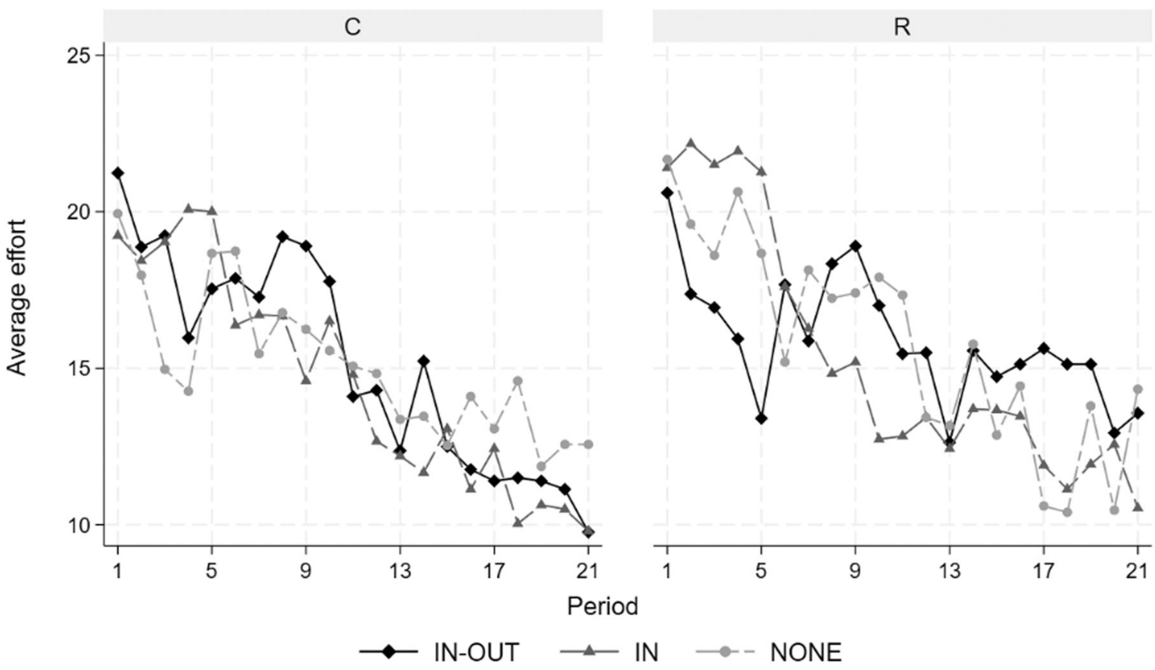

FIGURE 2 | Average individual effort over time.

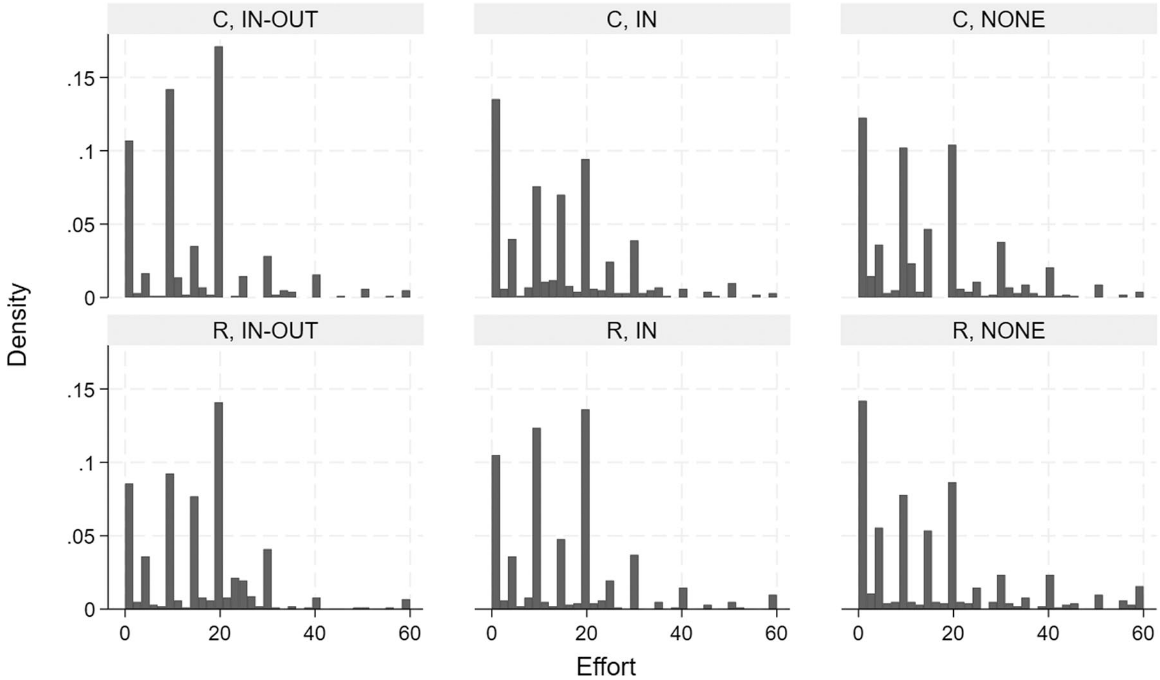

FIGURE 3 | Distribution of individual effort choices across treatments.

TABLE 2 | Tobit Regression of Individual Effort.

Dependent variable: Effort	All Coefficients (std. error)	C Coefficients (std. error)	R Coefficients (std. error)
IN	−0.13 (0.50)	0.05 (0.75)	−0.31 (0.65)
NONE	0.13 (0.63)	−0.30 (0.77)	0.03 (1.02)
R	0.28 (0.48)	—	—
Period	−0.08 (0.02)***	−0.09 (0.04)**	−0.08 (0.03)**
Lag effort	0.60 (0.06)***	0.67 (0.07)***	0.54 (0.09)***
Lag Winner	− 0.42 (0.38)	− 0.97 (0.45)**	0.15 (0.61)
Lag share in group	1.25 (2.26)	−0.57 (2.82)	2.87 (3.35)
Lag own group total	0.03 (0.02)	0.00 (0.02)	0.05 (0.03)
Lag opponent total	0.03 (0.01)***	0.03 (0.01)**	0.03 (0.02)
Constant	4.12 (1.20)***	4.68 (1.62)***	3.06 (1.25)**
No. of Observations	3600	1,800	1,800
F-stat (Prob $F = 0.00$)	118.71	77.23	63.82
Pseudo R-squared	0.07	0.08	0.06

Note: ** and *** indicate *p*-values less than 0.05 and 0.01, respectively. Std. errors are clustered at group level.

Therefore, we do not find support for Hypothesis 1. Neither the group matching compositions nor the minimal identity information seem to have any significant effect on the contest efforts. We also compared average effort from the comparable groups across each pair of group-matching compositions (i.e., IN-OUT vis-à-vis IN, IN vis-à-vis NONE, and IN-OUT vis-à-vis NONE) under both types of minimal identity information (i.e., R and C). For example, we subtracted the average effort in the KAND-1 group in IN-C from the average effort in the KAND-1 group in IN-OUT-C for each of the 20 periods of the repeated game. We then took the average of these differences over the 20 periods and the 10 groups, respectively. The justification for this exercise is that comparable groups experience the same out-group effort over the course of the game. Summary statistics for these average differences between the comparable groups are presented in Table 3. None of these figures are statistically significant but we observe that average effort in the comparable groups is highest in IN-OUT, followed by NONE and IN, respectively, under both concealed and revealed identities.

It is important to ask if this observation indicates a different possibility than what we had expected in our hypotheses. That is, is there higher efforts in NONE compared to IN because the presence of in-groups enhances concern about intra-group payoffs

TABLE 3 | Summary Statistics for Differences in Effort Across Comparable Groups (s.e. in Parentheses).

Difference between comparable groups	C	R
Effort in IN-OUT—Effort in IN	0.53 (0.64)	0.58 (0.75)
Effort in IN—Effort in NONE	−0.46 (0.69)	−0.44 (0.81)
Effort in IN-OUT—Effort in NONE	0.07 (0.68)	0.14 (0.79)

TABLE 4 | Probit Regression for Selfish Effort Choices.

$\left(DV = \begin{cases} 1 \text{ if effort} \leq 5 \\ 0 \text{ if effort} \in (5, 60] \end{cases}\right)$	All	C	R
R	0.02 (0.12)		
IN	0.19 (0.15)	0.30 (0.21)	0.08 (0.22)
NONE	0.31 (0.14)**	0.27 (0.19)	0.35 (0.20)*
Period	0.02 (0.01)	0.02 (0.01)***	0.02 (0.01)**
Lag effort	−0.02 (0.01)	−0.03 (0.02)	−0.00 (0.01)
Lag Winner	−0.07 (0.05)	−0.05 (0.07)	−0.10 (0.07)
Lag share in group	−1.86 (0.44)***	−1.61 (0.67)**	−2.04 (0.61)***
Lag group total	−0.02 (0.00)***	−0.01 (0.00)**	−0.02 (0.00)***
Lag opponent total	−0.00 (0.00)	−0.00 (0.00)	0.00 (0.00)
Constant	0.57 (0.18)***	0.43 (0.27)	0.69 (0.20)***
Observations	3600	1800	1800
Sig. Wald chi2(9)	228.97	183.16	100.81
Pseudo R2	0.24	0.27	0.23
Predicted probability of cooperative effort (Effort > 5 ECU)			
IN-OUT	0.18 (260)	0.16 (130)	0.19 (130)
IN	0.23 (337)	0.25 (186)	0.21 (151)
NONE	0.26 (392)	0.24 (178)	0.30 (214)

Note: *, ** and *** indicate p-values < 0.1, < 0.05 and < 0.01, respectively. The upper panel provides robust standard errors clustered at the group level in parentheses next to the coefficients. In the lower panel, we report the observed frequencies of selfish effort choices in parentheses next to the predicted probabilities. The predicted probabilities are all significant and have similar standard errors (not reported).

(IN has lower average effort compared to NONE) but the additional presence of out-groups moderates concerns for intra-group payoffs through an additional concern for inter-group payoffs (higher average effort in IN-OUT compared to IN)?

