Endogenous group formation in experimental contests*

Luisa Herbst Kai A. Konrad Florian Morath †

November 26, 2014

Abstract

We experimentally study endogenous alliance formation and contest effort choices in a generic three-player contest. Differences in intrinsic or extrinsic incentives to expend effort cause self-selection. Weakly motivated players have an incentive to enter into an alliance and to free-ride on strongly motivated players; hence, strong players prefer to stand alone. Self-selection has direct consequences for effort in endogenously formed alliances. But we also find evidence of an effort stimulating effect if players endogenously form an alliance, which is in line with theories of in-group favoritism. The experimental evidence on self-selection is in conformity with a theory analysis of the game.

JEL codes: D72, D74

Keywords: Endogenous group formation, contest, conflict, alliance, self-selection, moral hazard problem, free-riding, in-group favoritism, experiment

*We thank Stefania Bortolotti, Alessandra Casella, Bruno Frey, Werner Güth, Magnus Hoffmann, Changxia Ke, Martin Kocher, Martin Kolmar, Ian Levely, Sandra Ludwig, Petra Nieken, Julien Senn, Roman Sheremeta, Matthias Sutter, participants at the "Contests, Mechanisms & Experiments" conference in Exeter (2012), the SFB/TR 15 meeting in Bonn (2013), the Spring Meeting of Young Economists in Aarhus (2013), the Workshop on "Competition between Conflict and Cooperation" in Freiburg (2013), the APET meeting in Lisbon (2013), the IIPF congress in Taormina (2013), the EEA conference in Gothenburg (2013), the workshop on "Norms, Actions, and Games" in London (2014), the Political Economy Workshop in Milan (2014), seminar participants in Berlin, Innsbruck, Jena, and Munich as well as two anonymous referees and the associate editor for helpful comments. Moreover, we thank MELESSA of the University of Munich for providing laboratory resources and gratefully acknowledge financial support from the German Research Foundation (DFG, grant no. SFB/TR 15).

†Max Planck Institute for Tax Law and Public Finance, Department of Public Economics, Marstallplatz 1, 80539 Munich, Germany. Herbst: *luisa.herbst@tax.mpg.de*; Konrad: *kai.konrad@tax.mpg.de*; Morath: *florian.morath@tax.mpg.de.*

1 Introduction

This paper analyzes the determinants and consequences of group formation in a conflict framework of competition for a fixed amount of resources. Which characteristics determine whether a player prefers to compete in a group (an 'alliance') or to stand alone in an upcoming contest? How do players react to the choices of other players to join an alliance or to stand alone? How does the process of alliance formation affect contest behavior and what are the implications of alliance formation for the players' effort contributions and payoffs? These questions are difficult to address with empirical data on conflict.[1] Our paper uses an experimental approach. It provides answers to these questions and offers insights that are useful for institutional design when resources are allocated on the basis of relative performance.

For anecdotal evidence on possible answers to the questions outlined we can resort to classic fiction. In his drama *William Tell*, Friedrich Schiller (1804) describes the formation of an alliance as well as the conscious decision to abstain from joining an alliance, both for good economic reasons. First, the drama features the famous "Rütli-Oath" in which three men unite forces in an alliance to fight against tyranny.[2] Their oath is their mutual promise to act collectively and to jointly pursue a common interest in reference to a common history and family roots. It indirectly refers to the general problem of moral hazard in teams and appeals to the role of group spirit and in-group favoritism to overcome the moral hazard problem. Second, as the benefits of alliance formation can be asymmetric, we may expect players who would contribute a disproportionately large share in the alliance to decide against alliance formation. William Tell himself, the protagonist of the drama, behaves according to this principle. When Stauffacher argues that "even the weak grow strong by union," Tell counters the argument by claiming: "But the strong man is the strongest when alone," and refuses to join the alliance.

Our framework builds on the theory of contests and tournaments where success depends on relative performance. Tournaments have become increasingly important in organizations to incentivize and motivate employees; in many sectors, team formation in the workplace is a frequent phenomenon.[3] If several players form a team, this group formation adds a problem of moral hazard

[1] Empirically, the formation and resolution of alliances in conflicts has been studied by international relations scholars, using the ATOP (Alliance Treaty Obligations and Provisions Project) and the COW (Correlates of War) data sets. Precise answers on the questions we address are difficult to extract from these data since each international conflict has a number of idiosyncratic aspects. Moreover, international conflict typically does not emerge as a singular event, but is embedded in a specific historical context. Often, a conflict cannot be understood or interpreted without reference to preceding conflict. See Kimball (2006) and references therein for an account of the literature.

[2] The drama refers to the legend according to which three cantons formed a confederation that developed into what is Switzerland today.

[3] The seminal paper on tournaments in labor markets is Lazear and Rosen (1981). Team formation is often observed, for instance, in the context of sales or product development teams. The implementation of self-managed work teams can lead to productivity increases (see Lazear and Shaw 2007 for a discussion of the organization of work teams and the prevalence of teamwork). There is also anecdotal evidence of companies that have benefited from allowing their employees to initiate team formation (Wall Street Journal, 13 August 2007, How a Company

in teams to the tournament: An individual member's effort benefits all members of his group, and this free-riding problem has received considerable attention (Olson and Zeckhauser 1966, Holmstrom 1982). If individuals differ in their 'strength', expressed in terms of their fighting ability or their cost of contributing fighting effort, self-selection among players should further aggravate the problem and make voluntarily formed alliances a negative selection composed of 'weak' players: Joining an alliance is attractive for players who are less willing and/or less able to contribute to group effort. Strong and determined players may be concerned about having to bear a high share of the burden of contributing and may prefer to stand alone.[4]

The team-moral-hazard problem in groups might be mitigated by factors such as group spirit or in-group solidarity. As indicated by psychologists, members of a group may be motivated to contribute to the benefit of the group. And such in-group solidarity is even more pronounced in the presence of an out-group. Members of a group may develop a 'feeling to belong' to their group and may exhibit in-group favoritism and spiteful attitudes towards the out-group.[5] These motivations exist even if individuals are exogenously grouped together. Allowing individuals to choose whether or not to form a team may affect in-group solidarity and hence may have an impact on the individuals' contributions to team effort. This effect has attracted attention in other contexts. Although it is not the main focus of our analysis, this effect also appears in our framework and is a countervailing force to the negative strategic effects of alliance formation.

We analyze the role of heterogeneity among players for self-selection into alliances or into stand-alone positions in a controlled laboratory experiment in which we can measure players' types. The players can choose whether or not to enter into an alliance and how much effort to expend in a contest with other players. We consider the generic three-player framework to study alliance formation in the theory of conflict. The three players compete for a prize of a given size according to the rules of a Tullock (1980) contest. Prior to this competition, two players are given the opportunity to join forces and form an alliance, where the outside option is stand-alone play (to fight independently). The competing out-group is always represented by the third player.[6]

To analyze the selection effects as well as the behavioral effects of the endogenous process of alliance formation, we compare contest efforts across environments with exogenous alliances

Made Everyone a Team Player, http://online.wsj.com/article/SB118696661138495617.html).

[4]In order to explain the formation of alliances economists resorted, for instance, to technological benefits of fighting in an alliance (see Skaperdas 1998, Kovenock and Roberson 2012 and Konrad 2014 for a survey), while political scientists explain alliance formation with deterrence effects and balancing behavior (Gulick 1955, Morgenthau 1963, Waltz 1979, Sorokin 1994) as a means to avoid violent conflict or to end it more quickly.

[5]See, e.g., Sherif et al. (1961), Tajfel and Turner (1979), Tajfel (1982). There is also evidence from biology, and evolutionary game theory can explain such behavior (see, e.g., Maynard Smith 1974 and, for more recent contributions, Eaton at el. 2011, and Konrad and Morath 2012).

[6]Alliances in contests have been extensively studied by theorists, see Ursprung (1990), Nitzan (1991), Baik and Lee (2001), Esteban and Sákovics (2003), Konrad and Kovenock (2009), Kovenock and Roberson (2012), and, for a survey, Konrad (2014). For models of alliance formation see, for instance, Skaperdas (1998), Garfinkel (2004), Bloch et al. (2006), Sanchez-Pages (2007a,b), and Tan and Wang (2010); a recent survey of the literature is Bloch (2012).

("NO CHOICE" phase) and environments with endogenous alliances ("CHOICE" phase). The NO CHOICE phase also provides information on players' 'types'. We use the players' effort choices as a stand-alone player in the NO CHOICE phase to measure whether a player is 'strong' (that is, expends high effort as a stand-alone player in NO CHOICE) or 'weak' (that is, expends little effort as stand-alone player in NO CHOICE). This effort choice reveals differences in players' motivation or willingness (subjective cost) to expend effort and we relate this information to the player's choice of whether to form an alliance or to stand alone in the CHOICE phase. Our experiment includes environments where alliance formation occurs under majority voting (ties are broken randomly) as well as alliance formation as a decision that requires unanimity.[7] Moreover, we consider treatments where extrinsic incentives are identical across players and there is only heterogeneity in intrinsic incentives as well as an environment in which there is heterogeneity (and self-selection) along both dimensions. Finally, a control treatment also elicits the individuals' beliefs about their co-players' effort. These beliefs may be influenced by players' own effort choices and by the co-players' alliance formation choice and may hence reveal information about the strategic effects of alliance formation.

Some of the key findings are as follows: First, voluntary formation of an alliance is a frequent outcome. Strong players, i.e., players who expend a lot of effort as stand-alone players in the NO CHOICE phase, prefer not to join an alliance. This outcome is in line with the theory outlined. Because of the public good nature of individual contributions to alliance effort, strong players are "exploited" by their alliance partner when forming an alliance, and they get a higher expected payoff in the stand-alone contest. This explains their preference for standing alone and is much in line with William Tell's point of view.

Second, alliances that result from a voluntary choice of the players mobilize significantly more contest effort than exogenously formed alliances. Overall, the moral hazard in teams is weakened if team formation is an endogenous process. The higher effort in endogenous alliances is not a consequence of a selection effect of strong types but emerges although strong players opt for standing alone. Thus, the overall effect on effort measured by comparing endogenously to exogenously formed alliances underestimates the increase in group spirit due to endogenous alliance formation, as this overall effect includes the self-selection effect that works in the opposite direction.

Third, in the CHOICE phase effort choices depend on the co-player's vote on alliance formation. Strong players who end up in an alliance with a player who voted for alliance formation choose the highest effort anticipating that their alliance partner is likely to be a 'weak type' and will expend little effort. Similarly, weak players with a preference for alliance formation choose the lowest effort when they are in an alliance with a co-player who voted against alliance formation. This finding is in line with a strategic reaction of players who correctly interpret their co-player's

[7] Apart from its empirical relevance, majority voting leads to a greater heterogeneity in observed voluntary alliances, making the analysis of self-selection and how individuals react to it much richer. Moreover, it guarantees a clean experimental design by eliminating equilibria in weakly dominated strategies.

alliance formation choice as a signal of one's type.

Within experimental economics, there is a growing literature that studies contests between individuals as well as between groups, where the groups are exogenously imposed on subjects (see, e.g., Nalbantian and Schotter 1997 for an early experiment and Sutter and Strassmair 2009, Abbink et al. 2010, Sheremeta and Zhang 2010, Ahn et al. 2011, Cherry and Cotten 2011, and Cason et al. 2012 for more recent contributions; an excellent and comprehensive survey is Dechenaux et al. 2014).[8] In a complex, dynamic experiment, Smith et al. (2012) analyze the impact of group formation on efficiency "in anarchy" where subjects can invest in production, expropriation, and defense. Cherry et al. (2014) study the effects of investment cost, group size, and group formation on contributions to a group public good in a framework where contributions reduce the available total output. Choices to form groups have also been analyzed by Benenson et al. (2009) wherein coalition formation with up to two fictional opponents changes the (exogenously determined) probability of winning a prize. They find that relative power matters for coalition formation and that coalitions are more often formed with players called "friends." We are not aware of any other experimental group contest in which groups form endogenously and which studies self-selection and its consequences for contest behavior.[9]

While the role of endogeneity for the moral hazard problem is seemingly unexplored in experimental contests, endogenous group formation has attracted attention in a different area of economic experiments: public goods games. A seminal and pioneering paper is Ehrhart and Keser (1999). A focus of these studies has been on the impact of different institutional rules and their endogeneity on the resulting group size and the level of contributions, for instance, the role of entry and exit rules (Ahn et al. 2008 and 2009, Aimone et al. 2013, Charness and Yang 2014), minimum contribution levels (e.g., Dannenberg et al. 2014) or punishment opportunities and fines (e.g., Page et al. 2005, Sutter et al. 2010, Dal Bo et al. 2010), and endogenous group formation has been shown to increase cooperation (Keser and Montmarquette 2011).[10] The selection into teams with a focus on decision-making has been analyzed by Kocher et al. (2006) and with a focus on gender by Kuhn and Villeval (2014). Our contribution is in a different game context ('conflict') in which an out-group exists, and it unveils the role of a different dimension of player heterogeneity which we measure and describe as players' strength, and with the possible opting-out of players who are particularly motivated to expend effort. Endogenous institutional choice as a procedure is a topic that connects us with a recent field experiment by Babcock et al. (2014).

[8] This literature also analyzes multi-stage contests (Parco et al. 2005; Amaldoss and Rapoport 2005, 2009; Amegashie et al. 2007; Sheremeta 2010a; Chark et al. 2011; Altmann et al. 2012; Ke et al. 2013, 2014). Ke et al. (2013, 2014) examine three-player contests in a structurally related environment with exogenously imposed alliances, focusing, however, on the impact of potential internal conflict inside victorious alliances.

[9] In the context of contests between individuals, endogenous entry into tournaments and self-selection effects have been studied, for instance, by Eriksson et al. (2009), Cason et al. (2010), Dohmen and Falk (2011), and Morgan et al. (2012).

[10] As they are interested in stability and the cooperation of the groups formed, all of these experiments use fixed partner matching.

Our experiment is also related to the literature on in-group favoritism, which emanated from social psychology (Sherif et al. 1961, Brewer 1979). The phenomenon of in-group bias, or group solidarity, and its implications for economic outcomes have been analyzed and documented in a variety of different economic interactions: for instance, prisoner's dilemma and battle of the sexes (Charness et al. 2007), minimum effort games (Chen and Chen 2011), dictator and response games (Chen and Li 2009), market experiments (Li et al. 2011) and investment decisions (Sutter 2009).[11] Most findings in this literature support the emergence of in-group solidarity in social interactions, especially if group membership is made salient. Our experimental contest varies the salience of group membership by either exogenously imposing group formation onto subjects or by allowing subjects to voluntarily form groups.

2 Theoretical and experimental framework

2.1 Theoretical framework

We consider (variants of) a two-stage game with three players A, B, and C who compete for a prize with monetary value V. In stage 1, a decision is made about whether players A and B act in an alliance or as stand-alone players. In stage 2, players interact in a contest by choosing costly effort $x_i \geq 0$, $i \in \{A, B, C\}$. Depending on whether or not players A and B are in an alliance in the subgame of stage 2, this subgame is a contest between the alliance of players A and B and the out-group player C (the **"2-1" contest**) or a three-player Tullock (1980) lottery contest (the **"1-1-1" contest**). In the "2-1" contest, the probability that the alliance of A and B will win is equal to the share of $x_A + x_B$ in total effort $x_A + x_B + x_C$. If the alliance wins, the alliance players split the prize V such that A and B each obtain a share $V/2$. In the "1-1-1" contest, a player i's probability of winning the prize V is equal to the share of his own effort x_i in total effort $x_A + x_B + x_C$, for $i \in \{A, B, C\}$.[12,13]

The unit cost of effort is assumed to be constant and equal to k_i, $i = A, B, C$, and it can differ across players. This unit cost is interpreted as a player's subjective effort cost; it is allowed to consist of a monetary and a non-monetary component. Hence, the heterogeneity across players

[11] Subjects in these experiments were in most cases either randomly assigned into groups ('minimal groups') or divided according to their preferences over paintings. Goette et al. (2012a,b) analyze a prisoner's dilemma game with punishment opportunities, using randomly assigned groups which had built social ties from real social interactions over a certain time period. Other naturally occurring group identities (tribes) are utilized by Bernhard et al. (2006) for instance; Shayo and Zussman (2011) also use ethnic group membership and document in-group bias in a field experiment.

