

# ***Decentralized Treatment***

## **Instructions for the Experiment**

Please read carefully and raise your hand if you have any questions. All questions will be answered privately.

### **General Rules**

Welcome and thank you for participating in the experiment today. You automatically earned **\$30** pesos for participating.

**You have 20 minutes to read these instructions and complete the quiz. The quiz has 12 questions and all the answers can be found in the instructions. For every correct answer you will gain 1 peso. You will not lose pesos for any incorrect or incomplete answer.**

**Quiz: After you answered all the questions on the first page of the quiz, press NEXT. After you answered all the questions on the second page of the quiz, press SEND ANSWERS. Your answers will be sent automatically after 20 MINUTES even if you did not complete the quiz.**

We will pay 30 pesos plus your earnings from the quiz regardless of anything else that happens in the experiment. You will also have an opportunity to make additional money according to the rules described below.

Please do not talk with other subjects, attempt to communicate, or look at other subjects' computer screens at any time during the session. Please turn off your cellphones before the experiment begins.

### **Description of the Game**

In the experiment, you will be randomly and anonymously matched to some other participants several times. You and the participant that you are matched with will be grouped into two person teams. In each of these teams, you will be randomly assigned to one of two roles: Player 1, or Player 2. Each time that you are matched to another participant will be called a "round."

The experiment will last for 17 rounds, including two practice rounds that will not count for your monetary earnings. During each round, you will interact with the other participant to whom you are matched through a computer program as described below. In the 15 non-practice rounds, you will have the opportunity to make additional earnings. The amount will depend on your decisions and the decisions of the participants to whom you are matched.

## Additional Earnings from the Game

Every participant starts the game with **\$210 pesos**. Each round of the game, you will lose some points depending on the decisions made by you and the other participant that you are matched with during the round. At the end of the experiment, the points will be converted into pesos and subtracted from \$210 to determine your additional earnings:

$$\text{Additional earnings} = 210 - 3 \times \text{Total points you lost during the experiment}$$

Thus, for every point you lose during the experiment, you lose \$3 pesos. If your total of points lost exceeds 50 points at the end of any round during the experiment, you will be unable to continue to play. You will have to wait until the experiment is over to receive your payment.

The instructions below explain how the amount of points lost depends on your decisions and the decisions of other participants. Remember that you will receive the guaranteed amount of 30 pesos plus the earnings from the quiz regardless of the outcome of the experiment.

### Examples

1. If you do not lose any points during the experiment, your additional earnings are 210 pesos.
2. If you lose 30 points, your additional earnings are  $210 - 90 = 120$  pesos.
3. If you lose 65 points, your additional earnings are  $210 - 195 = 15$  pesos.

In all of these examples you receive the guaranteed amount of 30 pesos plus the earnings from the quiz.

**You cannot lose more than the \$210 pesos that you receive at the beginning of the experiment.**

## Description of Each Round

At the beginning of each round, the computer independently draws two random numbers which are called **Number1** and **Number2**.

- **Number1** is any number between -1 and 1 in increments of 0.01, each number has the same probability to be drawn by the computer.
- **Number2** is any number between -1 and 1 in increments of 0.01, each number has the same probability to be drawn by the computer.

**Notice that *Number1* is independent from *Number2*. This means that observing *Number1* gives you no information about what number the computer has drawn for *Number2*. Likewise, *Number2* is independent from *Number1*.**

Example: The computer has randomly drawn **Number1**=0.73 and **Number2**= -0.26.

If you observe **Number1** =0.73 but you do not observe **Number2**, **Number2** can be any number between -1 and 1, in increments of 0.01, with equal probability.

The same is true if you observe **Number2**= -0.26 but you do not observe **Number1**.

Please read the following pieces of information carefully:

- Player 1 observes *Number1* but does NOT observe *Number2*.
- Player 2 observes *Number2* but does NOT observe *Number1*.

## How You Lose Points: Decision Stage

In each round, Player 1 has to make one decision, which is called *Decision1*.

Similarly, Player 2 has to make one decision, which is called *Decision2*.

*Decision1* and *Decision2* can be any two numbers between -1 and 1, in increments of 0.01.

Player 1 does not observe what number Player 2 has chosen for *Decision2*, when he/she chooses *Decision1*.

Similarly, Player 2 does not observe what number Player 1 has chosen for *Decision1*, when he/she chooses *Decision2*.

## (Decentralized-High Treatment)

### Earnings of Player 1

Given two decisions, *Decision1* and *Decision2*, Player 1 loses points according to the following formula:

$$[1 \times (\mathit{Decision1} - \mathit{Number1})^2] + [3 \times (\mathit{Decision1} - \mathit{Decision2})^2]$$

Notice that Player 1 loses points when *Decision1* is different from *Number1*. The larger the distance between *Decision1* and *Number1*, the more points Player 1 loses.

Player 1 also loses points when *Decision1* is different from *Decision2*. The larger the distance between *Decision1* and *Decision2*, the more points Player 1 loses.

Notice also that because  $(\mathit{Decision1} - \mathit{Decision2})^2$  is multiplied by 3 and  $(\mathit{Decision1} - \mathit{Number1})^2$  is multiplied by 1, Player 1 loses more points when *Decision1* is far from *Decision2* than when *Decision1* is equally far from *Number1*.

Remember that Player 1 chooses *Decision1*, and Player 2 chooses *Decision2*.

### Earnings of Player 2

Given two decisions, *Decision1* and *Decision2*, Player 2 loses points according to the following formula:

$$[1 \times (\mathit{Decision2} - \mathit{Number2})^2] + [3 \times (\mathit{Decision1} - \mathit{Decision2})^2]$$

Notice that Player 2 loses points when *Decision2* is different from *Number2*. The larger the distance between *Decision2* and *Number2*, the more points Player 2 loses.

**Player 2 also loses points when *Decision1* is different from *Decision2*. The larger the distance between *Decision1* and *Decision2*, the more points Player 2 loses.**

Notice also that because  $(\textit{Decision1} - \textit{Decision2})^2$  is multiplied by 3 and  $(\textit{Decision2} - \textit{Number2})^2$  is multiplied by 1, Player 2 loses more points when *Decision2* is far from *Decision1* than when *Decision2* is equally far from *Number2*.

**Remember that Player 1 chooses *Decision1*, and Player 2 chooses *Decision2*.**

## Example

***Number1* = 0.73 and *Number2* = -0.26.**

If Player 1 chooses ***Decision1* = 0.10** and Player 2 chooses ***Decision2* = 0.10**, then:

- Player 1 loses the following points

$$[1 \times (0.10 - 0.73)^2] + [3 \times (0.10 - 0.10)^2] = [1 \times 0.3969] + [3 \times 0] = 0.3969 \text{ points}$$

Player 1 loses  $3 \times 0.3969 = 1.1907$  pesos.