Potentially higher effort in IN-OUT than IN is consistent with parochial altruism (Abbink et al. 2012), and the standard conjecture from social psychology that "*intergroup conflict serves as a unit-forming factor that enhances group identification beyond categorization and labeling alone*" (Bornstein and Ben-Yossef 1994, p. 64). However, the intra-group conflict of interest crowding out individual payoff concerns, i.e., potentially lower effort in IN compared to NONE, is not well-researched. To take a closer look at the same, we classify individual efforts relative to a benchmark guided by the theoretical predictions of equilibrium effort.

Given that the equilibrium group effort prediction is 15, we classify the individual efforts up to 5 (i.e., one-third of the equilibrium group effort, or a fair share) as "selfish" and individual efforts above 5 as "non-selfish". The frequency of selfish effort (effort up to 5 ECU) is higher in the NONE (392) and IN (337) treatments compared to the IN-OUT treatment (260) regardless of the identity condition (see lower panel of Table 4). Under concealed identity, the frequencies of selfish effort were rather similar in the IN (186) and NONE (178) treatments when compared to IN-OUT (130). Under revealed identity, the frequencies of selfish effort are closer in the IN-OUT (130) and IN (151) compared to NONE (214).

Result 2. *Overall, selfish effort decisions (defined as individual effort ≤ equilibrium group effort/group size) are most likely in the NONE treatment.*

Support: Table 4 presents a probit model with predicted probabilities of selfish effort choices under different group compositions and identity conditions. The set of independent variables are similar to the regression presented in Table 2. Based on the results of this model, selfish effort choice (effort ≤ 5 ECU) are significantly higher in the NONE treatment after controlling for all the previous period measurements and contest period. The predicted probabilities and frequencies reported in the lower panel tell us that selfish effort choices are more frequent throughout in the NONE and IN treatments than they are in the IN-OUT treatment. Examining the two identity conditions separately, we can say that the overall higher probability of selfish effort choices seems to be mostly driven by the revealed identity condition while the differences under concealed identity are not significantly different. These estimates, however, do not give any indication that the additional presence of out-groups induces higher effort because no significant difference in selfish effort choices could be found between IN and IN-OUT. The mere presence of in-groups cannot be claimed to affect individual effort either, as indicated by the selfish effort choices occurring with very similar probabilities in the IN and NONE treatments under concealed identity. Under revealed identity, selfish behavior becomes somewhat less likely in IN (not significant on its own) and somewhat more likely in NONE (not significant on its own) in comparison to how likely they are under concealed identity, rendering the difference between IN-OUT and NONE significantly large. This indicates that our minimal identity elicitation reduced selfish effort choices in the IN treatment, at least to a limited extent, although it did not impact the average effort. ■

The results from Table 4 provide partial support for hypothesis 2. That is, we confirm that selfish effort choices are indeed more likely in the NONE treatment, but there is no significant difference between IN and IN-OUT in terms of the probability of selfish effort choices. The observation that, in the absence of any identity information, selfish effort decisions occur at a statistically comparable rate in all three group composition manipulations suggests that the mere presence of in-groups or out-groups cannot significantly impact contest effort. With identity information revealed, selfish behavior has become less frequent in IN and more frequent in NONE, making the overall selfish choices significantly higher in the NONE treatment compared to the IN-OUT treatment. We cannot, however, infer whether it's the presence of the in-groups or the presence of out-groups or both that led to the difference in selfish effort choices between IN-OUT and NONE. We turn our attention to subjects' responses to the group-satisfaction questionnaire to look for some possible explanation in this regard.

The group-satisfaction index for each subject was constructed using the factor scores calculated from a factor analysis on participants' answers to 5 items on the Group Satisfaction questionnaire at the end of the contest game (provided in B).[7] The index values ranged between 1.6 and 4.4, a higher score interpreted as higher satisfaction with the group one was assigned to. It should be noted that participants in the NONE treatment were not assigned to any concurrent group, but their decisions were merely matched with two other previously active participants. However, since these two previously active participants were the same in every contest period and since participants in the NONE treatment were told that they were replacing a certain member in a previously active group, we also got the NONE subjects answer to this GS questionnaire. Because subjects answered the group-satisfaction questionnaire after making all their contest decisions, it is reasonable to assume that subjects' answers to these questions reflect their game-play experience rather than the other way round. Hence, we first regressed individual GS index scores on average effort over the course of the game. However, the model had very little explanatory power. Hence, we regressed GS index scores on the average share of the individual in their group's effort over the course of the repeated contest.

Result 3. *Group satisfaction (GS) score is negatively correlated to average individual share in group effort. Revealing identity information moderates this negative correlation in the IN treatment. GS is unrelated to individual share in group effort in the NONE treatment.*

Support: Our GS questionnaire (see B) consisted of six Likert items with 5-point response scales. Individual GS index scores were determined based on a factor analysis on five items. The Cronbach's α is sufficiently high (0.81), indicating internal consistency. Regressing GS scores on average share in group effort shows a significant negative correlation between the two ($\beta = -1.41$, cluster robust std. error = 0.32). We interact GS scores with identity information for each group composition manipulation. Table 5 shows the results from regressing individual GS scores on the average proportion of individual effort in the group total effort, the identity condition, and the interaction of the two. The GS score is negatively associated with average individual share in group effort only in the IN treatment, but there is a positive interaction effect of average within-group share and revealed identity. The finding that higher average share in the group effort over the course of the game significantly lowered subjects' satisfaction with their group only

TABLE 5 | Generalized Linear Regression of Group-Satisfaction Index (Based on Factor Scores) on Average Within-Group Effort Share.

GS score	IN-OUT	IN	NONE
Share in group effort	−0.91 (1.10)	−2.88 (0.38)***	−0.23 (0.62)
R	0.54 (0.50)	−0.61 (0.38)	0.38 (0.30)
Share in group effort × R	−1.97 (1.52)	1.95 (0.92)**	−0.76 (0.78)
Constant	3.34 (0.31)***	3.80 (0.15)***	3.10 (0.22)***
Average Marginal Effects			
Share in group effort	−1.90 (0.76)**	−1.91 (0.46)***	−0.61 (0.39)
R	−0.11 (0.21)	0.04 (0.21)	0.15 (0.20)
BIC	137.93	131.63	137.04
Wald chi(2) [Prob > chi^2]	9.8	64.43	—

Note: ** and *** indicate *p*-values < 0.05 and < 0.01, respectively. Standard errors are clustered at the group level.

in the IN treatment points at different expectations in the IN treatment. We argue that in the absence of any identity information, the public-good aspect of the inter-group contest was salient to the subjects in the IN treatment, which was not the case in IN-OUT or NONE. For this reason, those who contributed relatively more to their group ended up less satisfied with their group in the IN treatment. With identity information revealed, the salience of the inter-group aspect was higher, which improved the GS despite having contributed relatively more to the group pot. In other words, revealing identity moderated the negative effect of the average within-group share on the GS score. ■

We cannot claim full support for hypothesis 3 as individual effort did not necessarily correlate (positively) with group satisfaction. Instead, we looked at the correlation between the average share in group effort and group satisfaction. Our overall finding is that group satisfaction is lower for a higher share of group effort. Breaking down by the group compositions, we see that this negative correlation was specifically significant in the IN treatment but was moderated in the presence of identity information.

One possible explanation is that subjects view the IN treatment more as a public-good game and therefore have higher preferences for within-group equality. Accordingly, subjects who did not feel exploited within their group responded positively to the questions in the group-identification questionnaire and scored higher. Under revealed identity, the presence of in-groups with similar social identity moderates the aversion to intra-group exploitation.

The lack of significance of the GS in the NONE treatment is likely a consequence of our experimental design. The fitted regression lines in Figure 4 show that the correlation between individual effort and GS score are opposite for the concealed and revealed identity condition for both IN-OUT and IN treatments. However, the slopes in the IN-OUT treatment was not significant as shown in Table 5. What we can take away from this result is that in the IN treatment, subjects are more likely to focus on the aspect of intra-group conflict which gets diluted in the presence of the additional layer of a common social identity.

Note that we do not find support for Hypothesis 4. Neither of the regressions in Tables 4 or 5 indicate a statistically significant effect of Revealed identity (R). The interaction between the GS score and the R dummy in Table 5 can at most show that revealing identity has weakened the negative impact of fear of intra-group exploitation on effort. Overall, we do not find much conclusive evidence that group-related preferences are stronger when additional information is revealed about the groups being formed on the basis of a minimal categorical identity.

5 | Discussion

We employ a novel experimental design to investigate the effects of group-related preferences in inter-group conflicts. In-group favoritism in two-player games have been studied by exploring social preferences through strategy method (e.g., Herrmann and Orzen 2008; Hao et al. 2023), or by pairing active human subjects with inactive participants (Ahmed 2007), and also by utilizing previously active subjects (Cox 2017) as in our experiment. Our design stands out as the first to use previously active subjects to study behavior in group contests specifically. We also contribute to the area of intergroup competition over