[12] For completeness, we assume symmetric win probabilities for the borderline case in which all players choose zero effort.

[13] This contest success function is used in many areas of economics, including marketing, rent-seeking, military conflict, and sports competition. It has several axiomatic and microeconomic underpinnings. For a detailed review see Konrad (2009, chapter 2.3).

can reflect additional motives besides pure payoff maximization.[14] We assume that the vector (k_A, k_B, k_C) becomes common knowledge at the beginning of stage 1 of the game.[15]

The "1-1-1" contest. Consider first the case where no alliance is formed. In this subgame all players interact as stand-alone players in the "1-1-1" contest. Player i's expected payoff is equal to

$$\pi_i(x_i) = \frac{x_i}{x_A + x_B + x_C} V - k_i x_i,$$

that is, equal to his probability of winning multiplied by the prize, minus the effort cost. Maximizing this payoff yields an equilibrium effort choice equal to[16]

$$x_i^{1-1-1} = \frac{2\left(\sum_{j=A,B,C} k_j - 2k_i\right)}{\left(\sum_{j=A,B,C} k_j\right)^2} V, \quad i = A, B, C \tag{1}$$

and an expected equilibrium payoff of

$$\pi_i^{1-1-1} = \frac{\left(\sum_{j=A,B,C} k_j - 2k_i\right)^2}{\left(\sum_{j=A,B,C} k_j\right)^2} V, \quad i = A, B, C. \tag{2}$$

The "2-1" contest. Now suppose that A and B are in an alliance. Here, in stage 2, $i \in \{A, B\}$ maximizes his expected payoff

$$\pi_i(x_i) = \frac{x_A + x_B}{x_A + x_B + x_C} \frac{V}{2} - k_i x_i, \quad i = A, B$$

and the out–group player C maximizes

$$\pi_C(x_C) = \frac{x_C}{x_A + x_B + x_C} V - k_C x_C.$$

The win probability of a player $i \in \{A, B\}$ now depends on the sum of efforts by A and B; if the alliance wins each of the players A and B obtains half of the prize value V.

The equilibrium analysis of the "2-1" contest is in Appendix A.1. If A and B differ in their effort cost and, for instance, $k_A < k_B$, then only player A with the lower effort cost chooses positive

[14] Alternatively, we could assume that players differ in their subjective valuation of winning, which would yield the same conclusions.

[15] The assumption of complete information keeps the theoretical analysis tractable. Analyzing Tullock contests with incomplete information becomes very complex even for contests between individuals and under restrictive assumptions on the type distribution (compare, for instance, Malueg and Yates 2004, Ryvkin 2010, and Wasser 2013). On top of that, considering alliances and alliance formation, which introduces a signaling problem, is clearly beyond the scope of this paper. For an analysis of the signaling problem in the framework of a repeated two-player contest see Münster (2009).

[16] For a more detailed analysis of the two contest subgames see Appendix A.1.

effort, and player B chooses zero effort in equilibrium. Intuitively, making the alliance win is a public good for alliance members, and given the quasi-linearity of the payoff functions, only the player with the lower effort cost contributes to this public good. If A and B have exactly the same cost of effort, then there is a continuum of equilibria in which only the sum $(x_A + x_B)^{2-1}$ is uniquely determined. If, for $k_A = k_B$, the "symmetric equilibrium" is played[17] in which A and B choose the same effort, then the equilibrium effort of $i \in \{A, B\}$ in the "2-1" contest is

$$x_i^{2-1} = \begin{cases} \frac{k_C}{(2k_i+k_C)^2}V & \text{if} \quad k_i < k_j \\ \frac{1}{2}\frac{k_C}{(2k_i+k_C)^2}V & \text{if} \quad k_i = k_j \\ 0 & \text{if} \quad k_i > k_j \end{cases}, i, j \in \{A, B\}, j \neq i, \tag{3}$$

with an expected equilibrium payoff of

$$\pi_i^{2-1} = \begin{cases} \frac{k_C^2}{(2k_i+k_C)^2}\frac{V}{2} & \text{if} \quad k_i < k_j \\ \frac{k_C(k_i+k_C)}{(2k_i+k_C)^2}\frac{V}{2} & \text{if} \quad k_i = k_j \\ \frac{k_C}{2k_j+k_C}\frac{V}{2} & \text{if} \quad k_i > k_j \end{cases}, i, j \in \{A, B\}, j \neq i. \tag{4}$$

Comparison. To compare the players' expected continuation payoffs in the "2-1" and in the "1-1-1" subgame we focus on a simple specification of the unit cost: We assume that player C's effort cost is equal to $k_C = k$ and that the effort cost of player $i \in \{A, B\}$ can be either high or low. More precisely, we assume the cost types of A and B to be drawn independently from the set $\{k - \Delta, k + \Delta\}$ with $0 < \Delta < k/3$.[18] Let us refer to an alliance player with cost $k_i = k - \Delta$ as 'strong' and to a player with $k_i = k + \Delta$ as 'weak'. Focusing on the symmetric equilibrium (with $x_A^{2-1} = x_B^{2-1}$) in case of $k_A = k_B$, this leads to the following main theory result.

Proposition 1 *Independent of the co-player's type, (i) the expected payoff of a weak player $i \in \{A, B\}$ (i.e., a player with effort cost $k_i = k + \Delta$) is strictly higher in the "2-1" contest than in the "1-1-1" contest, and (ii) the expected payoff of a strong player $i \in \{A, B\}$ (i.e., with effort cost $k_i = k - \Delta$) is strictly lower in the "2-1" contest than in the "1-1-1" contest.*

The proof is in the appendix and shows that strong types with low (subjective and/or material) unit cost of effort are strictly better off in the "1-1-1" contest than in the "2-1" contest, independent of whether the potential alliance partner is weak or strong. Moreover, weak types with high unit effort cost are strictly better off in the "2-1" contest than in the "1-1-1" contest, both if their co-player is weak and even more if their co-player is strong. Weak types benefit from the lower efforts

[17] Small variations in the assumptions about effort cost yield this equilibrium as the unique equilibrium. See, for instance, Esteban and Ray (2001) for the case of increasing marginal effort costs.

[18] Assuming $\Delta < k/3$ guarantees that the equilibrium in the "1-1-1" contest is an interior equilibrium in the sense that all three players choose positive effort, but this assumption is not necessary for obtaining our main result in Proposition 1. Moreover, introducing the same heterogeneity for player C would, apart from having to consider additional cases, not qualitatively change the main proposition.

expended in the "2-1" contest, and they can fully free-ride on their co-player's effort if the co-player is strong. Strong players have higher chances of winning in the "1-1-1" contest and they may be "exploited" by weak types when entering into an alliance. The analysis of the contest subgames also includes the limit case in which all players are fully symmetric ($\Delta \to 0$). Then, with (2) and (4) and symmetric play by A and B in the "2-1" contest, we get $\pi_i^{1-1-1} = \pi_i^{2-1} = V/9$, $i = A, B$.[19] The lower effort cost due to less competition in the "2-1" contest just counterbalances the effect of the free-riding problem that the alliance faces in the "2-1" contest. This payoff equality for homogeneous players is convenient for comparisons when we turn to the experimental results.

We emphasize an important implication of Proposition 1 for self-selection: Weak players prefer alliance formation while strong players prefer to stand alone.

2.2 Experimental design

The experiment took place at the University of Munich and was programmed using z-Tree (Fischbacher 2007). Overall, we conducted 33 sessions with a total of 519 subjects, mainly students.[20] To each of the experimental sessions we typically admitted 18 subjects. To ensure that subjects properly understood the rules of the game, they had to answer a set of pre-experimental questions. The subjects were randomly assigned a fixed role ("A," "B," or "C," to be explained below) at the beginning of the experiment. Then, the subjects were divided into groups of three players (consisting of one player of each role) and interacted exactly once before they were randomly re-matched, keeping their role as player A, B or C.[21]

We conducted experiments in four different treatments. Each treatment comprised two phases, 'NO CHOICE' and 'CHOICE'. Each phase consisted of 15 rounds.[22,23] After having completed the 2×15 rounds, subjects answered a set of post-experimental questions.[24] A session took about

[19] Note that the out-group player C is strictly better off if A and B form an alliance. In the experiment, however, player C does not make a decision about which contest is played and is thus not our focus of interest.

[20] Table A.1 in the appendix summarizes some socioeconomic characteristics of the participants. The subjects were recruited using ORSEE (Greiner 2004).

[21] The experimental instructions did not describe the procedure of the random re-matching in detail. For the random matching we randomly divided the participants of a session into matching groups of nine subjects in order to avoid dependencies between all observations of one session.

[22] For half of the sessions, subjects started with the NO CHOICE phase, followed by the CHOICE phase; for the other half of the sessions, the order of NO CHOICE and CHOICE was reversed. After each interaction, the subjects were randomly rematched.

[23] The rules of the first phase to be played (CHOICE or NO CHOICE) were made common knowledge at the beginning of the experiment, and the rules for the second phase were made common knowledge only after the first phase had been completed. The subjects were initially told that the experiment would consist of two parts, but that the rules of the second part would only be announced after the end of the first part. A sample of the instructions is in Appendix B.

[24] In some of the sessions we used an extended post-experimental questionnaire. For instance, we elicited the individual "utility of winning" by letting subjects compete in "2-1" and "1-1-1" contests with a prize of value zero (Sheremeta 2010b). Moreover, we included a task on ambiguity aversion and a question on the willingness to take risks (as in Dohmen et al. 2011) and we elicited distributional preferences using two-person allocation decisions (following Balafoutas et al. 2012).

one and a half hours, and subjects earned an average of 25 euros plus the show-up fee (paid separately and in private). Each participant was paid his/her profits (possibly negative) earned in six rounds of the experiment (three rounds per phase), which were randomly drawn at the end of the experiment. In addition, each participant received 0.60 euro for each of the 30 rounds (which essentially served to avoid bankruptcy), plus a 4 euros show-up fee.

Baseline experiment ("BASE"). The baseline experiment implements the two-stage game outlined in the theory section, using two different variants as regards the process of alliance formation in stage 1. In one phase of the experiment a random device determines whether (i) players A, B, and C interact as three stand-alone players in a contest that follows the rules of the "1-1-1" contest or (ii) A and B are teamed up in an alliance, leading to a contest interaction that follows the rules of the "2-1" contest.[25] We refer to this phase of exogenous alliance formation as 'NO CHOICE'. In the other phase, which we refer to as 'CHOICE', players A and B are asked independently and simultaneously whether they would like to form an alliance or to stand alone. If A and B both choose "1-1-1" or both choose "2-1," the chosen subgame is played. If A and B express diverging preferences, they form an alliance with probability 1/2 and stand alone otherwise.

Stage 2 follows the same rules for all 30 rounds, i.e., for both phases. At the beginning of stage 2 the subjects learn whether an alliance has been formed. Importantly, in the CHOICE phase all three players within a group learn the stage 1 choices of A and B on alliance formation. Then all subjects simultaneously choose a number of tokens (a non-negative integer) which they want to expend in the contest. These tokens represent the subjects' effort choices denoted as x_A, x_B, and x_C and are sunk. Next, these choices (x_A, x_B, x_C) are shown to A, B, and C and a "fortune wheel" serves as a device to randomly determine the winning party according to the rules of the Tullock lottery contest outlined in the theory section.[26] The winning party receives $V = 450$ tokens; the losing party receives zero tokens.[27]

In this *BASE* treatment the monetary cost per unit of effort is the same for all subjects and is equal to the monetary value of tokens.[28] Different strengths of players may, however, originate

[25] Within this phase, the "2-1" contest is selected in 10 out of the 15 rounds and the "1-1-1" contest is played in the remaining five rounds. The order of these contests is randomly chosen but is the same for all treatments and sessions.

[26] The fortune wheel is a circle area with various colored segments, whose size is proportional to the share of effort. A pointer spins clockwise and then stops in one of the segments to determine the winner. In the "1-1-1" contest, the fortune wheel consists of three segments, one for each player A, B, and C; in the "2-1" contest, there are only two segments: one for the alliance of AB and another one for player C.

[27] The exchange rate used in all sessions was 45 tokens = 1 euro.

[28] Recall from the theory section that this implies that in the absence of non-monetary motivations players get the same payoff in the "2-1" and in the "1-1-1" contest. To break this possible indeterminacy in the CHOICE phase, the *BASE* treatment (as well as *UNANIMITY* and *BELIEFS* below) adds a small monetary cost attached to the choice between the subgames. More precisely, in one half of the sessions of each treatment, players A and B had to pay five tokens whenever "2-1" was played and in the other half this payment applied to "1-1-1". To avoid asymmetries in "sunk cost" or "budget", this payment was kept symmetric across players A and B (irrespective of

from an additional psychological (non-monetary) cost or benefit from expending effort. Effort choices in the "1-1-1" contest of the NO CHOICE phase provide us with data about heterogeneity in intrinsic motivations: Choices in an otherwise symmetric three-player contest in an exogenous environment can be seen as a measure of 'strength'. The CHOICE phase uses these measures to identify self-selection by relating a player's 'strength' to his vote on alliance formation.

Unanimity voting ("UNANIMITY"). A second treatment differs from the baseline treatment in one respect. In the CHOICE phase of the "*UNANIMITY*" treatment alliances are formed if and only if both players voted for alliance formation. Otherwise, if one (or two) of the players voted against alliance formation, the game proceeds to stand-alone play by all players (the "1-1-1" contest).[29] Except for the new voting regime, all other aspects of the experiment remain unchanged. The choice of a symmetric random mechanism to determine alliance formation in *BASE* in case only one player votes for alliance formation leads to alliances with heterogeneous types and is, therefore, important from a measurement point of view, among other things. Yet alliances often require unanimous support and varying the institutional rules might also change behavior in contests and when voting on alliance formation.

Belief elicitation ("BELIEFS"). This treatment also departs from the *BASE* treatment exactly along one dimension: When deciding on their own effort, the subjects were also asked to give an estimate of what amount of effort the other player (A or B) would invest.[30] Belief elicitation was incentivized.[31] Moreover, beliefs were elicited both in the CHOICE and in the NO CHOICE phase as well as both in "2-1" and in "1-1-1" contests; all other aspects remained exactly as in *BASE*. If players are of intrinsically heterogeneous types, a vote for or against alliance formation can be informative about a player's type and, hence, his subsequent effort choice. The "*BELIEFS*" treatment analyzes whether players in the laboratory actually react to other players' votes on alliance formation.

Heterogeneity in monetary costs ("HET-COST"). A final treatment introduces heterogeneity in extrinsic motivations. This heterogeneity adds to the heterogeneous intrinsic motivations for winning the contest (expending effort) which are the predominant feature of the *BASE* treatment. Recall that the theory model of section 2.1 is unspecific about the source of cost heterogeneity that is described by Δ and allows for heterogeneity in extrinsic or intrinsic motivation.

---

the own subgame choice) and was applied in both phases CHOICE and NO CHOICE.

[29] Under the unanimity rule, there always exists the trivial equilibrium where both players decide not to form an alliance: Independently of the own preference, this is a best response to the other player's decision to stand alone. Randomization in case of diverging preferences as in *BASE* is a means to eliminate this (trivial) equilibrium and to incentivize subjects to state their true preference.

[30] Players C were asked to estimate the average effort of players A and B.

[31] Subjects were informed that if a round was selected for payment, they would earn up to 10 euros (the more the closer their estimate to the actual effort).

	BASE	UNANIMITY	BELIEFS	HET-COST
voting rule (in the CHOICE phase)	majoritarian	**unanimous**	majoritarian	majoritarian
belief elicitation	no	no	**yes**	no
monetary effort cost	homogeneous	homogeneous	homogeneous	**heterogeneous**
subjects	231	144	72	72

Note: Each treatment consists of the NO CHOICE and the CHOICE phase. Within BASE, UNANIMITY and BELIEFS, in one half of the sessions NO CHOICE was played first (NC-C) and in the other half CHOICE was played first (C-NC).

Table 1: Summary of the experimental treatments.

In the "*HET-COST*" treatment, players differ in their monetary unit cost of effort: Player A is the stronger player with a monetary unit cost of 0.8 while player B is the weaker player with a monetary unit cost of 1.2; player C's effort cost remains unchanged with a unit cost of 1. Except for the change in the cost parameters (both in the "2-1" and in the "1-1-1" contests), everything else stays the same as in the *BASE* experiment.[32] In the theory section we can set $k = 1$ and $\Delta = 0.2$ to obtain the equilibrium prediction for players who maximize their monetary payoffs. In particular, Proposition 1 now holds even when players are symmetric along the non-monetary component (or care only about monetary payoffs). Table 1 summarizes the four treatments.

