Appendix A: Additional Analyses

Table A1: Average group efforts by treatment.

Treatment	Periods 1-20	Periods 21-45	All Periods
Symmetric homogeneous	82.4	55.0	67.2
	(36.4)	(31.6)	(32.4)
Symmetric heterogeneous	96.4	66.6	79.8
	(37.7)	(33.3)	(33.0)
Asymmetric	115.6	75.1	93.3
	(37.4)	(31.1)	(33.1)
Mann Whitney U tests:			
Symmetric homogeneous vs. Symmetric heterogeneous	$p = 0.451$	$p = 0.425$	$p = 0.252$
Symmetric homogeneous vs. Asymmetric	$p = 0.029$	$p = 0.063$	$p = 0.057$
Symmetric heterogeneous vs. Asymmetric	$p = 0.227$	$p = 0.511$	$p = 0.511$

Notes: Numbers in parentheses are standard deviations using a contest between two competing groups as the unit of observation.

Table A2: Group effort by group and contest type.

Dependent variable: Group Effort	Homogeneous Groups (1)	Heterogeneous Groups (2)	Asymmetric Contest (3)
Asymmetric contest *1 if contest is asymmetric, 0 otherwise*	30.320** (13.312)	8.857 (11.775)	
Homogeneous group *1 if group is homogeneous, 0 otherwise*			8.851 (8.764)
Constant	67.191*** (8.828)	79.803*** (8.007)	88.660*** (9.575)
Random intercepts:			
Contest	Yes	Yes	Yes
Group	Yes	Yes	Yes
Observations	1980	1890	1260

Notes: Multilevel linear mixed-effects models using random intercepts for matching groups (a contest between two groups) and groups. Numbers in parentheses indicate standard errors. Model (1) uses only data from homogeneous groups and Model (2) uses only data from heterogeneous groups. Model (3) compares behaviour from homogeneous and heterogeneous groups in the asymmetric contest. Significance levels * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Rankings of effort levels by ability type in symmetric and asymmetric contests

	Symmetric contests [$n = 28$]			Asymmetric contests [$n = 14$]		
	Ranked 1st	Ranked 2nd	Ranked 3rd	Ranked 1st	Ranked 2nd	Ranked 3rd
High-ability player	32% [9]	36% [10]	32% [9]	43% [6]	36% [5]	21% [3]
Medium-ability player	36% [10]	36% [10]	29% [8]	50% [7]	21% [3]	29% [4]
Low-ability player	32% [9]	29% [8]	39% [11]	7% [1]	43% [6]	50% [7]

Notes: The table shows for heterogeneous groups the number of times the different ability players were the top, medium, or low contributor within their group, based on their total contributions across all rounds. The numbers in brackets display absolute frequencies.

Table A4: Earnings and inequality by group type.

Dependent variable:	Individual Earnings			Inequality		
	Symmetric contest	Asymmetric contest	Combined	Symmetric contest	Asymmetric contest	Combined
	(1)	(2)	(3)	(4)	(5)	(6)
Homogeneous group *1 if group is homogeneous,0 otherwise*	4.204 (3.907)	-3.268 (4.061)	0.355 (2.845)	1.121 (2.019)	-0.622 (2.244)	0.265 (1.572)
Constant	123.399*** (2.810)	120.605*** (3.490)	123.242*** (2.233)	15.635*** (1.452)	20.286*** (1.878)	17.304*** (1.194)
Random intercepts:						
Contest	Yes	Yes	Yes	Yes	Yes	Yes
Group	Yes	Yes	Yes	Yes	Yes	Yes
Subject	Yes	Yes	Yes	No	No	No
Observations	7830	3780	11610	2610	1260	3870

Notes: Multilevel linear mixed-effects models using random intercepts for matching groups (a contest between two groups), groups, and individuals. Models (4) – (6) only use contest and group random effects as the dependent variable is calculated at the group level. Models (1) and (4) only use data from symmetric contests, and Models (2) and (5) only use data from asymmetric contests. Models (3) and (6) use all data. Numbers in parentheses indicate standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Earnings and inequality by contest type.

