Technical Appendix for "Bounded Rationality and Directed Cognition"

Xavier Gabaix
MIT and NBER

David Laibson
Harvard University and NBER*

June 24, 2004

Abstract

This Appendix contains the instructions for the experiment described in the paper, and two questionnaires administered after the experiment.

*Gabaix: Department of Economics, MIT, and NBER, Cambridge, MA 02142, xgabaix@mit.edu. Laibson: Department of Economics, Harvard University, and NBER, Cambridge MA 02138, dlaibson@harvard.edu.

Complex Games

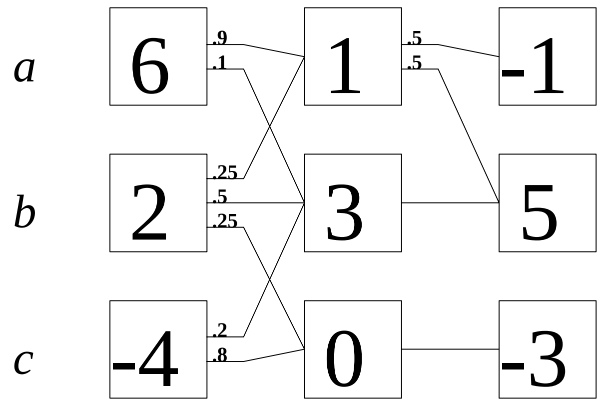
Start Time:

Latest Stop Time (40 minutes from start time):

Time Handed In:

Experimental Code Number:
(must match code number on questionnaire)

You will be asked to analyze 12 different games in the next 40 minutes. They will all look more or less like larger versions of this game:



Here we have boxes arranged in columns, with pathways connecting boxes. You will analyze the game, but you won't actually play the game. To explain how the game works, it will help to discuss an imaginary player which we will refer to as the "runner."

When the game is played, the runner is moved from left to right according to probabilities fixed in the game. Specifically, if the runner is in a box, the probability of being moved to a particular box to the right is printed on the pathway connecting the two boxes. For example, the probability of being moved from the box with the 6 to the box with the 1 is .9 (90%), and the probability of being moved from the box with the 6 to the box with the 3 is .1 (10%).

The runner starts in one of the left-most boxes (labeled "a", "b", and "c"). The pathways and their probabilities then show the various ways that the runner might be moved from any starting box through the game to the right-most column. Chance and only chance determines the path that the runner actually takes through the game.

For example, if the runner starts in Box "a" (with the 6), there is a .9 (90%) chance of being moved to the box with the 1 and a .1 (10%) chance of being moved to the box with the 3. From the box with the 1 there is a .5 (50%) chance of being moved to the box with the -1 and a .5 (50%) chance of being moved to the box with the 5. Alternatively, from the box with the 3, the runner would automatically be moved to the box with the 5. From any starting box there are many paths that the runner might travel through the game. The actual path is determined by chance. The runner has no control over movement through the game.

The total payoff for the runner from any run of the game is the sum of the numbers contained in each box through which the runner is moved. If the runner is moved from the 6 to the 1 to the -1, the total payoff for that run would be $6 + 1 + -1 = 6$; the total payoffs for the other possible runs from starting box "a" would be $6 + 1 + 5 = 12$ and $6 + 3 + 5 = 14$.

Statisticians often use the concept of "expected value" to analyze games like the one above. You can think of "expected value" as the average payoff you would expect to receive if you repeated the game thousands of times. For example, if you were flipping a coin, you would have a 50% chance of getting a heads and a 50% chance of a tails. If we were paying you \$2 for a heads and \$4 for a tails, you might be paid either \$2 or \$4 on any given flip, but over thousands of coin tosses your expected value would be \$3.

Now reconsider the game on the previous page. The expected value of starting in any particular box is the average total payoff you would expect the runner to receive if the runner was moved from the starting box to the end of the game thousands of times. We have calculated that the expected value of starting in box "a" is 9.5. The expected value of starting in box "b" is 6. The expected value of starting in box "c" is -4.8.

You are now going to analyze 12 games (one game per page) like the game on the previous page. In each game we want you to choose the starting box which you believe has the greatest expected value. These 12 games are significantly more complex than the game on the previous page. Indeed, the 12 games are so complex that you may not be able to calculate exactly the expected value of each starting box. For each game, we simply want you to make your best guess as to which starting box has the highest expected value.

To encourage you to seek the greatest expected value, we will pay you based on the quality of your choices. Specifically, at the end of the entire experiment we will select 1 of these 12 games at random by rolling a 12-sided die, and we will pay you the true expected value in dollars for the starting box you chose in that game. We will also pay you for another task that you will do after analyzing the 12 games. We guarantee that the **sum** of your two payments will be at least \$7.00. If you do well, you can earn substantially more than \$7.00.

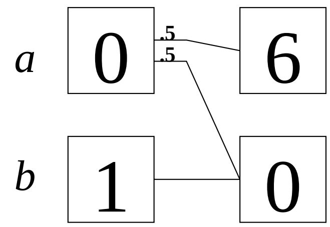
For each game on the following sheets indicate the starting box which you believe has the greatest expected value by circling the letter to its left. You may circle only 1 letter per game. You may not use any aids such as calculators and you must complete the games within the time allotted. Please refrain from discussion during the experiment. When you are finished, return this form to the experimental assistant. Good Luck!!

