Appendix A

Strategy estimation procedure

To estimate the prevalence of each strategy in our dataset we use a standard maximum likelihood (ML) procedure, as in Dal Bó and Frechette (2011) and Fudenberg et al. (2011). There are two basic assumptions. First, each subject $j = 1, \ldots, J$ (where $J = 40$ in each of our four treatments) adopts the same strategy $k \in K$ in all periods of a cycle $n = 1, \ldots, 5$. Subject j *may* choose a different strategy in different cycles, unlike in Dal Bó and Frechette (2011) and Fudenberg et al. (2011). Therefore, we denote by $i \in I := \{1, \ldots, 5J\}$ the *individual*, i.e., a subject in a cycle. The individual is our unit of observation. Second, in every period, individual i may make a mistake in choosing the action prescribed by the strategy adopted. This mistake is distributed identically and independently across individuals and periods.

More specifically, consider individual i in period $t = 1, \ldots, T^i$, where T^i is individual-specific because cycles have generally different durations. Let $s_t^i(k) = -1, 1$ denote the choice of individual i in period t if she follows strategy k; -1 indicates that D should be implemented, and 1 indicates C. It is assumed that individual i chooses C if $y_t^i = 1$ and chooses D otherwise, where we define

$$y_t^i := \begin{cases} 1 & \text{if } \; s_t^i(k) + \gamma \varepsilon_t^i \geq 0 \\ 0 & \text{otherwise.} \end{cases}$$

Here ε_t^i is an error term with probability density function such that the likelihood $P^i(k)$ that individual i adopts strategy k has a logistic distribution. The parameter γ controls

the variance of the error. Consequently, $\frac{1}{1+e^{-1/\gamma}}$ is the probability that the action implemented by an individual in any period coincides with the actions prescribed by the strategy. Hence, the likelihood that individual i adopts strategy k is

$$P^i(k) = \prod_{t=1}^{T^i} \left(\frac{1}{1+\exp(-s_t^i(k)/\gamma)} \right)^{y_t^i} \left(\frac{1}{1+\exp(s_t^i(k)/\gamma)} \right)^{1-y_t^i}.$$

The function we wish to maximize is the log-likelihood

$$\sum_{i \in I} \ln \left(\sum_{k \in K} \pi_k P^i(k) \right). \tag{1}$$

We estimate the parameter vector $\pi := (\pi_k)_{k \in K}$ and the variance parameter γ that maximize (1). The vector π describes the probability distribution over the set K of strategies. The estimated parameter $\hat{\pi}_k \in \hat{\pi}$, represents the proportion of individuals (or observations) that is attributed to strategy k, or, equivalently, the prevalence of each strategy in our dataset. The estimated parameter $\hat{\gamma}$ provides a measure of the probability of mistakes.

Appendix B—Not for Publication

Instructions for the NP treatment without personal punishment

Overview

This is an experiment in decision-making. Purdue University has provided funds for this research. The instructions are simple. If you follow them carefully and make good decisions, you can earn an appreciable amount of money. These earnings will be paid to you in cash at the end of the experiment.

We ask that you not talk with one another for the duration of the experiment. Please turn off your cell-phones. Do not use e-mail.