Dependent variable:	Individual Earnings			Inequality		
	Homo-geneous	Hetero-geneous	Combined	Homo-geneous	Hetero-geneous	Combined
	(1)	(2)	(3)	(4)	(5)	(6)
Asymmetric contest *1 if contest is asymmetric,0 otherwise*	-10.265** (4.620)	-2.794 (4.383)	-6.602* (3.478)	2.908 (2.402)	4.651** (2.366)	3.761* (1.796)
Constant	127.603*** (3.080)	123.399*** (2.641)	125.573*** (1.985)	16.756*** (1.386)	15.635*** (1.556)	16.215*** (1.025)
Random intercepts:						
Contest	Yes	Yes	Yes	Yes	Yes	Yes
Group	Yes	Yes	Yes	Yes	Yes	Yes
Subject	Yes	Yes	Yes	No	No	No
Observations	7830	3780	11610	2610	1260	3870

Notes: Multilevel linear mixed-effects models using random intercepts for matching groups (a contest between two groups), groups, and individuals. Models (4) – (6) only use contest and group random effects as the dependent variable is calculated at the group level. Models (1) and (4) only use data from symmetric contests, and Models (2) and (5) only use data from asymmetric contests. Models (3) and (6) use all data. Numbers in parentheses indicate standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6: Equilibrium selection for $\tau = 0.7$

Symmetric contests											
Heterogeneous				13							
Homogeneous		9*	…	13	17	…	22	23	24	…	27
Asymmetric contests											
Homogeneous (Het=11)							22*	23	24		
Homogeneous (Het=12)	8	9		13	17	…	22	23*	24		
Homogeneous (Het=13)	8	9	…	13	17	…	22*				

* Pareto dominant equilibrium

Figure A1: Group effort in symmetric and asymmetric contest by group type.

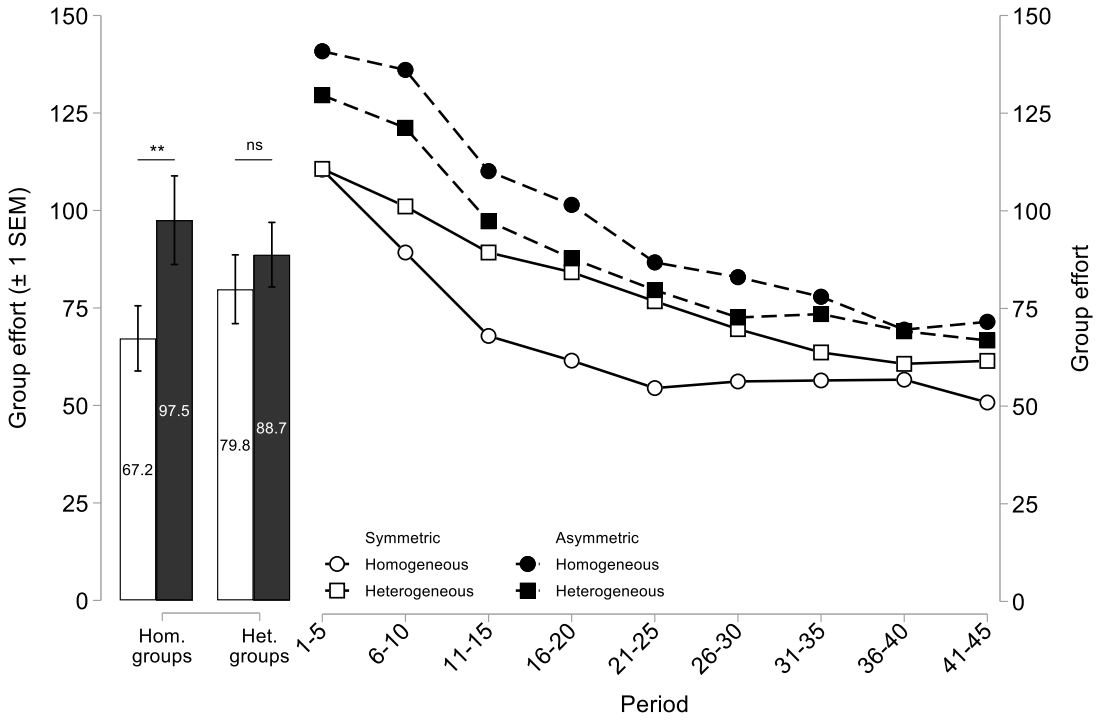


Figure A2: Change in effort between symmetric and asymmetric contest by group and ability type.