2.3 Main predictions

Our setup allows us to identify what determines the players' vote to enter into an alliance or to stand alone. In daily life interactions, the motivation of players is usually unobserved. Our experiment with exogenous stand-alone contests and exogenous alliance contests, however, reveals information about players' motivations. Based on the high effort choices in contest experiments and the observed heterogeneity, it has been suggested that players have motivations that add to the monetary incentives (see, e.g., Sheremeta 2010b). Players who expend much effort in an exogenously arranged stand-alone contest reveal their high motivation to expend effort. We call such players 'strong'. In contrast, players who systematically expend little effort in exogenously arranged stand-alone contests reveal a low motivation, and we call these players 'weak'.

Building on Proposition 1 above, players who feel a particularly low cost of effort or strong

[32] As the *HET-COST* treatment focuses especially on self-selection (and not so much on contest efforts), we only run one sequence of play: All players first went through the measurement phase NO CHOICE before they played the selection phase CHOICE.

motivation for winning should have a preference for standing alone. If they stand alone, their willingness to expend much effort cannot be opportunistically exploited by their co-players.[33] Other players who care less about winning or are less inclined to expend a lot of effort should be more inclined to enter into an alliance. When entering into an alliance they can benefit from and free-ride on the efforts of others.

Prediction 1 *In the CHOICE phase, players self-select according to their 'strength': Strong players are less likely to vote for alliance formation and are more likely to vote for standing alone, compared to weak players.*

Prediction 1 is established for the *BASE* experiment in which the monetary cost of effort is the same for all players but for which players may differ in their psychological cost, as revealed in the NO CHOICE phase of *BASE*. In addition to heterogeneity in intrinsic motivations, self-selection should also occur if strong and weak players arise from differences in monetary incentives. Since Proposition 1 also applies to the *HET-COST* treatment in which players differ in their monetary cost of effort, we expect the low-cost player A to be less likely to vote for alliance formation and more likely to vote for standing alone, compared to the high-cost player B in *HET-COST*.

Prediction 1 should also hold in the treatment with belief elicitation (*BELIEFS*) and under unanimity voting. In *UNANIMITY*, even though incentives for self-selection are the same, there might be psychological factors that cause the requirement of a unanimous decision for alliance formation to have an impact on voting choices; the analysis of self-selection will control for this possibility.

Our analysis of self-selection also generates testable predictions on contest behavior. If strong players stay away from forming an alliance, the subsample of players in endogenously formed alliances (in the CHOICE phase) would be made up of individuals who typically expend less-than-average effort. Such self-selection would lead to alliance effort being lower in endogenously formed alliances than in exogenously formed alliances.[34]

In addition to self-selection affecting efforts, the endogenous choice of alliance formation can evoke behavioral reactions that have so far been ignored in the theory model. First, in addition to heterogeneity in the players' 'strength', there might be heterogeneity in factors like in-group favoritism and a selection along this dimension into voluntarily formed alliances. Moreover, from a rational choice perspective the process of alliance formation should not matter for the subgame equilibrium efforts; but endogenously and voluntarily formed alliances may exhibit a stronger in-group favoritism, leading to a higher willingness to expend effort in order to increase the joint

[33] This also depends on whether there is a positive correlation between the inclination to expend efforts when standing alone and when being in an alliance.

[34] This result can easily be derived in the theory model above, using efforts in (3) and calculating the ex ante expected efforts for a given distribution of types.

prospect of victory.[35] The existence of a competing out-group could make in-group feelings even stronger. Finally, there might be a psychological effect of a conscious choice to form an alliance and to select the preferred game (see, e.g., Babcock et al. 2014).

Prediction 2 *a) The selection of weak players into endogenously formed alliances leads to average effort in endogenously formed alliances being lower than average effort in exogenously formed alliances.*
b) Stronger in-group favoritism in endogenously formed alliances leads to average effort in endogenously formed alliances being higher than average effort in exogenously formed alliances.

Which of the two effects in Prediction 2 prevails will be tested by comparing the alliance effort in the NO CHOICE and in the CHOICE phase of the *BASE* treatment. While we expect this comparison to be the same in the *BELIEFS* treatment, both effects could be strengthened in the *UNANIMITY* treatment. First, because endogenously formed alliances will only consist of players who actually voted for alliance formation (in contrast to majority voting), self-selection of weak players into alliances will be strengthened.[36] Second, however, also selection of players with strong in-group favoritism may be strengthened and the unanimous choice of alliance formation may further contribute to in-group favoritism. Overall, this may cause effort in endogenously formed alliances of *UNANIMITY* to be different from the *BASE* treatment, and the *UNANIMITY* treatment will help to understand the link between institutional rules and behavior.

Self-selection may also cause indirect effects. The selection choices of a player may reveal information about his strength to his co-players. Correct interpretation of this information should affect the players' effort choices in endogenously selected contests. Under majority voting players should behave differently in endogenous alliances, depending on whether both or only one player voted for an alliance. Taking Prediction 1 into account, if a strong type ends up in an alliance, he can anticipate that his co-player is weak and that he has to choose high effort in order to maintain the alliance's chances of winning. Weak types, in turn, can choose the lowest effort if they end up in an alliance with a player who voted against alliance formation, anticipating that this player is a strong type and chooses high effort.

Prediction 3 *In endogenously formed alliances, (i) the highest effort is chosen by strong types who end up in an endogenous alliance with a player who voted for alliance formation, and (ii) the lowest effort is chosen by weak types whose co-player voted against alliance formation.*

[35] In the theory model such an effect can be captured in the simplest way by assuming that voluntary alliance formation reduces an alliance player's subjective effort cost in the "2-1" contest of CHOICE, compared to the NO CHOICE phase. This hypothesis extrapolates from experimental results on the effect of endogenous institutions in the context of voluntary contributions to a public good suggesting that endogenous group formation fosters cooperation among group members. Compare, for instance, Boun My and Chalvignac (2010), Dal Bo et al. (2010), Sutter et al. (2010), Aimone et al. (2013), and Charness and Yang (2013).

[36] If, in addition, there are differences in monetary effort cost as in the *HET-COST* treatment, the self-selection effect on efforts as in Prediction 2a should be even stronger.

The ranking of efforts in Prediction 3 follows directly from the equilibrium prediction in (3). For the treatments with majority voting (*BASE* and *BELIEFS* in particular) we can separate the players' effort choices in endogenously formed alliances according to the votes on alliance formation. Whether or not the effort choices are indeed consistent with beliefs about other players' types and anticipations of their effort is analyzed in the *BELIEFS* treatment.

To complete the picture, when analyzing the total effect of endogenizing alliance formation on win probabilities and payoffs, we have to take the out-group player C's reaction into account. The existence of a competing out-group is a novel feature of our design. We expect that the out-group player C uses the selection choices of potential alliance players A and B to update his beliefs about these players' types. This means that when fighting against an alliance, the larger the number of co-players A and B who voted against the formation of an alliance, i.e., the larger the number of strong opponents, the more effort player C expends.

3 Results

The main focus of our analysis is on which type of player selects into an alliance. In addition, we consider the effect of self-selection on contest behavior. The summary statistics in Table A.1 in the appendix provide an overview of the average probabilities of voting for alliance formation as well as the average effort levels chosen in both contest subgames ("2-1" and "1-1-1" contest) and both institutional phases (NO CHOICE and CHOICE), separately for all four treatments.

The main results on self-selection are illustrated in Figure 1. First, focusing on heterogeneity in intrinsic motivations to expend effort we measure the efforts chosen by players in the "1-1-1" contest of the NO CHOICE phase and use these efforts as a proxy of the players' strength. We find that relatively weak players are more likely to vote for alliance formation than relatively strong players. For the treatments *BASE*, *UNANIMITY,* and *BELIEFS*, the first two bars in the left panel of Figure 1 separate players according to whether their average effort under exogenous stand-alone play ("1-1-1" contests of NO CHOICE) is below total average effort ('weak') or above total average effort ('strong') in these contests. Among weak types, the share of players who vote for alliance formation is 65.3%, compared to only 51.4% for strong types.

Second, if we induce further differences in strength by inducing differences in monetary effort costs, these differences also lead to self-selection. In the *HET-COST* treatment, high-monetary-cost players are more likely to vote for alliance formation than low-monetary-cost players. As the right panel of Figure 1 reveals, there is selection both along extrinsic and intrinsic motivations: For a given monetary cost of effort, the proxy of 'strength' from the NO CHOICE phase further separates the alliance formation choices of low-cost and high-cost players along the dimension of non-monetary motivation. In total, incentivized strength that is based on monetary cost advantages and strength as measured in the *BASE* treatment both lead to self-selection.

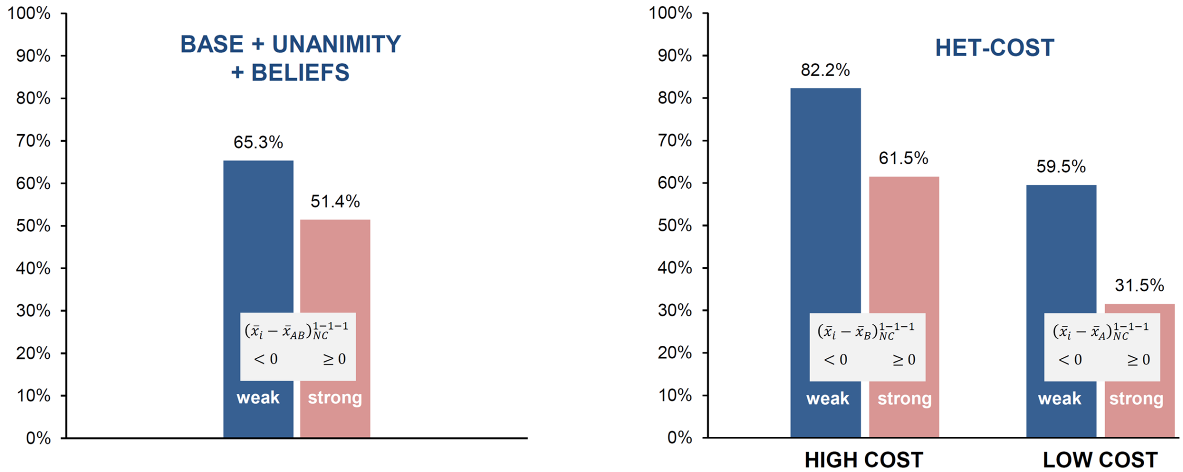

Figure 1: Average probability to vote for alliance formation in the CHOICE phase.

3.1 Votes on alliance formation

In this section we test Prediction 1 on self-selection. Table 2 presents the results of the random-effects logistic regressions of player A or B's vote on alliance formation in the CHOICE phase. The dependent variable v_{it} is equal to 1 if, in round t, player $i \in \{A, B\}$ votes for an alliance and 0 otherwise. All estimations control for individual-specific characteristics using socioeconomic information from the exit questionnaire.[37] Estimations 1 and 2 include the data from treatments *BASE*, *BELIEFS*, and *UNANIMITY*, while estimation 3 analyzes the treatment with heterogeneity in monetary effort cost (*HET-COST*).

Our main interest is in the explanatory power of a player's intrinsic motivation. We proxy a player's 'strength' by his effort choice under exogenous stand-alone play, measured by the variable $(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$. This variable is computed as the difference between an individual's average effort and the average effort of all players A or B in the "1-1-1" contests of the NO CHOICE phase.[38] The significantly negative coefficient on $(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$ in all estimations of Table 2 shows that stronger players are less likely to vote for alliance formation.

[37] The included variables are age, gender, field of study, number of siblings, height, and number of books in the parents' household. None of these variables significantly explain individual choices, the only exception being that in estimation (3) the more siblings a player has, the more likely the player is to vote for alliance formation. Moreover, when using the extended post-experimental questionnaire, we find that individual efforts in "2-1" and "1-1-1" contests with a prize value of zero ("utility of winning") are uncorrelated with the choice of alliance formation. Among the variables for distributional preferences, efficiency-minded individuals are more likely to vote for the "2-1" contest, but only with marginal significance. Finally, the variable which measures risk aversion is insignificant when included as a control variable in the estimations. However, pairwise correlations of risk aversion and an individual's average probability to vote for alliance formation suggest that more risk averse individuals are more likely to vote for the "2-1" contest (the Spearman correlation coefficient is 0.159^{**}). The latter result is in line with the intuition that the "2-1" contest is less risky in the sense that the stakes are lower.

[38] This variable is computed exclusively from the observations of the NO CHOICE phase in order to identify a player's 'type' in situations where it cannot be affected by the preceding choice of the game.

Dependent variable: individual vote on alliance formation (v_{it}=1 if vote = "2-1", i=A,B, t=round)			
	BASE+UNANIMITY+BELIEFS		HET-COST
Indep. var.	xlogit 1	xlogit 2	xlogit 3
Constant	0.491*	0.491*	1.80***
	(0.279)	(0.279)	(0.456)
$(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$	−0.009***	−0.009***	−0.020**
	(0.002)	(0.002)	(0.008)
$(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$ ×UNANIMITY		0.001	
		(0.004)	
UNANIMITY	0.554*	0.555*	
(=1 if unanimous voting rule)	(0.311)	(0.310)	
BELIEFS	0.140	0.147	
(=1 if beliefs elicited)	(0.397)	(0.398)	
Low-cost player			−2.00***
(=1 if c_i=0.8)			(0.628)
$(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$ ×Low-cost player			0.003
			(0.010)
$(\bar{x}_i - \bar{x}_{A,B})^{2-1}_{NC}$	0.007	0.007	−0.006
	(0.004)	(0.004)	(0.011)
$\left(\bar{\pi}_i^{2-1} - \bar{\pi}_i^{1-1-1}\right)_{NC}$	0.003*	0.003*	0.005
	(0.001)	(0.001)	(0.003)
C-NC	0.462	0.460	
(=1 if CHOICE first)	(0.284)	(0.284)	
PAY2-1	−0.638**	−0.636**	
(=1 if fee for "2-1")	(0.278)	(0.278)	
Socioeconomics	YES	YES	YES
Observations	4470	4470	720
Log likelihood	−2211.22	−2211.19	−319.16

Note: Random-effects logistic regressions (298/48 individuals); standard errors in parentheses; ***(**,*) significant at 1%(5%,10%). "UNANIMITY" and "BELIEFS" are dummy variables for the different treatments; "Low-cost player" is a dummy variable for the player with lower monetary effort cost in the *HET-COST* treatment; $(\bar{\pi}_i^{2-1} - \bar{\pi}_i^{1-1-1})_{NC}$ is an individual's average difference in payoffs of the "2-1" minus the "1-1-1" contest in the NO CHOICE phase; "C-NC" and "PAY2-1" are control variables for the different sessions. $\left(\bar{x}_i - \bar{x}_{A,B}\right)^{1-1-1}_{NC}$ and $\left(\bar{x}_i - \bar{x}_{A,B}\right)^{2-1}_{NC}$ are an individual's average efforts in the NO CHOICE phase (in the "1-1-1" and the "2-1" contests, respectively), compared to the average effort of all players A or B in these contests (for estimation 3, compared to average effort of all players with same cost).

Table 2: Individual choices on alliance formation in the CHOICE treatment.