- Player 2 loses the following points

$$[1 \times (0.10 - (-0.26))^2] + [3 \times (0.10 - 0.10)^2] = [1 \times 0.1296] + [3 \times 0] = 0.1296 \text{ points}$$

Player 2 loses  $3 \times 0.1296 = 0.3888$  pesos.

## Example

***Number1* = 0.73 and *Number2* = -0.26.**

If Player 1 chooses ***Decision1* = 0.6** and Player 2 chooses ***Decision2* = -0.10**, then:

- Player 1 loses the following points

$$[1 \times (0.60 - 0.73)^2] + [3 \times (0.60 - (-0.10))^2] = [1 \times 0.0169] + [3 \times 0.49] \\ = 1.4869 \text{ points}$$

Player 1 loses  $3 \times 1.4869 = 4.4607$  pesos.

- Player 2 loses the following points

$$[1 \times (-0.10 - (-0.26))^2] + [3 \times (0.60 - (-0.10))^2] = [1 \times 0.0256] + [3 \times 0.49] \\ = 1.4956 \text{ points}$$

Player 2 loses  $3 \times 1.4956 = 4.4868$  pesos.

## ***(Decentralized-Low Treatment)***

### **Earnings of Player 1**

Given two decisions, ***Decision1*** and ***Decision2***, Player 1 loses points according to the following formula:

$$[3 \times (\mathbf{Decision1} - \mathbf{Number1})^2] + [1 \times (\mathbf{Decision1} - \mathbf{Decision2})^2]$$

Notice that Player 1 loses points when ***Decision1*** is different from ***Number1***. The larger the distance between ***Decision1*** and ***Number1***, the more points Player 1 loses.

Player 1 also loses points when ***Decision1*** is different from ***Decision2***. The larger the distance between ***Decision1*** and ***Decision2***, the more points Player 1 loses.

Notice also that because  $(\mathbf{Decision1} - \mathbf{Number1})^2$  is multiplied by 3 and  $(\mathbf{Decision1} - \mathbf{Decision2})^2$  is multiplied by 1, Player 1 loses more points when ***Decision1*** is far from ***Number1*** than when ***Decision1*** is equally far from ***Decision2***.

Remember that Player 1 chooses ***Decision1***, and Player 2 chooses ***Decision2***.

### **Earnings of Player 2**

Given two decisions, ***Decision1*** and ***Decision2***, Player 2 loses points according to the following formula:

$$[3 \times (\mathbf{Decision2} - \mathbf{Number2})^2] + [1 \times (\mathbf{Decision1} - \mathbf{Decision2})^2]$$

Notice that Player 2 loses points when ***Decision2*** is different from ***Number2***. The larger the distance between ***Decision2*** and ***Number2***, the more points Player 2 loses.

Player 2 also loses points when ***Decision1*** is different from ***Decision2***. The larger the distance between ***Decision1*** and ***Decision2***, the more points Player 2 loses.

Notice also that because  $(\mathbf{Decision2} - \mathbf{Number2})^2$  is multiplied by 3 and  $(\mathbf{Decision1} - \mathbf{Decision2})^2$  is multiplied by 1, Player 2 loses more points when ***Decision2*** is far from ***Number2*** than when ***Decision2*** is equally far from ***Decision1***.

Remember that Player 1 chooses ***Decision1***, and Player 2 chooses ***Decision2***.

### **Example**

***Number1*** = 0.73 and ***Number2*** = -0.26.

If Player 1 chooses ***Decision1*** = 0.10 and Player 2 chooses ***Decision2*** = 0.10, then:

- Player 1 loses the following points

$$[3 \times (\mathbf{0.10} - \mathbf{0.73})^2] + [1 \times (\mathbf{0.10} - \mathbf{0.10})^2] = [3 \times \mathbf{0.3969}] + [1 \times \mathbf{0}] = \mathbf{1.1907 points}$$

Player 1 loses  $3 \times 1.1907 = 3.5721$  pesos.

- Player 2 loses the following points

$$[3 \times (0.10 - (-0.26))^2] + [1 \times (0.10 - 0.10)^2] = [3 \times 0.1296] + [1 \times 0] = 0.3888 \text{ points}$$

Player 2 loses  $3 \times 0.3888 = 1.1664$  pesos.

## Example

**Number1**=0.73 and **Number2**= -0.26.

If Player 1 chooses **Decision1**=0.6 and Player 2 chooses **Decision2**= -0.10, then:

- Player 1 loses the following points

$$[3 \times (0.60 - 0.73)^2] + [1 \times (0.60 - (-0.10))^2] = [3 \times 0.0169] + [1 \times 0.49] \\ = 0.5407 \text{ points}$$

Player 1 loses  $3 \times 0.5407 = 1.6221$  pesos.

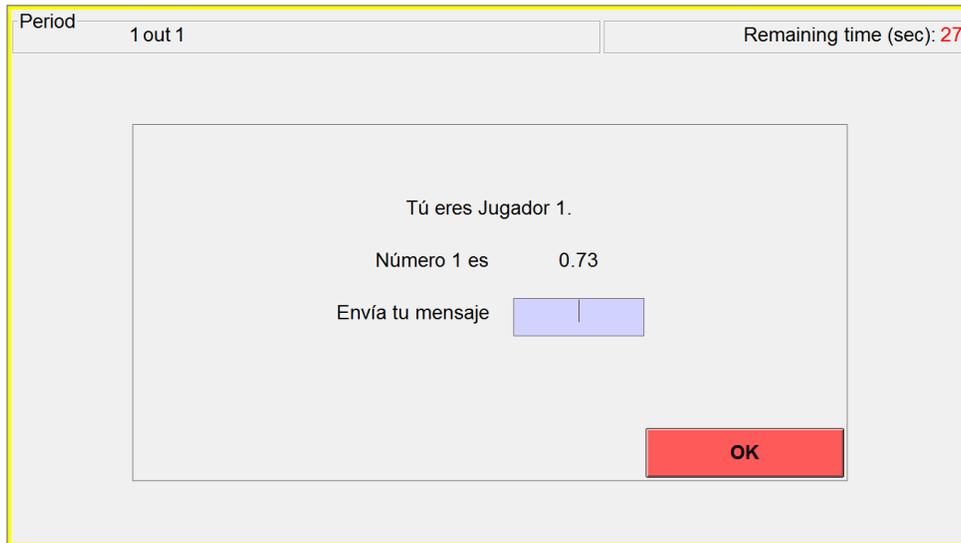
- Player 2 loses the following points

$$[3 \times (-0.10 - (-0.26))^2] + [1 \times (0.60 - (-0.10))^2] = [3 \times 0.0256] + [1 \times 0.49] \\ = 0.5668 \text{ points}$$

Player 2 loses  $3 \times 0.5668 = 1.7004$  pesos.