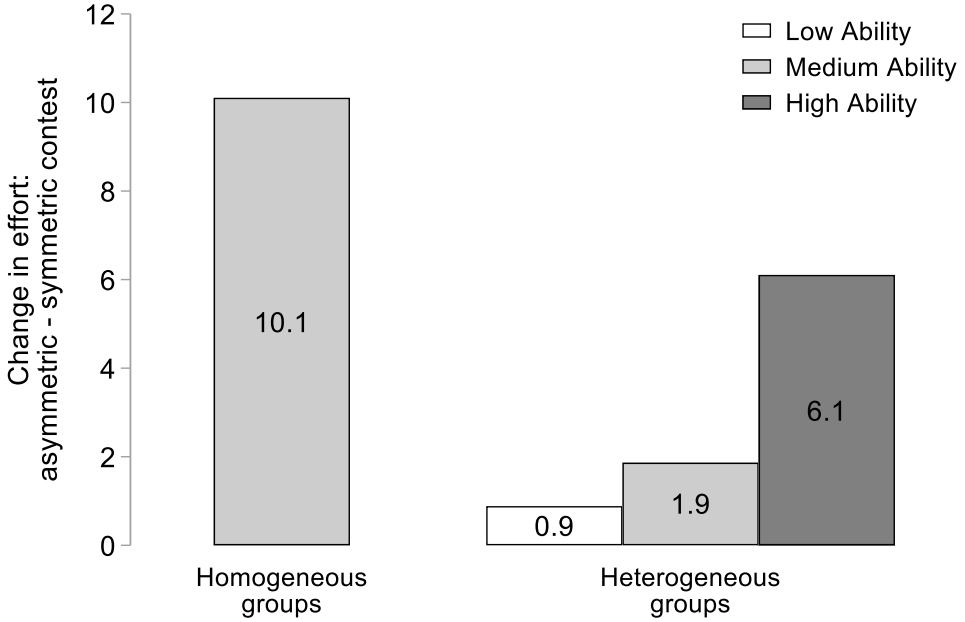
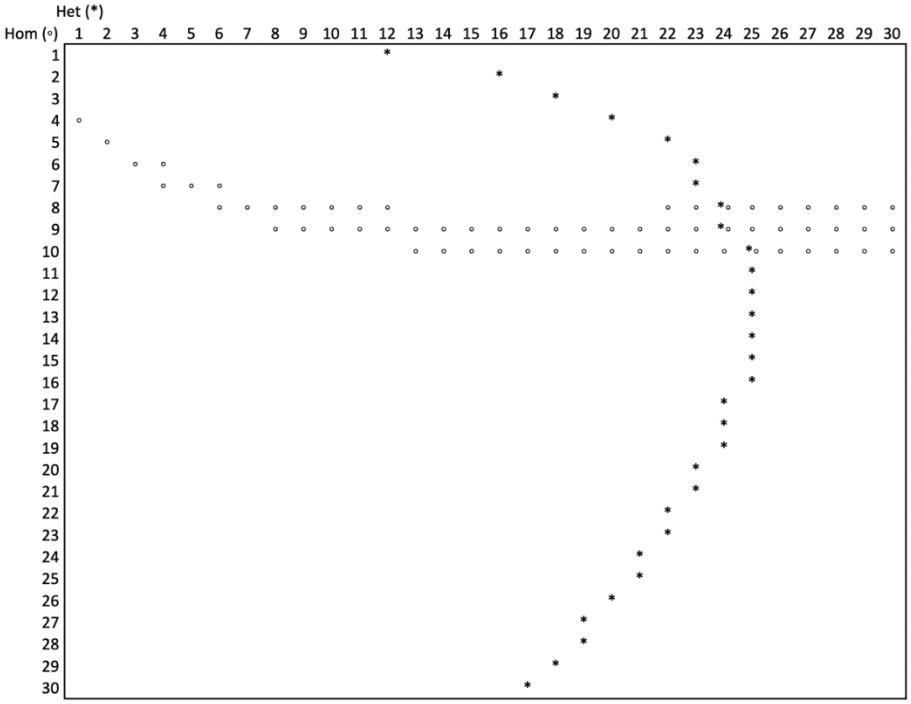