Result 1 *Players who typically contribute more than the average player A or B in exogenously assigned stand-alone contests are significantly less likely to choose alliance formation.*

Estimations 1 and 2 in Table 2 also show that the probability of voting for alliance formation can be (weakly) explained by the difference between an individual's average payoff in the "2-1" contests and in the "1-1-1" contests of the NO CHOICE phase ($(\bar{\pi}_i^{2-1} - \bar{\pi}_i^{1-1-1})_{NC}$).[39,40]

On unanimity voting: The indicator variables "UNANIMITY" and "BELIEFS" control for treatment differences. As expected, belief elicitation (in the second stage when players decide on their effort levels) does not affect the probability to vote for alliance formation. The voting institutions, however, influence the vote on alliance formation: The (weakly) significantly positive coefficient on "UNANIMITY" in estimations 1 and 2 of Table 2 suggests that the probability of voting for alliance formation is slightly higher under the unanimity voting rule than under majority voting. Self-selection of strong players is very similar in *UNANIMITY* and in *BASE*; the interaction term of the proxy for strength (the variable $(\bar{x}_i - \bar{x}_{A,B})_{NC}^{1-1-1}$) with "UNANIMITY" in estimation 2 is statistically not different from zero.[41] We did not formulate a testable hypothesis on this coefficient ex ante and one may speculate on different reasons. The higher overall probability of voting for alliance formation in *UNANIMITY* might be explained, for instance, by an increased focality of alliance formation or by subjects who enjoy being in a team with "one of their kind." Summing up this finding:

Result 2 *When alliance formation decisions require unanimity, the individual probability of voting for alliance formation is higher than under majority voting.*

On heterogeneity in monetary effort cost: Estimation 3 of Table 2 considers votes on alliance formation when players differ in their monetary cost of effort ('extrinsic heterogeneity') in addition to potential heterogeneity in non-monetary motivations ('intrinsic heterogeneity'). In the *HET-COST* treatment, player A is the player with a low unit cost of 0.8 and player B is the player

[39] It turns out that the purely monetary payoff of players is higher in the "2-1" contest than in the "1-1-1" contest. But players who typically invest higher-than-average monetary effort gain relatively less in monetary terms from choosing the "2-1" contest. Moreover, for those 'strong' players, the monetary payoff is likely to disregard other aspects they seem to care about. Their win probability in the "1-1-1" contest (and hence their expected share in the prize) is higher than average (around 42% for players who are 'strong' as defined as in Figure 1); in contrast, strong players gain an expected prize share in the "2-1" contest which is only about 24%.

[40] The regressions also control for "C-NC" and "PAY2-1". The variable "C-NC" indicates that the CHOICE phase was played first; the estimated coefficient is insignificant. The dummy "PAY2-1" is equal to 1 whenever players A and B had to make a small incentivizing payment in case the "2-1" contest was played; estimations 1 and 2 show that the probability of voting for alliance formation is systematically lower whenever the small incentivizing payment was applied to the "2-1" contest. Hence, the small monetary incentives for or against alliance formation in *BASE*, *UNANIMITY* and *BELIEFS* worked in the predicted way, but left scope for self-selection according to intrinsic motivations.

[41] The test for the self-selection of strong types in *UNANIMITY* (the sum of $(\bar{x}_i - \bar{x}_{A,B})_{NC}^{1-1-1}$ and $(\bar{x}_i - \bar{x}_{A,B})_{NC}^{1-1-1}$ ×UNANIMITY) yields a p-value of 0.008.

with a high unit cost of 1.2.[42] Estimation 3 includes an indicator variable for the low-monetary-cost player; the estimated coefficient is strongly negative and significant at the 1% level; hence, low-monetary-cost players are significantly less likely to vote for alliance formation compared to high-cost players, which is in line with Proposition 1. But estimation 3 also includes the proxy for (intrinsic) strength, now calculated as a player's average effort under exogenously assigned stand-alone play compared to the average effort of all players with the same monetary unit cost. Again, players who are relatively strong compared to players who face the same monetary incentives are significantly less likely to vote for alliance formation, and this holds both for low-cost and for high-cost players.[43] Therefore, extrinsic heterogeneity plays out just as the theory predicts but does not eliminate the effect of intrinsic heterogeneity: For given monetary incentives, relatively strong types are significantly less likely to vote for alliance formation than relatively weak types.

Result 3 *a) Players with low monetary effort cost are less likely to vote for alliance formation than players with high monetary effort cost.*
b) Among the players with identical monetary incentives, those who typically contribute more than the average player in exogenously assigned stand-alone contests are significantly less likely to choose alliance formation.

Our analysis of self-selection uses effort levels in exogenously imposed stand-alone contests to measure strength. Alternatively one may think about using effort levels in exogenously imposed "2-1" contests, i.e., the variable $(\bar{x}_i - \bar{x}_{A,B})^{2-1}_{NC}$, which measures the difference between an individual's average effort and the average effort of all players A or B in such contests. This variable cannot explain the selection of players into endogenously formed alliances as can be seen from Table 2. The coefficient of $(\bar{x}_i - \bar{x}_{A,B})^{2-1}_{NC}$ is not significantly different from zero. The lower predictive power of this variable is intuitively plausible. Additional motivations may affect effort in the "2-1" contests. For instance, one cannot rule out that players develop a feeling of solidarity with the fellow alliance partner or in-group favoritism more generally and effort in alliances is affected both by in-group favoritism as well as the intrinsic motivation to win.[44] Such in-group favoritism can increase the probability of voting for alliance formation and thus countervail the effect of higher commitment to expend effort. We will discuss this conjecture in the following.

[42] Note that in the four sessions of this treatment we did not change the order of play nor did we introduce a small incentivizing payment (since monetary incentives for self-selection already emerge as a consequence of the changes in effort cost).

[43] Now, the variable $(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$ measures the effect of 'strength' for high-cost players, and the sum of $(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$ and its interaction with "Low-cost player" measures the effect of 'strength' for low-cost players (the latter is significant at the 5% level). The insignificant coefficient on the interaction term implies that the effect of intrinsic motivations on voting probabilities does not differ between high-cost and low-cost players.

[44] Note that an individual's average effort in "2-1" contests is significantly positively correlated with his effort in "1-1-1" contests.

Correlation with: $\bar{v}_i$ **(average probability of voting for alliance formation)**			
	$\bar{x}_{i,NC}^{2-1} - \bar{x}_{i,NC}^{1-1-1}$	$\bar{x}_{i,NC}^{2-1}/\bar{x}_{i,NC}^{1-1-1}$	Allocation to in-group
Correlation coeff.	0.2780	0.2047	0.0119
p-value	0.000	0.000	0.8698
Observations	346	346	192
	General identity	Identification	Comfortable
Correlation coeff.	0.0579	0.1818	0.2291
p-value	0.6960	0.2163	0.1172
Observations	48	48	48

Reported are Spearman correlation coefficients. One observation = one individual i = A,B. "Allocation to in-group" stems from distribution decisions in an other-other allocation task. The other variables are agreement/answers on a scale from 0 to 10 to the following statements/questions: "General identity": "We are all members of different groups, e.g., ethnicity, nation, religion, etc. In general, belonging to social groups is an important part of my self-image."; "Identification": "How much did you identify yourself as a member of the group of players A/B in this experiment?"; "Comfortable": "How comfortable did you feel as a member of the group of players A/B?".

Table 3: Correlations of individual choices on alliance formation and measures of in-group favoritism.

On in-group favoritism: Do players with a stronger in-group bias select into endogenously formed alliances? It is hard to measure in-group favoritism directly in the present experiment, but suppose that players do not only differ in their subjective effort cost (or their intrinsic value of winning), but that one particular player's subjective effort cost (intrinsic motivation) differs in the "2-1" and in the "1-1-1" contest. Then, players with a strong in-group bias should have a lower subjective effort cost (higher intrinsic value of winning) in the "2-1" contest than in the "1-1-1" contest. A proxy for this bias is the difference, or the ratio, of a particular player i's average effort levels $\bar{x}_{i,NC}^{2-1}$ and $\bar{x}_{i,NC}^{1-1-1}$ in these two contests of the measurement phase NO CHOICE.

In Table 3 we correlate the difference as well as the ratio of an individual's effort levels in "2-1" and "1-1-1" contests of the NO CHOICE phase with this individual's average probability of voting for alliance formation. We find a significantly positive correlation: The higher a player's in-group bias as measured by the difference (or the ratio) of effort levels in the two subgames, the higher his probability to vote for alliance formation is.

Result 4 *A stronger in-group bias of a player as measured by his willingness to expend effort in the "2-1" contest relative to the "1-1-1" contest is significantly positively correlated with this player's probability of voting for alliance formation.*

Deducing in-group bias from effort data is not the most direct route to take; therefore, we also included a direct and incentivized test for in-group favoritism in the sessions using an extended post-experimental questionnaire. For players A and B, the task of dividing some amount of money between two other players of which one is a member of the in-group (another player A or B) and the other is a member of the out-group (a player C) should deliver a more direct measure of in-group favoritism. In Table 3, however, the variable "Allocation to in-group" which measures the share of money allocated to an in-group player is not correlated with the average probability of voting for alliance formation.

Another way to measure in-group favoritism from psychology, however not incentivized, are questions on how much one identifies with a group in a general or more specific sense.[45] We only added these post-experimental questions in the most recently conducted sessions (all from the *HET-COST* treatment). The general sense of group identification that players express ("general identity") is not correlated with the vote to form an alliance. The degree of identification with other players A/B ("Identification") and how "comfortable" a player felt as a member of the group of players A/B yields positive correlation coefficients with the vote to form an alliance.[46]

Overall, and applying different variables, we find mild evidence of a correlation of in-group favoritism with the individual voting decision. Self-selection of players who feel strong in-group favoritism can mitigate the consequences of Result 1 (selection of low-effort types into alliances) for effort levels, as we analyze in the next section.

3.2 Effort choices in endogenous alliances

In this section we test predictions 2 and 3. Table 4 presents the results of random-effects regressions of x_{it}, the effort of an alliance player $i \in \{A, B\}$ in the "2-1" contest (in round t).[47] All estimations control for whether the observed effort stems from voluntarily ("CHOICE" $= 1$) or from exogenously formed alliances ("CHOICE" $= 0$). Moreover, the vector of explanatory variables contains two dummy variables that control for the different treatments ("UNANIMITY" and "BELIEFS").[48] We also include controls for individual-specific characteristics using socioeconomic

[45] See, e.g., Luhtanen and Crocker (1992) and Sachdev and Bourhis (1987, 1991).

[46] Despite the small sample size, some identification measures are significantly correlated within subgroups of players (low-cost or high-cost players).

[47] The summary statistics of effort in "2-1" contests in both phases can be found in Table A.1 and time series of efforts are illustrated in Figure A.1 in the appendix. In all treatments, players expend higher effort than the effort that maximizes monetary payoffs. The overdissipation observed is very much in line with general findings in contest experiments. Explanations for overdissipation and a high variability in efforts include spite and inequality aversion (Herrmann and Orzen 2008), non-monetary utility of winning (Sheremeta 2010b), risk preferences (Millner and Pratt 1991), endowment effects (Price and Sheremeta 2012), and mistakes (Potters et al. 1998). See Sheremeta (2013) for an overview.

[48] Table 4 pools the data from all treatments with identical monetary incentives for choosing effort (*BASE*, *UNANIMITY*, and *BELIEFS*). Again, we include the dummies "C-NC" and "PAY2-1" as control variables for the different sessions. (Recall that we varied the order of CHOICE and NO CHOICE and that the sessions included small monetary incentives for the vote on alliance formation to break the theoretical indeterminacy for monetary payoff maximizing players.) As shown in Table 4, these dummy variables have no explanatory power for effort choices.

information from the exit questionnaire.[49]

Estimation 1 shows that endogenous alliance formation leads to an increased mobilization of efforts: Alliance players expend on average 5.8 points more if the alliance emerges endogenously, and the coefficient of "CHOICE" is significantly different from zero at the 1%-level. Note that the higher effort in endogenous alliances cannot be explained by a selection of high-effort players. The increase is actually observed despite the selection: Strong types are more likely to stand alone; accordingly, fewer of them are members of an alliance that is voluntarily formed than of an alliance that is randomly imposed.[50] The finding of self-selection is also important when interpreting findings about the impact of the voluntary formation of groups on in-group favoritism. The directly measured effect may be biased due to the countervailing effects of self-selection.

Result 5 *Average effort in voluntarily formed alliances is significantly higher than average effort in randomly and exogenously formed alliances.*

A possible reason for the higher effort levels by endogenous alliances could be that individuals with stronger in-group favoritism are more likely to join an alliance (see the discussion in the previous subsection) and increase their effort very strongly in an alliance. We find that the 'individual CHOICE effect', i.e., the difference between an individual's average alliance effort in CHOICE and NO CHOICE ($\bar{x}_{i,C}^{2-1} - \bar{x}_{i,NC}^{2-1}$) is positively correlated with in-group favoritism as measured by the share of money a player A or B allocates to another player A or B in the post-experimental other-other allocation task.[51]

Estimation 2 of Table 4 provides additional information as to why and when effort in the CHOICE phase is higher. Here, we separate the effect of endogenous alliance formation ("CHOICE") according to the possible voting outcomes which led to the alliance formation (v_{it} and v_{-it} indicate i's and his co-player's choices). If both players voted for alliance formation ($I_{(v_{it},v_{-i,t})=(1,1)} = 1$), there is a moderate increase in effort expended; the estimated coefficient of 3.2 is significant at the 5%-level. Yet, the result for "mixed" alliances in which only one player voted for alliance formation is different: The player who actually voted for alliance formation does not change his effort decision compared to the NO CHOICE phase (hence, choosing the lowest effort among all cases in CHOICE), while the highest increase in efforts in "2-1" contests (by 22.3 points compared to the average effort in NO CHOICE) is made by individuals who voted against alliance

[49] As control variables we include age, gender, field of study, number of siblings, height, and number of books in the parents' household. None of these variables significantly explain individual effort choices. When using the extended post-experimental questionnaire, we find that individual effort in a "2-1" contest with a prize value of zero ("utility of winning") is significantly positively correlated with effort in actual "2-1" contests. The measures for risk aversion and distributional preferences, however, do not signficantly explain effort in "2-1" contests.

[50] Table 4 shows: The higher individual effort in the "1-1-1" contests of NO CHOICE is, the higher the individual effort in "2-1" contests is (compare the coefficient of $(\bar{x}_i - \bar{x}_{A,B})_{NC}^{1-1-1}$), but the lower the probability to enter into an alliance is (compare Table 2).

[51] This, however, only holds in variants of the task which do not allow for the possibility of a 50-50 split (which is otherwise the predominant choice). In this case, the Spearman correlation coefficient is 0.4689.

Dependent variable: individual effort x_{it} of alliance player i=A,B in round t of the "2-1" contest (alliance AB vs. player C)				
	BASE+UNANIMITY+BELIEFS			
Indep. var.	xtreg 1	xtreg 2	xtreg 3	xtreg 4
Constant	58.4***	58.0***	49.5***	57.7***
	(3.69)	(3.69)	(4.03)	(3.70)
CHOICE	5.8***		5.2***	7.4***
(=1 if CHOICE phase)	(1.24)		(1.52)	(1.45)
$I_{(v_{it},v_{-i,t})=(1,1)}\times$CHOICE		3.2**		
		(1.41)		
$I_{(v_{it},v_{-i,t})=(1,0)}\times$CHOICE		−0.4		
		(2.59)		
$I_{(v_{it},v_{-i,t})=(0,1)}\times$CHOICE		22.3***		
		(2.64)		
UNANIMITY	−2.6	−1.3	−1.7	−0.6
(=1 if unanimous voting rule)	(4.11)	(4.12)	(4.29)	(4.23)
BELIEFS	4.0	4.0	2.6	4.0
(=1 if beliefs elicited)	(5.19)	(5.19)	(5.37)	(5.18)
UNANIMITY$\times$CHOICE				−5.6**
				(2.78)
$(\bar{x}_i - \bar{x}_{A,B})_{NC}^{1-1-1}$	0.17***	0.17***	0.14***	0.17***
	(0.02)	(0.02)	(0.03)	(0.02)
$(\bar{x}_i - \bar{x}_{A,B})_{NC}^{1-1-1}\times$CHOICE	0.04***	0.03*	0.04*	0.04**
	(0.02)	(0.02)	(0.02)	(0.02)
$(x_{C,t-1})^{2-1}$			0.04***	
			(0.01)	
C-NC	1.4	1.6	0.5	1.4
(=1 if CHOICE first)	(3.69)	(3.69)	(3.82)	(3.68)
PAY2-1	0.1	−0.1	0.0	0.2
(=1 if fee for "2-1")	(3.65)	(3.66)	(3.79)	(3.65)
Socioeconomics	YES	YES	YES	YES
Observations	5220	5220	2880#	5220
R^2	0.0925	0.0993	0.1116	0.0933

Note: Random-effects regression (298 individuals); standard errors in parentheses; ***(**,*) significant at 1%(5%,10%). "CHOICE" indicates whether the observation stems from a voluntarily formed alliance; "UNANIMITY" and "BELIEFS" are control variables for the different treatments; "C-NC" and "PAY2-1" are control variables for the different session types; $(\bar{x}_i - \bar{x}_{A,B})_{NC}^{1-1-1}$ is an individual's average effort in the "1-1-1" contests of the NO CHOICE phase, compared to average effort of all players A or B in these contests.