## How the Program Works

Once the computer has drawn **Number1** and **Number2**, Player 1 sees the following screen.



The screenshot shows a game window with a yellow border. At the top left, it says "Period 1 out 1". At the top right, it says "Remaining time (sec): 27". In the center, the text reads "Tú eres Jugador 1." followed by "Número 1 es 0.73". Below this is a text input field labeled "Envía tu mensaje" with a blue border and a vertical cursor. At the bottom right, there is a red button labeled "OK".

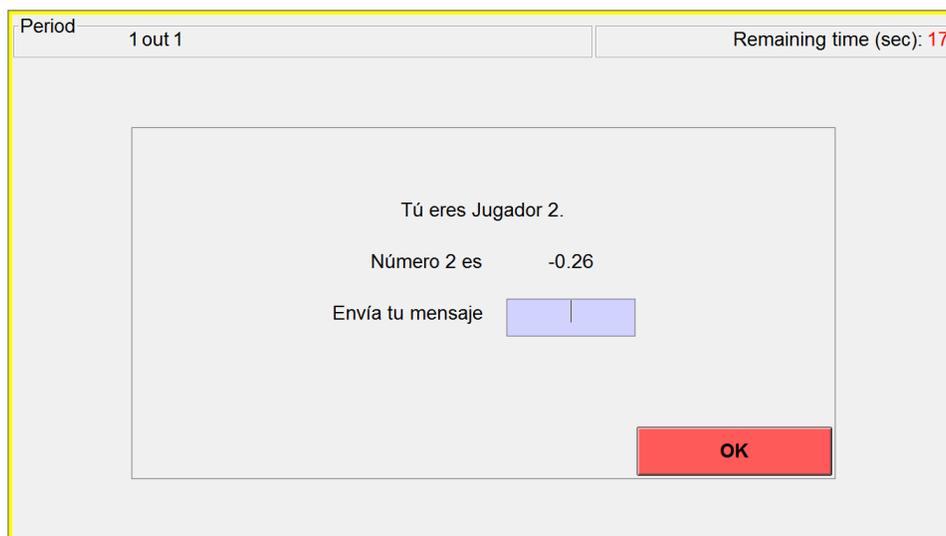
The screen shows **Number1** and asks Player 1 to send a message about **Number1** to Player 2. Recall that Player 1 is the only player that knows **Number1**.

The message of Player 1 can be any number between -1 and 1, in increments of 0.01.

**Player 1 does NOT have to send a message equal to **Number1**. Player 1 also does NOT have to send a message different from **Number1**.**

Example: Player 1 observes **Number1**=0.73. Messages such as -0.22, -0.10, 0.73, 0.85, 0.91, etc. are all possible messages that Player 1 can send.

Player 2 sees a similar screen which shows **Number2** and asks Player 2 to send a message about **Number2** to Player 1.



The screenshot shows a game window with a yellow border. At the top left, it says "Period 1 out 1". At the top right, it says "Remaining time (sec): 17". In the center, the text reads "Tú eres Jugador 2." followed by "Número 2 es -0.26". Below this is a text input field labeled "Envía tu mensaje" with a blue border and a vertical cursor. At the bottom right, there is a red button labeled "OK".

**Player 2 does NOT have to send a message equal to **Number2**. Player 2 also does NOT have to send a message different from **Number2**.**

After Player 1 and Player 2 send their messages, Player 1 sees the following screen and makes **Decision1**.

Period 1 out 1 Remaining time (sec): 0

Tú eres Jugador 1.

Número 1 es 0.73

El mensaje del Jugador 2 -0.36

Decisión 1

OK

**Decision1** can be any numbers between -1 and 1, in increments of 0.01.

Similarly, Player 2 sees the following screen and makes **Decision2**.

Period 1 out 1 Remaining time (sec): 28

Tú eres Jugador 2.

Número 2 es -0.26

El mensaje del Jugador 1 0.63

Decisión 2

OK

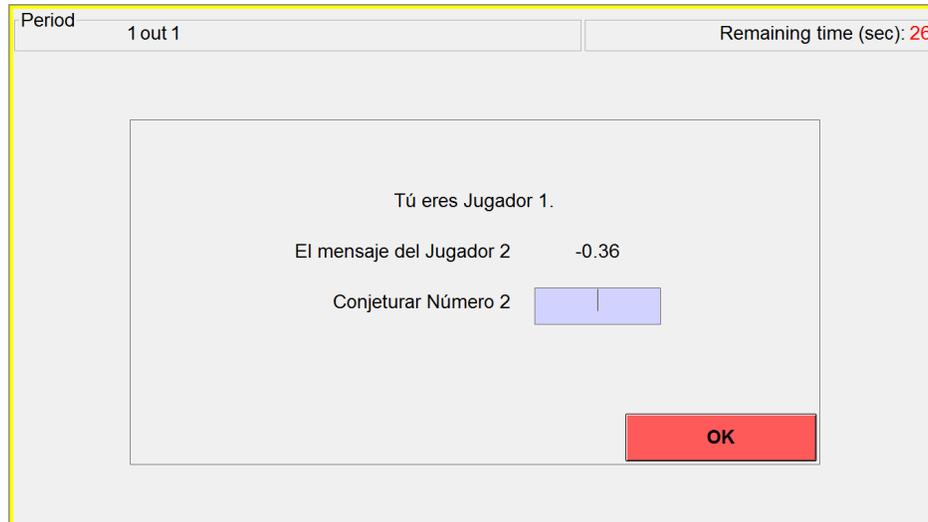
**Decision2** can be any numbers between -1 and 1, in increments of 0.01.

**These decisions determine how many points Player 1 and Player 2 lose in this round.**

## The Guessing Game

After Player 1 and Player 2 have made their decisions, all players are asked to guess what **Number1** and **Number2** are.

Player 1 sees the following screen.



Player 1 again observes the message that Player 2 sent and is asked to guess what **Number2** is.

Player 1 loses points according to the following formula:

$$(\text{Guess1} - \text{Number2})^2$$

**Guess1**=Player 1's guess about **Number2**

**Notice that Player 1 loses less points the closer his/her guess is to Number2.**

Example: **Number2**= -0.26.

If Player 1 guesses exactly -0.26, he/she loses zero points. This is the best that Player 1 can do when guessing **Number2**!