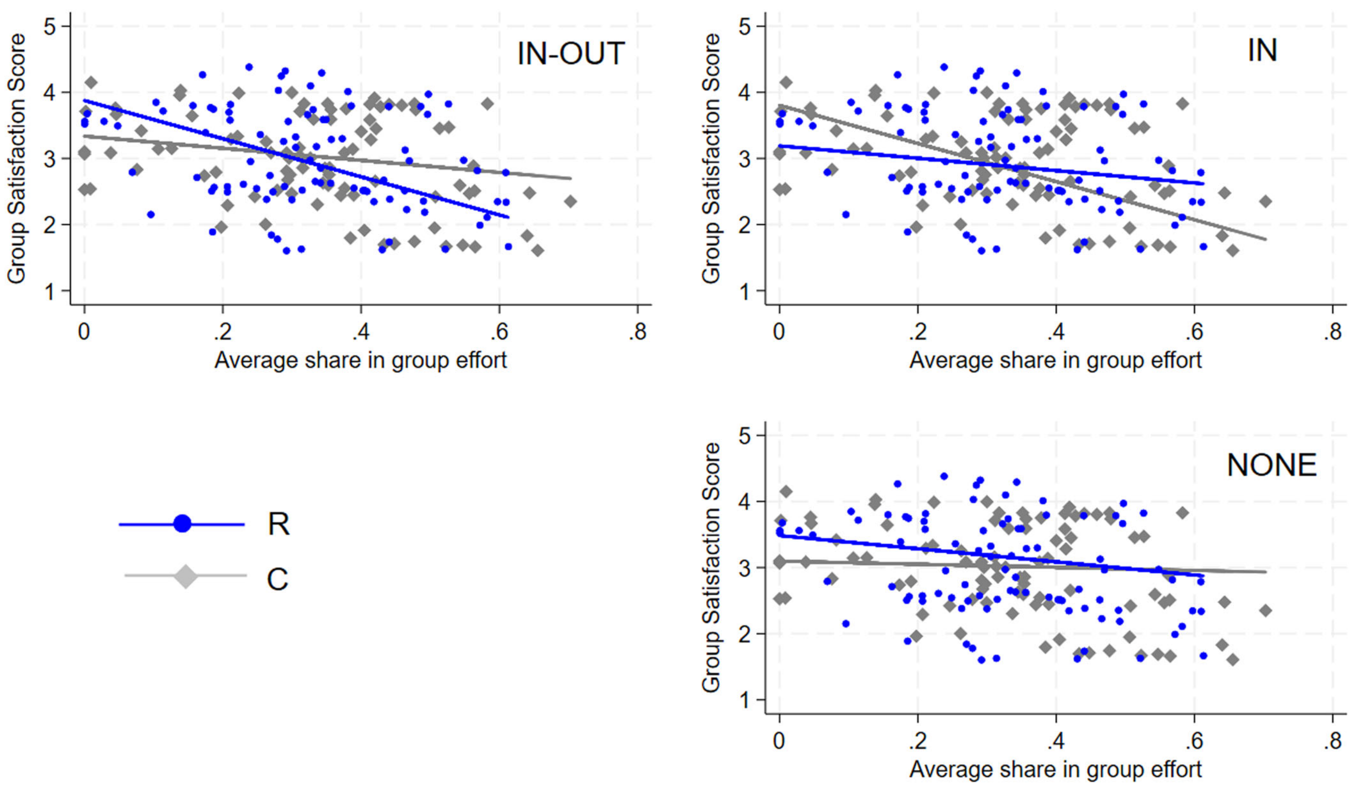

FIGURE 4 | Actual values of GS and fitted values from the regression in Table 5.

public-good rewards (Rapoport 1985; Rapoport and Bornstein 1987). However, while such studies consider all-or-nothing contributions towards intergroup conflict, we consider a continuous decision space and an uncertainty underlying the competition outcome.

Our results show little support for group-related preferences affecting strategic choices in inter-group contests. There is no significant difference in the average effort observed across various treatments. However, upon closer scrutiny of individual choices, it becomes apparent that the presence of in-groups heightens individual concerns about personal payoffs, inducing a larger number of selfish effort choices. Yet, the introduction of out-groups tampers these concerns for individual payoffs by partly shifting the focus on inter-group outcomes.

Additionally, our study reveals an intriguing pattern: when identities are concealed, individuals who contributed relatively less to their group reported higher post-conflict satisfaction with their own, especially when out-groups are absent. However, this relationship reverses under revealed identity. This finding supports the idea that individuals perceive their own group as a cohesive social unit primarily in the presence of either an out-group or a shared social identity among group members. Consequently, we can interpret the presence of out-groups and a common social identity as interchangeable motivational factors.

In summary, the results from our experiment indicates that absence of an active out-group may allow in-group members behave in a relatively more self-serving fashion. This may seem in contrast to the claim by Gunnthorsdottir and Rapoport (2006) that embedding intra-group conflict may reduce free-riding by inducing competitiveness among the in-group players. But our result can be interpreted as the other side of the same coin. In their study, the subjects increase their contributions to gain an advantage in the intra-group conflict, while in our study, the subjects reduce their effort to avoid being disadvantaged within the group.

The lack of any significant difference in aggregate effort across treatments can be due to a number of reasons. It may be due to the low salience of matching variation and/or low salience of the minimal identity manipulation. The design feature of matching the active groups with previously active in-groups and out-groups is similar in nature to what Cox (2017) implements in the context of an individual lottery contest. Cox (2017) also fails to find any treatment difference at the aggregate level between the standard human-human contest and a human-robot contest where the robot imitates some previously active player's effort decisions. Our study complements Cox (2017) by indicating that this particular design feature may not be successful in removing social preferences in contests. The low salience of the minimal identity elicitation is also reported by Chowdhury et al. (2016) at a group contest level. They show that revealing subjects' real identity (ethnicity) increases effort but revealing an induced identity (calling the groups as green or blue) does not do so.

Huang et al. (2021) showed that even real categorical identities like political partisanship may not have an impact on competitive behavior. Therefore, employing our current design under conditions involving real identity might amplify group-related preferences. However, it's important to note that not all natural identities are equally effective in eliciting conflict. For instance, Bhaumik et al. (2023) provided evidence from a two-player individual contest where information about chosen identity, specifically immigration status, failed to influence conflict dynamics. Weisel and Böhm (2015) also find that display of out-group hate by actively harming the out-groups is only significant when the group distinction was morality-based. Both Weisel and Böhm (2015) and Moscatelli and Rubini (2017) emphasize the role of perceived enmity in eliciting hostile behavior towards the out-group. This indicates that the effectiveness of different identities in stimulating conflict can vary significantly, and further research is warranted. However, the limitations of minimal identity in contests, as we point out, is important to note and further research in this area is warranted.

Eckel et al. (2022) find that in-group favoritism based on minimal group identities lies in between weak and strong real-life identities. Kranton et al. (2020) categorize experimental subjects as “groupy” or “non-groupy” and argue that only groupy participants respond to group contexts while non-groupy participants' behavior is unaffected by group-related preferences. In our experimental setting with no real-life conflict, it is possible that subjects care mainly about their payoffs and not social preferences. This would explain subjects' general tendency to match the average effort from others in all treatments except NONE because there were no other players in NONE to match with.

Additionally, it's worth considering that the joy of winning or potential judgmental biases, as discussed in Sheremeta (2020), could counterbalance any motivational impact of social preferences observed in our study. Furthermore, our experimental design falls between the third (generic social context) and fourth (induced identity level) hierarchies of social context, as per Huettel and Kranton's (2012) social context taxonomy. The manipulations along the group-composition dimension and the identity dimension might engage distinct neuro-cognitive processes. Hence, conducting a neuroeconomics investigation could provide valuable insights into the underlying neural mechanisms behind our observed results.

Note that our experiment considered the contesting groups to be “symmetric” in the sense that both groups were trying to win a reward. Different contexts of group conflict such as attack and defense (Chowdhury and Topolyan 2016) or gain and loss frames (see Chowdhury et al. 2018) may bring about different results. However, no research has been carried out to investigate the effects of either identity or in-group out-group preferences in such an attack and defense context. Answers to these questions are beyond the scope of our study but allow avenues for further research in this area.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1]We are implementing a public-good prize with an equal sharing rule for our intergroup contest. However, other types of prize sharing rules can be traced in the literature as well as in real life contests. The challenge of distributing the reward is typically addressed through intragroup conflict resolution methods (Münster 2007; Choi et al. 2016). We avoid this in our experiment to rule out intra-group competition.

[2]In an intergroup lottery contest featuring additive group effort and a public-good prize, individuals with a lower valuation for the prize can exploit the efforts of those valuing it more, leading to a free-rider problem. At the group level, equilibrium effort can be uniquely defined through a pure strategy equilibrium. However, at the individual level, a continuum of pure strategy equilibria exists if all players value the reward equally or if at least two players attribute the highest value (Baik 1993). Consequently, some players free ride with positive probability. Note that this free-riding phenomenon depends on the group effort production technology. When the technology is additive or a best-shot type (Chowdhury et al. 2013), then free-riding occurs. With complementarity in effort (Lee 2012; Kolmar and Rommeswinkel 2013) free riding might not occur.

[3]An example of disentangling intertwined motives through experiment is Rapoport and Eshed-Levy (1989), who study the exclusive effects of greed and fear by experimentally switching off one or the other.

[4]The differential effects of in-groups vis-à-vis out-groups have been studied in the context of social dilemma games (e.g., Prisoner's Dilemma and iterated Prisoner's Dilemma (Bornstein and Ben-Yossef 1994), iterated Prisoner's Dilemma maximizing-difference (Halevy et al. 2008), and stag-hunt and battle-of-the-sexes (Ahmed 2007)), but not for contests or conflicts. Using our experimental design, we are able to observe how in-group preferences motivate effort in comparison to no group-related preferences, and how the additional presence of an out-group may alter this motivation.

[5]There are various explanations for overbidding and overspreading of effort (see Dechenaux et al. 2015 and Sheremeta 2020). However, discrepancy from equilibrium behavior is not our focus. Our specific interest lies in examining whether and how the presence of other in-group and out-group members affect contest behavior.

[6]In IN-OUT, the random matching in each period means neither subject's decisions, nor a group, nor a pair of contesting groups can be treated as an independent observation. IN, on the other hand, matched the active groups with historical groups and therefore, each three-player group constitutes one independent unit of observation in the repeated contest. Each subject in NONE was matched with historical in-groups and out-groups and never interacted with other subjects in the same session. Each subject, therefore, comprises an independent observation.

[7]Although we had 6 total items on the questionnaire, Queston 4 was dropped based on the Cronbach α reliability test; please refer to Appendix B for details We also constructed an alternative index using the mean scores for participants' answers to the questionnaire. Our result remained qualitatively similar.

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Appendix A

Sample instructions

Part I Instruction *(Same for all treatments)*

In Part I, everyone will be shown five pairs of paintings by two artists Paul Klee and Wassily Kandinsky. Each pair will contain one painting by Klee and one painting by Kandinsky. However, there will be no information on which painting belongs to which artist. Each pair of paintings will also be shown in the same order to all the participants. Please state your preferences over each pair of paintings by clicking on the "Select" button corresponding to your preferred painting. A red check mark appears against your selected painting. Please note that you may not select both the paintings in a pair at the same time and you may not go back to a previous pair at any point. So, please make sure that the red check mark is visible against your preferred painting while confirming your choices by clicking on the "Confirm" button that appears below each screen. The next pair of paintings will be shown only after you have confirmed your preferences over the current pair.