#Estimation 3 only includes observations for which the "2-1" contest was played in two consecutive rounds.

Table 4: Alliance players' effort in the "2-1" contest.

formation but ended up in an alliance because their co-player voted in favor of an alliance formation. Similarly, the 'stronger' a player (identified by the proxy $(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$ of the measurement phase), the higher the increase in effort following endogenous alliance formation is: The coefficient of the interaction of $(\bar{x}_i - \bar{x}_{A,B})^{1-1-1}_{NC}$ with the variable "CHOICE" is significantly positive throughout all estimations. In other words, the 'democracy premium' (that is, the effect of endogenous institutions as in CHOICE on efforts in an alliance) is larger the stronger a player is.

Result 6 *The high effort in voluntarily formed alliances is, to a large extent, due to 'strong types' who vote against alliance formation but choose high effort when ending up in an alliance.*

The significant effect of the institutional variation of endogenous alliance formation on efforts poses the question of how the out-group player C reacts to endogenous alliance formation. While section 3.3 addresses this question in more detail, estimation 3 of Table 4 includes the lagged effort of player C (of the previous round) into the vector of explanatory variables.[52] The estimated coefficient of $x^{2-1}_{C,t-1}$ confirms that players A and B positively react to the observed effort levels of the out-group player. This result emerges even though the identity of C changes in each round due to random re-matching. Note already that the same is true for player C (see estimation 3 in Table A.3 in the appendix). More importantly, however, even after controlling for player C's effort, the coefficient of "CHOICE" remains significantly positive and almost unchanged (compare estimations 1 and 3 of Table 4).

On unanimity voting: The fact that the effort increase in the CHOICE phase is mainly driven by strong types who did not choose alliance formation themselves confirms that the self-selection problem of weak types (Prediction 2a) will be stronger in unanimously formed alliances. Estimation 4 adds an interaction term of "CHOICE" and the indicator variable "UNANIMITY"; the significantly negative coefficient reflects the lower effort contributed in unanimously and voluntarily formed alliances. In contrast to *BASE*, alliance efforts in *UNANIMITY* are not statistically different in CHOICE and in NO CHOICE.[53]

Result 7 *Under the unanimity voting rule, fewer 'strong types' enter into an alliance and the effort of endogenously formed alliances does not differ from the effort of exogenous alliances.*

The unanimity voting rule imposes a higher hurdle for alliance formation. Strong types, if they vote against alliance formation, do not end up in an endogenous alliance. Hence, alliances formed

[52] More precisely, the variable $x^{2-1}_{C,t-1}$ is the effort of the out-group player against who player i played in the previous round (in a "2-1" contest), that is, the out-group effort which i observed in the previous round. For reasons of comparability we only include observations for which the "2-1" contest was played in two subsequent rounds, which reduces the number of observations considerably (from 5220 to 2880).

[53] The test on the sum of "CHOICE" and "UNANIMITY×CHOICE" yields a p-value of 0.456. Moreover, comparing efforts of unanimously formed alliances and alliances formed under majority rule (the test on the sum of "UNANIMITY" and "UNANIMITY×CHOICE") yields a p-value of 0.168.

Average own effort x_i, co-player's effort x_{-i}, and i's beliefs μ_i about x_{-i} in "2-1" contests conditional on the votes on alliance formation in the respective round $(i = A, B)$					
	$i = A, B$				
	Own effort x_i	Beliefs μ_i	Effort x_{-i}	Corr(μ_i, x_{-i})	#obs.
NO CHOICE	67.6 (5.30)	73.2 (4.48)	67.6 (3.86)	0.3397^{***}	480
CHOICE (overall)	73.1 (6.17)	78.4 (4.63)	73.1 (4.63)	0.2928^{***}	374
- if $(v_{it}, v_{-it}) = (1, 1)$:	72.2 (6.64)	83.0 (5.08)	72.2 (6.49)	0.2830^{***}	216
- if $(v_{it}, v_{-it}) = (1, 0)$:	60.7 (9.58)	70.6 (8.24)	87.7 (10.15)	0.2922^{***}	79
- if $(v_{it}, v_{-it}) = (0, 1)$:	87.7 (10.60)	73.5 (8.76)	60.7 (7.67)	0.3203^{***}	79

Note: Observations from the BELIEFS treatment only (48 individuals A or B). Calculated are average efforts, average estimate of the effort of co-player's (A or B), average actual effort of the co-player, and correlation Corr(μ_i, x_{-i}) between estimated and actual effort of the co-player (Spearman's ρ), for players i=A,B, conditional on the own vote v_{it} and the co-player's vote v_{-it} on whether to vote for alliance formation (v_{it}=1 if, in round t, i voted for the "2-1" contest). Standard errors in parentheses (clustered at the individual level); *** significant at 1%.

Table 5: Alliance effort and beliefs about co-player's effort in the "2-1" contest conditional on the choices on alliance formation.

under unanimity are more homogeneously and adversely composed of weak players. The strong adverse composition effect is compensated for by other effects of endogenous alliance formation such that total alliance effort is not significantly different in exogenously and unanimously formed alliances.

On beliefs about co-players' effort. Players who vote for the "1-1-1" contest and players who vote for the "2-1" contest tend to be different, and this matters for beliefs. Individuals who vote against alliance formation and who end up being in an alliance in the CHOICE phase know that their co-player wanted to form an alliance – which seemingly goes hand-in-hand with lower effort levels (see the result on selection in Section 3.1). If an individual is highly motivated (has low subjective effort cost) and if this individual wants to maintain his chances of winning in the "2-1" contest, he will, in equilibrium, make up for the lower effort of his co-player by increasing his own effort. Thus, the effort increase of strong players might be interpreted as a behavior that accommodates to the co-player's anticipated behavior, as further discussed below.

Table 5 summarizes the stated beliefs about the co-player's effort in "2-1" contests of both the

NO CHOICE and the CHOICE phase, in the latter conditional on the players' votes on alliance formation (v_{it} and v_{-it}). First, note that beliefs are affected by a player's own type: Individuals tend to consider their own effort choices as a benchmark, causing own effort x_i and the belief μ_i about the co-player's effort to be positively correlated (the Spearman correlation coefficient is 0.4477^{***}). That is, introspection seems to play a substantial role.

Second, individual estimates μ_i of the co-player's effort tend to be informed and are significantly positively correlated with the actual effort x_{-i} of the co-player (compare the correlation coefficients in column 5 of Table 5). Third, players anticipate higher efforts in the CHOICE phase compared to NO CHOICE: The increase by 5.2 points mirrors the coefficient of "CHOICE" in the effort regressions in Table 4 above.

Finally, separating the beliefs in CHOICE according to the votes on alliance formation yields mixed results. In particular, weak types do not anticipate the high effort of individuals who voted against alliance formation (case $(v_{it}, v_{-it}) = (1, 0)$). Taking into account that own effort is seemingly a benchmark, players with $v_{it} = 1$ expect approximately 10 points more from their co-player than they themselves invest, independent of the co-player's vote.[54] By a related argument, however, the only incidence in which players expect lower effort from the co-player compared to own effort is the case of strong types who voted against alliance formation and end up in an alliance with a weak type (case $(v_{it}, v_{-it}) = (0, 1)$). The latter result is in line with the observed self-selection of weak types into alliances and the interpretation of Result 6 on the effort increase of strong types.[55]

3.3 Effort of out-group players C in "2-1" contests

The process of endogenous alliance formation has interesting welfare implications. Although endogenously formed alliances may be able to mobilize more effort, their probability of winning is *not* higher compared to exogenously formed alliances. This is due to the reaction of the out-group player C. Thus, the players' payoffs are slightly lower in the case of endogenously formed alliances.

Remember that the roles of the subjects were fixed throughout the experiment. Also recall that player C has no influence on whether he fights against an alliance or against two single players. Hence, there is no selection effect for players C. Estimating player C's effort choice in parallel to the estimations for the effort of players A and B (from Table 4), we find that C's effort against voluntarily formed alliances (CHOICE) is slightly higher than C's effort against

[54] Beliefs can be interpreted as "overly optimistic," both compared to the actual effort of the co-player (which is overestimated with the exception of $(v_{it}, v_{-it}) = (1, 0)$) and compared to own effort (which is lower with the exception of $(v_{it}, v_{-it}) = (0, 1)$).

[55] In Table A.2 in the appendix we also show that players C expect the alliance to expend less effort if both alliance players voted for alliance formation (and are 'weak') than if only one alliance player voted for alliance formation, in line with actual alliance effort. We further show that in "1-1-1" contests, players generally expect less effort from their co-players. Only the players who voted in favor of alliance formation anticipate higher effort from a player who decided against alliance formation (and is a 'strong' type).

exogenously formed alliances. The increase is, however, only marginally significant (the regression results are in Table A.3 of the appendix).[56]

Out-group players C knew whether the alliance they were facing had been formed voluntarily and they knew the alliance players' individual voting decisions (there was complete information at the contest stage). Separating player C's effort choice according to whether one or both of the alliance players voted for alliance formation, we find that the out-group player's effort is lower (by 12 points) when facing an alliance wherein both individuals had voted for alliance formation than when facing an alliance wherein one of the alliance members had voted for standing alone (compare the coefficient of "$I_{(v_{A,t},v_{B,t})=(1,1)}\times$CHOICE" in estimation 2 of Table A.3). This can constitute optimizing behavior in response to alliance effort which is highest whenever the alliance contains 'strong types' who actually prefer to fight on their own.[57]

Estimation 3 of Table A.3 establishes that player C positively reacts to the lagged effort of players A and B he observed in the "2-1" contest which took place in the previous round. This lagged reaction emerges even though players are re-matched in each round. The magnitude of the reaction is slightly larger than the reaction of total alliance effort to C's lagged effort (compare estimation 3 of Table 4). In contrast to alliance effort, however, the effect of endogenous alliance formation ("CHOICE") on C's effort becomes insignificant once we control for the higher alliance effort via the lagged effort $x^{2-1}_{AB,t-1}$.

Overall, the out-group player C reacts less strongly to endogenous alliance formation than players A and B who actually made this choice. The institutional variation in CHOICE also has implications for endogenous stand-alone play by players A and B in "1-1-1" contests, and we refer the interested reader to Appendix A.5 where we show that effort under endogenously chosen stand-alone play is higher than under exogenous stand-alone play and is highest among players who voted for the "1-1-1" contest, which can be interpreted as a direct consequence of self-selection of strong types into stand-alone play.

4 Conclusion

Our analysis aimed at a better understanding of self-selection into alliances and its implications for contest behavior. Why are alliances formed? Which factors or circumstances determine whether an individual prefers to form an alliance or to stand alone? What are the implications of voluntary alliance formation for the contest outcome? We find that players who vote for alliance formation and players who vote against alliance formation are different. The differences strongly correlate

[56]In the *UNANIMITY* treatment, player C's effort does not increase in CHOICE, similar to the result for players A and B (testing the joint significance of "CHOICE" and "UNANIMITY_CHOICE" in estimation 3 of Table A.3 yields a p-value of 0.2491).

[57]The *BELIEFS* treatment confirms that player C expects the alliance to expend less effort if both alliance players voted for alliance formation than if only one alliance player voted for alliance formation, in line with actual alliance effort, see Table A.2.

with the differences in the motivation to expend effort under exogenous stand-alone play. Key insights from our analysis are as follows.

(1) Players who are committed to expending amounts of effort that are above average are inclined to stand alone. In this respect, our analysis is in line with the behavioral choice of Friedrich Schiller's protagonist William Tell, who considers himself as a strong player and decides to stand alone. Strong players win with a higher-than-average probability when standing alone and gain a much lower expected resource share when in an alliance. The finding on self-selection is thus in line with the rational choice calculus of the players. Players who have a lower subjective effort cost (or a higher subjective valuation of winning the contest) anticipate that they will contribute more effort than others and that, in an alliance, other players inside their alliance may free-ride on them. This makes such strong players bear a disproportionately high share of the cost of alliance effort; logically, strong players have a stronger incentive to stand alone. The other players who are less eager to expend a lot of effort, however, benefit from this free-riding possibility.

(2) Selection occurs along heterogeneity in both intrinsic and extrinsic motivations. Players who have a low monetary and/or non-monetary cost of expending effort select predominantly into stand-alone contests, while players with a high monetary and/or non-monetary effort cost enter into endogenously formed alliances. Moreover, while the average probability of voting for alliance formation is higher under voting institutions which require unanimity, the self-selection of weak types is more severe in unanimously formed alliances.

(3) Whether players team up in an alliance on a voluntary basis or are exogenously assigned to be a member of an alliance is important for their performance in the alliance. On average, players in a voluntary alliance expend more resources than players in an exogenous alliance. The higher effort in voluntary alliances is not a consequence of straightforward selection, but occurs even though there is a selection effect that downward biases the effort in the voluntary alliance. This result is in line with results on in-group favoritism in psychology if one assumes that the voluntary association of an alliance has stronger group-formation power than the simple exogenous formation of alliances.

(4) The effort increase in endogenously formed alliances is largest for 'strong' players who actually voted against alliance formation. Consequently, the efforts of unanimously formed alliances are lower. Strong types who voted against alliance formation seem to correctly anticipate the lower effort choice of their fellow alliance member who voted in favor of alliance formation. In order to compensate for this low effort and to keep their chances of winning high, they strongly increase their own effort. Their alliance partners, in turn, reduce their effort contribution. Similar strategic reactions can be observed on the part of the out-group players who, facing voluntarily formed alliances, choose particularly high effort when fighting against an alliance wherein one of the players voted against alliance formation and subsequently chooses high effort.

Overall, we find that players who are willing to expend high effort correctly anticipate that they will be exploited in an alliance and hence prefer to stand alone. We also find evidence of higher in-group favoritism in endogenously formed alliances that compensates for the negative effect of the selection of weak players into alliances. These findings have important implications for curbing or intensifying competition in contests and tournaments or, more specifically, for the design of work structures in labor markets. A contest designer interested in maximizing the total effort expended can best achieve this goal by preventing the formation of teams and letting the individuals interact as stand-alone players. However, a substantial share of individuals seems to prefer competing in groups. Taking this preference for alliance formation into account, it is advisable to let individuals freely choose whether or not to form groups. It strengthens their willingness to contribute to group success more than if a team structure is imposed on them. This holds despite the fact that voluntary group formation leads to less win-motivated individuals selecting into the team. Moreover, as individuals understand this selection effect and react to it when choosing their own contribution, a contest designer who wants to elicit high effort choices may prefer to team up 'weak' and 'strong' individuals: In our experiment, the largest increase of group effort is observed in "mixed" alliances where an individual who voted against alliance formation (over)compensated for the low expected effort of his co-player (this also holds for the total effort of all three players). Therefore, while participant involvement in the procedure of alliance formation leads to stronger in-group solidarity, a procedure that benefits such types of mixed group compositions may also be desirable when designing tournament environments.

References

[1] Abbink, Klaus, Jordi Brandts, Benedikt Herrmann, and Henrik Orzen, 2010, Intergroup conflict and intra-group punishment in an experimental contest game, American Economic Review 100(1), 420-447.

[2] Ahn, T. K., R. Mark Isaac, and Timothy C. Salmon, 2008, Endogenous group formation, Journal of Public Economic Theory 10(2), 171-194.

[3] Ahn, T. K., R. Mark Isaac, and Timothy C. Salmon, 2009, Coming and going: Experiments on endogenous group sizes for excludable public goods, Journal of Public Economics 93(1-2), 336-351.

[4] Ahn, T. K., R. Mark Isaac, and Timothy C. Salmon, 2011, Rent-seeking in groups, International Journal of Industrial Organization 29, 116-125.

[5] Aimone, Jason, Laurence R. Iannaccone, Michael D. Makowsky, and Jared Rubin, 2013, Endogenous group formation via unproductive costs, Review of Economic Studies 80(4), 1215-1236.

[6] Altmann, Steffen, Armin Falk, and Matthias Wibral, 2012, Promotions and incentives: The case of multi-stage elimination tournaments, Journal of Labor Economics 30(1), 149-174.