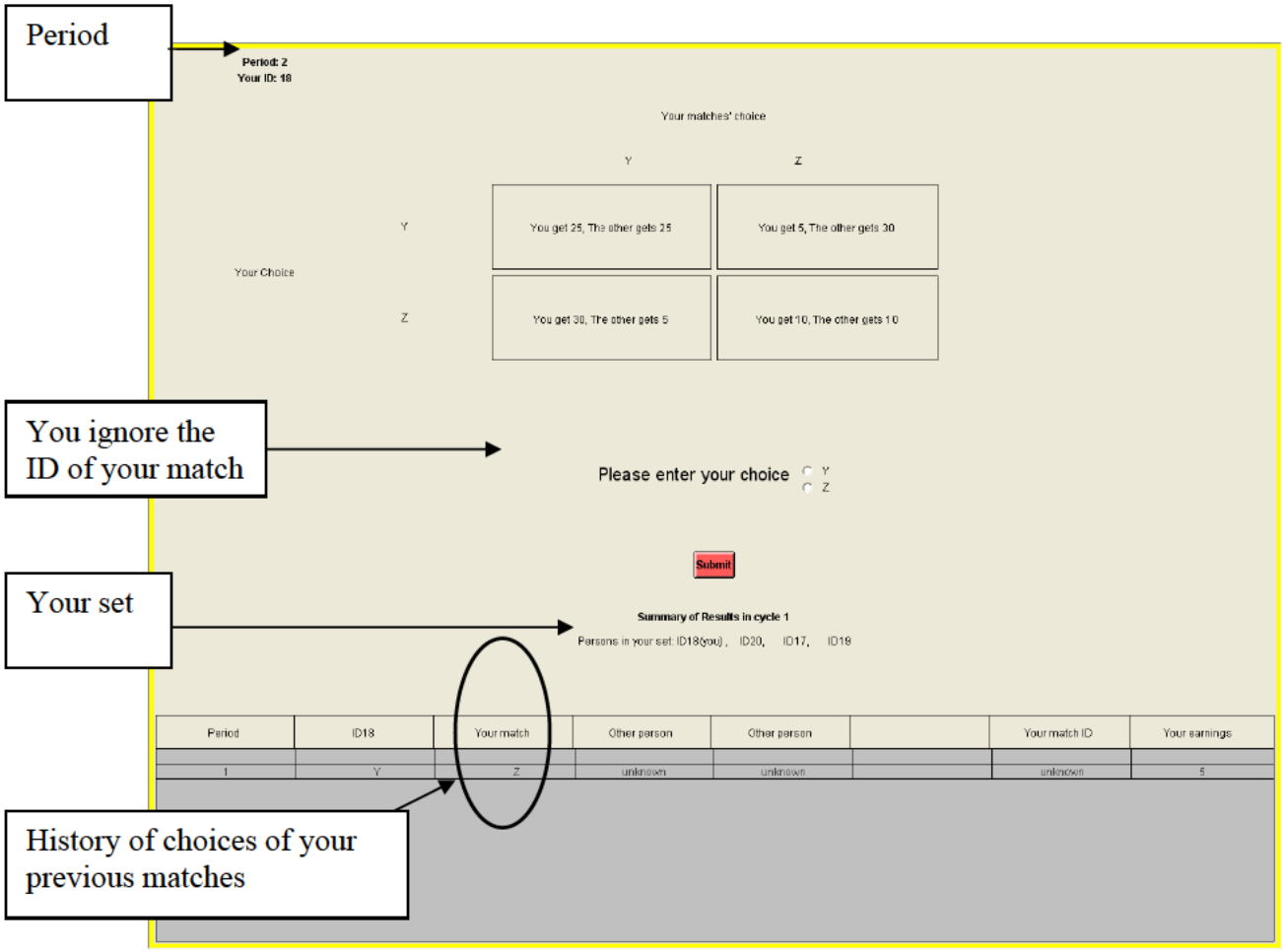
During the course of this experiment, you will be called upon to make decisions in several periods. The experiment is divided into **five** sequences of periods and each sequence is referred to as a **cycle**.

- At the beginning of a cycle, each participant in this room will be randomly assigned to a **set**.
- In each set there will be **four** persons**.**
- For the whole duration of a cycle, you will interact exclusively with the three other participants in that set and nobody else.
- You will never meet again these participants in the following cycles.

In each **period** of a cycle:

- In each period you will be matched to one other participant selected at random from the set you are assigned to. We will refer to this person as "**your match**."
- You will not be informed of the identity of your match. Hence, you do not know when you have already interacted with that person in previous periods of the same cycle.
- You and your match will interact according to the rules described in the upper portion of your screen. The rules will be explained in a moment.

- After each period you will be re-matched to a participant chosen at random from the set you are assigned to. There is one chance out of three that you will be matched with any given person in your set.



Interaction rules

In a period you and your match can make either of two choices, Y or Z. The points you earn in a period depend upon both the choice you make and the choice made by your match in that period. As the payoff table on your screen (above) indicates, there are four possible outcomes:

