

Experimental Instructions
for

“Environmental variability and collective action: Experimental insights from an irrigation game”

Instruction Script Summary

The pages that follow contain the instruction script used during the experiments. The first page shows the overall progression of the experiment (not read to subjects). The instructions to subjects begin on page 2. Following the general introduction, participants are taken through the screenshots of the actual experiment. The text boxes that appear on each page are the instructions read to the participants by the facilitator when each screen appears on their computers. The instructions were administered interactively, and the students following along filling in values as appropriate. After instructions were read for each screen, participants were asked whether they had any questions regarding that screen. The instructions for the 4 different treatments were slightly different. At the end of the instruction script, there are two variations of the last paragraph that were read for the appropriate treatment.

Overall scheme of instructions and practice

- Introduction to experiment [text]
- chat ["type in hi"]
- investment page ["explain and type in 7"]
- result investments [explain]
- screenshot crop growing [explain]
- 50 seconds crop growing
- results view of practice round 1
- quiz questions
- give answers to questions [store answers from participants]
- do practice round 2
- Experiment start 10 rounds + 10 rounds

General Introduction

**[WHEN PEOPLE COME IN THE SCREEN GIVES A WELCOME MESSAGE.
WHEN EVERYBODY IS READY ALLEN WILL START THE GAME]**

Welcome, I am Dr. Anderies, a professor here at ASU and we will conduct a decision-making exercise today. Allen Lee will assist me during the exercise. Before we go to the instructions, I will ask you to turn off any mobile phones and other mobile devices that might disrupt the exercise. I also ask that you not speak during the exercise. If you have a question, raise your hand, and I will address your question.

This exercise consists of two practice rounds and twenty rounds for real. Each round is about two minutes.

[TELL ALLEN: START INSTRUCTION SCREEN]

Carefully read the instructions on the screen. Because it is important for the results that you understand the instructions, I will also read the instructions out loud. You will be able to earn money in this exercise based on the decisions you are making and the decisions the participants in your group are making.

1 General Instructions

You have already earned 5 dollars by showing up for this exercise. You can earn more, up to an extra 30 dollars.

You will participate in this exercise as a part of a group of five participants. Your group has been formed by randomly assigning you to FOUR other participants in the room.

The amount of money you earn will depend on the decisions made by you and the other members of your group.

This exercise mimics decisions people make in irrigation systems.

In each round you will receive 10 tokens which you can invest in the irrigation infrastructure. Based on the water delivery capacity of the irrigation infrastructure and the availability of water you will be able to grow crops.