After everybody submits their preferences over all five pairs, each of you will be classified as either a KLEE person or a KANDINSKY person. All participants will be privately informed about their individual classification.

Part II General Instruction *(Same for all treatments)*

Part II of this experiment consists of two phases. Instructions for Phase II will be given once all participants have finished Phase I. Please follow the instructions carefully. If you have any questions or need assistance of any kind, please raise your hand and an experimenter will come to you.

You will have chances of earning money in this part of the experiment. Your earnings will partly depend on your as well as some other participants' decisions and partly on chance. The experimental currency used for this part of the experiment is called"Experimental Currency Units" or ECU. Please note that every 40 ECU will be exchanged for £1 at the end of the experiment.

The second part of today's experiment consists of a decision-making task that is closely described by the following situation. Your role in the actual task will be instructed later. Suppose, there are two groups, Group A and Group B, and there is a reward that can be won by only one of the two groups. There are three members in each group and each member has 60 ECU in their individual accounts. Each member of a group independently decides how many ECU to allocate to the group account, the allocation can be any number of ECU from 1 to 60 inclusive. The total allocations in the two groups' accounts determine which group receives the reward. Each member in the reward-receiving group earns another 60 ECU in their individual account as reward. The final earnings of an individual are the final amount of ECU in their individual accounts.

How is the receiver of the reward determined?

Each penny in Group A's account is exchanged for an "A" token. Each penny in group B's account is exchanged for a "B" token. All "A" and all 'B" tokens are put into the same box and shuffled well. One token is drawn blindly. If it is an "A" token, Group A receives the reward. If it is a "B" token, Group B receives the reward. A computer program performs this blind draw. Number of a group's tokens = Member 1's allocation + Member 2's allocation + Member 3's allocation.

$$\textit{A group's chance of receiving the reward} = \frac{\textit{Own group token}}{\textit{Own group tokens} + \textit{Other group tokens}}$$

Individual Earnings:

60 – Allocation + 60 (reward) ECU, if the group receives the reward.

60 – Allocation ECU, if the group does not receive the reward.

Click 'Continue' to see a hypothetical example illustrating the entire process.

Example

Group A	Initial ECU	Allocation	Group B	Initial ECU	Allocation
Member 1	60	30	Member 1	60	35
Member 2	60	18	Member 2	60	5
Member 3	60	42	Member 3	60	0
Total Allocation		90	Total Allocation		40

Number of A tokens = Total allocation in Group A's account = 90

Number of B tokens = Total allocation in Group B's account = 40

Total number of tokens in the box = $90 + 40 = 130$

Suppose an "A" token has been drawn. Group A receives the reward. The earnings of the two group's members will be as follows.

Group A	Final earnings ECU	Group B	Final Earnings
Member 1	60–30 + 60 = 90 ECU	Member 1	60–35 + 0 = 25 ECU
Member 2	60–18 + 60 = 102 ECU	Member 2	60–5 + 0 = 55 ECU
Member 3	60–42 + 60 = 78 ECU	Member 3	60–0 + 0 = 60 ECU

Part II General Quiz:

1. How many members are there in each group? (Answer: 3)
2. If, in some period, member 1 of Group A allocates 50 ECU and each of the other two members allocates 10 ECU each, who will have the highest earnings in Group A in that period?
   a. Member 1
   b. Member 2 or Member 3
   c. Member 2 and Member 3 (Answer)
3. What is the maximum amount one can allocate to their group account? (Answer: 60 ECU)
4. If, in some period, total allocation in Group A's account is 40 ECU and total allocation in Group B's account is 60 ECU, what chances does Group B have of receiving the reward?
   a. 40 out of 100
   b. 20 out of 100
   c. 60 out of 100 (Answer)

Your Task: Phase I

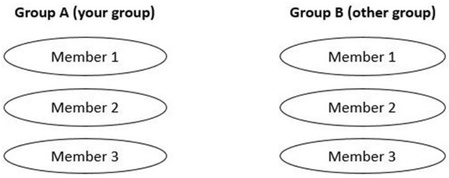
[IN-OUT-C]

In this session, you will take part in a similar decision-making task.

You are anonymously placed in a 3-member group along with two other participants from this room. Your group is matched with another such 3-member group.

Suppose your group is called Group A. Your group is matched with another group, say Group B. Members in each group simultaneously and independently decide how much to allocate to their respective group accounts.

The following picture demonstrates this.



You will make your allocation decision without knowing any other participant's decision. Your allocation will be added to the allocations of the other two members of your group to determine total allocation in your group account. Total allocation in Group B's account will be the sum of the allocations from its members.

Then the two groups' allocations are used for a computerized blind draw. There will be as many "A" tokens as the total allocation in your group account and as many "B" tokens as was the total allocation in Group B's account. If an "A" token is drawn, each member in your group will receive a 60 ECU reward in your individual accounts. If a "B" token is drawn, you will not receive any extra money. Your earnings in a period will be

60 − Allocation + 60 (reward) ECU, if an A token is drawn.

60 − Allocation ECU, if a B token is drawn.

Phase I quiz:

Suppose, You are member 1 in your group. Members 2 and 3 in your group have allocated 20 and 30 ECU, respectively, to the Group account. Total allocation in Group B's account is 40 ECU. If you allocate 10 ECU to the group account,

1. How many total ECU will there be in your group account? (Answer: 60)
2. What chance will you have of receiving the reward?
   a. 10 out of 50.
   b. 10 out of 60.
   c. 60 out of 100. (Answer)
   d. 10 out of 40.
3. How much will member 3 in your group earn if your group receives the reward?
   a. 60 − 30 + 60 = 90 ECU. (Answer)
   b. 60 − 20 + 60 = 100 ECU.
   c. Will not earn anything.

[IN-OUT-R] (*as it was instructed to a KLEE person*)

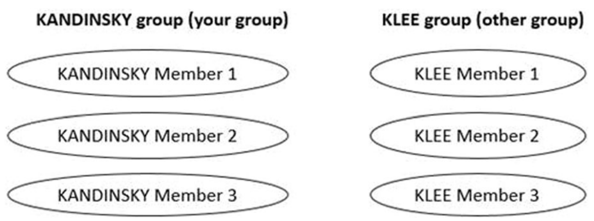
In this session, you will take part in a similar decision-making task.

You, being a KLEE person, are anonymously placed in a 3-member group along with two other KLEE persons from this room, and your group is called a KLEE group. Your group is matched with a

KANDINSKY group, all three members in which are KANDINSKY persons present in this room.

Every KLEE group is named as KLEE, followed by a unique digit. Similarly, every KANDINSKY group is named as KANDISNKY, followed by a unique digit. Your group is a KLEE group and is matched with a KANDINSKY group. Members in each group simultaneously and independently decide how much to allocate to their respective group accounts.

The following picture demonstrates this.



You will make your allocation decision without knowing any other participant's decision. Your allocation will be added to the allocations of the other two members of your group to determine total allocation in your group account. Total allocation in the KANDINSKY group's account will be the sum of the allocations from its members.

Then the two groups' allocations are used for a computerized blind draw. There will be as many "KLEE" tokens as the total allocation in your group account and as many "KANDINSKY" tokens as was the total allocation in the KANDISNKY group's account. If a "KLEE" token is drawn, each member in your group will receive a 60 ECU reward in your individual accounts. If a "KANDINSKY" token is drawn, you will not receive any extra money. Your earnings in a period will be

60 – Allocation + 60 (reward) ECU, if a KLEE token is drawn.

60 – Allocation ECU, if a KANDINSKY token is drawn.

Phase I quiz:

Suppose, You are member 1 in your group. Members 2 and 3 in your group have allocated 20 and 30 ECU, respectively, to the Group account. Total allocation in the KANDINSKY group's account is 40 ECU. If you allocate 10 ECU to the group account,

1. How many total ECU will there be in your group account? (Answer: 60)
2. What chance will you have of receiving the reward?
   a. 10 out of 50.
   b. 10 out of 60.
   c. 60 out of 100. (Answer)
   d. 10 out of 40.
3. How much will member 3 in your group earn if your group receives the reward?
   a. 60 − 30 + 60 = 90 ECU. (Answer)
   b. 60 − 20 + 60 = 100 ECU.
   c. Will not earn anything.

[IN-C]

Other people have previously participated in the decision-making task described above. These previous participants were anonymously placed into 3-member groups and each group was matched with another 3-member group as explained before. They had decided their allocations to their respective group accounts, the draw was performed and rewards were allocated. All participants were paid and the computer had recorded their decisions.

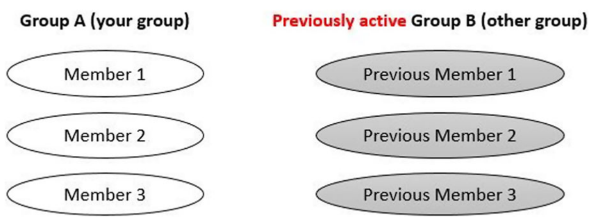
In this session, you will take part in a similar decision-making task, but without any other participants in the other group (the group that your group is matched with).

You are anonymously placed in a 3-member group along with two other participants from this room. Your group's allocations are then matched with the allocations from a previously active group, whose allocation decisions were recorded by the computer.

Then what does the other group mean?

Every group is named with a letter of the English alphabet. Suppose, your group is called Group A. The computer matches your group with a previously active group, say Group B, and recalls the total allocation in Group B's account from the previous session. Members in your group simultaneously and independently decide how much to allocate to the group account.

The following picture demonstrates this.



You will make your allocation decision without knowing the previous participants' decisions. Your allocation will be added to the allocations of the other two members in your group to determine total allocation in your group account. The allocation in Group B's account remains as it was.

Then the two groups' allocations are used for a computerized blind draw. There will be as many "A" tokens as the total allocation in your group account and as many "B" tokens as was the total allocation in the previously active Group B's account. If an "A" token is drawn, each member in your group will receive 60 ECU as reward. If a "B" token is drawn, you will not receive any extra money. Your earnings in a period will be

60 – Allocation + 60 (reward) ECU, if an A token is drawn.

60 – Allocation ECU, if a B token is drawn.