If Player 1 instead guesses -0.82, he/she loses  $(-0.82 - (-0.26))^2 = 0.3136$  points for the guess or **0.9408** pesos.

If Player 1 instead guesses 0.50, he/she loses  $(0.50 - (-0.26))^2 = 0.5776$  points for the guess or **1.7328** pesos. **Notice that in this case the number of points lost is higher because Player 1's guess is far from the actual Number2.**

**The guessing game of Player 2 is symmetric to the guessing game of Player 1.** Thus, Player 2 sees the following screen.

Period 1 out 1 Remaining time (sec): 17

Tú eres Jugador 2.

El mensaje del Jugador 1 0.63

Conjeturar Número 1

OK

Player 2 again observes the message that Player 1 sent and is asked to guess what **Number1** is.

Player 2 loses points according to the following formula

$$(\mathit{Guess2} - \mathit{Number1})^2$$

**Guess2**=Player 2's guess about **Number1**

**Notice that Player 2 loses less points the closer his/her guess is to Number1.**

## End of Round Information

At the end of each round, you will observe a screen which contains all the information about the round. This screen shows what numbers the computer has drawn for **Number1** and **Number2**, the messages that Player 1 and Player 2 sent, the decisions made by Player 1 and Player 2, the number of points that a player lost during the round, the overall number of points that a player lost and the overall amount of pesos lost.

For example, for Player 2, this screen looks like the following.

Period: 1 out 1 Remaining time (sec): 60

Tú eres Jugador 2.

Número 2	...
Número 1	...
Tu mensaje	...
El mensaje del Jugador 1	...
Decisión 1	...
Decisión 2	...
Puntos perdidos de Decisión 1 y Decisión 2	...
Tu conjetura acerca Número 1	...
Puntos perdidos de conjeturar	...
Puntos perdidos para la ronda	...
Total de puntos perdidos hasta ahora	...
Pesos perdió hasta ahora	...

OK

Please note that the experiment automatically continues to the next round after 1 MINUTE, unless you push OK.

# *Centralized Treatment*

## Instructions for the Experiment

Please read carefully and raise your hand if you have any questions. All questions will be answered privately.

### General Rules

Welcome and thank you for participating in the experiment today. You automatically earned **\$30** pesos for participating.

**You have 20 minutes to read these instructions and complete the quiz. The quiz has 12 questions and all the answers can be found in the instructions. For every correct answer you will gain 1 peso. You will not lose pesos for any incorrect or incomplete answer.**

**Quiz: After you answered all the questions on the first page of the quiz, press NEXT. After you answered all the questions on the second page of the quiz, press SEND ANSWERS. Your answers will be sent automatically after 20 MINUTES even if you did not complete the quiz.**

We will pay 30 pesos plus your earnings from the quiz regardless of anything else that happens in the experiment. You will also have an opportunity to make additional money according to the rules described below.

Please do not talk with other subjects, attempt to communicate, or look at other subjects' computer screens at any time during the session. Please turn off your cellphones before the experiment begins.

### Description of the Game

In the experiment, you will be randomly and anonymously matched to two other participants several times. You and the participants that you are matched with will be grouped into three person teams. In each of these teams, you will be randomly assigned to one of three roles: Player 1, Player 2, or Player 3. Each time that you are matched to two other participants will be called a "round."

The experiment will last for 17 rounds, including two practice rounds that will not count for your monetary earnings. During each round, you will interact with the other participants to whom you are matched through a computer program as described below. In the 15 non-practice rounds, you will have the opportunity to make additional earnings. The amount will depend on your decisions and the decisions of the participants to whom you are matched.

## Additional Earnings from the Game

Every participant starts the game with **\$210 pesos**. Each round of the game, you will lose some points depending on the decisions made by you and the participants you are matched with during the round. At the end of the experiment, the points will be converted into pesos and subtracted from \$210 to determine your additional earnings:

$$\text{Additional earnings} = 210 - 3 \times \text{Total points you lost during the experiment}$$

Thus, for every point you lose during the experiment, you lose \$3 pesos. If your total of points lost exceeds 50 points at the end of any round during the experiment, you will be unable to continue to play. You will have to wait until the experiment is over to receive your payment.

The instructions below explain how the amount of points lost depends on your decisions and the decisions of other participants. Remember that you will receive the guaranteed amount of 30 pesos plus the earnings from the quiz regardless of the outcome of the experiment.

### Examples

1. If you do not lose any points during the experiment, your additional earnings are 210 pesos.
2. If you lose 30 points, your additional earnings are  $210 - 90 = 120$  pesos.
3. If you lose 65 points, your additional earnings are  $210 - 195 = 15$  pesos.

In all of these examples you receive the guaranteed amount of 30 pesos plus the earnings from the quiz.

**You cannot lose more than the \$210 pesos that you receive at the beginning of the experiment.**

## Description of Each Round

At the beginning of each round, the computer independently draws two random numbers which are called **Number1** and **Number2**.

- **Number1** is any number between -1 and 1 in increments of 0.01, each number has the same probability to be drawn by the computer.
- **Number2** is any number between -1 and 1 in increments of 0.01, each number has the same probability to be drawn by the computer.

**Notice that *Number1* is independent from *Number2*. This means that observing *Number1* gives you no information about what number the computer has drawn for *Number2*. Likewise, *Number2* is independent from *Number1*.**

Example: The computer has randomly drawn **Number1**=0.73 and **Number2**= -0.26.

If you observe **Number1** =0.73 but you do not observe **Number2**, **Number2** can be any number between -1 and 1, in increments of 0.01, with equal probability.

The same is true if you observe **Number2**= -0.26 but you do not observe **Number1**.

If you do not observe either **Number1** or **Number2**, **Number1** can be any number between -1 and 1, in increments of 0.01, with equal probability. Similarly, **Number2** can be any number between -1 and 1, in increments of 0.01, with equal probability.

Please read the following pieces of information carefully:

- Player 1 observes **Number1** but does NOT observe **Number2**.
- Player 2 observes **Number2** but does NOT observe **Number1**.
- Player 3 does NOT observe **Number1** or **Number2**.

## How You Lose Points: Decision Stage

In each round Player 3 has to make two decisions, which are called **Decision1** and **Decision2**.

**Decision1** and **Decision2** can be any two numbers between -1 and 1, in increments of 0.01.

## ***(Centralized-High Treatment)***

### Earnings of Player 1

Given two decisions, **Decision1** and **Decision2**, Player 1 loses points according to the following formula:

$$[1 \times (\mathbf{Decision1} - \mathbf{Number1})^2] + [3 \times (\mathbf{Decision1} - \mathbf{Decision2})^2]$$

Notice that Player 1 loses points when **Decision1** is different from **Number1**. The larger the distance between **Decision1** and **Number1**, the more points Player 1 loses.