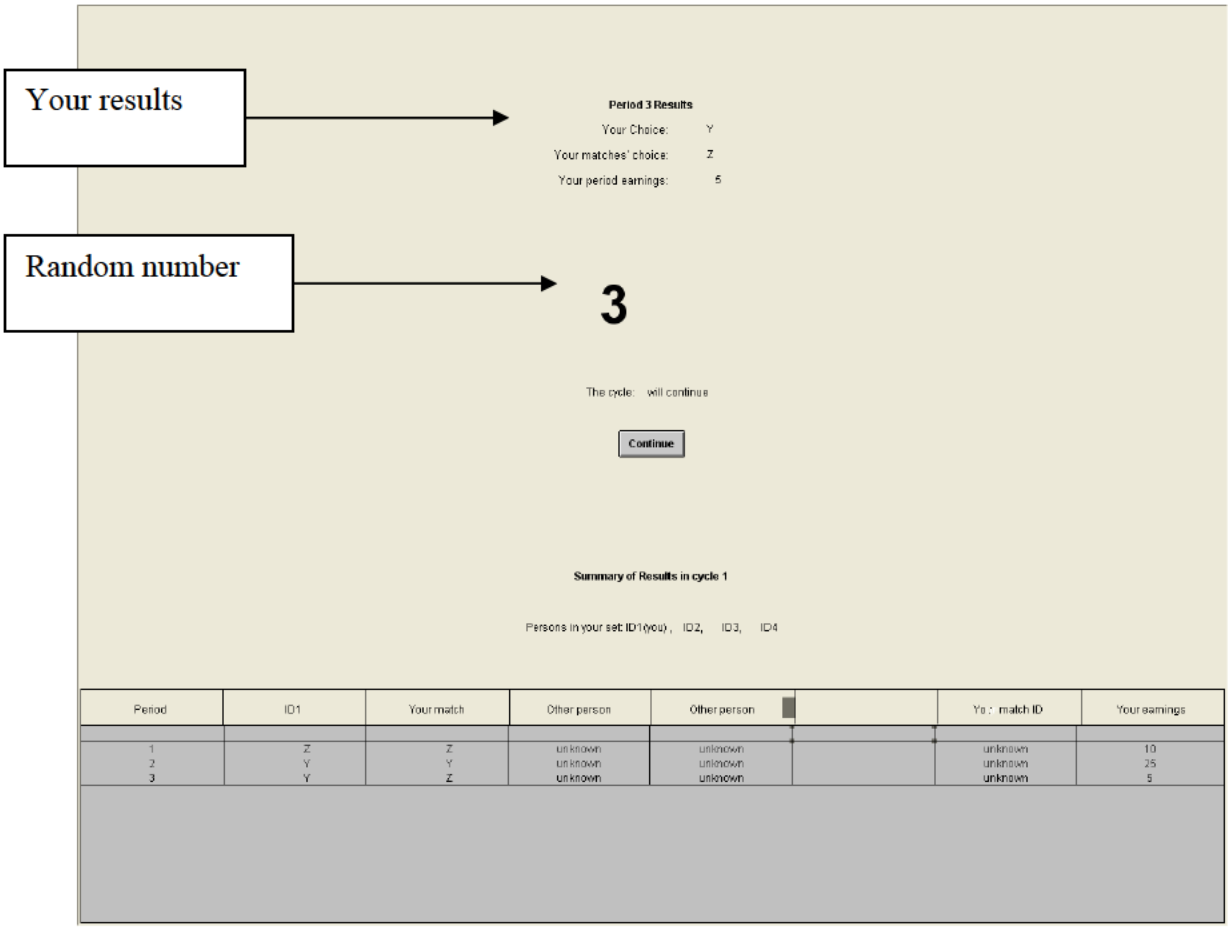
1. If both of you choose Y this period then: you both earn ***25*** points.

2. If you choose Y this period and your match chooses Z then: you earn ***5*** points and your match earns ***30*** points.

3. If you choose Z this period and your match chooses Y then: you earn ***30*** points and your match earns ***5*** points.

4. If you both choose Z then: you both earn ***10*** points.

To make your choice in each period, click the button next to either Y or Z. You may change your mind at any time prior to clicking the "Submit" button by simply clicking on the button next to Y or Z. You are free to choose Y or Z in every period. When you are satisfied with your choice, click the "Submit" button. After all persons have made their choices, the results of the period will appear on your screen.



The result screen (above) will display the number of points you have earned for the period along with **your choice and the choice of your match.** The first column of the 'Summary of Results' table contains your past choices. The second column concerns the choices of your previous matches. Notice that **choices in the second column were most likely made by different persons in different periods. You are not given information on the choices made by the other two persons in your set**. Please record your results for the period on your RECORD SHEET under the appropriate headings.

At this stage a ball will be drawn from an urn containing one hundred balls numbered from 1 to 100. Each ball is equally likely to be selected. The computer program will randomly draw a ball and show the number on the result screen (above). If this random number is less than or equal to 95, then the cycle will continue into the next period. If this number is greater than 95, then the cycle ends. Therefore, **after each period there is a 95% chance that there will be another period of interactions in the cycle and a 5% chance that the cycle will end**.