Figure A3: Best response functions in Asymmetric tournaments

(a) $\tau = 0.2$



(b) $\tau = 0.7$

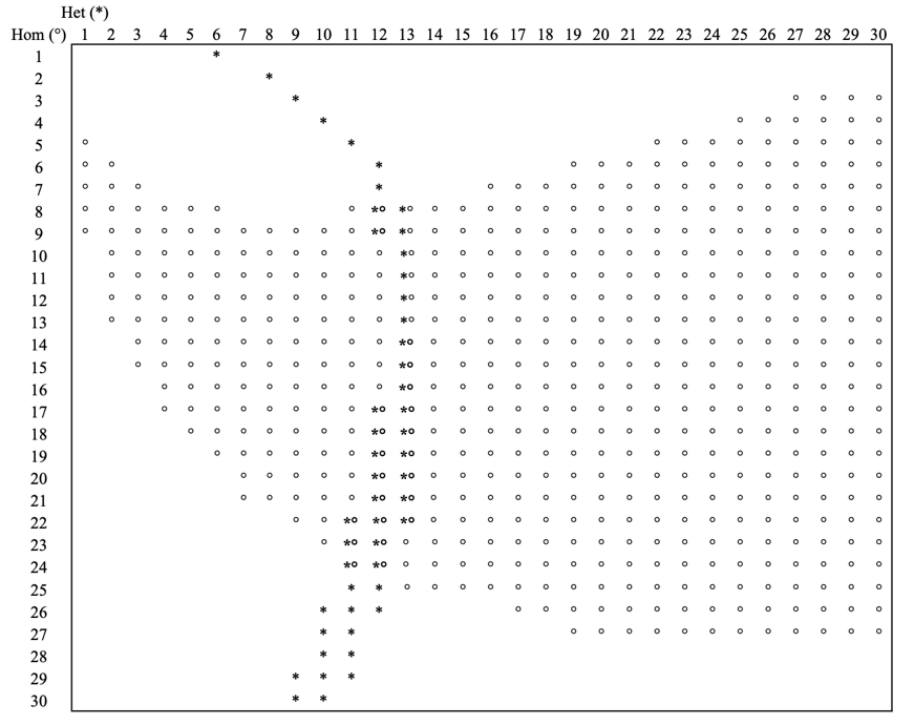


Figure A3 plots the reaction functions of homogeneous and heterogeneous groups for two different values of τ, $\tau = 0.2$ and $\tau = 0.7$. For any symmetric individual effort level in homogeneous groups (from 1 to 30), stars (*) identify the best response of players in heterogeneous groups, while circles (°) identify the best response of players in homogeneous groups for a given level of effort in heterogeneous groups. Whenever the star and the circle cross, we have mutual best responses, identifying an equilibrium in pure strategies of the stage game. Note that for heterogeneous groups and $\tau = 0.2$, the best response determines the effort only for the high-ability player (the other two are predicted to free ride), while for $\tau = 0.7$ the best response determines the efforts of all players.

Appendix B: Experimental Instructions (translated from Italian)

Instructions

Welcome! You are about to take part in an experiment about decision-making. It is important that you do not talk to any of the other participants until the experiment is over. If you have a question at any time, please raise your hand and an experimenter will come to your desk to answer it.

During the experiment you will have the chance to earn points, which will be converted into cash using an exchange rate of # points = 10p. At the end of today's session, you will be paid in private and in cash. The amount you earn will depend on your decisions, so please follow the instructions carefully.

At the beginning of the experiment, you will be matched with two other people to form a **team of three**. These people will be randomly selected from the participants in this room. The composition of the team will stay the same throughout the experiment, i.e., you will form a group with the same two other participants during the whole experiment. Your team will be matched with another team. This other team will be randomly selected at the beginning of the experiment, and will stay the same throughout the whole experiment.

Note that you will not know the identity of members of your team or the other team, neither during nor after today's session. Likewise, other participants will not know your identity.

Decision task

The experiment will consist of **45 rounds**, and in each round your team and the other team will compete for a prize, as will now be explained.

Each round has the same structure. At the beginning of each round each person will be given an endowment of **100 tokens. There are three types of tokens: BLUE tokens, RED tokens, and GREEN tokens**. Each person will be endowed with tokens of one colour only.

Each person can keep his/her tokens for himself/herself, or use them to buy "contest tickets". Each BLUE token buys 1 contest ticket. Each RED token buys 2 contest tickets; and each GREEN ticket buys three contest tickets.