[7] Amaldoss, Wilfred, and Amnon Rapoport, 2005, Collaborative product and market development: Theoretical implications and experimental evidence, Marketing Science 24(3), 396-414.

[8] Amaldoss, Wilfred, and Amnon Rapoport, 2009, Excessive expenditures in two-stage contests: Theory and experimental evidence. In: Ingrid N. Hangen and Anna S. Nilsen (Eds.), Game Theory: Strategies, Equilibria, and Theorems, Nova Science Publishers, NY, 241-266.

[9] Amegashie, J. Atsu, Charles B. Cadsby, and Yang Song, 2007, Competitive burnout: Theory and experimental evidence, Games and Economic Behavior 59, 213-239.

[10] Babcock, Philip, Kelly Bedard, Gary Charness, John Hartman, and Heather Royer, 2014, Letting down the team? Social effects of team incentives, mimeo, Department of Economics, University of California, Santa Barbara.

[11] Baik, Kyung Hwan, and Sanghack Lee, 2001, Strategic groups and rent dissipation, Economic Inquiry 39(4), 672-684.

[12] Balafoutas, Loukas, Rudolf Kerschbamer, and Matthias Sutter, 2012, Distributional preferences and competitive behavior, Journal of Economic Behavior & Organization 83(1), 125-135.

[13] Benenson, Joyce F., Henry Markovits, Melissa E. Thompson, and Richard W. Wrangham, 2009, Strength determines coalitional strategies in humans, Proceedings of the Royal Society B: Biological Sciences 276, 2589-2595.

[14] Bernhard, Helen, Urs Fischbacher, and Ernst Fehr, 2006, Parochial altruism in humans, Nature 442(7105), 912-915.

[15] Bloch, Francis, 2012, Endogenous formation of alliances in contests. In: Michelle R. Garfinkel and Stergios Skaperdas (Eds.), Oxford Handbook of the Economics of Peace and Conflict, Oxford University Press, 473-502.

[16] Bloch, Francis, Santiago Sanchez-Pages ,and Raphael Soubeyran, 2006, When does universal peace prevail? Secession and group formation in conflict, Economics of Governance 7, 3-29.

[17] Boun My, Kene, and Benoît Chalvignac, 2010, Voluntary participation and cooperation in a collective-good game, Journal of Economic Psychology 31(4), 705-718.

[18] Brewer, Marilynn B., 1979, In-group bias in the minimal intergroup situation: A cognitive-motivational analysis, Psychological Bulletin 86(2), 307-324.

[19] Cason, Timothy N., William A. Masters, and Roman M. Sheremeta, 2010, Entry into winner-take-all and proportional-prize contests: An experimental study, Journal of Public Economics 94(9-10), 604-611.

[20] Cason, Timothy N., Roman M. Sheremeta, and Jingjing Zhang, 2012, Communication and efficiency in competitive coordination games, Games and Economic Behavior 76(1), 26-43.

[21] Chark, Robin, Amnon Rapoport, and Rami Zwick, 2011, Experimental comparison of two multiple-stage contest designs with asymmetric players, Public Choice 147(3), 305-329.

[22] Charness, Gary, Luca Rigotti, and Aldo Rustichini, 2007, Individual behavior and group membership, American Economic Review 97(4), 1340-1352.

[23] Charness, Gary, and Chun-Lei Yang, 2013, Starting small towards voluntary formation of efficient large groups in public goods provision, Journal of Economic Behavior & Organization 102, 119-132.

[24] Chen, Roy, and Yan Chen, 2011, The potential of social identity for equilibrium selection, American Economic Review 101(6), 2562-2589.

[25] Chen, Yan, and Sherry Xin Li, 2009, Group identity and social preferences, American Economic Review 99(1) 431-457.

[26] Cherry, Todd L., and Stephen J. Cotten, 2011, Sleeping with the enemy: The economic cost of internal environmental conflicts, Economic Inquiry 49(2), 530-539.

[27] Cherry, Josh, Stephen Salant, and Neslihan Uler, 2014, Experimental departures from self-interest when competing partnerships share output, Experimental Economics, doi:10.1007/s10683-014-9413-0.

[28] Dal Bo, Pedro, Andrew Foster, and Louis Putterman, 2010, Institutions and behavior: Experimental evidence on the effects of democracy, American Economic Review 100(5), 2205-2229.

[29] Dannenberg, Astrid, Andreas Lange, and Bodo Sturm, 2014, Participation and commitment in voluntary coalitions to provide public goods, Economica 81(322), 257-275.

[30] Dechenaux, Emmanuel, Dan Kovenock, and Roman M. Sheremeta, 2014, A survey of experimental research on contests, all-pay auctions and tournaments, Experimental Economics, doi:10.1007/s10683-014-9421-0.

[31] Dohmen, Thomas, and Armin Falk, 2011, Performance pay and multidimensional sorting: Productivity, preferences, and gender, American Economic Review 101(2), 556-590.

[32] Dohmen, Thomas, Armin Falk, David Huffman, Uwe Sunde, Jürgen Schupp and Gert G. Wagner, 2011, Individual risk attitudes: Measurement, determinants, and behavioral consequences, Journal of the European Economic Association 9(3), 522-550.

[33] Eaton, B. Curtis, Mukesh Eswaran, and Robert J. Oxoby, 2011, 'Us' and 'them': The origin of identity, and its economic implications, Canadian Journal of Economics 44(3), 719-748.

[34] Ehrhart, Karl-Martin, and Claudia Keser, 1999, Mobility and cooperation: On the run, CIRANO Working Paper No. 99s-24.

[35] Eriksson, Tor, Sabrina Teyssier, and Marie-Claire Villeval, 2009, Self-selection and the efficiency of tournaments, Economic Inquiry 47(3), 530-548.

[36] Esteban, Joan M., and Debraj Ray, 2001, Collective action and the group size paradox, American Political Science Review 95(3), 663-672.

[37] Esteban, Joan M., and József Sákovics, 2003, Olson vs. Coase: Coalitional worth in conflict, Theory and Decision 55(4), 339-357.

[38] Fischbacher, Urs, 2007, Z-tree: Zurich tool box for ready-made economic experiments, Experimental Economics 10(2), 171-178.

[39] Garfinkel, Michelle R., 2004, Stable alliance formation in distributional conflict, European Journal of Political Economy 20, 829-852.

[40] Goette, Lorenz, David Huffman, and Stephan Meier, 2012a, The impact of social ties on group interactions: Evidence from minimal groups and randomly assigned real groups, American Economic Journal: Microeconomics 4(1), 101-115.

[41] Goette, Lorenz, David Huffman, Stephan Meier, and Matthias Sutter, 2012b, Competition between organizational groups: Its impact on altruistic and antisocial motivations, Management Science 58(5), 948-960.

[42] Greiner, Ben, 2004, An online recruitment system for economic experiments. In: Kurt Kremer, Volker Macho (eds.): Forschung und wissenschaftliches Rechnen 2003, GWDG Bericht 63, Göttingen: Ges. für Wiss. Datenverarbeitung, 79-93.

[43] Gulick, Edward V., 1955, Europe's classical balance of power: A case history of the theory and practice of one of the great concepts of European statecraft, Cornell University Press for the American Historical Association.

[44] Herrmann, Benedikt, and Henrik Orzen, 2008, The appearance of homo rivalis: social preferences and the nature of rent seeking, CeDEx Discussion Paper No. 2008-10.

[45] Holmstrom, Bengt, 1982, Moral hazard in teams, Bell Journal of Economics 13(2), 324-340.

[46] Katz, Eliakim, Shmuel Nitzan, and Jacob Rosenberg, 1990, Rent-seeking for pure public goods, Public Choice 65(1), 49-60.

[47] Ke, Changxia, Kai. A. Konrad, and Florian Morath, 2013, Brothers in arms - An experiment on the alliance puzzle, Games and Economic Behavior 77(1), 61-76.

[48] Ke, Changxia, Kai A. Konrad, and Florian Morath, 2014, Alliances in the shadow of conflict, Economic Inquiry, doi: 10.1111/ecin.12151.

[49] Keser, Claudia, and Claude Montmarquette, 2011, Voluntary versus enforced team effort, Games 2, 277-301.

[50] Kimball, Anessa L., 2006, Alliance formation and conflict initiation: The missing link, Journal of Peace Research 43(4), 371-389.

[51] Kocher, Martin, Sabine Strauß, and Matthias Sutter, 2006, Individual or team decision-making - Causes and consequences of self-selection, Games and Economic Behavior 56(2), 259-270.

[52] Konrad, Kai A., 2009, Strategy and dynamics in contests, Oxford University Press.

[53] Konrad, Kai A., 2014, Strategic aspects of fighting in alliances, in: Karl Wärneryd (ed.), The Economics of Conflict, Theory and Empirical Evidence, MIT Press, 1-22.

[54] Konrad, Kai A., and Dan Kovenock, 2009, The alliance formation puzzle and capacity constraints, Economics Letters 103, 84-86.

[55] Konrad, Kai A., and Florian Morath, 2012, Evolutionarily stable in-group favoritism and out-group spite in intergroup conflict, Journal of Theoretical Biology 306, 61-67.

[56] Kovenock, Dan, and Brian Roberson, 2012, Coalitional Colonel Blotto games with application to the economics of alliances, Journal of Public Economic Theory 14(4), 653-676.

[57] Kuhn, Peter, and Marie Claire Villeval, 2014, Are women more attracted to co-operation than men?, The Economic Journal, doi: 10.1111/ecoj.12122.

[58] Lazear, Edward P., and Sherwin Rosen, 1981, Rank-order tournaments as optimum labor contracts, Journal of Political Economy 89(5), 841-864.

[59] Lazear, Edward P., and Kathryn L. Shaw, 2007, Personnel economics: The economist's view of human resources, Journal of Economic Perspectives 21(4), 91-114.

[60] Li, Sherry Xin, Kutsal Dogan, and Ernan Haruvy, 2011, Group identity in markets, International Journal of Industrial Organization 29, 104-115.

[61] Luhtanen, Riia, and Jennifer Crocker, 1992, A Collective Self-Esteem Scale: Self-Evaluation of One's Social Identity, Personality and Social Psychology Bulletin 18(3), 302-318.

[62] Malueg, David A., and Andrew J. Yates, 2004, Rent seeking with private values, Public Choice 119(1-2), 161-178.

[63] Maynard Smith, John, 1974, The theory of games and the evolution of animal conflicts, Journal of Theoretical Biology 47, 209-221.

[64] Millner, Edward L., and Michael D. Pratt, 1991, Risk aversion and rent-seeking: An extension and some experimental evidence, Public Choice 69, 81-92.

[65] Morgan, John, Henrik Orzen, and Martin Sefton, 2012, Endogenous entry in contests, Economic Theory 51(2), 435-463.

[66] Morgenthau, Hans J., 1963, Politics among nations: The struggle for power and peace.

[67] Münster, Johannes, 2009, Repeated contests with asymmetric information, Journal of Public Economic Theory 11(1), 89-118.

[68] Nalbantian, Haig R., and Andrew Schotter, 1997, Productivity under group incentives: An experimental study, American Economic Review 87(3), 314-341.

[69] Nitzan, Shmuel, 1991, Collective rent dissipation, Economic Journal 101(409), 1522-1534.

[70] Olson, Mancur, and Richard Zeckhauser, 1966, An economic theory of alliances, The Review of Economics and Statistics 48(3), 266-279.

[71] Page, Talbot, Louis Putterman, and Bulent Unel, 2005, Voluntary association in public goods experiments: Reciprocity, mimicry and efficiency, Economic Journal 115(506), 1032-1053.

[72] Parco, James E., Amnon Rapoport, and Wilfred Amaldoss, 2005, Two-stage contests with budget constraints: An experimental study, Journal of Mathematical Psychology 49(4), 320-338.

[73] Potters, Jan C., Casper G. de Vries, and Frans van Winden, 1998, An experimental examination of rational rent seeking, European Journal of Political Economy 14, 783-800.

[74] Price, Curtis R., and Roman M. Sheremeta, 2012, Endowment origin, demographic effects and individual preferences in contests, Chapman University, Economic Science Institute, Working Paper No. 12-07.

[75] Ryvkin, Dmitry, 2010, Contests with private costs: Beyond two players, European Journal of Political Economy 26(4), 558-567.

[76] Sachdev, Itesh, and Richard Y. Bourhis, 1987, Status differentials and intergroup behaviour, European Journal of Social Psychology 17(3), 277–293.

[77] Sachdev, Itesh, and Richard Y. Bourhis, 1991, Power and status differentials in minority and majority group relations, European Journal of Social Psychology 21(1), 1–24.

[78] Sanchez-Pages, Santiago, 2007a, Endogenous coalition formation in contests, Review of Economic Design 11, 139-163.

[79] Sanchez-Pages, Santiago, 2007b, Rivalry, exclusion, and coalitions, Journal of Public Economic Theory 9(5), 809-830.

[80] Schiller, Friedrich von, 1804, Wilhelm Tell, J. G. Cotta, Tübingen. Translation by Theodore Martin, 2007, Dodo Press.

[81] Shayo, Moses, and Asaf Zussman, 2011, Judicial ingroup bias in the shadow of terrorism, The Quarterly Journal of Economics 126, 1447-1484.

[82] Sheremeta, Roman M., 2010a, Expenditures and information disclosure in two-stage political contests, Journal of Conflict Resolution 54(5), 771-798.

[83] Sheremeta, Roman M., 2010b, Experimental comparison of multi-stage and one-stage contests, Games and Economic Behavior 68, 731-747.

[84] Sheremeta, Roman M., 2013, Overbidding and heterogeneous behavior in contest experiments, Journal of Economic Surveys 27(3), 491-514.

[85] Sheremeta, Roman M., and Jingjing Zhang, 2010, Can groups solve the problem of overbidding in contests?, Social Choice and Welfare 35(2), 175-197.

[86] Sherif, Muzafer, O.J. Harvey, B. Jack White, William R. Hood, and Carolyn W. Sherif, 1961, Intergroup conflict and cooperation: The robber cave experiment, Norman, Oklahoma: University Books.

[87] Skaperdas, Stergios, 1998, On the formation of alliances in conflict and contests, Public Choice 96, 25-42.

[88] Smith, Adam C., David B. Skarbek, and Bart J. Wilson, 2012, Anarchy, groups, and conflict: An experiment on the emergence of protective associations, Social Choice and Welfare 38(2), 325-353.

[89] Sorokin, Gerald L., 1994, Arms, alliances, and security tradeoffs in enduring rivalries, International Studies Quarterly 38(3), 421-446.

[90] Sutter, Matthias, 2009, Individual behavior and group membership: Comment, American Economic Review 99(5), 2247-2257.

[91] Sutter, Matthias, Stefan Haigner, and Martin G. Kocher, 2010, Choosing the carrot or the stick? Endogenous institutional choice in social dilemma situations, Review of Economic Studies 77(4), 1540-1566.

[92] Sutter, Matthias, and Christina Strassmair, 2009, Communication, cooperation and collusion in team tournaments - An experimental study, Games and Economic Behavior 66(1), 506-525.

[93] Tajfel, Henri, 1982, Social psychology of intergroup relations, Annual Review of Psychology, 33, 1-39.

[94] Tajfel, Henri, and John Turner, 1979, An integrative theory of intergroup conflict. In: William Austin and Stephen Worchel (Eds.), The Social Psychology of Intergroup Relations, Monterey, CA, Brooks/Cole Publ., 33-48.

[95] Tan, Guofu, and Ruqu Wang, 2010, Coalition formation in the presence of continuing conflict, International Journal of Game Theory 39, 273-299.

[96] Tullock, Gordon, 1980, Efficient rent seeking. In: James M. Buchanan, Robert D. Tollison, and Gordon Tullock (Eds.), Toward a Theory of the Rent-Seeking Society, Texas A&M University Press, 97-112.

[97] Ursprung, Heinrich W., 1990, Public goods, rent dissipation, and candidate competition, Economics and Politics 2, 115-132.

[98] Waltz, Kenneth N., 1979, Theory of international politics, McGraw-Hill.

[99] Wasser, Cédric, 2013, Incomplete information in rent-seeking contests, Economic Theory 53(1), 239-268.

A Appendix

A.1 Proof of Proposition 1

In this appendix, we first provide more details on the equilibrium in the two contest subgames and then compare the players' expected payoffs in these contests.