Suppose that a number less than or equal to 95 has been drawn. Then you press the "Continue" button to proceed. You will face the same decisional situation as in the previous period, but **with a person selected at random from the set of participants you were assigned to**. Remember that there are four participants in each set.

Before making your choice, you may review all the outcomes in previous periods of the cycle by scrolling down the "Summary of Results" table. The table shows your history and the past choices of the persons who happened to be your match in the period. You then choose either Y or Z. Your choice and the choice of your match this period are recorded and added to the Summary of Results table in the lower portion of your screen. You record the outcome and your point earnings for the period.

If the number drawn is greater than 95 then the cycle ends. When a cycle ends, you will be notified in a new screen. There will be a total of five cycles. The rules in the following cycles are the same as in the first, but you will interact with different persons. More precisely, after each cycle, new sets of persons will be formed. This assignment does not depend on actual choices. **A participant will never interact with a person for more than one cycle.**

<u>Earnings</u>

The points you earned in each period are added up. For every 10 points that you earn you will receive 13 cents ($.13). Therefore, the more points you earn the more money you earn. In addition, you will receive a $10 show-up fee. You will be paid your earnings in cash and in private at the end of today's session.

Final Comments

First, do not discuss your choices or your results with anyone at any time during the experiment.

Second, your ID# is private. Do not reveal it to anyone.

Third, since there is a 95% chance that at the end of a period the cycle will continue, you can expect, on average, to interact for 20 periods in a given cycle. However, since the stopping decision is made randomly, some cycles may be much longer than 20 periods and some others may be much shorter.

Fourth, remember that after each period you will be matched randomly to someone in the set you were assigned to. As there are four people in the set, the probability of you being matched with the same person in two consecutive periods of a cycle is 1/3. You are not told the identity of your match.

Fifth, the rules are the same in all five cycles. After a cycle, you will never meet again the same participants.

Questions?

Now is the time for questions. Does anyone have any questions before we begin?

Instructions for the PP treatment with personal punishment

Overview

This is an experiment in decision-making. Purdue University has provided funds for this research. The instructions are simple. If you follow them carefully and make good decisions, you can earn an appreciable amount of money. These earnings will be paid to you in cash at the end of the experiment.

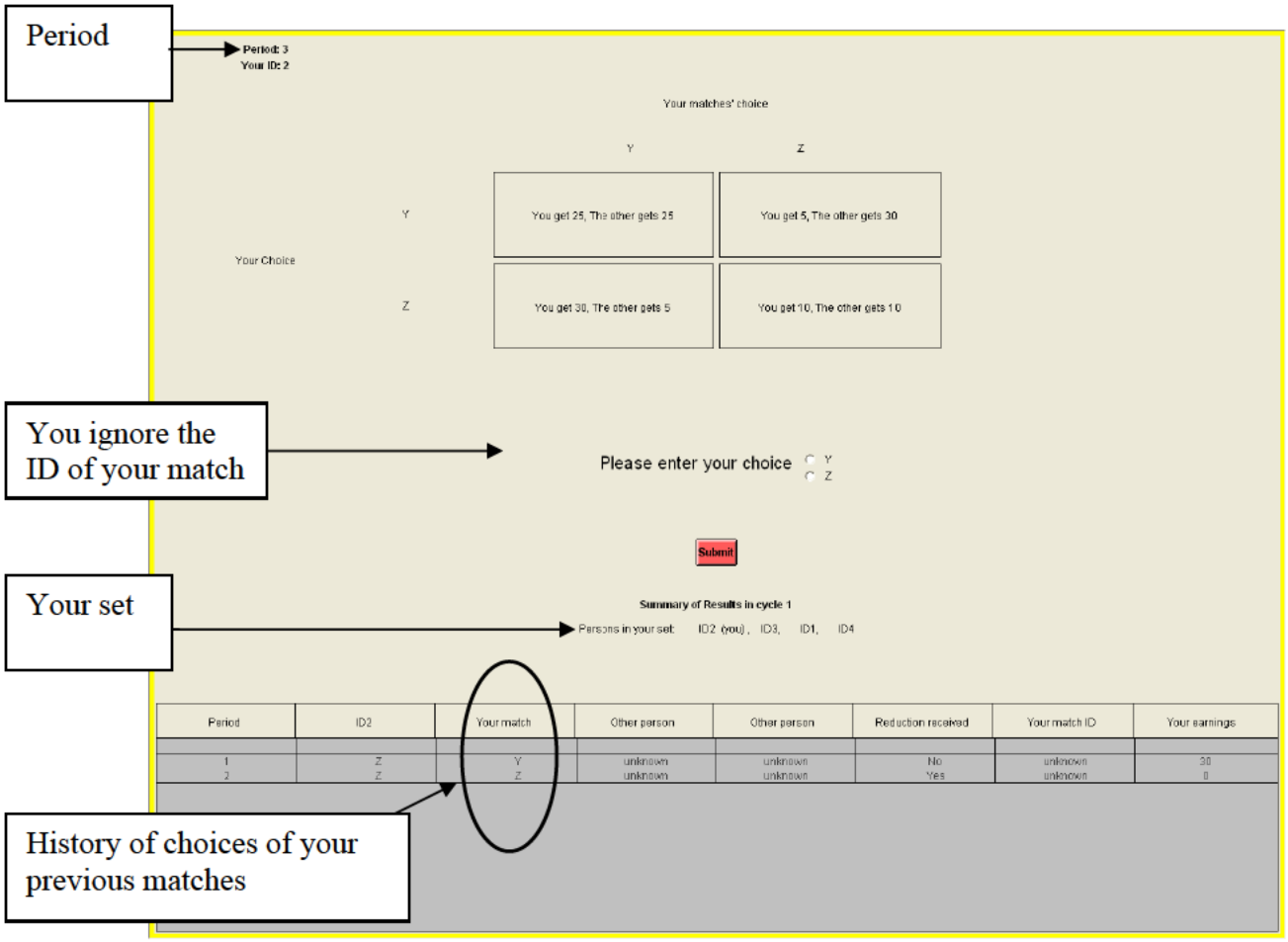
We ask that you not talk with one another for the duration of the experiment. Please turn off your cell-phones. Do not use e-mail.