Player 1 also loses points when **Decision1** is different from **Decision2**. The larger the distance between **Decision1** and **Decision2**, the more points Player 1 loses.

Notice also that because  $(\mathbf{Decision1} - \mathbf{Decision2})^2$  is multiplied by 3 and  $(\mathbf{Decision1} - \mathbf{Number1})^2$  is multiplied by 1, Player 1 loses more points when **Decision1** is far from **Decision2** than when **Decision1** is equally far from **Number1**.

Remember that Player 3 chooses **Decision1** and **Decision2**.

### Earnings of Player 2

Given two decisions, **Decision1** and **Decision2**, Player 2 loses points according to the following formula:

$$[1 \times (\mathbf{Decision2} - \mathbf{Number2})^2] + [3 \times (\mathbf{Decision1} - \mathbf{Decision2})^2]$$

Notice that Player 2 loses points when **Decision2** is different from **Number2**. The larger the distance between **Decision2** and **Number2**, the more points Player 2 loses.

Player 2 also loses points when *Decision1* is different from *Decision2*. The larger the distance between *Decision1* and *Decision2*, the more points Player 2 loses.

Notice also that because  $(\textit{Decision1} - \textit{Decision2})^2$  is multiplied by 3 and  $(\textit{Decision2} - \textit{Number2})^2$  is multiplied by 1, Player 2 loses more points when *Decision2* is far from *Decision1* than when *Decision2* is equally far from *Number2*.

Remember that Player 3 chooses *Decision1* and *Decision2*.

## Earnings of Player 3

Given two decisions, *Decision1* and *Decision2*, Player 3 loses a number of points equal to the average of the points lost by Player 1 and Player 2.

In other words, Player 3 loses points according to the following formula:

$$\frac{[1 \times (\textit{Decision1} - \textit{Number1})^2] + [1 \times (\textit{Decision2} - \textit{Number2})^2]}{2} + [3 \times (\textit{Decision1} - \textit{Decision2})^2]$$

Remember that each player loses \$3 pesos for every 1 point, and that *Decision1* and *Decision2* are made by Player 3.

## Example

*Number1* = 0.73 and *Number2* = -0.26.

If Player 3 chooses *Decision1* = *Decision2* = 0.10, then:

- Player 1 loses the following points

$$[1 \times (0.10 - 0.73)^2] + [3 \times (0.10 - 0.10)^2] = [1 \times 0.3969] + [3 \times 0] = 0.3969 \textit{ points}$$

Player 1 loses  $3 \times 0.3969 = 1.1907$  pesos.

- Player 2 loses the following points

$$[1 \times (0.10 - (-0.26))^2] + [3 \times (0.10 - 0.10)^2] = [1 \times 0.1296] + [3 \times 0] = 0.1296 \textit{ points}$$

Player 2 loses  $3 \times 0.1296 = 0.3888$  pesos.

- Player 3 loses the following points

$$\frac{[1 \times (0.10 - 0.73)^2] + [1 \times (0.10 - (-0.26))^2]}{2} + [3 \times (0.10 - 0.10)^2]$$

$$= \frac{[1 \times 0.3969] + [1 \times 0.1269]}{2} + [3 \times 0] = 0.26325 \textit{ points}$$

Player 3 loses  $3 \times 0.26325 = 0.78975$  pesos.

## Example

**Number1**=0.73 and **Number2**= -0.26.

If Player 3 chooses **Decision1**=0.6 and **Decision2**= -0.10, then:

- Player 1 loses the following points

$$\begin{aligned} [1 \times (0.60 - 0.73)^2] + [3 \times (0.60 - (-0.10))^2] &= [1 \times 0.0169] + [3 \times 0.49] \\ &= 1.4869 \text{ points} \end{aligned}$$

Player 1 loses  $3 \times 1.4869 = 4.4607$  pesos.

- Player 2 loses the following points

$$\begin{aligned} [1 \times (0.10 - (-0.26))^2] + [3 \times (0.60 - (-0.10))^2] &= [1 \times 0.0256] + [3 \times 0.49] \\ &= 1.4956 \text{ points} \end{aligned}$$

Player 2 loses  $3 \times 1.4956 = 4.4868$  pesos.

- Player 3 loses the following points

$$\begin{aligned} \frac{[1 \times (0.60 - 0.73)^2] + [1 \times (-0.10 - (-0.26))^2]}{2} + [3 \times (0.60 - (-0.10))^2] \\ = \frac{[1 \times 0.0169] + [1 \times 0.0256]}{2} + [3 \times 0.49] = 1.49125 \text{ points} \end{aligned}$$

Player 3 loses  $3 \times 1.49125 = 4.47375$  pesos.

## (Centralized-Low Treatment)

### Earnings of Player 1

Given two decisions, **Decision1** and **Decision2**, Player 1 loses points according to the following formula:

$$[3 \times (\mathbf{Decision1} - \mathbf{Number1})^2] + [1 \times (\mathbf{Decision1} - \mathbf{Decision2})^2]$$

Notice that Player 1 loses points when **Decision1** is different from **Number1**. The larger the distance between **Decision1** and **Number1**, the more points Player 1 loses.

Player 1 also loses points when **Decision1** is different from **Decision2**. The larger the distance between **Decision1** and **Decision2**, the more points Player 1 loses.

Notice also that because  $(Decision1 - Number1)^2$  is multiplied by 3 and  $(Decision1 - Decision2)^2$  is multiplied by 1, Player 1 loses more points when **Decision1** is far from **Number1** than when **Decision1** is equally far from **Decision2**.

Remember that Player 3 chooses **Decision1** and **Decision2**.

## Earnings of Player 2

Given two decisions, **Decision1** and **Decision2**, Player 2 loses points according to the following formula:

$$[3 \times (Decision2 - Number2)^2] + [1 \times (Decision1 - Decision2)^2]$$

Notice that Player 2 loses points when **Decision2** is different from **Number2**. The larger the distance between **Decision2** and **Number2**, the more points Player 2 loses.

Player 2 also loses points when **Decision1** is different from **Decision2**. The larger the distance between **Decision1** and **Decision2**, the more points Player 2 loses.

Notice also that because  $(Decision2 - Number2)^2$  is multiplied by 3 and  $(Decision1 - Decision2)^2$  is multiplied by 1, Player 2 loses more points when **Decision2** is far from **Number2** than when **Decision2** is equally far from **Decision1**.