The "1-1-1" contest. In the "1-1-1" contest, each player $i \in \{A, B, C\}$ chooses a nonnegative effort x_i; the choices are made simultaneously and independently. The vector of effort choices (x_A, x_B, x_C) determines i's expected payoff as

$$\pi_i^{1-1-1} = p_i V - k_i x_i, \;\; i \in \{A, B, C\}.$$

Here, p_i constitutes the probability that player $i \in \{A, B, C\}$ wins the contest, in which case he is attributed a prize of value V. With probability $1 - p_i$, player i does not win and is attributed a prize of value zero. Independent of winning or losing the contest, i has to bear the cost of his own effort x_i, which is assumed to be equal to $k_i x_i$, $k_i > 0$. Player i's probability of winning is given by

$$p_i = \frac{x_i}{x_A + x_B + x_C}$$

if $x_A + x_B + x_C > 0$, and $p_i = 1/3$ if all three contestants expend zero effort. The Nash equilibrium of this contest is known to be unique and can be determined using the first order conditions[58]

$$\frac{X - x_i}{X^2} V = k_i, \; i \in \{A, B, C\}$$

where $X = \sum_{i=A,B,C} x_i$. Solving for X, we get total equilibrium effort as

$$X^{1-1-1} = \sum_i x_i = \frac{(n-1)}{\sum_i k_i} V,$$

and substituting X into i's first order condition yields equilibrium effort of i as

$$x_i^{1-1-1} = \frac{(n-1)\left(\sum_i k_i - (n-1)\, k_i\right)}{\left(\sum_i k_i\right)^2} V, \;\; i \in \{A, B, C\} \tag{5}$$

where $n = 3$ is the number of contestants.[59]

[58] Note that the maximization problem is well behaved and the first order conditions are sufficient for the equilibrium characterization.

[59] The assumptions on k_i ($\Delta < k/3$ in particular) guarantee that $x_i > 0$ for all three contestants.

Given equilibrium effort choices, we can compute i's equilibrium expected payoff as

$$\pi_i^{1-1-1} = \frac{\left(\sum_i k_i - (n-1)\, k_i\right)^2}{\left(\sum_i k_i\right)^2} V, \quad i \in \{A, B, C\}\,. \tag{6}$$

The "2-1" contest. In the "2-1" contest, players A and B are in alliance and compete against player C. As in "1-1-1", each player $i \in \{A, B, C\}$ chooses a nonnegative effort x_i, and all players choose their effort independently and simultaneously. The vector of action choices (x_A, x_B, x_C) determines the individual expected payoff as

$$\begin{aligned} \pi_i^{2-1} &= p_{AB}\frac{V}{2} - k_i x_i \quad \text{for } i \in \{A, B\}\,, \\ \pi_C^{2-1} &= (1 - p_{AB})V - k_C x_C, \end{aligned}$$

where the probability p_{AB} that the alliance of A and B will win is defined as

$$p_{AB} = \frac{x_A + x_B}{x_A + x_B + x_C} \tag{7}$$

if $x_A + x_B + x_C > 0$ and $p_{AB} = 1/2$ otherwise. If the alliance wins, players A and B receive equal shares of the prize V; if player C wins, he gets the full prize V. All losers get a prize of zero. By (7), the alliance's probability of winning depends on the sum of the alliance members' efforts and not on the composition of $x_A + x_B$; alliance members' efforts are perfect substitutes when determining the alliance's win probability.

Maximizing the expected payoff of player $i \in \{A, B\}$ yields the first order conditions

$$\frac{x_C}{(x_A + x_B + x_C)^2}\frac{V}{2} = k_i,\ i \in \{A, B\}\,.$$

Since the left-hand side of this equation (the marginal benefit of increasing x_i) is the same for both A and B, the equilibrium is a corner solution if $k_A \neq k_B$: Only the player $i \in \{A, B\}$ with the lower unit cost k_i chooses strictly positive effort, and the other player free-rides. If $k_A = k_B$, however, the "2-1" contest has multiple equilibria that differ in the individual payoff of the alliance players; joint alliance effort is identical in all equilibria.[60]

Therefore, suppose first that $k_A < k_B$. Then, in equilibrium, only A and C choose positive

[60] See, e.g., Katz et al. (1990) and Nitzan (1991).

effort, and equilibrium efforts are equal to[61]

$$x_A^{2-1} = \frac{k_C}{(2k_A+k_C)^2}V \quad \text{and} \quad x_B^{2-1}=0,$$
$$x_C^{2-1} = \frac{2k_A}{(2k_A+k_C)^2}V.$$

Moreover, expected equilibrium payoffs are

$$\pi_A^{2-1} = \frac{k_C^2}{(2k_A+k_C)^2}\frac{V}{2} \tag{8}$$

and

$$\pi_B^{2-1} = p_{AB}\frac{V}{2} = \frac{k_C}{2k_A+k_C}\frac{V}{2} \tag{9}$$

for the alliance players and

$$\pi_C^{2-1} = \frac{(2k_A)^2}{(2k_A+k_C)^2}V$$

for the out-group player.

Now suppose that $k_A = k_B$. Here, we have a continuum of equilibria where effort choices are such that

$$(x_A+x_B)^{2-1} = \frac{k_C}{(2k_A+k_C)^2}V \quad \text{and} \quad x_C^{2-1} = \frac{2k_A}{(2k_A+k_C)^2}V.$$

Total effort of the alliance and of player C, respectively, remain as in the case of $k_A < k_B$, but now individual efforts x_A and x_B are not uniquely determined. This yields expected equilibrium payoffs of

$$(\pi_A+\pi_B)^{2-1} = \frac{k_C(k_A+k_C)}{(2k_A+k_C)^2}V \quad \text{and} \quad \pi_C^{2-1} = \frac{(2k_A)^2}{(2k_A+k_C)^2}V.$$

In the symmetric equilibrium with $x_A = x_B$, we have

$$\pi_A^{2-1} = \pi_B^{2-1} = \frac{k_C(k_A+k_C)}{(2k_A+k_C)^2}\frac{V}{2}. \tag{10}$$

Comparison. We now compare the expected payoff of a player $i \in \{A,B\}$ in these two contest subgames in two separate steps for 'weak' and for 'strong' types. We consider the case where $k_i \in \{k-\Delta, k+\Delta\}$ for $i = A, B$ and $k_C = k$.[62] If players A and B are symmetric ($k_A = k_B$), we select the equilibrium with $x_A = x_B$ in the "2-1" contest subgame.

Step 1: Suppose that player A is a weak type with $k_A = k+\Delta$. If B also is a weak type

[61] This can easily be verified by using the results for the "1-1-1" contest: Since player A only gets $V/2$ in case the alliance wins, we can obtain his equilibrium effort by setting $k_A^{'} = 2k_A$ and $n = 2$ in equation (5) above.

[62] Recall that differences in effort cost can be due to differences in monetary and/or non-monetary motivations. This includes the case in which k is a common monetary cost component and Δ captures both the differences in monetary and in psychological effort cost across players A and B.

$(k_B = k + \Delta)$, then, by (6),

$$\pi_A^{1-1-1} = \frac{(3k + 2\Delta - 2(k + \Delta))^2}{(3k + 2\Delta)^2} V = \frac{k^2}{(3k + 2\Delta)^2} V.$$

Moreover, using (10), in the symmetric equilibrium of the "2-1" contest A gets

$$\pi_A^{2-1} = \frac{k(2k + \Delta)}{(3k + 2\Delta)^2} \frac{V}{2} = \frac{k^2 + \frac{1}{2}k\Delta}{(3k + 2\Delta)^2} V > \pi_A^{1-1-1}.$$

If instead $k_B = k - \Delta$, then

$$\pi_A^{1-1-1} = \frac{(3k - 2(k + \Delta))^2}{(3k)^2} V = \frac{(k - 2\Delta)^2}{(3k)^2} V,$$

while in the "2-1" contest A's payoff is

$$\pi_A^{2-1} = \frac{k}{3k - 2\Delta} \frac{V}{2}.$$

Hence, $\pi_A^{2-1} > \pi_A^{1-1-1}$ is equivalent to

$$\frac{k}{2}(3k)^2 > (3k - 2\Delta)(k - 2\Delta)^2 \Leftrightarrow \frac{3}{2}k^3 + 2\Delta\left(3k^2 - 2k\Delta + (2k - 2\Delta)^2\right) > 0$$

which is true by assumption of $\Delta < k$. Altogether, a weak player A is strictly better off in the "2-1" contest, independently of B's type.

Step 2: Suppose that player A is a strong type with $k - \Delta$. If $k_B = k - \Delta$, then, by (6),

$$\pi_A^{1-1-1} = \frac{(3k - 2\Delta - 2(k - \Delta))^2}{(3k - 2\Delta)^2} V = \frac{k^2}{(3k - 2\Delta)^2} V.$$

Moreover, using (10), in the symmetric equilibrium we have

$$\pi_A^{2-1} = \frac{k(k - \Delta + k)}{(3k - 2\Delta)^2} \frac{V}{2} = \frac{k^2 - \frac{1}{2}k\Delta}{(3k - 2\Delta)^2} V < \pi_A^{1-1-1}.$$

If instead $k_B = k + \Delta$, then

$$\pi_A^{1-1-1} = \frac{(3k - 2(k - \Delta))^2}{(3k)^2} V = \frac{(k + 2\Delta)^2}{(3k)^2} V$$

and

$$\pi_A^{2-1} = \frac{k^2}{(3k - 2\Delta)^2} \frac{V}{2}.$$

Since $\pi_A^{2-1} < V/2$, it holds that $k^2/\left(3k-2\Delta\right)^2 < 1$ and hence

$$\pi_A^{2-1} = \frac{k^2}{\left(3k-2\Delta\right)^2}\frac{V}{2} = \frac{k^2}{\left(3k\right)^2 - \left(12k\Delta - \left(2\Delta\right)^2\right)}\frac{V}{2} < \frac{k^2 + 12k\Delta - \left(2\Delta\right)^2}{\left(3k\right)^2}\frac{V}{2}.$$

Thus, it is sufficient to show that

$$\left(k^2 + 12k\Delta - \left(2\Delta\right)^2\right)\frac{V}{2} < \left(k+2\Delta\right)^2 V \Leftrightarrow \left(k-2\Delta\right)^2 + 8\Delta^2 > 0,$$

which implies that $\pi_A^{2-1} < \pi_A^{1-1-1}$.

Steps 1 and 2 complete the proof of Proposition 1.

A.2 Summary statistics

Average probability to vote for alliance formation (in %)

	BASE		*UNANIMITY*		*BELIEFS*		*HET-COST*	
	PAY21	PAY111	PAY21	PAY111	PAY21	PAY111	A	B
	48.6	62.9	63.1	64.0	51.4	58.6	46.7	74.4
	(4.16)	(3.50)	(4.45)	(4.48)	(7.40)	(7.71)	(6.94)	(6.25)

Average effort choice

	BASE		*UNANIMITY*		*BELIEFS*		*HET-COST*#		
	A or B	C	A or B	C	A or B	C	A	B	C
"2-1" contest	57.2	143.5	57.8	148.8	67.6	161.1	68.4	55.6	153.2
NO CHOICE	(2.97)	(9.26)	(3.57)	(10.57)	(5.28)	(13.83)	(6.74)	(7.15)	(17.17)
"2-1" contest	65.7	158.2	56.2	149.4	73.1	149.3	55.6	40.6	155.3
CHOICE	(3.66)	(10.58)	(4.21)	(11.89)	(6.15)	(14.12)	(8.60)	(5.44)	(16.96)
"1-1-1" contest	154.0	128.0	136.1	144.2	161.2	135.7	159.0	106.0	134.9
NO CHOICE	(6.53)	(8.04)	(8.25)	(11.41)	(11.46)	(11.85)	(15.41)	(12.79)	(12.13)
"1-1-1" contest	135.6	137.7	140.7	137.8	160.3	138.1	191.6	106.0	135.4
CHOICE	(6.31)	(9.43)	(7.72)	(9.55)	(10.75)	(12.82)	(20.86)	(17.26)	(17.30)

Individual characteristics

% male	38.5	39.6	40.3	45.8
	(3.21)	(4.09)	(5.82)	(5.91)
avg. age	23.5	24.0	23.1	22.0
	(0.31)	(0.41)	(0.41)	(0.38)
% econ stud.	26.0	29.2	25.0	44.4
	(42.89)	(3.80)	(5.14)	(5.90)

Note: Average probability to vote for alliance formation: in treatments BASE, UNANIMITY and BELIEFS depending on whether the session included a small incentivizing payment for a selection of the "2-1" contest (PAY21) or the "1-1-1" contest (PAY111); in treatment HET-COST separately for low-cost player (A) and high-cost player (B). Average effort by subgame ("2-1" or "1-1-1") and phase (NO CHOICE or CHOICE): in treatments BASE, UNANIMITY and BELIEFS separately for player A or B (individual effort) or player C; in treatment HET-COST separately for A, B, and C. Standard errors in parentheses (clustered at the individual level).
#Note that in HET-COST, the NO CHOICE phase was always played first.

Table A.1: Summary statistics.

A.3 Beliefs: additional results

Average own effort, beliefs and co-player's average effort, conditional on the votes on alliance formation in the respective round						
		BELIEFS of player C in "2-1" contests				
		Own effort x_C	Beliefs μ_C	Effort $\frac{x_{AB}}{2}$	Corr(μ_C, $\frac{x_{AB}}{2}$)	#obs.
	NO CHOICE	161.1 (14.03)	90.7 (7.51)	67.6 (4.65)	0.3985***	240
	CHOICE (overall)	149.3 (14.32)	92.5 (5.81)	73.1 (4.66)	0.2366***	187
-	if $(v_{At}, v_{Bt}) = (1,1)$:	136.7 (16.39)	89.3 (6.37)	72.2 (5.08)	0.2568***	108
-	if $(v_{At}, v_{Bt}) \in \{(0,1),(1,0)\}$	166.5 (13.90)	97 (8.79)	74.2 (6.86)	0.2194*	79
		BELIEFS of players A and B in "1-1-1" contests				
		Own effort x_i	Beliefs μ_i	Effort x_{-i}	Corr(μ_i, x_{-i})	#obs.
	NO CHOICE	161.2 (11.50)	143.5 (6.19)	161.2 (8.27)	0.1642**	240
	CHOICE (overall)	160.3 (10.79)	148.9 (7.66)	160.3 (7.46)	0.2878***	346
-	if $(v_{it}, v_{-it}) = (1,0)$:	113.8 (18.11)	160.2 (8.86)	183.9 (11.01)	0.2630***	101
-	if $(v_{it}, v_{-it}) = (0,1)$:	183.9 (13.88)	124.5 (9.58)	113.8 (13.12)	0.0984	101
-	if $(v_{it}, v_{-it}) = (0,0)$:	176.5 (10.33)	158.0 (10.53)	176.5 (8.02)	0.3119***	144

Note: Observations of the BELIEFS treatment. Beliefs of C in "2-1": Calculated are average effort of players C, average estimate of average alliance effort, average actual alliance effort and correlation Corr(μ_C,$\frac{x_{AB}}{2}$) between estimated and actual average alliance effort (Spearman's ρ), conditional on the votes v_{At} and v_{Bt} on alliance formation (v_{it}=1 if, in round t, i voted for the "2-1" contest). Beliefs of A and B in "1-1-1": Calculated are average own effort, average estimate of effort of co-player (A or B), average actual effort of co-player (A or B), and correlation Corr(μ_i, x_{-i}) between estimated and actual effort of co-players (Spearman's ρ), conditional on the own vote v_{it} and the co-player's vote v_{-it} on whether to vote for alliance formation (v_{it}=1 if, in round t, i voted for the "2-1" contest). ***(**,*) significant at 1%(5%,10%). Standard errors in parentheses (clustered at the individual level).

Table A.2: Beliefs of out-group players C in the "2-1" contest and beliefs of players A and B in the "1-1-1" contest, conditional on the votes on alliance formation.