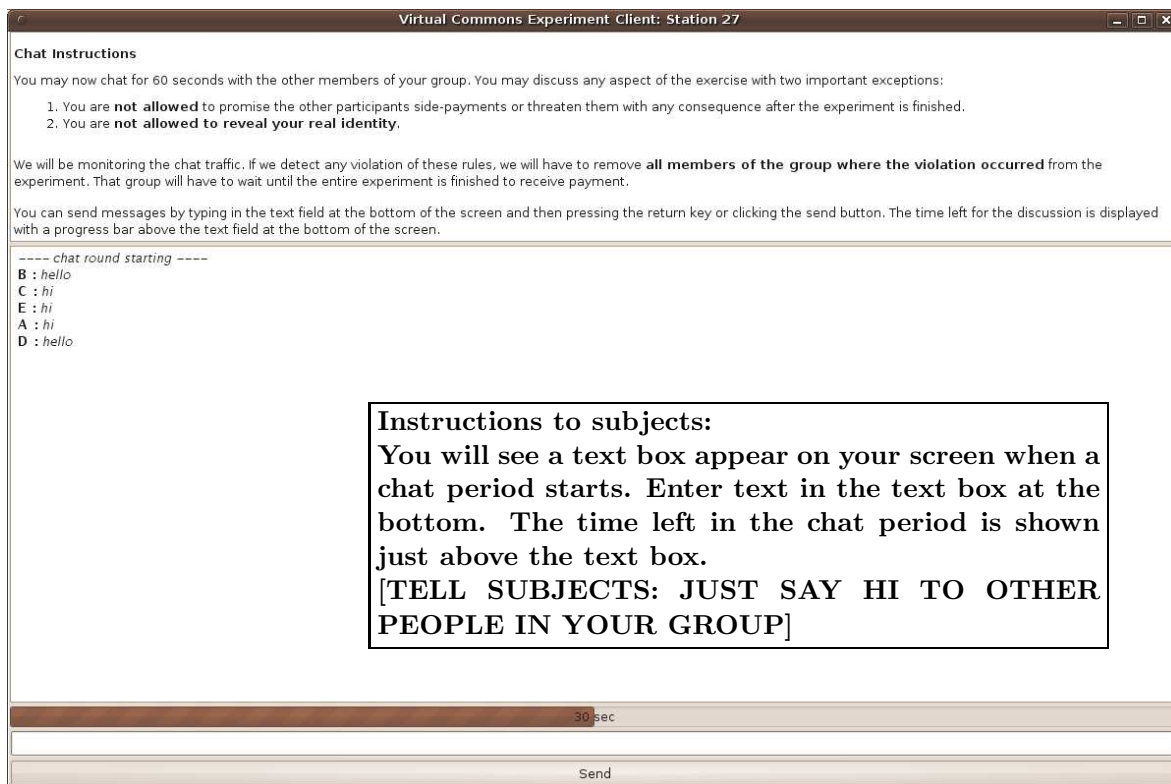
Tokens earned in a round is the sum of tokens not invested plus tokens earned by growing crops. Each token is worth 5 cents.

In each round you will first decide how much to invest in the irrigation infrastructure. Based on the combined contributions of all 5 participants in your group in each round, your group can maintain the capacity of the irrigation infrastructure for growing crops.

Before each round in this experiment you will have a chat period of 60 seconds where you can send text messages to the other participants. You may discuss any aspect of the exercise with two important exceptions: You are not allowed to promise the other participants side-payments or threaten them with any consequence after the experiment is finished. You are not allowed to reveal your real identity. We will be monitoring the chat traffic. If we detect any violation of these rules, we will have to remove all members of the group where the violation occurred from the experiment. That group will have to wait until the entire experiment is finished to receive payment.

We will now start a practice round to help illustrate the experiment.

[TELL ALLEN: START CHAT ROUND]



[MOVE ON TO INVESTMENT PAGE]

[Explain investment table to subjects]

At the beginning of each round, each participant will be given 10 tokens. You must then decide what to do with these tokens. You may decide to invest some tokens in the irrigation infrastructure or to keep the tokens. For example, if you keep the tokens, you will earn 10 tokens in that round. On the other hand, if you invest some tokens in the irrigation infrastructure, you may be able to earn more than this amount by growing crops. In fact, by growing crops you can triple your earnings compared to doing nothing. But note that the actual earnings depend on what you and the other participants in the experiment do.

1. Instructions to subjects:
 After each round the condition of the irrigation system declines such that its water delivery efficiency drops by 25%. Investment is necessary to keep the irrigation infrastructure from deteriorating. If you decide to invest in irrigation infrastructure, you must decide on the amount, as you will need a certain level of irrigation infrastructure before you can grow crops.

Virtual Commons Experiment Client: 5

Current infrastructure efficiency: 50% ←

Current water delivery capacity: 5 cubic feet per second

Available water supply: 30 cubic feet per second

You have been endowed with 10 tokens to invest. You must make a decision about how much you wish to invest [0,10] in the irrigation infrastructure. You can see the relationship between total investment and irrigation infrastructure in the table below. After you have entered the number of tokens you'd like to invest, hit the enter key or click the submit button to confirm your investment. When everybody has made their decision, the total investment will be calculated and the overall irrigation infrastructure will be displayed. Each token you invest corresponds to one percent of infrastructure efficiency, so if you invest 10 tokens you are contributing 10% to the overall infrastructure efficiency.