Remember that Player 3 chooses **Decision1** and **Decision2**.

## Earnings of Player 3

Given two decisions, **Decision1** and **Decision2**, Player 3 loses a number of points equal to the average of the points lost by Player 1 and Player 2.

In other words, Player 3 loses points according to the following formula:

$$\frac{[3 \times (Decision1 - Number1)^2] + [3 \times (Decision2 - Number2)^2]}{2} + [1 \times (Decision1 - Decision2)^2]$$

Remember that each player loses \$3 pesos for every 1 point, and that **Decision1** and **Decision2** are made by Player 3.

## Example

**Number1** = 0.73 and **Number2** = -0.26.

If Player 3 chooses **Decision1** = **Decision2** = 0.10, then:

- Player 1 loses the following points

$$[3 \times (0.10 - 0.73)^2] + [1 \times (0.10 - 0.10)^2] = [3 \times 0.3969] + [1 \times 0] = 1.1907 \text{ points}$$

Player 1 loses  $3 \times 1.1907 = 3.5721$  pesos.

- Player 2 loses the following points

$$[3 \times (0.10 - (-0.26))^2] + [1 \times (0.10 - 0.10)^2] = [3 \times 0.1296] + [1 \times 0] = 0.3888 \text{ points}$$

Player 2 loses  $3 \times 0.3888 = 1.1664$  pesos.

- Player 3 loses the following points

$$\frac{[3 \times (0.10 - 0.73)^2] + [3 \times (0.10 - (-0.26))^2]}{2} + [1 \times (0.10 - 0.10)^2]$$
$$= \frac{[3 \times 0.3969] + [3 \times 0.1296]}{2} + [1 \times 0] = 0.78975 \text{ points}$$

Player 3 loses  $3 \times 0.78975 = 2.36925$  pesos.

## Example

**Number1**=0.73 and **Number2**= -0.26.

If Player 3 chooses **Decision1**=0.60 and **Decision2**= -0.10, then:

- Player 1 loses the following points

$$[3 \times (0.60 - 0.73)^2] + [1 \times (0.60 - (-0.10))^2] = [3 \times 0.0169] + [1 \times 0.49]$$
$$= 0.5407 \text{ points}$$

Player 1 loses  $3 \times 0.5407 = 1.6221$  pesos.

- Player 2 loses the following points

$$[3 \times (-0.10 - (-0.26))^2] + [1 \times (0.60 - (-0.10))^2] = [3 \times 0.0256] + [1 \times 0.49]$$
$$= 0.5668 \text{ points}$$

Player 2 loses  $3 \times 0.5668 = 1.7004$  pesos.

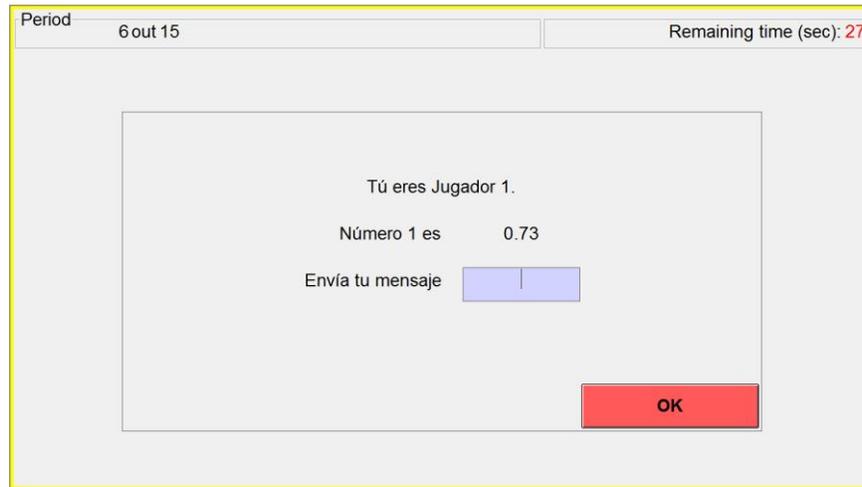
- Player 3 loses the following points

$$\frac{[3 \times (0.60 - 0.73)^2] + [3 \times (-0.10 - (-0.26))^2]}{2} + [1 \times (0.60 - (-0.10))^2]$$
$$= \frac{[3 \times 0.0169] + [3 \times 0.0256]}{2} + [1 \times 0.49] = 0.55375 \text{ points}$$

Player 3 loses  $3 \times 0.55375 = 1.66125$  pesos.

## How the Program Works

Once the computer has drawn **Number1** and **Number2**, Player 1 sees the following screen.



The screenshot shows a game window with a yellow border. At the top left, it says "Period 6 out 15". At the top right, it says "Remaining time (sec): 27". The main content area is a light gray rectangle containing the text "Tú eres Jugador 1." followed by "Número 1 es 0.73". Below this is a text input field labeled "Envía tu mensaje" with a blue border and a vertical cursor. At the bottom right of the content area is a red button labeled "OK".

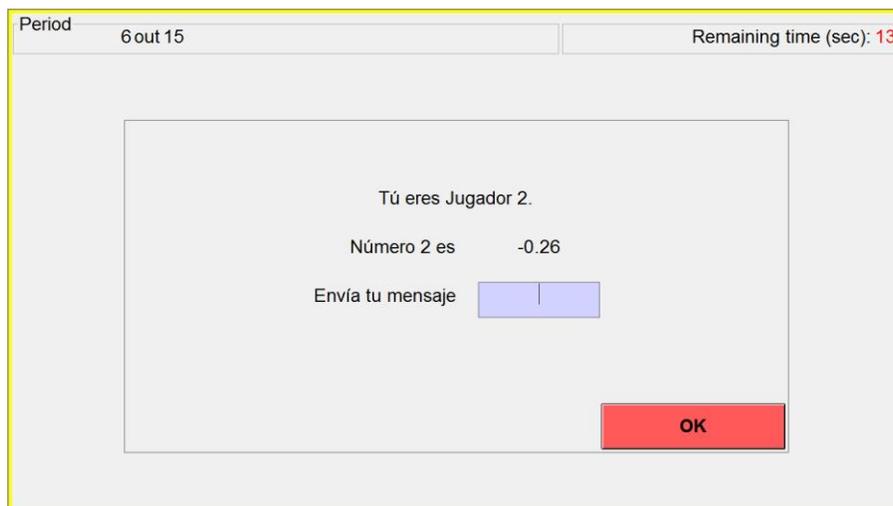
The screen shows **Number1** and asks Player 1 to send a message about **Number1** to Player 3. Recall that Player 1 is the only player that observes **Number1**.