Since no member in the other group are participating at present and have already been paid for their previous participation, they will not gain or lose anything due to the outcomes in this session.

Phase I quiz:

Suppose, You are Member 1 in your group. Members 2 and 3 in your group have allocated 20 and 30 ECU, respectively, to the group account. Total allocation in the previously active Group B's account was 40 ECU. If you allocate 10 ECU,

1. How many ECU will there be in your group account? (Answer: 60)
2. What chance will you have of receiving the reward?
   a. 10 out of 50.
   b. 10 out of 60.

c. 60 out of 100. (Answer)
d. 10 out of 40.

3. How much will member 3 in your group earn if your group receives the reward?
   a. 60 − 30 + 60 = 90 ECU. (Answer)
   b. 60 − 20 + 60 = 100 ECU.
   c. Will not earn anything.

[IN-R] (*as it was instructed to a KLEE person*)

Other people have previously participated in the decision-making task described above. These previous participants were anonymously placed into 3-member groups depending on whether they were KLEE or KANDINSKY persons. A KLEE (KANDINSKY) person was always placed in a group with two other KLEE (KANDINSKY) persons and their group was called a KLEE (KANDINSKY) group. A KLEE group was matched with a KANDINSKY group. They had decided their allocations to their respective group accounts, the draw was performed and rewards were allocated.

In each pair of groups, either the KLEE group or the KANDINSKY group won the reward.

All participants were paid and the computer had recorded their decisions.

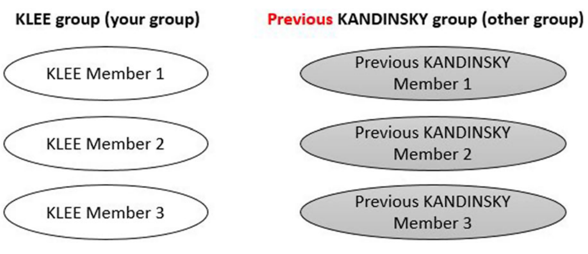
In this session, you will take part in a similar decision making task, but without any other participants in the matched KANDINSKY group (the group that your group is matched with).

You, being a KLEE person, are anonymously placed in a 3-member group along with two other KLEE persons from this room and your group is called a KLEE group. Your group's allocations are then matched with a previously active KANDINSKY group, whose allocation decisions were recorded by the computer.

Then what does the other group mean?

Every KLEE group in any session is named as KLEE, followed by a unique digit. Similarly, every KANDINSKY group in a session is named as KANDINSKY, followed by a unique digit. Your group is a KLEE group. The computer matches your group's allocations with the allocation of a previously active KANDINSKY group. Members in your group simultaneously and independently decide how much to allocate to the group account.

The following picture demonstrates this.



You will make your allocation decision without knowing the previous participants' decisions. Your allocation will be added to the allocations of the other two members in your group to determine total allocation in your group account. The allocation in the KANDINSKY group's account remains as it was.

Then the two groups' allocations are used for a computerized blind draw. There will be as many "KLEE" tokens as the total allocation in your group account and as many "KANDINSKY" tokens as was the total allocation in the previously active KANDINSKY group's account. If a "KLEE" token is drawn, each member in your group will receive 60 ECU as reward. If a "KANDINSKY" token is drawn, you will not receive any extra money. Your earnings in a period will be

60 − Allocation + 60 (reward) ECU, if an KLEE token is drawn.

60 − Allocation ECU, if a KANDINSKY token is drawn.

Since no member in the KANDINSKY group are participating at present and have already been paid for their previous participation, they will not gain or lose anything due to the outcomes in this session.

Phase I quiz:

Suppose, You are Member 1 in your group. Members 2 and 3 in your group have allocated 20 and 30 ECU, respectively, to the group account. Total allocation in the previously active KANDINSKY group's account was 40 ECU. If you allocate 10 ECU,

1. How many ECU will there be in your group account? (Answer: 60)
2. What chance will you have of receiving the reward?
   a. 10 out of 50.
   b. 10 out of 60.
   c. 60 out of 100. (Answer)
   d. 10 out of 40.
3. How much will member 3 in your group earn if your group receives the reward?
   a. 60 − 30 + 60 = 90 ECU. (Answer)
   b. 60 − 20 + 60 = 100 ECU.
   c. Will not earn anything.

[NONE-C]

Other people have previously participated in the decision-making task described above. These previous participants were matched into 3-member groups and each group was matched with another 3-member group as explained before. They had decided their allocations to their respective group accounts, the draw was performed and rewards were allocated. All participants were paid and the computer had recorded their decisions.

In this session, you will take part in a similar decision-making task, but without any other participants either in your group or in the other group (the group that your group is matched with).

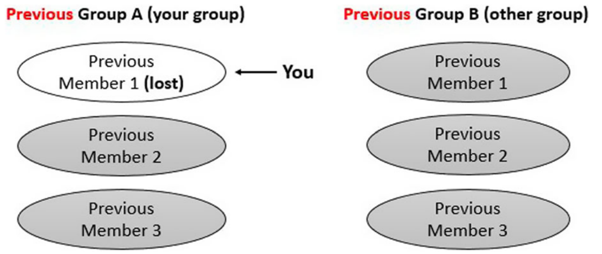
Then what does my group and the other group mean?

Note that any matched pair of groups in the previous sessions had six participants—three members in each group. However, for some matched pair of groups, the computer can recall only two members' allocations in one group's account and all three member's allocations in the other group's account. The computer will place you in the missing person's position for one such pair of groups.

How does it work exactly?

Every group is named with a letter of the English alphabet. Think of two groups that were matched in a previous session, say Group A and Group B. The computer can recall the allocation decisions of all members in the two groups except Member 1 in Group A. You will replace that member for the present draw and decide your allocation to the group account.

The following picture demonstrates this.



You will make your allocation decisions without knowing without knowing the previous participants' decisions. Your allocation will be added to the pre-existing allocations of the two members of Group A to determine total allocation in your group account. The allocation in Group B's account remains as it was.

Then the two group's allocations are used for the blind draw. There will be as many "A" tokens as the total allocation in your group account and as many "B" tokens as was the total allocation in the previously active Group B's account. If an "A" token is drawn, you will receive a 60 ECU reward in your individual account. If a "B" token is drawn, you will not receive any extra money. Your earnings in a period will be

60 – Allocation + 60 (reward) ECU, if an A token is drawn.

60 – Allocation ECU, if a B token is drawn.

Since none of the other members in your group or the other group are participating at present and have already been paid for their previous participation, they will not gain or lose anything due to the outcomes in this session.

Phase I quiz:

Suppose, members 2 and 3 in the previously active Group A had allocated 20 and 30 ECU to the Group account. You become member 1 in this group. Total allocation in the previuously active Group B's account was 40 ECU. If you allocate 10 ECU,

1. How many ECU will there be in your group account? (Answer: 60)
2. What chance will you have of receiving the reward?
   a. 10 out of 50.
   b. 10 out of 60.
   c. 60 out of 100. (Answer)
   d. 10 out of 40.
3. How much will member 3 in your group earn if your group receives the reward?
   a. 60 – 30 + 60 = 90 ECU.
   b. 60 – 20 + 60 = 100 ECU.
   c. Will not earn anything. (Answer)

[NONE-R] *(Instruction for a KLEE person)*

Other people have previously participated in the decision-making task described above. These previous participants were matched into 3-member groups depending on whether they were KLEE persons or KANDINSKY persons. A KLEE (KANDINSKY) person was always placed in a group with two other KLEE (KANDINSKY) persons and their group was called a KLEE (KANDINSKY) group. A KLEE group was matched with a KANDINSKY group. They had decided their allocations to their respective group accounts, the draw was performed and rewards were allocated.

In each pair of groups, either the KLEE group or the KANDINSKY group won the reward. All participants were paid, and the computer had recorded their decisions.

In this session, you will take part in a similar decision-making task, but without any other participants either in your group or in the other group (the group that your group is matched with).

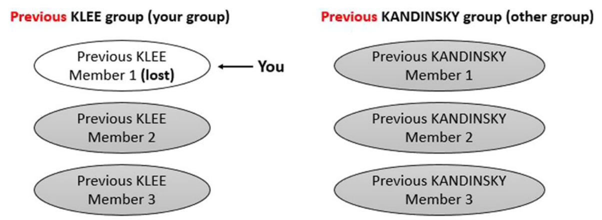
Then what does my group and the other group mean?

Note that any matched pair of groups in the previous sessions had six participants—three members in the KLEE group and three members in the KANDINSKY group. However, for some matched pair of groups, the computer can recall only two members' allocations in the KLEE group's account and all three member's allocations in the KANDINSKY group's account. You being a KLEE person, the computer will place you in the missing person's position in one such pair of groups.

How does it work exactly?

Every KLEE group in any session is named as KLEE, followed by a unique digit. Similarly, every KANDINSKY group in a session is named as KANDINSKY, followed by a unique digit. Think of a KLEE group and a KANDINSKY group that were matched in a previous session. The computer can recall the allocation decisions of all members in the two groups except Member 1 in the KLEE group. You will replace that member for the present draw and decide your allocation to the group account.

The following picture demonstrates this.



You will make your allocation decisions without knowing without knowing the previous participants' decisions. Your allocation will be added to the preexisting allocations of the two KLEE members to determine total allocation in your group account. The allocation in the KANDINSKY group's account remains as it was.

Then the two groups' allocations are used for the blind draw. There will be as many "KLEE" tokens as the total allocation in your group account and as many "KANDINSKY" tokens as was the total allocation in the previously active KANDISNKY group's account. If an "KLEE" token is drawn, you will receive a 60 ECU reward in your individual account. If a "KANDINSKY" token is drawn, you will not receive any extra money.

Your earnings in a period will be

60 – Allocation + 60 (reward) ECU, if one of your group's tokens is drawn.

60 – Allocation ECU, if one of the other group's tokens is drawn.

Since none of the other members in your group or the other group are participating at present and have already been paid for their previous participation, they will not gain or lose anything due to the outcomes in this session.