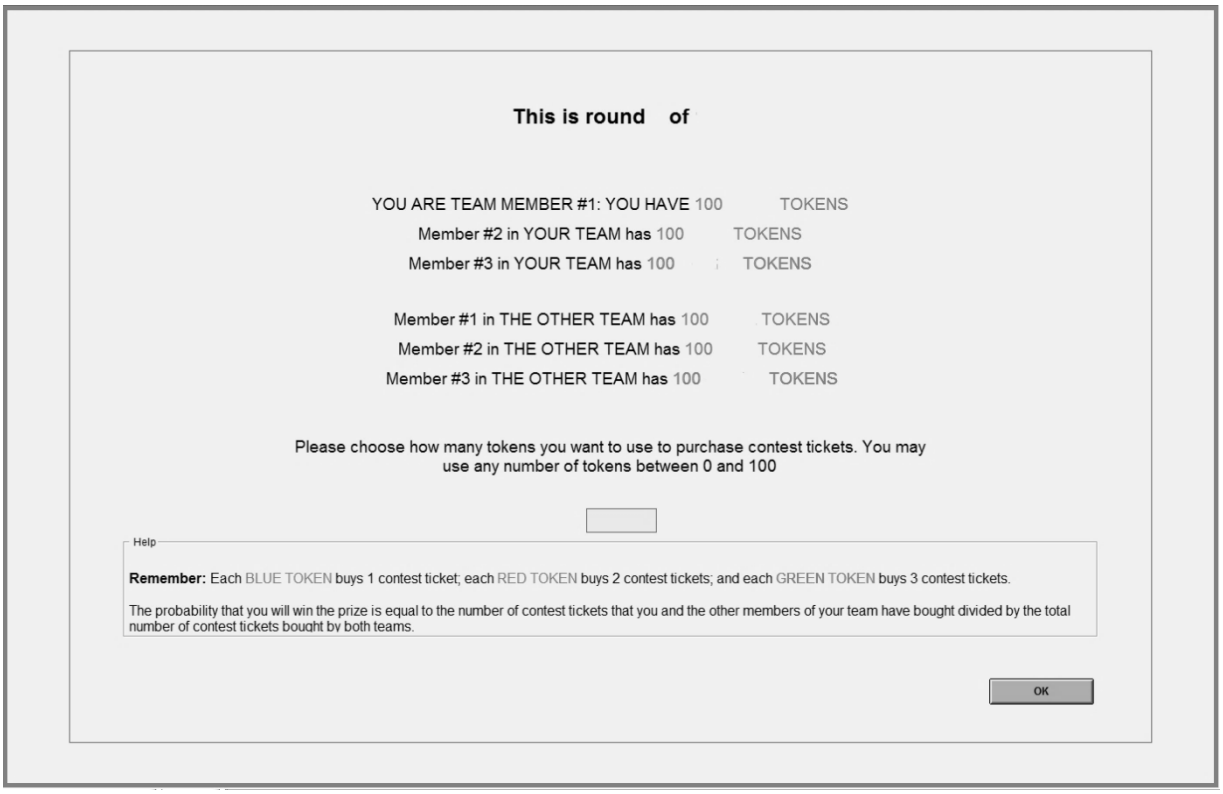
In other words, if you received 100 BLUE tokens you can buy between 0 and 100 contest tickets; if you received 100 RED tokens you can buy between 0 and 200 contest tickets; and if you received 100 GREEN tokens you can buy between 0 and 300 contest tickets.

The type of tokens each person receives in each round remains constant throughout the experiment. For example, if someone receives BLUE tokens in the first round, that person will receive BLUE tokens throughout the experiment. You will learn which type of tokens you receive, which type of

tokens the other members of your group receive, and which type of tokens each member of the other group receives.

Tokens that are not used to buy contest tickets are worth 1 point per token, regardless of the colour. These points will be added to the respective person's point balance.

In each round each person must decide how many tokens to use to buy contest tickets. Each participant will enter his or her decision via the computer. An example screenshot is shown below.



Determining the Winning Team

After each round, as soon as everybody has made a decision, the computer will calculate the total number of contest tickets purchased by each team and determine which team wins the prize. The prize is worth **300 points**, which are divided equally between the three members of the winning team, so each team member receives **100 points**. The chance that your team wins the prize depends on the number of contest tickets bought by your team, and the number of contest tokens bought by the other team. In general, the more contest tickets your team purchases, the higher your chance of winning the contest; the less contest tickets your team purchases, the lower your chances of winning the contest. The same applies for the other team

The exact chance of winning the contest is given by the number of contest tickets bought by your team, divided by the total number of contest tickets bought by both teams. If your team buys X contest tickets and the other team buys Y contest tickets, then your team's chance of winning the prize is $\frac{X}{X+Y}$, and the other team's chance of winning is $\frac{Y}{X+Y}$.