Total Infrastructure Efficiency (percent)	Water delivery (cubic feet per second)
≤ 45	0
46-51	5
52-55	10
56-58	15
59-61	20
62-65	25
66-70	30
71-80	35
81-100	40

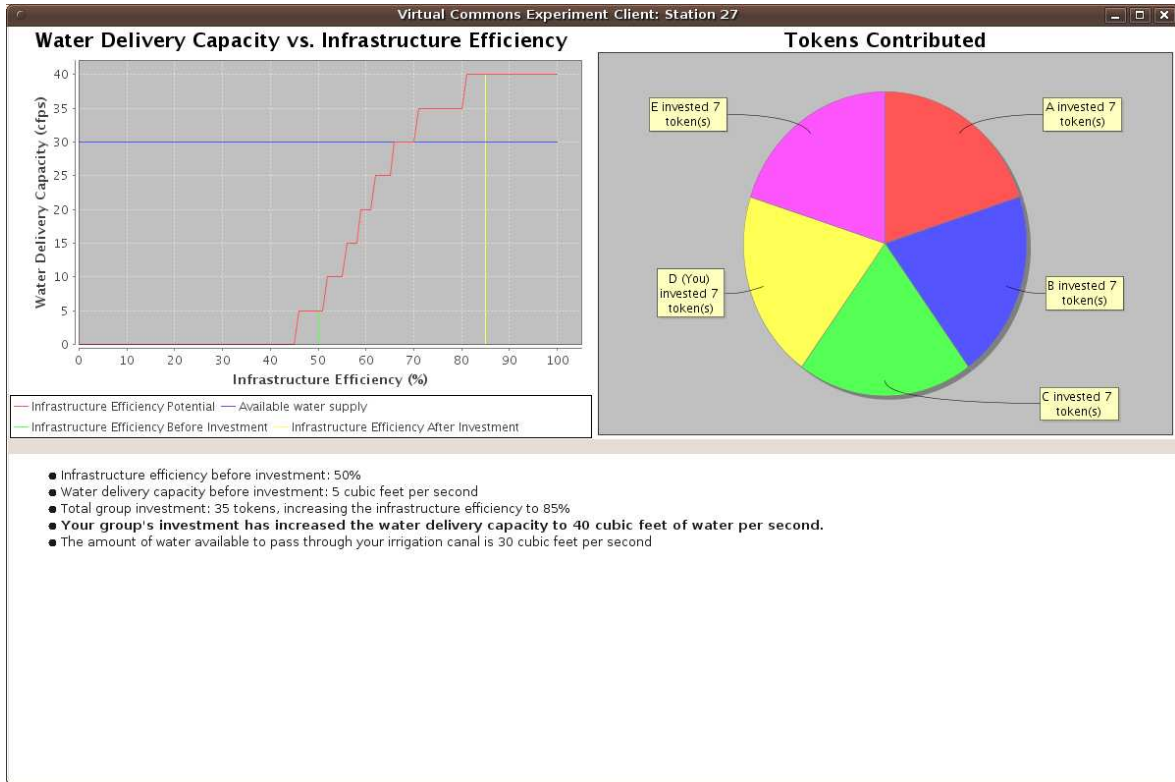
Invest

2. Instructions to subjects:
 The investment of all five participants is added together and will amount to between 0 and 50 tokens. Each token invested will increase the efficiency of the system by one by one percentage point up to a maximum of 100%. In the table you will see the water delivery capacity measured in water units per second as a function of condition of the irrigation infrastructure. When the infrastructure is at 100% efficiency, 40 cubic feet per second will be available. If system efficiency falls below 45%, no capacity for transporting water will be available.