Phase I quiz:

Suppose, members 2 and 3 in the previously active KLEE group had allocated 20 and 30 ECU to the Group account. You become member 1 in this group. Total allocation in the previously active KANDINSKY group's account was 40 ECU. If you allocate 10 ECU,

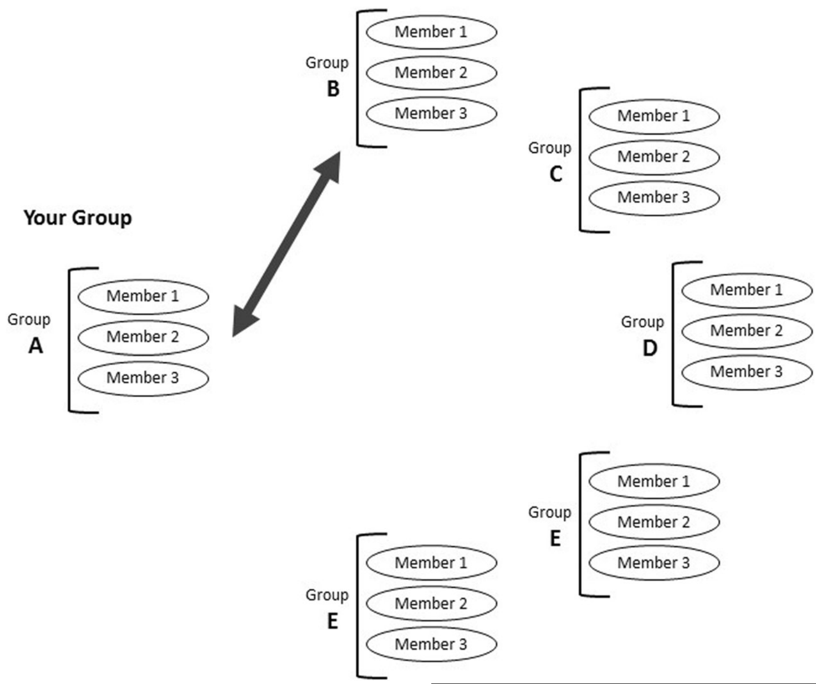
1. How many ECU will there be in your group account? (Answer: 60)
2. What chance will you have of receiving the reward?
   a. 10 out of 50.
   b. 10 out of 60.
   c. 60 out of 100. (Answer)
   d. 10 out of 40.
3. How much will member 3 in your group earn if your group receives the reward?
   a. 60 − 30 + 60 = 90 ECU.
   b. 60 − 20 + 60 = 100 ECU.
   c. Will not earn anything. (Answer)

Your task: Phase II

[IN-OUT-C]

You will participate in the same decision-making task for another 20 periods, though you will be paid for only 4 periods. Those four periods will be randomly decided at the end of the experiment. Therefore, each of the 20 decision-making periods is equally important.

Composition of each group remains the same for all 20 periods. Your group will be randomly matched with one of five other 3-member groups in different periods. The following image shows for example, how your group is randomly matched with different other groups in different periods.



Note: This was a GIF image showing how Group A was matched randomly with one of the five other groups in each period. The arrow indicating the other matched group kept moving in the GIF.

In each period, the allocation decisions from the other two members of your group will be added to your allocation to determine total allocation in your group account. Individual allocations from the three members of the other group will be added up to determine total allocation in their group account. You will make your allocation decisions without knowing any other participant's decision and you may not be told which other group your group was matched with in any period.

Your Earnings from Phase II: At the end of the experiment, a random participant will be asked to pick up 4 balls from a sack containing 20 balls numbered from 1 to 20. The number of those 4 balls will determine the 4 periods that will be considered for actual payment. Your period earnings in ECU for those 4 periods will be added to your earnings from Phase I of your task and converted to cash at the end of the session.

Phase II quiz:

Suppose, you are Member 1 in your group. The following are the total allocations from five groups (B, C, D, E and F) in three periods. The last column gives the total allocation from the two other members of your group.

Groups	B	C	D	E	F	Group A (Members 2 and 3 Total)
Period 1	20	60	5	100	70	10
Period 2	40	60	30	50	50	20
Period 3	50	40	45	30	0	0

Suppose, your group is matched with Groups D, F and B in periods 1, 2 and 3, respectively. Please answer the following questions.

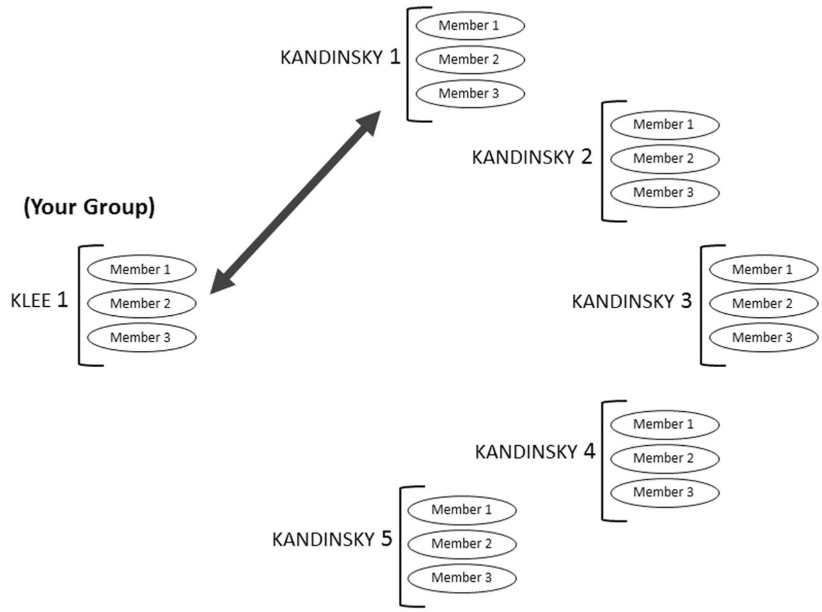
1. If you allocate 10 ECU to the group account in period 1, what will be the total allocation in your group account? (Answer: 20)
2. How many tokens will belong to the other group in period 3? (Answer: 50)

This is a hypothetical scenario. In the actual task, you cannot observe the pre-existing allocations before making your own decisions.

[IN-OUT-R] (***as it was instructed to a KLEE person***)

You will participate in the same decision-making task for another 20 periods, though you will be paid for only 4 periods. Those four periods will be randomly decided at the end of the experiment. Therefore, each of the 20 decision-making periods is equally important.

Composition of each group remains the same for all 20 periods. Your group will be randomly matched with one of five other KANDINSKY groups in different periods. The following image shows for example, how your group is randomly matched with different other groups in different periods.



Note: This was a GIF image showing how KLEE-1 group was matched randomly with one of the five KANDINSKY groups in each period. The arrow indicating the matched KANDINSKY group kept moving in the GIF.

In each period, the allocation decisions from the other two members of your group will be added to your allocation to determine total allocation in your group account. Individual allocations from the three members of the KANDINSKY group will be added up to determine total allocation in their group account. You will make your allocation decisions without knowing any other participant's decision and you may not be told which KANDINSKY group your group is matched with in any period.

Your Earnings from Phase II: At the end of the experiment, a random participant will be asked to pick up four balls from a sack containing 20 balls numbered from 1 to 20. The number of those four balls will determine the four periods that will be considered for actual payment. Your period earnings in ECU for those four periods will be added to your earnings from Phase I of your task and converted to cash at the end of the session.

Phase II quiz:

Suppose, you are Member 1 in your group. Following are the total allocations from five groups (KAND-1, KAND-2, KAND-3, KAND-4 and KAND-5) in 3 periods. The last column gives the total allocation from the two other members of your group.

Groups	KAND-1	KAND-2	KAND-3	KAND-4	KAND-5	KLEE-1 (Members 2 and 3 Total)
Period 1	20	60	5	100	70	10
Period 2	40	60	30	50	50	20
Period 3	50	40	45	30	0	0

Suppose your group is matched with Groups KAND-3, KAND-5, and KAND-1 in periods 1, 2 and 3, respectively. Please answer the following questions.

1. If you allocate 10 ECU to the group account in period 1, what will be the total allocation in your group account? (Answer: 20)
2. How many tokens will belong to the other group in period 3? (Answer: 50)

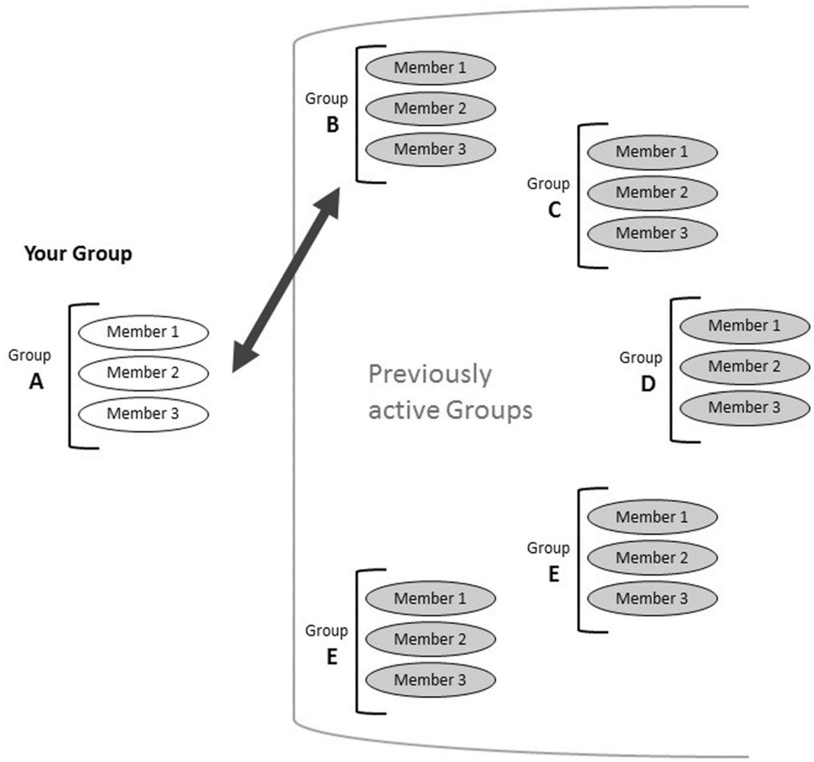
This is a hypothetical scenario. In the actual task, you cannot observe the preexisting allocations before making your own decisions.

