This document contains the instructions for the experiment of the Group Size Effect in Sequential Multi-battle Contest: An Experiment Study. We put the instructions for the all-pay contest on the left-hand side and the instructions for the Tullock lottery contest on the right-hand side. Participants of the experiment saw the instructions separately on their screens at Virginia Tech Economics Laboratory depending on the randomized order assigned to play the games.

Welcome to our experiment!

• During today's experiment you will play **24 games** with other participants.

• There will be **12 "auction games"** followed by **12 "lottery games"**.

• At the end of today's experiment, we will pay you, in cash, the amount that you earn in the following 4 tasks.

    ○ **$7** compensation.

    ○ Your earnings from one randomly selected **auction game**.

    ○ Your earnings from one randomly selected **lottery game**.

    ○ Your earnings from three preferences surveys.

• Good luck!

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• Good luck!

Page 0

Instructions for Auction Games

• Let's read the instructions and learn how to play the **auction game**!

Page 0

Instructions for Lottery Games

• Let's read the instructions and learn how to play the **lottery game**!

New Rule for the Battles

• For this section of the game, we will change the rules for deciding who wins a battle.

• Instead of drawing a token at random, now the player with **the highest bid wins** the battle.

• Make sure you read **"The Result of a Battle"** instructions page carefully for the details.

New Rule for the Battles

• For this section of the game, we will change the rules for deciding who wins a battle.

• Instead of the highest bid wins the battle, we will **draw a token at random** to determine who wins the battle.

• Make sure you read **"The Result of a Battle"** instructions page carefully for the details.

Decision-Making

Participants in your group: 3

• You will play 12 multi-battle contest **auction games**.

• You will play each game with a different group of **3** randomly selected players.

• There is no way to tell which other participants are in your group for each game. Just know that after every game we will randomly pick new groups.

How to play: bid between 0 and 1000 tokens

• Each game will have between 2 and 4 battles.

• During each battle, you and the other 2 participants in your group will simultaneously bid an integer (whole number) of tokens **between 0 and 1000**.

An example page is below

Battle 1

This is a multi-battle contest auction game with **3** players per group.

The prize for winning this game is **1000 token(s)**.

The first player, who wins **2** battles, wins the prize.

Battle won

You
[0]

Opponent 1
[0]

Opponent 2
[0]

How many token(s) (between 0 and 1000) would you bid to win the 1st battle?

[   ] token(s)

Decision-Making

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[0]

Opponent 2
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[   ] token(s)

The Result of a Battle

Who wins a battle: the highest bid wins

• After each battle, your bid and the other 2 participants' bids will be displayed on your screen.

• If your bid is the **highest** among the 3 participants in your group, you **win** that battle.

• If the highest bids happened with a **tie in the bid**, we will **randomly select one participant** with the tie bid as the battle winner. In other words, there is always only one winner for a battle.

• The more your bid, the more likely you are to win the battle.

How to win a game: be the first one to win 2 battles

• To win the game, you need to be the **first player to win 2 battles**.

• A game ends when someone wins 2 battles.

An example page is below

Result of the Battle 1

Your bid was **345 token(s)**, and you placed in **1st**.

You **won** the first battle!

You need **1 more "battle won"** to win the game.

	You	Opponent 1	Opponent 2
1st bid	345 token(s)	327 token(s)	332 token(s)

The Result of a Battle

Who wins a battle: the highest bid wins

• After each battle, your bid and the other 2 participants' bids will be displayed on your screen.

• We will put all of the tokens that you and your opponent bid into a bin. Then the computer draws a token randomly from the bin. The **owner** of the randomly drawn token wins the battle.

• *The chance of you winning the battle* $= \frac{Your\ bid}{The\ total\ bids\ among\ the\ 3\ players\ in\ your\ group}$

• For example, suppose 3 participants' bids in your group for a battle are listed in the following table.

	You	Opponent 1	Opponent 2
1st bid	156 tokens	138 tokens	125 tokens

○ **Total bid** is 156+138+125 = 419.

○ **Your** chance of winning the battle will be 156/419 = 37.23%.

○ **Opponent 1's** chance of winning the battle will be 138/419 = 32.94%.

○ **Opponent 2's** chance of winning the battle will be 125/419 = 29.83%.

• The more your bid, the more likely you are to win the battle.

How to win a game: be the first one to win 2 battles

• To win the game, you need to be the **first player to win 2 battles**.

• A game ends when someone wins 2 battles.

An example page is below

Result of the Battle 1

Your bid was **156 token(s)**, with a winning chance of **37.23%**.

You **lost** the first battle.

You need **2 more "battle won"** to win the game.