3. Instructions to subjects:
 Before the growing crops component of the exercise starts, each participant independently makes a decision as to how much to invest in irrigation infrastructure maintenance. After everybody has made their decision, the condition of the infrastructure and the associated total maximum capacity to distribute water that will be available during the crop growing component of the exercise is announced.

For this practice round we just ask you to type in 7, hit return, or click the investment button.

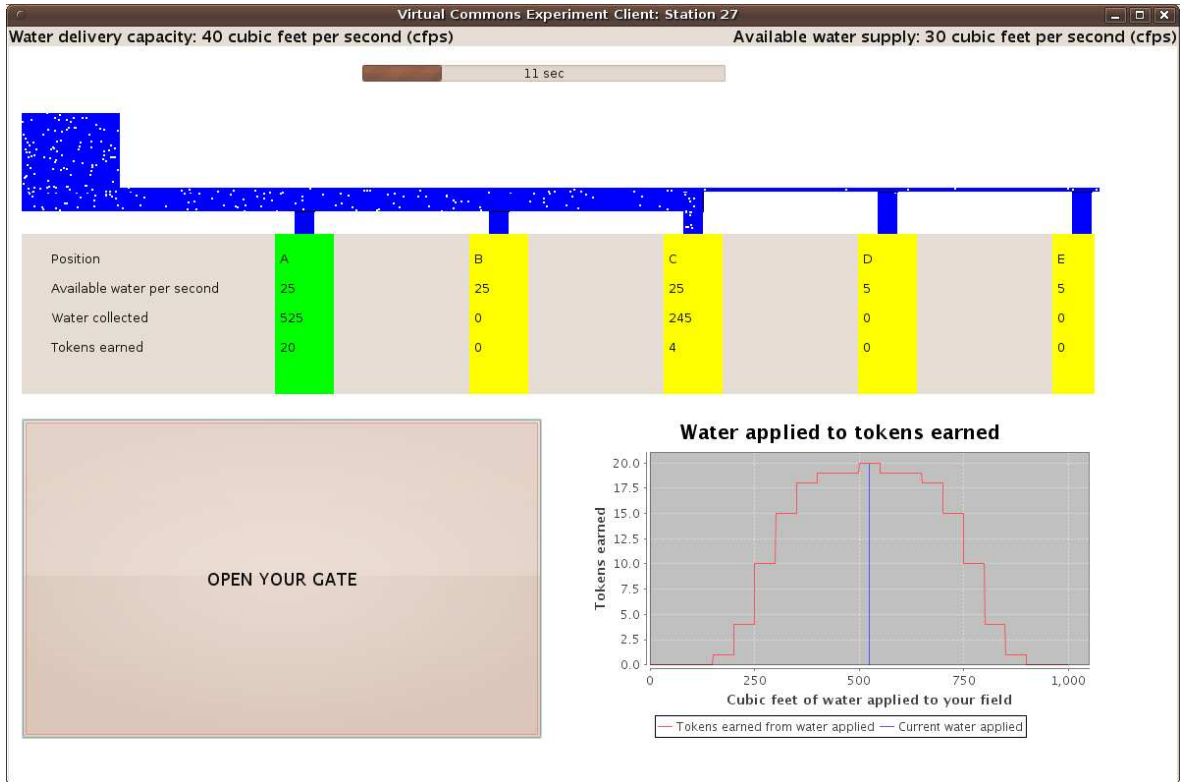
[TELL ALLEN: MOVE ON TO INVESTMENT RESULTS PAGE]



You now see a table summarizing the results of group investment. The infrastructure had an efficiency of 50% and you as a group invested 35. Now the infrastructure is 85%. Reading to the left where the yellow line hits the red, stair-stepped curve, shows the water delivery capacity, in this case 40 cfps. The blue line shows the amount of water available - in this case, 30 cfps.

In the pie diagram on the right you see how much every participant in your group contributed.