Experimental Code #:

Try to estimate the expected value for all starting boxes in the following games. Remember, the expected value is the average total payoff you would expect to receive if you repeated the game thousands of times. You will be rewarded for **every** answer within 10% of the correct answer. You may not use any aids, such as calculators. Write your answers in the spaces provided.

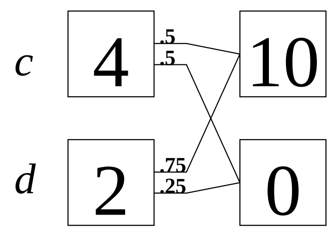
Expected Payoff for starting in box "a": ________
Reward of $0.50 for answers within 10% of the correct answer.

Expected Payoff for starting in box "b": ________
Reward of $0.50 for answers within 10% of the correct answer.



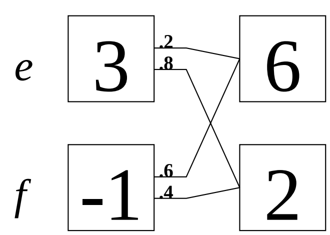
Expected Payoff for starting in box "c": ________
Reward of $0.75 for answers within 10% of the correct answer.

Expected Payoff for starting in box "d": ________
Reward of $0.75 for answers within 10% of the correct answer.



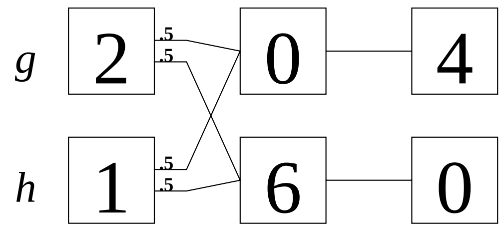
Expected payoff for starting in box "e": ________
Reward of $1.00 for anwers within 10% of the correct answer.

Expected payoff for starting in box "f": ________
Reward of $1.00 for answers within 10% of the correct answer.



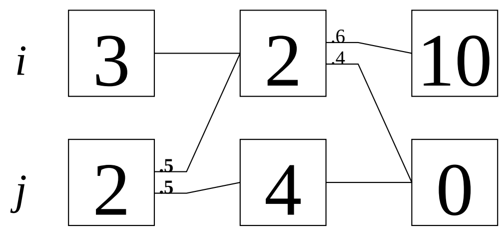
Expected payoff for starting in box "g": ________
Reward of $1.25 for answers within 10% of correct answer.

Expected payoff for starting in box "h": ________
Reward of $1.25 for answers within 10% of correct answer.



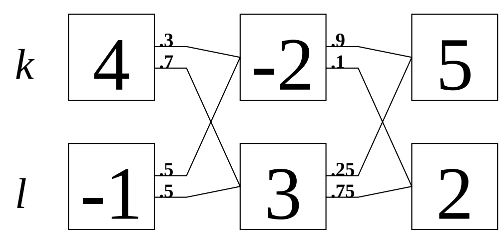
Expected payoff for starting in box "i": ________
Reward of $1.50 for answers within 10% of correct answer.

Expected payoff for starting in box "j": ________
Reward of $1.50 for answers within 10% of correct answer.



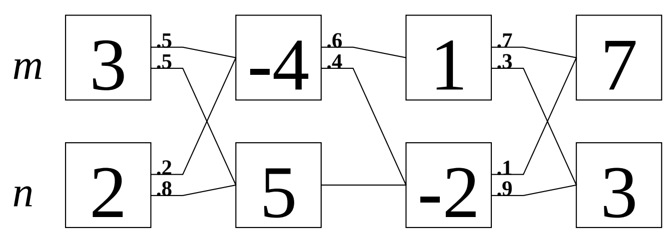
Expected payoff for starting in box "k": ________
Reward of $1.75 for answers within 10% of correct answer.

Expected payoff for starting in box "l": ________
Reward of $1.75 for answers within 10% of correct answer.



Expected payoff for starting in box "m":
Reward of $2.00 for answers within 10% of correct answer.

Expected payoff for starting in box "n":
Reward of $2.00 for answers within 10% of correct answer.



Start Time: Experimental Code Number:
Time Returned: (must match Complex Game code)

Questionnaire

1. Please describe how you approached the problem of finding the best starting boxes in the 12 games you just analyzed. Your detailed response to this question will be very helpful to us.

2. Has any part of this experiment been confusing? Please explain.

3. Concentration:

4. a) Year: b) Age: c) Gender: M F

5. We would like to know something about your math and statistical background. Please circle any of the following which you have taken:

   High school: statistics calculus

   Mathematics: Xa Xb 1a 1b 19 20 21a 21b 23a 23b 25 55 higher

   Statistics: 100 101 102 104 110 111 higher

   Economics: 10 (Social Analysis 10) 1010a 1011a 1123 1126

6. Please list any other courses you have taken which covered statistics, such as Government 1000 or Social Studies 20:

7. Please list any courses not listed in (5) or (6) above that taught the concept of "expected value":