A.4 Effort of out-group players in the "2-1" contest

Dependent variable: individual effort x_{Ct} of out-group player C in the "2-1" contest (alliance AB vs. player C)				
	BASE+UNANIMITY+BELIEFS			
Indep. var.	xtreg 1	xtreg 2	xtreg 3	xtreg 4
Constant	158.2***	157.8***	141.2***	158.4***
	(9.21)	(9.24)	(10.09)	(9.24)
CHOICE	5.2*	13.6***	6.3	4.7
(=1 if CHOICE phase	(2.87)	(4.51)	(3.94)	(3.38)
$I_{(v_{At},v_{B,t})=(1,1)} \times$CHOICE		-12.0**		
		(4.98)		
UNANIMITY	-8.7	-6.9	-6.3	-9.3
(=1 if unanimous voting rule)	(10.11)	(10.17)	(10.57)	(10.38)
BELIEFS	8.5	8.3	6.7	8.5
(=1 if beliefs elicited)	(12.97)	(13.01)	(13.47)	(12.95)
UNANIMITY$\times$CHOICE				1.6
				(6.42)
$(\bar{x}_i - \bar{x}_C)_{NC}^{1-1-1}$	0.59***	0.59***	0.58***	0.59***
	(0.06)	(0.06)	(0.07)	(0.06)
$x_{AB,t-1}^{2-1}$			0.11***	
(lagged effort of AB)			(0.03)	
C-NC	-11.2	-11.2	-11.8	-11.2
(=1 if CHOICE first)	(9.04)	(9.07)	(9.39)	(9.03)
PAY2-1	-5.9	-6.3	-2.7	-5.9
(=1 if fee for "2-1")	(9.22)	(9.25)	(9.59)	(9.21)
Socioeconomics	YES	YES	YES	YES
Observations	2610	2610	1403	2610
R^2	0.2444	0.2451	0.2568	0.2444

Note: Random-effects regression (298 individuals); standard errors in parentheses; ***(**,*) significant at 1%(5%,10%). "CHOICE" indicates whether the observation stems from a contest against a voluntarily formed alliance; "UNANIMITY" and "BELIEFS" are control variables for the different treatments; "C-NC" and "PAY2-1" are control variables for the different session types; $(\bar{x}_i - \bar{x}_C)_{NC}^{1-1-1}$ is an individual's average effort in the "1-1-1" contests of the NO CHOICE phase, compared to average effort of all players C in these contests. The dummy variable $I_{(v_{A,t},v_{B,t})=(1,1)}$ indicates whether both alliance players had voted for alliance formation.

Table A.3: Effort of the out-group player C in the "2-1" contest.

A.5 Effort of players A and B in the "1-1-1" contest

Dependent variable: individual effort x_{it} of player i=A,B in round t of the "1-1-1" contest			
	BASE+UNANIMITY+BELIEFS		
Indep. var.	xtreg 1	xtreg 2	xtreg 3
Constant	132.7***	132.3***	130.6***
	(7.61)	(7.27)	(7.64)
CHOICE	6.8***		11.0***
(=1 if CHOICE phase	(2.37)		(2.96)
$I_{(v_{it},v_{-i,t})=(0,0)} \times$CHOICE		16.8***	
		(3.22)	
$I_{(v_{it},v_{-i,t})=(0,1)} \times$CHOICE		20.1***	
		(3.39)	
$I_{(v_{it},v_{-i,t})=(1,0)} \times$CHOICE		-14.7***	
		(3.36)	
UNANIMITY	-8.8	-6.6	-1.9
(=1 if unanimous voting rule)	(8.37)	(8.00)	(8.85)
BELIEFS	7.5	8.2	7.4
(=1 if beliefs elicited)	(10.63)	(10.14)	(10.61)
UNANIMITY$\times$CHOICE			-11.9**
			(4.96)
$(\bar{x}_i - \bar{x}_{A,B})^{2-1}_{NC}$	0.69***	0.69***	0.70***
	(0.10)	(0.10)	(0.10)
C-NC	18.3**	18.5**	18.3**
(=1 if CHOICE first)	(7.52)	(7.18)	(7.51)
PAY2-1	-0.7	-1.7	-0.9
(=1 if fee for "2-1")	(7.49)	(7.15)	(7.48)
Socioeconomics	YES	YES	YES
Observations	3720	3720	3720
R^2	0.0929	0.1263	0.0936

Note: Random-effects regression (298 individuals); standard errors in parentheses; *** significant at 1%. "CHOICE" indicates whether the observation stems from voluntary stand-alone play;the dummy variable $I_{(v_{it,t},v_{B-itt})}$ indicates the votes of players A and B on alliance formation; "UNANIMITY" and "BELIEFS" are control variables for the different treatments; "C-NC" and "PAY2-1" are control variables for the different session types; $(\bar{x}_i - \bar{x}_{A,B})^{2-1}_{NC}$ is an individual's average effort in the "2-1" contests of the NO CHOICE phase, compared to average effort of all players A or B in these contests.

Table A.4: Effort of players A and B in the "1-1-1" contest.

Table A.4 presents the results of random-effects regressions of x_{it}, the effort of player $i \in \{A, B\}$ in the "1-1-1" contest (in round t) in parallel to Table 4 for behavior in the "2-1" contest. All estimations control for whether the observed effort stems from endogenous stand-alone play ("CHOICE"=1) or from exogenous stand-alone play ("CHOICE"=0).

The main findings are as follows: First, effort is significantly higher in the CHOICE phase than in the NO CHOICE phase (compare estimation 1). Second, effort is highest for strong types who voted against alliance formation ($v_{it} = 0$), while weak types who voted for alliance formation ($v_{it} = 1$) invest significantly less than the average player in NO CHOICE (compare the interaction terms with the indicator variables for (v_{it}, v_{-it}) in estimation 2). Third, when alliance formation is decided by unanimity rule (in the *UNANIMITY* treatment), more players end up in the stand-alone contest (also some weak types who voted for alliance formation); therefore, the coefficient on the interaction term "UNANIMITY×CHOICE" (estimation 3) is significantly negative, corresponding to lower effort levels in the CHOICE phase of the *UNANIMITY* treatment compared to the CHOICE phase under majority voting.

A.6 Time series of efforts of players A, B and C in "2-1" contests

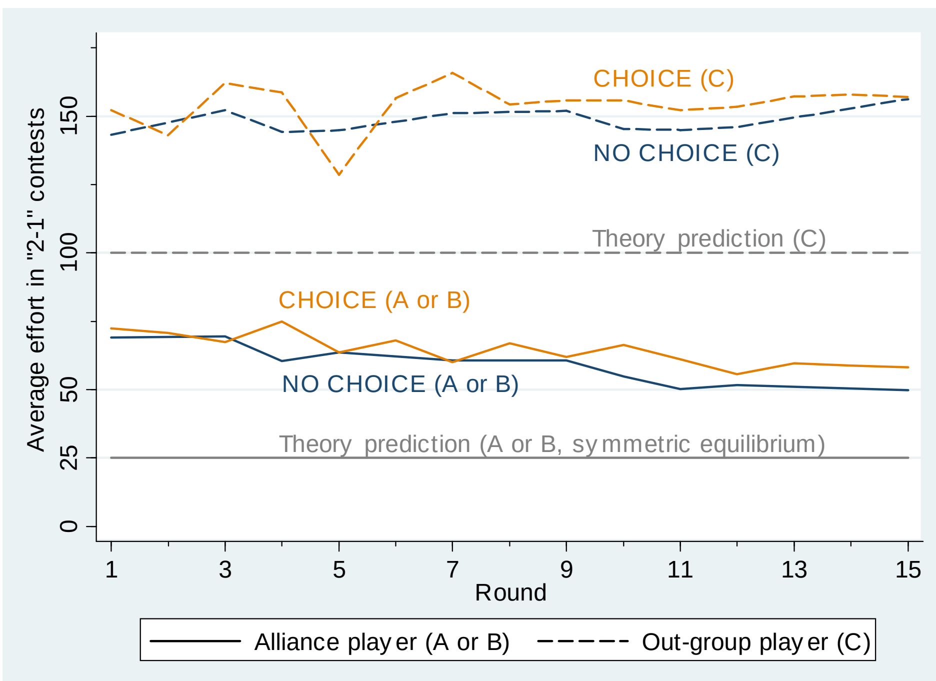

Figure A.1: Individual effort in "2-1" contests.

Note: Data from all sessions with homogeneous monetary cost of effort (treatments BASE, UNANIMITY, and BELIEFS).

B Experimental instructions[1]

Welcome! Please read these instructions carefully and completely. Properly understanding them will help you to make better decisions and, hence, to earn more money.

Your earnings in this experiment will be measured in Tokens. At the end of the experiment we will convert the Tokens you have earned to cash and we will pay you in private. For every 45 Tokens you earn you will be paid 1 Euro in cash. In addition to the Tokens earned during the experiment, each participant will receive a show-up-fee of 4 Euros.

Please keep in mind that you are not allowed to communicate with other participants during the experiment. If you do not obey this rule you will be asked to leave the laboratory without getting paid. Whenever you have a question, please raise your hand and we will help you.

1. Your task Before beginning this experiment you will need to answer a quiz on your computer screen. It contains questions regarding situations which might occur during the experiment. Consulting these instructions will help you to answer them.

The experiment consists of three parts. These parts are independent from each other; your decisions in one part have no influence on the other parts.

For the experiment, groups consisting of three people are formed. The experiment will be repeated several times. The participants in your group will usually vary each period, since the groups are randomly composed in each period.

Your task in each period is to make an effort decision. The money you earn depends on your decision and the decisions of the other players in your group. Let the three players in one group be called A, B, and C. In each period, three players A, B, and C compete for a prize of 450 Tokens. The competition works through two options. These are called "Single" and "Alliance."

You will play both options during this experiment.

Following the quiz you will be able to try out both options in a trial period. The monitor will show you in each period which option is at hand.

The rules of both options are as follows:

Option "Single": The computer designates each player his role (A, B or C). All players will simultaneously choose their respective effort in Tokens. The effort affects the probability of winning the prize. Every player can choose any number of Tokens as effort. Tokens are not divisible, so you can only choose whole numbers, such as 0, 1, 2, 3, ...

You will have to pay this amount of Tokens to the lab, whether or not you win the competition.

[1] This section contains a translation of the set of instructions for the *BASE* treatment of a session in which a small fee was applied to the "2-1" contest and where the NO CHOICE phase was played first and the CHOICE phase was played second. The instructions for the first part (here: NO CHOICE) were handed out on paper, and the instructions for the second part (here: CHOICE) were shown on screen after completion of the first part.

When all players have chosen their efforts, a fortune wheel will decide who will win the prize of 450 Tokens. The fortune wheel is divided into three colors: blue, green, and purple. Blue represents the Tokens A has bet. Green represents the amount B has chosen, and purple C's amount.

The fractions of the colors on the fortune wheel correspond exactly to the proportion of the respective efforts to the total effort of all three players together.

All efforts of your group, and therefore the probability of each player winning the prize, will be presented to you for your information.

At the center of the fortune wheel there is an arrow initially pointing to the top. After some time the arrow starts to rotate and then stops randomly. If the arrow stops in the blue-colored area, player A wins. If the arrow stops in the green-colored area, player B wins the prize; If the arrow stops in the purple-colored area, player C wins the prize.

This means that the probability of player A, B or C winning the prize is equal to his corresponding share of the effort in the total expense, hence

Probability that player A wins $= \frac{\text{effort of player A}}{\text{total expense of A, B and C together}}$.

Analogous formulas apply for players B and C.

Therefore, each player's probability of winning depends not only on his own expenditure in the competition but also on the expenditures of the other players in the group.

Note that the more Tokens a player spends, the more likely it is that he wins the competition. More effort expended, however, also means that a player has to pay more Tokens to the lab.

If none of the players expend any Tokens, then it is equally likely (probability of 1/3rd) that A, or B or C wins.

As soon as at least one Token is bet, the above given formula for the probability of winning holds. If two players do not expend any Tokens, but the third player (e.g. B) expends at least one Token, the third player (i.e. B) wins the competition.

Every player has to pay his effort (in Tokens) to the lab, irrespective of the outcome of the fortune wheel.

Therefore, your earnings per period will be calculated as your prize in the competition minus your effort: earnings = prize - effort.

The winning player gets the prize of 450 Token and the losing players get nothing. The winning player's earnings = 450 – own effort, while the losing players have to pay their efforts to the lab and don't get any winnings.

Note: Should you bet more Tokens in a period than you can actually win, you will certainly make a loss.

The payment will only take place at the end of the entire experiment.

Option "Alliance": The two players A and B form an alliance. Player C is playing on his own.

Your role in the experiment, either A, B or C, will be randomly assigned to you. Each participant will keep his role throughout the entire experiment.

All players will simultaneously choose an effort (whole number), which they would like to bet. Each player independently decides on his effort. A player's effort can be any number of Tokens, which he will have to pay to the lab whether or not he wins the competition.

Players A and B have to pay five Tokens for every period they play in an "Alliance."

After the individual decisions have been made, a fortune wheel will turn and decide whether the alliance consisting of players A and B or player C wins the 450 Token-prize. As you will see, the fortune wheel is divided into two colors – turquoise and purple. The turquoise color represents the total Tokens spent by players A and B. The purple color represents the Tokens spent by player C.

For your information, you will be shown the amount of Tokens that the other players in your group have expended as well as the respective probabilities of A and B, or C of winning the prize.

If the arrow stops in the turquoise-colored area, players A and B win the prize. If the arrow stops in the purple-colored area, player C wins the prize.

Probability of players A and B winning the contest= $\frac{\text{effort of A and B}}{\text{sum of efforts of A,B and C}}$.

Probability of player C winning the contest= $\frac{\text{effort of player C}}{\text{sum of efforts of A,B and C}}$.

Therefore, each player's probability of winning depends not only on his own expenditure in the competition but also on the expenditures of the other players in the group.

If none of the players expend any Tokens then it is equally likely that the alliance consisting of players A and B or that player C wins.

As soon as at least one Token is bet, the above given formulas for the probability of winning hold.

Every player has to pay his effort (in Tokens) to the lab, irrespective of the outcome of the fortune wheel. Therefore, your earnings per period will be calculated as your prize in the competition minus your effort: earnings = prize - effort.

If the alliance of A and B wins, each player receives only half of the prize. Their respective earnings are: 225 - 5 - own effort. Player C does not win anything but has to pay his effort.

If C wins, his earnings are his prize of 450 minus his own effort. Players A and B don't receive any earnings but each have to pay their respective effort plus 5 Tokens.

Note: Should you bet more Tokens in a period than you can actually win, you will certainly make a loss.

The payment will only take place at the end of the entire experiment.

2. Procedure The experiment will consist of 15 periods. In each period, you will have the same role (player A, B or C). The other two players in your group will be randomly assigned to you in each period.

Player C always plays alone. Players A and B either play alone or in an alliance, depending on the game option (Single or Alliance). The two players in your group will be randomly assigned to you in each period. You will not know who the other players in your group are. Any attempt to reveal your identity to anyone is prohibited.

At the end of today's experiment, we will randomly choose three periods out of 15; your total earnings in those three periods will be added up, converted to Euros and paid to you in cash. This means that the earnings of all other 12 periods will not be paid to you and that you do not have to pay your efforts from those periods either. You will get to know which three out of the 15 periods will be chosen only at the end of this experiment. In addition, you will receive 0.60 Euros for each of the 15 periods.

You will receive information about the second and third parts of the experiment on your screen. After the experiment, you will be asked to answer some questions, including some personal information (e.g., gender, age, major...). All the information you provide will be kept anonymous and is strictly confidential.

We will begin now with the quiz, after which you will have the opportunity to try playing one Single and one Alliance game. We would like to thank you in advance for participating and wish you good luck!

****

Part 2[2] This part will consist of 15 periods.

In each period, players A and B will vote on whether they would like to play option Single or option Alliance.

- If player A and player B both choose Single, option Single will be played.
- If player A and player B both choose Alliance, option Alliance will be played.
- If each option receives one vote, there will be a random draw. The options are then chosen with equal probability.

At all times, the screen will keep you informed about which option was picked for the period you are in.

- If option Alliance is realized, player A and player B will each have to pay five additional Tokens to the laboratory. Player C does not have to pay any additional Tokens.
- If option Single is realized, no additional payment from anyone is incurred.

All other rules, as described in the instructions, remain in place.

Three out of the following 15 periods will be chosen for payment. In addition, you will receive 0.60 Euros for every period in this part.

[2] The instructions for the second part were displayed on the screen. This sample is for the baseline treatment and for sessions where the small fee was applied to the "2-1" contest and where *NO CHOICE* was played first. Hence, Part 2 refers to the *CHOICE* treatment.