[IN-C]

You will participate in the same decision-making task for another 20 periods, though you will be paid for only four periods. Those four periods will be randomly decided at the end of the experiment.

Therefore, each of the 20 decision-making periods is equally important.

The previous participants also made their decisions for 20 consecutive periods. The composition of each group remained the same for all 20 periods. Each group was randomly matched with one of five other groups in different periods. The following image shows, for example, how Group A was randomly matched with one of five other groups in different periods.



Note: This was a GIF image showing how Group A was matched randomly with one of the five other groups in each period. The arrow indicating the other matched group kept moving in the GIF.

In each period, the allocation decisions from the other two members of your group will be added to your allocation to determine total allocation in your group account. Allocation in the other group's account will stay as it was in the corresponding period of the previous session. You will make your allocation decisions without knowing the previous participants' decisions and you may not be told which previous group your group was matched with in any period.

Your earnings in phase II: At the end of the experiment, a random participant will be asked to pick up four balls from a sack containing 20 balls numbered from 1 to 20. The numbers of those balls will determine the four periods that will be considered for actual payment. Your period earnings in ECU for those four periods will be added to your earnings from Phase I of your task and converted to cash at the end of the session.

Phase II quiz:

Suppose, you are Member 1 in Group A. Following are the total allocations from five groups (B, C, D, E, and F) in three periods in the previous session. The last column gives the total allocation from the two other members of your group in three periods in the current session. You are placed in this group.

Groups	B	C	D	E	F	Group A (Members 2 and 3 Total)
Period 1	20	60	5	100	70	10
Period 2	40	60	30	50	50	20
Period 3	50	40	45	30	0	0

Suppose, your group is matched with the previously active Groups D, F and B in periods 1, 2 and 3, respectively. Please answer the following questions.

1. If you allocate 10 ECU to the group account in period 1, what will be the total allocation in your group account? (Answer: 20)
2. How many tokens will belong to the other group in period 3? (Answer: 50)

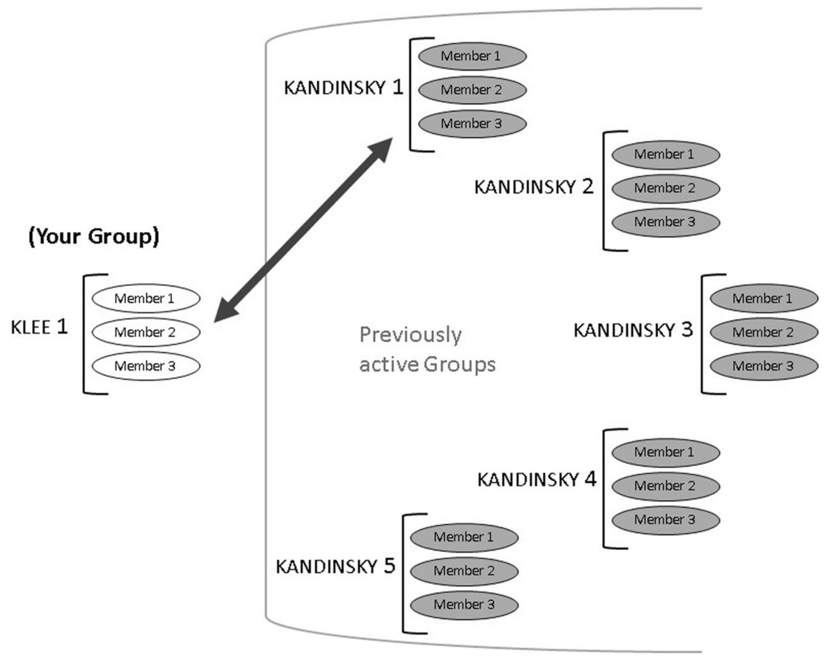
This is a hypothetical scenario. In the actual task, you cannot observe the preexisting allocations before making your own decisions.

[IN-R] (*as it was instructed to a KLEE person*)

You will participate in the same decision-making task for another 20 periods, though you will be paid for only 4 periods. Those 4 periods will be randomly decided at the end of the experiment. Therefore, each of the 20 decision-making periods is equally important.

The previous participants also made their decisions for 20 consecutive periods. The composition of each group remained the same for all 20 periods. Each KLEE group was randomly matched with one of five different KANDINSKY groups in different periods. Similarly, every period in this session, your group will be randomly matched with one of five different previously active KANDINSKY groups.

The following image shows, for example, how your group is matched with different previously active KANDINSKY groups in different periods.



Note: This was a GIF image showing how the concurrently active group KLEE-1 is matched randomly with one of the five previously active KANDINSKY groups in each period. The arrow indicating the other matched group kept moving in the GIF.

In each period, the allocation decisions from the other two members in your group will be added to your allocation to determine total allocation in your group account. Allocation in the matched KANDINSKY group's account will stay as it was in the corresponding period of that session. You will make your allocation decisions without knowing the previous participants' decisions and you may not be told which KANDINSKY group your group was matched with in any period.

Your earnings in phase II: At the end of the experiment, a random participant will be asked to pick up four balls from a sack containing 20 balls numbered from 1 to 20. The number of those balls will determine the four periods that will be considered for actual payment. Your period earnings in ECU for those four periods will be added to your earnings from Phase I of your task and converted to cash at the end of the session.

Phase II quiz:

Suppose, following are the total allocations from five groups (KAND-1, KAND-2, KAND-3, KAND-4 and KAND-5) in three periods in the previous session. The last column gives the total allocation from the two other members in your group in three periods in the current session.

Groups	KAND-1	KAND-2	KAND-3	KAND-4	KAND-5	KLEE-1 (Members 2 and 3 Total)
Period 1	20	60	5	100	70	10
Period 2	40	60	30	50	50	20
Period 3	50	40	45	30	0	0

Suppose your group is matched with the previously active groups KAND-3, KAND-5, and KAND-1 in periods 1, 2, and 3, respectively. Please answer the following questions.

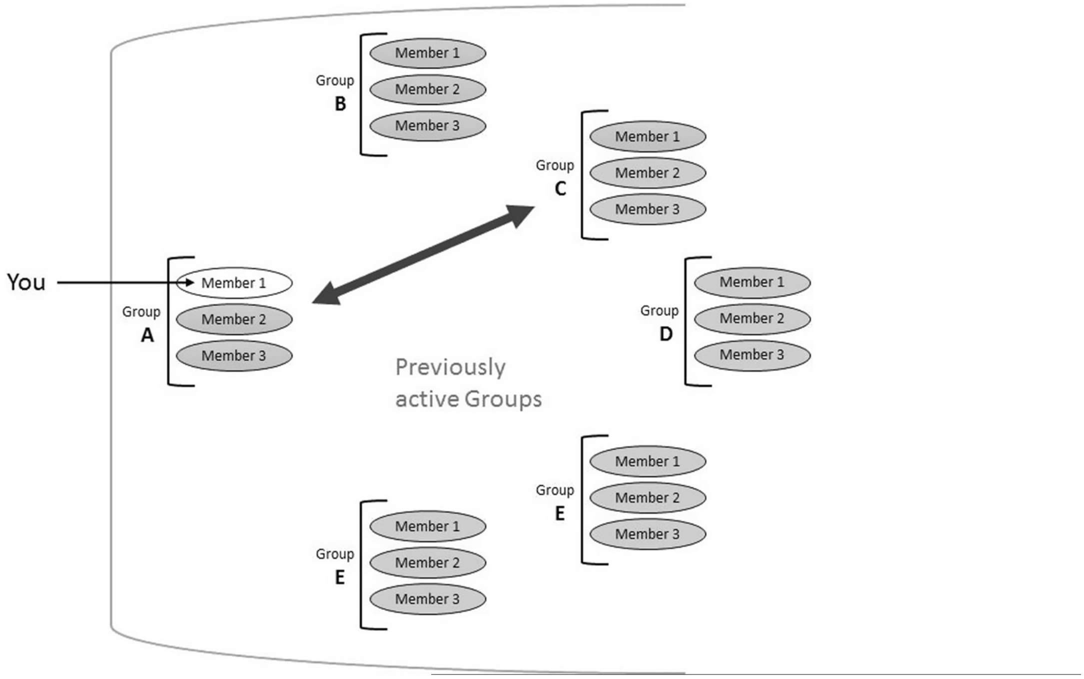
1. If you allocate 10 ECU to the group account in period 1, what will be the total allocation in your group account? (Answer: 20)
2. How many tokens will belong to the other group in period 3? (Answer: 50)

This is a hypothetical scenario. In the actual task, you cannot observe the pre-existing allocations before making your own decisions.

[NONE-C]

You will participate in the same decision-making task for another 20 periods, though you will be paid for only 4 periods. Those 4 periods will be randomly decided at the end of the experiment. Therefore, each of the 20 decision making periods are equally important.

The previous participants also made their decisions for 20 consecutive periods. The composition of each group remained the same for all 20 periods. Each group was randomly matched with one of five other groups in different periods. The following image shows, for example, how Group A was randomly matched with one of five other groups in different periods.



Note: This was a GIF image showing how Group A was matched randomly with one of the five other groups in each period. The arrow indicating the other matched group kept moving in the GIF.

Suppose, the computer has lost the decisions of Member 1 in the previously active Group A. Your allocation decision will replace that lost decision in every period.

In each period, the preexisting allocation decisions from members 2 and 3 of Group A will be added to your allocation to determine total allocation in your group account. Allocation in the other group's account will stay as it was in the corresponding period of that session. You will make your allocation decisions without knowing the previous participants' decisions and you may not be told which other group your group was matched with in any period.

Your earnings in phase II: At the end of the experiment, a random participant will be asked to pick up 4 balls from a sack containing 20 balls numbered from 1 to 20. The number of those balls will determine the 4 periods that will be considered for actual payment. Your period earnings in ECU for those four periods will be added to your earnings from Phase I of your task and converted to cash at the end of the session.

Phase II quiz:

Suppose, following are the total allocations from five groups (B, C, D, E and F) in three periods in the previous session. The last column gives the total allocation from the two members of Group A, whose decisions the computer can recall. You are placed in this group.