During the course of this experiment, you will be called upon to make decisions in several periods. The experiment is divided into **five** sequences of periods and each sequence is referred to as a **cycle**.

- At the beginning of a cycle, each participant in this room will be randomly assigned to a **set**.
- In each set there will be **four** persons**.**
- For the whole duration of a cycle, you will interact exclusively with the three other participants in that set and nobody else.
- You will never meet again these participants in the following cycles.

In each **period** of a cycle:

- In each period you will be matched to one other participant selected at random from the set you are assigned to. We will refer to this person as "**your match**."
- You will not be informed of the identity of your match. Hence, you do not know when you have already interacted with that person in previous periods of the same cycle.
- You and your match will interact according to the rules described in the upper portion of your screen. The rules will be explained in a moment.
- After each period you will be re-matched to a participant chosen at random from the set you are assigned to. There is one chance out of three that you will be matched with any given person in your set.



Interaction rules

Each period is divided into two stages. In stage 1 you and your match can make either of two choices, Y or Z. The points you earn depend upon both the choice you make and the choice made by your match in that period. As the payoff table on your screen (above) indicates, there are four possible outcomes for stage 1:

1. If both of you choose Y this period then: you both earn ***25*** points.

2. If you choose Y this period and your match chooses Z then: you earn ***5*** points and your match earns ***30*** points.

3. If you choose Z this period and your match chooses Y then: you earn ***30*** points and your match earns ***5*** points.