	You	Opponent 1	Opponent 2
1st bid	156 token(s)	138 token(s)	125 token(s)

(same for both auction games and lottery games, except for the example page)

Summary of a Game
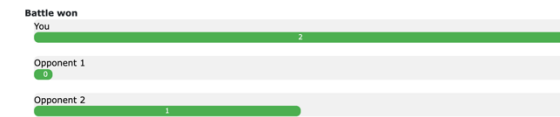
The prize for winning a game: 1000 tokens

• The prize for each game is **1000 tokens**. **Only one** among the 3 of you will win the prize.

• The payoff of a game will be calculated based on the following rules.

    ○ If you **win** the game,
    Payoff = 1000 tokens – your total bids among the battles.

    ○ If you **lose** the game,
Payoff = 0 tokens – your total bids among the battles.

An example page is below

Summary of the Game 1

Battle won

You   2

Opponent 1   0

Opponent 2   0

	Your bid	Your place	Your result
Battle 1	345 token(s)	1st	won
Battle 2	322 token(s)	1st	won
Battle 3	None	None	None
Battle 4	None	None	None

• The winner's payoff = 1000 tokens - total bids among the battles that were played.

• The losers' payoff = 0 token - total bids among the battles that were played.

• You **won** this game; therefore, your payoff for this game is **333 token(s)**.

Summary of the Game 1

Battle won

You   2

Opponent 1   0

Opponent 2   1

	Your bid	Your chance	Your result
Battle 1	156 token(s)	37.23%	lost
Battle 2	135 token(s)	32.51%	won
Battle 3	121 token(s)	29.35%	won
Battle 4	None	None	None

• The winner's payoff = 1000 tokens - total bids among the battles that were played.

• The losers' payoff = 0 token - total bids among the battles that were played.

• You **won** this game; therefore, your payoff for this game is **588 token(s)**.

The examples below show how payoffs for a game would be calculated

If you win two battles (the game ends in two battles):

• In Battle 1 you bid 345 tokens and Battle 2 you bid 322.

• So, your payoff for this game is 1000-(345+322) = 333 tokens.

If you win one battle and lose two battles (the game ends in three battles), you lose the game:

• In Battle 1 you bid 345 tokens and win, in Battle 2 you bid 322 tokens and lose, and in Battle 3 you bid 350 tokens and lose.

• So, your payoff for this game is 0-(345+322+350) = -1017 tokens.

If you win two battles and win the game (the game ends in two battles), but end up losing tokens:

• In Battle 1 you bid 545 tokens and Battle 2 you bid 522.

• So, your payoff for this game is 1000-(545+522) = -67 tokens.

End of Section Earnings

Earnings for this section: based on randomly selected game

• After **12 games**, we will determine your earnings for this section.

• We will **randomly select** one payoff out of 12 games for your actual earnings.

• We will convert **100 tokens in the contest to 1 US dollar** to finalize your earnings.

Endowment: 1200 tokens

• We will add 1200 tokens as your endowment to the randomly selected game's payoff when calculating your earnings.

    ○ Suppose your earnings are positive; we will add them to your endowment to calculate your total earnings from the experiment.

    ○ Suppose your earnings are negative; we will subtract them from your endowment to calculate your total earnings from the experiment.

An example page is below

End of the Section

The randomly selected game to calculate your earnings is the **game 7**.

Your earnings for this section is **$ 7.36**.

We will add this amount to your final earnings.

Summary of the Instructions

• In your group, **3** participants compete for **a prize worth 1000 tokens** in a contest game.

• There are **multiple battles** (between 2 and 4) in a game.

• For every battle, you and your opponents will **simultaneously submit a bid** between 0 and 1000 tokens.

• **The highest bid wins a battle**.

• The player **who wins 2 battles first wins the game and the 1000 token prize.**

• The **winner** of a game's payoff equals the prize (1000 tokens) minus all of the bids he or she submitted for the battles.

• The **losers** of a game lose the sum of the bids he or she submitted for the battles.

• We will choose **one payoff out of the 12 auction games** at random to determine your earning.

• When calculating your earnings in the auction game, the exchange rate is **100 tokens = $1**.

• Your earnings in the auction game will be added to your other earnings and paid to you, in cash, at the end of the experiment.

Decision

• For each question in the following table, please choose **A** or **B** as your preferred opinion.

• There are 12 questions in total, and please consider each of them as a separate decision.

Earning

• We will **select one out of 12 questions at random** (roll a 12-sided dice) to calculate your earnings at the end of the experiment.

• For example, suppose question 6 (see below) is selected by the 12-sided dice to calculate your earning:

  ○ If your choice is option A (for question 6), there is a 50% of chance we pay you $3.00 and a 50% of chance we pay you $0.00 (flip a coin).

  ○ If your choice is option B (for question 6), we will pay you $1.50.