The message of Player 1 can be any number between -1 and 1, in increments of 0.01.

**Player 1 does NOT have to send a message equal to Number1. Player 1 also does NOT have to send a message different from Number1.**

Example: Player 1 observes **Number1**=0.73. Messages such as -0.22, -0.10, 0.73, 0.85, 0.91, etc. are all possible messages that Player 1 can send.

Player 2 sees a similar screen which shows **Number2** and asks Player 2 to send a message about **Number2** to Player 3. Recall that Player 2 is the only player that observes **Number2**.



The screenshot shows a game window with a yellow border. At the top left, it says "Period 6 out 15". At the top right, it says "Remaining time (sec): 13". The main content area is a light gray rectangle containing the text "Tú eres Jugador 2." followed by "Número 2 es -0.26". Below this is a text input field labeled "Envía tu mensaje" with a blue border and a vertical cursor. At the bottom right of the content area is a red button labeled "OK".

**Player 2 does NOT have to send a message equal to Number2. Player 2 also does NOT have to send a message different from Number2.**

While Player 1 and Player 2 are deciding what message to send, Player 3 waits (see screen below).



After Player 1 and Player 2 send their messages to Player 3, Player 3 sees the following screen and makes ***Decision1*** and ***Decision2***.

A software interface window with a yellow border. The title bar contains two fields: "Period 6 out 15" and "Remaining time (sec): 18". The main content area is a gray rectangle containing the text "Tú eres Jugador 3." followed by a list of messages: "El mensaje del Jugador 1 0.63" and "El mensaje del Jugador 2 -0.36". Below this, it says "Toma tus decisiones." and has two input fields labeled "Decisión 1" and "Decisión 2". A red "OK" button is at the bottom right.

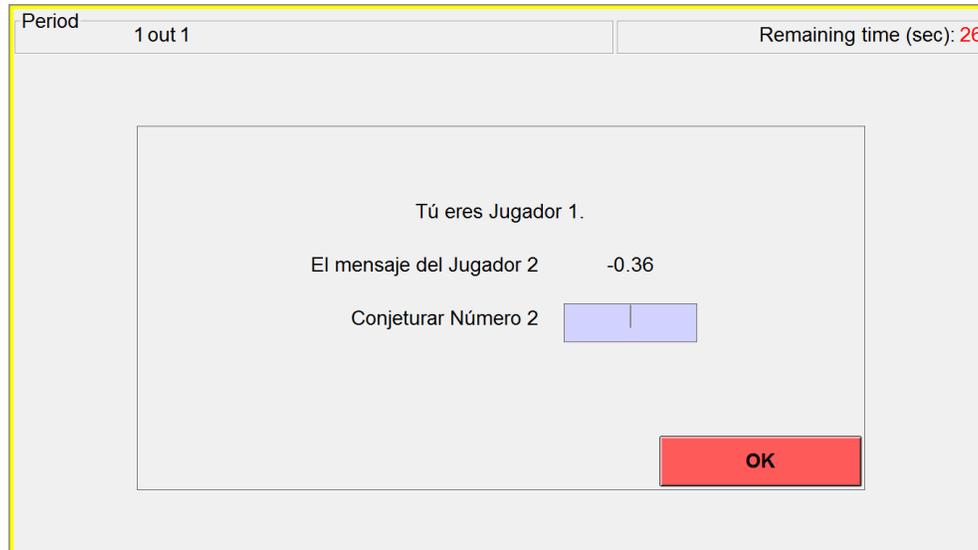
***Decision1*** and ***Decision2*** can be any two numbers between -1 and 1, in increments of 0.01.

**These decisions determine how many points Player 1, Player 2, and Player 3 lose in this round.**

## The Guessing Game

After Player 3 has made his/her two decisions, all players (including Player 3) are asked to guess what **Number1** and **Number2** are.

Player 1 sees the following screen.



Period 1 out 1 Remaining time (sec): 26

Tú eres Jugador 1.

El mensaje del Jugador 2 -0.36

Conjeturar Número 2

OK

Player 1 observes the message that Player 2 sent to Player 3 and is asked to guess what **Number2** is.

Player 1 loses points according to the following formula:

$$(\text{Guess1} - \text{Number2})^2$$

**Guess1**=Player 1's guess about **Number2**

**Notice that Player 1 loses less points the closer his/her guess is to Number2.**

Example: **Number2**= -0.26.

If Player 1 guesses exactly -0.26, he/she loses zero points. This is the best that Player 1 can do when guessing **Number2**!

If Player 1 instead guesses -0.82, he/she loses  $(-0.82 - (-0.26))^2 = 0.3136$  points for the guess or **0.9408** pesos.

If Player 1 instead guesses 0.50, he/she loses  $(0.50 - (-0.26))^2 = 0.5776$  points for the guess or **1.7328** pesos. **Notice that in this case the number of points lost is higher because Player 1's guess is far from the actual Number2.**

The guessing game of Player 2 is symmetric to the guessing game of Player 1. Thus, Player 2 sees the following screen.

Period 1 out 1 Remaining time (sec): 17

Tú eres Jugador 2.

El mensaje del Jugador 1 0.63

Conjeturar Número 1

OK

Player 2 observes the message that Player 1 sent to Player 3 and is asked to guess what **Number1** is.

Player 2 loses points according to the following formula

$$(Guess2 - Number1)^2$$

**Guess2**=Player 2's guess about **Number1**

Notice that **Player 2** loses less points the closer his/her guess is to **Number1**.

Player 3 also plays the guessing game. He/she observes the following screen and is asked to guess **Number1** and **Number2**.

Period 6 out 15 Remaining time (sec): 30

Tú eres Jugador 3.

El mensaje del Jugador 1 0.63

El mensaje del Jugador 2 -0.36

Conjeturar Número 1 y Número 2.

Número 1

Número 2

OK

Player 3 loses points according to the following formula

$$\frac{(FirstGuess3 - Number1)^2}{2} + \frac{(SecondGuess3 - Number2)^2}{2}$$

**FirstGuess3**=Player 3's guess about **Number1**

**SecondGuess3**=Player 3's guess about **Number2**

Notice that **Player 3** loses less points the closer **FirstGuess3** is to **Number1** and the closer **SecondGuess3** is to **Number2**.

Example: **Number1**=0.73 and **Number2**= -0.26.