Groups	B	C	D	E	F	Group A (Members 2 and 3 Total)
Period 1	20	60	5	100	70	10
Period 2	40	60	30	50	50	20
Period 3	50	40	45	30	0	0

Suppose in the previous session, Group A was matched with Group D, F, and B in periods 1, 2, and 3, respectively. Please answer the following questions.

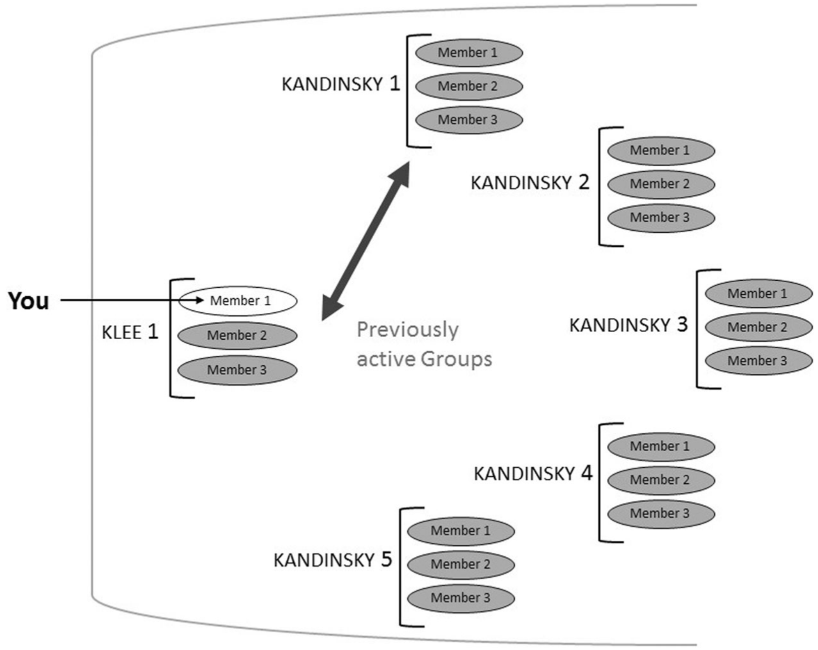
1. If you allocate 10 ECU to the group account in period 1, what will be the total allocation in your group account? (Answer: 20)
2. How many tokens will belong to the other group in period 3? (Answer: 50)
3. Suppose your allocation to the group account in period 2 was such that your chance of receiving the reward was 50-50. How many ECU did you allocate? (Answer: 30)

This is a hypothetical scenario. In the actual task, you cannot observe the preexisting allocations before making your own decisions.

[NONE-R] (*as it was instructed to a KLEE person*)

You will participate in the same decision-making task for another 20 periods, though you will be paid for only 4 periods. Those four periods will be randomly decided at the end of the experiment. Therefore, each of the 20 decision-making periods is equally important.

The previous participants also made their decisions for 20 consecutive periods. Composition of each group remained the same for all 20 periods. Each KLEE group was randomly matched with one of five different KANDINSKY groups in different periods. The following image shows, for example, how the group called KLEE-1 was randomly matched with different KANDINSKY groups in different periods.



Note: This was a GIF image showing how the group KLEE-1 was matched randomly with one of the five KANDINSKY groups in each period. The arrow indicating the other matched group kept moving in the GIF.

Suppose, the computer has lost the decisions of Member 1 in such a previously active KLEE group. Your allocation decision will replace that lost decision in every period.

In each period, the pre-existing allocation decisions from member 2 and 3 of the KLEE group will be added to your allocation to determine total allocation in your group account. Allocation in the matched KANDINSKY group's account will stay as it was in the corresponding period of that session. You will make your allocation decisions without knowing the previous participants' decisions and you may not be told which KANDINSKY group your group was matched with in any period.

Your earnings in phase II: At the end of the experiment, a random participant will be asked to pick up 4 balls from a sack containing 20 balls numbered from 1 to 20. The numbers of those balls will determine the 4 periods that will be considered for actual payment. Your period earnings in ECU for those 4 periods will be added to your earnings from Phase I of your task and converted to cash at the end of the session.

Phase II quiz:

Suppose, following are the total allocations from five groups (KAND-1, KAND-2, KAND-3, KAND-4 and KAND-5) in three periods in the previous session. The last column gives the total allocation from the two members of KLEE-1, whose decisions the computer can recall. You are placed in this group.

Groups	KAND-1	KAND-2	KAND-3	KAND-4	KAND-5	KLEE-1 (Members 2 and 3 Total)
Period 1	20	60	5	100	70	10
Period 2	40	60	30	50	50	20
Period 3	50	40	45	30	0	0

Suppose in the previous session, KLEE-1 was matched with Groups KAND-3, KAND-5, and KAND-1 in periods 1, 2, and 3, respectively. Please answer the following questions.

1. If you allocate 10 ECU to the group account in period 1, what will be the total allocation in your group account? (Answer: 20)
2. How many tokens will belong to the other group in period 3? (Answer: 50)
3. Suppose your allocation to the group account in period 2 was such that your chance of receiving the reward was 50-50. How many ECU did you allocate? (Answer: 30)

This is a hypothetical scenario. In the actual task, you cannot observe the pre-existing allocations before making your own decisions.

Appendix B

Group Satisfaction Index (GS)

The group satisfaction questionnaire asked the following questions on a 5-point scale.

- GS-1: I am glad to belong to this group.
- GS-2: I feel held back by this group.
- GS-3: I think this group worked well together.
- GS-4: I saw myself as an important part of this group.
- GS-5: I didn't consider the group to be important.

- GS-6: I think the other members of this group acted as if we were (a) one group (b) separate individuals.

Question 1–5 were adapted from Hinkle et al. (1989) and 6 was adapted from Insko et al. (2013). GS-4 exhibited a lower correlation with the other items; the overall reliability improved considerably when GS4 was excluded (Overall Cronbach α was 0.74 with and 0.81 without GS-4). Also, it was negatively correlated with the scale while Hinkle et al. (1989) considered it to be a positive item. That's because in our experiment, the more ECUs one spent the more important one thought one was to be, but that corresponded to relatively lower effort from the other members. This explains the negative correlation between GS-4 and the overall GS scale.

The Cronbach α reliability of the individual items was as follows

See Table B1.

Std.α is the standardized measure calculated from the inter-item correlations and indicate the overall reliability of the scale if the corresponding item is dropped. The sign/noise ratio for all the items above are 1 but highest for GS-4 followed by GS-5. Raw α (omitted) for each item is exactly one percentage point less than the standardized α.

Std.r is the item correlation with the entire scale if each item were standardized, *r.cor* corrects for any item overlap by subtracting the item variance and then replacing this with the best estimate of common variance, and *r.drop* is the correlation of the item with the scale composed of the remaining items. We decided to drop GS-4 as this was negatively correlated with the overall scale, even after reversal.

The GS scores were determined based on a factor analysis of all the items in the questionnaire except item 4. The following table shows the summary statistics for the GS score:

See Table B2.

Appendix C

Choice Reasons Questionnaire

Please indicate to what extent each of the following reasons explains your decisions about how much to allocate to the group account.

The leftmost button indicates strong disagreement, and the rightmost button indicates strong agreement. If you are unsure, please select the middle button.

TABLE C1 | Average Effort Regressed on Choice Reasons.

Average individual effort	Marginal effects (std. err.)
IN	−1.01 (1.53)
NONE	0.04 (1.56)
R	0.47 (1.28)
CR1: I wanted to earn as much as possible	**−2.79 (0.73)*** **
CR2: I wanted our group to earn as much as possible	**2.36 (0.51)*** **
CR4: to defeat the other group (if they were)	−0.22 (0.40)
CR5: could not trust others to have allocated enough	−0.31 (0.52)
CR6a: others allocated too much	−0.39 (0.81)
CR6b: others allocated too little	1.20 (0.75)

Note: Std. Errors clustered at group level. The bold figures and *** indicate p-value < 0.01.
Tests of correlation further reveal a significant negative correlation between average effort and CR1 only in NONE-R and significant positive correlation between average effort and CR2 in IN-C, IN-R and NONE-R.

TABLE B1 | Cronbach α Reliability of GS Questionnaire Items.

						Non-missing response frequency				
	Std. α	Std. r	r.cor	r.drop	Mean	1	2	3	4	5
GS-1	0.60	0.84	0.84	0.75	3.3	0.07	0.13	0.38	0.29	0.13
GS-2 (-)	0.70	0.68	0.58	0.51	3.3	0.12	0.37	0.36	0.18	0.08
GS-3	0.66	0.80	0.78	0.67	3.1	0.10	0.21	0.29	0.31	0.09
GS-4 (-)	0.82	0.17	0.00	-0.60	2.7	0.09	0.15	0.25	0.36	0.16
GS-5 (-)	0.80	0.27	0.11	0.04	3.4	0.16	0.35	0.25	0.16	0.08
GS-6a	0.65	0.82	0.84	0.71	2.8	0.14	0.29	0.22	0.30	0.05
GS-6b (-)	0.65	0.81	0.82	0.72	2.6	0.03	0.22	0.23	0.36	0.16

TABLE B2 | GS Scores (Based on Factor Analysis).

Treatments	IN-OUT-C	IN-OUT-R	IN-C	IN-R	NONE-C	NONE-R
Average GS scores (std. dev.)	3.03 (0.67)	2.91 (0.80)	2.84 (0.77)	2.87 (0.71)	3.02 (0.64)	3.18 (0.72)
(min−max)	1.66–3.91	1.63–4.27	1.60–4.15	1.60–4.03	1.83–3.98	1.84–4.38
Pairwise Ranksum	$z = 0.665$ prob > $\|z\| = 0.51$		$z = 0.059$ prob = 0.95		$z = -0.761$ prob = 0.45	
K-Wallis			Chi2 = 3.341 (Prob = 0.6475)			

1. I wanted to earn as much as possible.
2. I wanted our group to earn as much as possible.
3. I wanted our group to earn more than the other group. (Only in IN-OUT)
4. I wanted to defeat the other group (IN-OUT)/I wanted to feel as if we could have defeated the other group if they were present (IN/NONE).
5. I could not trust my group members to have allocated enough.
6. I think the other members of my group allocated (a) too much (b) too little.

We regress average individual effort over the course of the game on treatment manipulations and choice reasons (Appendix C)

See Table C1.