Example:

1. If your team purchases 300 contest tickets and the other team purchases 300 contest tickets, then the total number of contest tickets is 600, and your team's chance of winning is $\frac{300}{600} = \frac{1}{2} = 50\%$. The other team's chance is $\frac{300}{600} = \frac{1}{2} = 50\%$.
2. If your team purchases 300 contest tickets and the other team purchases 100 contest tickets, then the total number of contest tickets is 400, and your team's chance of winning is $\frac{300}{400} = \frac{3}{4} = 75\%$. The other team's chance is $\frac{100}{400} = \frac{1}{4} = 25\%$.
3. If your team purchases 100 contest tickets and the other team purchases 300 contest tickets, then the total number of contest tickets is 400, and your team's chance of winning is $\frac{100}{400} = \frac{1}{4} = 25\%$. The other team's chance is $\frac{300}{400} = \frac{3}{4} = 75\%$.

Note that if one of the teams doesn't buy any contest tickets, the other team wins the prize with certainty. If both teams do not buy any contest tickets, the prize is awarded randomly (with equal probability) to one of the two teams.

Determining Payoffs

If your team wins the contest: you will earn points from the tokens you kept for yourself, and your share from the team prize.

$$Earnings = 100 - number\ of\ tokens\ used\ to\ purchase\ contest\ tickets + share\ in\ the\ prize$$

If your team does not win the contest: you will only earn points from the tokens you kept for yourself.

$$Earnings = 100 - number\ of\ tokens\ used\ to\ purchase\ contest\ tickets$$

Example:

Suppose you

- Receive 100 RED tokens
- Keep 80 tokens for yourself

- Use 20 tokens to purchase 40 contest tickets (at a price of 2 tickets per token)

Suppose further that the second member in your team

- Receives 100 BLUE tokens
- Keeps 80 tokens for him/herself
- Uses 20 tokens to purchase 20 contest tickets (at a price of 1 tickets per token)

And that the third member in your team

- Receives 100 GREEN tokens
- Keeps 90 tokens for him/herself
- Uses 10 tokens to purchase 30 contest tickets (at a price of 3 tickets per token)

This means that your team purchased 90 (40+20+30) contest tickets in total. Suppose that the other team purchased a total of 210 contest tickets.

Then, the chance that

- your team wins is $\frac{90}{90+210} = \frac{90}{300} = 0.30 = 30\%$
- and the chance that the other team wins is $\frac{210}{90+210} = \frac{210}{300} = 0.70 = 70\%$

Payoff

If your team wins the contest:

You will earn 80 points from the 80 RED tokens you kept for yourself, and 100 points from your share of the team prize, for a total of 180 points in the round.

$$Your\ payoff = 100 - 20 + 100 = 180$$

The second member in your group will earn 80 points from the 80 BLUE tokens he/she kept for him/herself, and 100 points from his/her share of the team prize, for a total of 180 points in the round.

$$Second\ member\ payoff = 100 - 20 + 100 = 180$$

The third member in your group will earn 90 points from the 90 GREEN tokens he/she kept for him/herself, and 100 points from his/her share of the team prize, for a total of 190 points in the round.

$$Third\ member\ payoff = 100 - 10 + 100 = 190$$

If your team does not win the contest:

You will earn 80 points from the 80 RED tokens you kept for yourself, and nothing from the prize.

$$Your\ payoff = 100 - 20 = 80$$

The second member in your group will earn 80 points from the 80 BLUE tokens he/she kept for him/herself, and nothing from the prize

$$Second\ member\ payoff = 100 - 20 = 80$$

The second member in your group will earn 90 points from the 90 GREEN tokens he/she kept for him/herself, and nothing from the prize

$$Second\ member\ payoff = 100 - 10 = 90$$

End of each period

After all participants have made a decision, a feedback screen will appear showing the results from the current round. Each participant will receive the following summary of the period:

- Number of contest tickets purchased by his/her team
- Number of contest tickets purchases by other team
- Which team won the competition

As well as the following information about him/herself and each of his/her two group members:

- Initial number of tokens
- Type (color) of tokens
- Number of tokens kept
- Number of tokens used to purchase contest tickets
- Number of contest tickets purchased
- Earnings from the contest
- Total earnings in the period

The information is sorted by the number of contest tickets purchased in descending order (with the participant who purchased most contest tickets listed first). Thus, a participant's information may be listed on different rows in different rounds.

An example feedback screen:

The points you earn in each round will be added to the points you earned in the previous rounds, and at the end of the session you will be paid based on your total point earnings from all 45 rounds.

Beginning the experiment

If you have any questions, please raise your hand an experimenter will come to your desk to answer it.

Before starting the decision-making part of the experiment a set of questions will appear on your screen. These will help you to gain an understanding of the calculation of your earnings.