If Player 3 guesses **FirstGuess3**=0.10 and **SecondGuess3**= -0.20, he/she loses

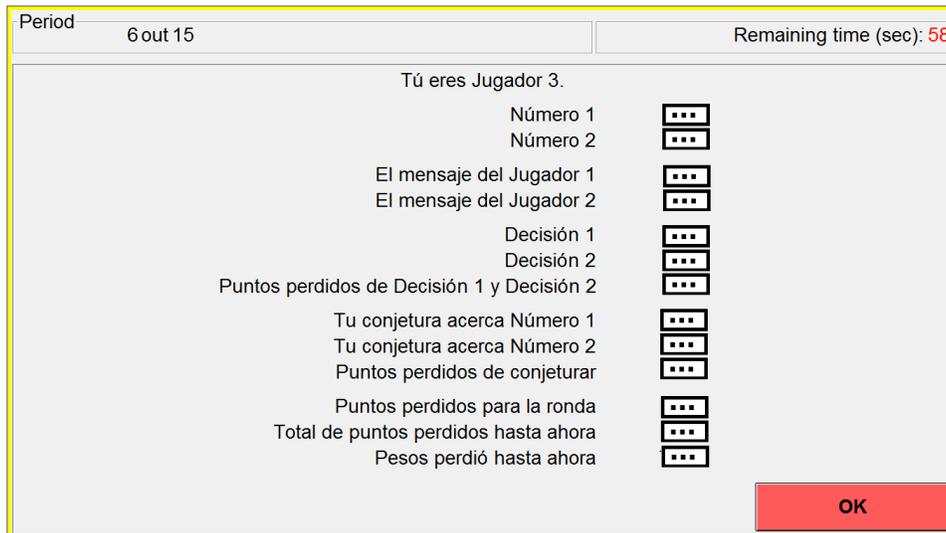
$$\frac{(0.10-0.73)^2}{2} + \frac{(-0.20-(-0.26))^2}{2} = \frac{0.3969+0.0036}{2} = \mathbf{0.20025}$$

points for the guesses or **0.60075** pesos.

## End of Round Information

At the end of each round, you will observe a screen which contains all the information about the round. This screen shows what numbers the computer has drawn for **Number1** and **Number2**, the messages that Player 1 and Player 2 sent, the decisions made by Player 3, the number of points that a player lost during the round, the overall number of points that a player lost and the overall amount of pesos lost.

For example, for Player 3, this screen looks like the following.



Please note that the experiment automatically continues to the next round after 1 MINUTE, unless you push OK.

# Quiz

**Question 1:** Suppose that you observe **Number1**=0.15, which of the following statements is true:

- A. **Number2** is more likely to be a number higher than 0.15
- B. **Number2** is more likely to be a number lower than 0.15
- C. **Number2** is equally likely to be any number between -1 and 1

**Question 2: (DECENTRALIZED TREATMENT)** Which of the following statements is true?

- A. At the beginning of each round of the game, you are randomly and anonymously matched to one other participant
- B. At the beginning of the game, you are randomly and anonymously matched to one other participant
- C. At the beginning of each round of the game, you are matched to one other participant in a prearranged manner

**Question 2: (CENTRALIZED TREATMENT)** Which of the following statements is true?

- A. At the beginning of each round of the game, you are randomly and anonymously matched to two other participants
- B. At the beginning of the game, you are randomly and anonymously matched to two other participants
- C. At the beginning of each round of the game, you are matched to two other participants in a prearranged manner

**Question 3:** Suppose that you lost 50 points during the game, how many pesos do you receive at the end of the game?

- A. 80 pesos + 30 pesos plus your earnings from the quiz
- B. 60 pesos + 30 pesos plus your earnings from the quiz
- C. 30 pesos + 30 pesos plus your earnings from the quiz

**Question 4: (DECENTRALIZED TREATMENT)** Who makes **Decision1** and **Decision2**?

- A. Player 1 makes **Decision1** and Player 2 makes **Decision2**
- B. Player 2 makes **Decision1** and Player 1 makes **Decision2**
- C. Player 1 makes both **Decision1** and **Decision2**
- D. Player 2 makes both **Decision1** and **Decision2**

**Question 4: (CENTRALIZED TREATMENT)** Who makes **Decision1** and **Decision2**?

- A. Player 1 makes **Decision1** and Player 2 makes **Decision2**
- B. Player 3 makes **Decision1** and Player 2 makes **Decision2**
- C. Player 3 makes both **Decision1** and **Decision2**

**Question 5: (DECENTRALIZED TREATMENT)** **Number1** and **Number2** depend on:

- A. Player 1's choices (message, decision, and guess)
- B. Player 2's choices (message, decision, and guess)
- C. Nobody's choices

**Question 5: (CENTRALIZED TREATMENT) *Number1* and *Number2* depend on:**

- A. Player 1's choices (message and guess)
- B. Player 2's choices (message and guess)
- C. Player 3's choices (decisions and guesses)
- D. Nobody's choices

**Question 6: *Number1* and *Number2* can be:**

- A. Any two numbers between -1 and 1 in increments of 0.01 with equal probability
- B. Any two numbers between -1 and 2 in increments of 0.03 with equal probability
- C. Any two numbers between -2 and 2 in increments of 0.01 with equal probability

**Question 7: *Decision1* and *Decision2* can be:**

- A. Any two numbers between -1 and 1 in increments of 0.02
- B. Any two numbers between -2 and 2 in increments of 0.03
- C. Any two numbers between -1 and 1 in increments of 0.01

**Question 8: At the beginning of each round, Player 1 observes:**

- A. *Number1* but does not observe *Number2*
- B. *Number2* but does not observe *Number1*
- C. *Number1* and *Number2*
- D. Neither *Number1* nor *Number2*

**Question 9: At the beginning of each round, Player 2 observes:**

- A. *Number1* but does not observe *Number2*
- B. *Number2* but does not observe *Number1*
- C. *Number1* and *Number2*
- D. Neither *Number1* nor *Number2*

**Question 10: (DECENTRALIZED TREATMENT) Player 1 observes the decision made by Player 2 before making his/her own decision.**

- A. True
- B. False

**Question 10: (CENTRALIZED TREATMENT) At the beginning of each round, Player 3 observes:**

- A. *Number1* but does not observe *Number2*
- B. *Number2* but does not observe *Number1*
- C. *Number1* and *Number2*
- D. Neither *Number1* nor *Number2*

**Question 11: If  $Decision1 = Decision2$ , Player 1 loses points:**

- A. If *Number1* is different from *Decision1*
- B. If *Number2* is different from *Decision2*
- C. If *Number1* is different from *Decision2*
- D. If *Number2* is different from *Decision1*

**Question 12:** If *Decision2* = *Number2*, Player 2 loses points:

- A. If *Number1* is different from *Decision1*
- B. If *Decision2* is different from *Decision1*
- C. If *Decision2* is different from *Number1*
- D. If *Decision1* is different from *Number2*