[TELL ALLEN: MOVE ON TO GAME INTERFACE PAGE]



There are FIVE participants, each of which is randomly assigned to one of the five positions, A, B, C, D or E. Water comes from the box to the left and the five players are located from upstream to downstream. To illustrate the game, assume you are in position A. The black lines represent gates that you control (i.e open and close). Right now, your gate is closed, and player C's gate is open.

Each round will take 50 seconds and the amount of time left in the round is indicated at the top of the screen.

During this round you can irrigate your field. The earnings depend on the amount of water you put on your field as will be explained in the next screen. How fast you can grow a crop depends only on the amount of water that is available to you. The maximum flow capacity of the main canal shared by A, B, C, D, and E is 40 cubic feet per second (cfps).

The actual amount of water that is available for the group depends on the amount of water entering the system. Your group might have created an irrigation infrastructure with a capacity of 40 cfps, but due to lack of rainfall only 30 cfps is available. On the other hand, if infrastructure capacity is 30 cfps and 40 cfps of water is available to the system, only 30 cfps can be delivered. The maximum capacity that can flow through your gate when it is opened is 25 cubic feet per

second. If other people are using the canal, the water flow available to you might be less, and it may take longer to get water to your field.

The water flow capacity available for your field is shown as a number. If somebody upstream uses water, less water is available for you. The thickness of the blue bar is the relative amount of water available. To start growing crops, click on the large button “open your gate”. This will open your irrigation gate and water will begin to flow to your field. The text on the button will turn to “close your gate”. If you would like to close the gate, click on the yellow button again. The gate closes and the text on the button returns back to “open your gate”. The amount of water units (cubic feet) your field has received is shown on the screen, as well as the resulting amount of tokens earned from growing a crop. The number of tokens earned in each round depends on how much water you have diverted to your field. If you receive less than 150 cubic feet (cf) the crop has not received enough water to grow a crop and you will thus not receive any tokens. The maximum earnings are received when between 500 cf and 549 cf are diverted to your field. If more than 549 cf water is diverted to your field, this will negatively affect the growth of the crop (i.e. overwatering) and less tokens will be earned. In the graph in the right bottom of the screen you can see the amount of tokens earned as a result of the amount of water applied to your field.

Your earnings at the end of the round depend on your investment and the number of tokens received for the crop. We will now start a crop season for 50 seconds. Just try out what happens when you open and close the gate on your earnings. See the table on your handout.

[TELL ALLEN: START 50 SECOND CROPPING ROUND]

You see now a table summarizing how much you and other group members have earned if this round was for real. You see how much you have invested or not, and how many tokens you earned from growing a crop.

If you have any questions feel free to raise your hand and to ask your question. Do you have any questions so far?

We will now ask you to answer a number of quiz questions which gives us a better idea how well you understood the instructions.

Instructions for Round 11-20, Treatments 1 and 2

In the past rounds the infrastructure efficiency declined from one round to the next at a constant amount of 25%. In the following rounds the average decline of the infrastructure efficiency will remain the same, but the actual amount of decline can vary from round to round. This means that in some rounds the decline will be larger than 25% and some rounds the decline will be smaller than 25%. Before each round begins you will continue to make a decision on how much to invest in the irrigation infrastructure. After all of your investment contributions have been submitted the resulting level of infrastructure efficiency will be displayed and then the cropping round will begin. If you have any questions, please ask them now.

Instructions for Round 11-20, Treatments 3 and 4

In the past rounds the water available during the crop growing round was 30 cfps. In the

following rounds the average water availability will remain the same, but the actual amount of water available can vary from round to round. This means that in some rounds the amount of water available will be larger than 30 cfs and some rounds the amount of water available will be smaller than 30 cfs. Before each round begins you will continue to make a decision on how much to invest in the irrigation infrastructure. After all of your investment contributions have been submitted the resulting level of infrastructure efficiency will be displayed and then the cropping round will begin. If you have any questions, please ask them now.