	Option A	Option B
Question 1	**$3.00** with 50% chance and **$0.00** with 50% chance	**$0.25** for sure
Question 2	**$3.00** with 50% chance and **$0.00** with 50% chance	**$0.50** for sure
Question 3	**$3.00** with 50% chance and **$0.00** with 50% chance	**$0.75** for sure
Question 4	**$3.00** with 50% chance and **$0.00** with 50% chance	**$1.00** for sure
Question 5	**$3.00** with 50% chance and **$0.00** with 50% chance	**$1.25** for sure
Question 6	**$3.00** with 50% chance and **$0.00** with 50% chance	**$1.50** for sure
Question 7	**$3.00** with 50% chance and **$0.00** with 50% chance	**$1.75** for sure
Question 8	**$3.00** with 50% chance and **$0.00** with 50% chance	**$2.00** for sure
Question 9	**$3.00** with 50% chance and **$0.00** with 50% chance	**$2.25** for sure
Question 10	**$3.00** with 50% chance and **$0.00** with 50% chance	**$2.50** for sure
Question 11	**$3.00** with 50% chance and **$0.00** with 50% chance	**$2.75** for sure
Question 12	**$3.00** with 50% chance and **$0.00** with 50% chance	**$3.00** for sure

Decision

• For each question in the following table, please choose **A** or **B** as your preferred opinion.

• There are 12 questions in total, and please consider each of them as a separate decision.

Earning

• We will **select one out of 12 questions at random** (roll a 12-sided dice) to calculate your earnings at the end of the experiment.

• For example, suppose question 6 (see below) is selected by the 12-sided dice to calculate your earning:

○ If your choice is option A (for question 6), we will pay you either $3.00 or $0.00.

∗ We will randomly draw a ball from a bag of 20 balls (either red or white). You don't know the exact number of red and white balls at the moment when you make your choice. If the drawn ball is your chosen color, we will pay you $3.00, otherwise $0.00.

○ If your choice is option B (for question 6), we will pay you $1.50.

	Option A	Option B
Question 1	**$3.00** or **$0.00** with unknown chance	**$0.25** for sure
Question 2	**$3.00** or **$0.00** with unknown chance	**$0.50** for sure
Question 3	**$3.00** or **$0.00** with unknown chance	**$0.75** for sure
Question 4	**$3.00** or **$0.00** with unknown chance	**$1.00** for sure
Question 5	**$3.00** or **$0.00** with unknown chance	**$1.25** for sure
Question 6	**$3.00** or **$0.00** with unknown chance	**$1.50** for sure
Question 7	**$3.00** or **$0.00** with unknown chance	**$1.75** for sure
Question 8	**$3.00** or **$0.00** with unknown chance	**$2.00** for sure
Question 9	**$3.00** or **$0.00** with unknown chance	**$2.25** for sure
Question 10	**$3.00** or **$0.00** with unknown chance	**$2.50** for sure
Question 11	**$3.00** or **$0.00** with unknown chance	**$2.75** for sure
Question 12	**$3.00** or **$0.00** with unknown chance	**$3.00** for sure

Decision

• For each question in the following table, please choose **A** or **B** as your preferred opinion.

• There are 12 questions in total, and please consider each of them as a separate decision.

Earning

• We will **select one out of 12 questions at random** (roll a 12-sided dice) to calculate your earnings at the end of the experiment.

• For example, suppose question 6 (see below) is selected by the 12-sided dice to calculate your earning:

  ○ If your choice is option A (for question 6), there is a 50% of chance we pay you $3.00 and a 50% of chance we deduct $3.00 from your participation reward (flip a coin).

  ○ If your choice is option B (for question 6), we will pay you $0.00.

	Option A	Option B
Question 1	**$3.00** with 50% chance and **$-0.50** with 50% chance	**$0.00** for sure
Question 2	**$3.00** with 50% chance and **$-1.00** with 50% chance	**$0.00** for sure
Question 3	**$3.00** with 50% chance and **$-1.50** with 50% chance	**$0.00** for sure
Question 4	**$3.00** with 50% chance and **$-2.00** with 50% chance	**$0.00** for sure
Question 5	**$3.00** with 50% chance and **$-2.50** with 50% chance	**$0.00** for sure
Question 6	**$3.00** with 50% chance and **$-3.00** with 50% chance	**$0.00** for sure
Question 7	**$3.00** with 50% chance and **$-3.50** with 50% chance	**$0.00** for sure
Question 8	**$3.00** with 50% chance and **$-4.00** with 50% chance	**$0.00** for sure
Question 9	**$3.00** with 50% chance and **$-4.50** with 50% chance	**$0.00** for sure
Question 10	**$3.00** with 50% chance and **$-5.00** with 50% chance	**$0.00** for sure
Question 11	**$3.00** with 50% chance and **$-5.50** with 50% chance	**$0.00** for sure
Question 12	**$3.00** with 50% chance and **$-6.00** with 50% chance	**$0.00** for sure