4. If you both choose Z then: you both earn ***10*** points.

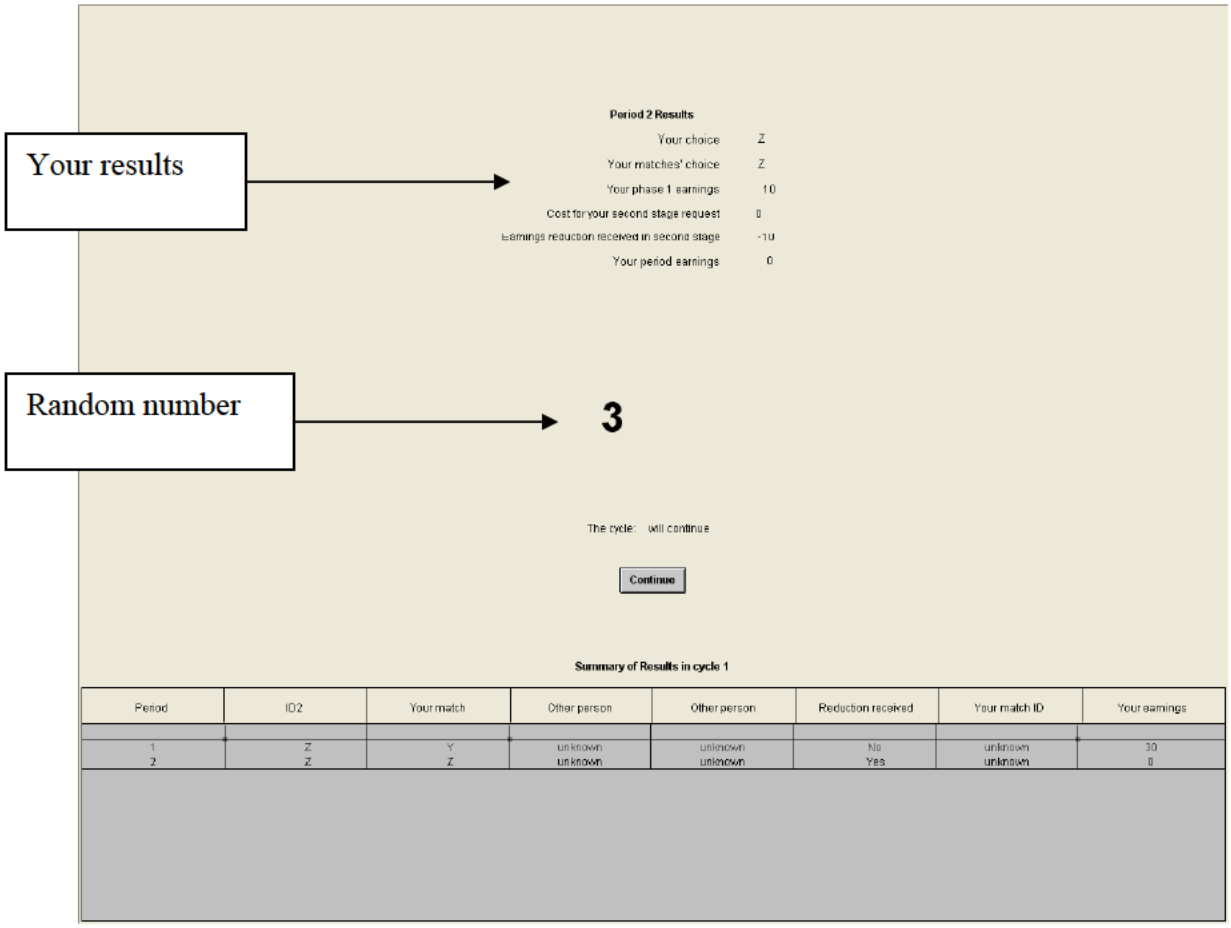
To make your choice in stage 1, click the button next to either Y or Z. You may change your mind at any time prior to clicking the "Submit" button by simply clicking on the button next to Y or Z. You are free to choose Y or Z in every period. When you are satisfied with your choice, click the "Submit" button. After all persons have made their choices, the results of stage 1 will appear on your screen (below).

Before moving to another period, you have the opportunity to pay a cost to lower the earnings of your match (stage 2). You can click the button next to either NO or YES and then click submit when satisfied with your choice.

If you choose NO, no points will be subtracted from the earnings of your match.

If you choose YES, 5 points will be subtracted from your earnings and 10 points will be subtracted from the earnings of your match.

After all persons have made their choices for stage 2, the final results of the period will appear on the lower portion of your screen (see screen below). Please notice that your period earnings can be negative. If your earnings in the period are negative, they will reduce your cumulative earnings.



The result screen (above) will display the number of points you have earned for the period along with **your choices and the choices of your match** for both stage 1 and stage 2**.** The first column of the 'Summary of Results' table contains your past choices in stage 1. The second column concerns the choices in stage 1 of your previous matches. Notice that **choices in the second column were most likely made by different persons in different periods. You are not given information on the choices made by the other two persons in your set**. One of the columns lists the "Reduction received" in each period. It is marked "Yes" when your match requested to lower your earning and "No" otherwise. Please record your results for the period on your RECORD SHEET under the appropriate headings.

At this stage a ball will be drawn from an urn containing one hundred balls numbered from 1 to 100. Each ball is equally likely to be selected. The computer program will randomly draw a ball and show the number on the result screen (above). If this random number is less than or equal to 95, then the cycle will continue into the next period. If this number is greater than 95, then the cycle ends. Therefore, **after each period there is a 95% chance that there will be another period of interactions in the cycle and a 5% chance that the cycle will end**.

Suppose that a number less than or equal to 95 has been drawn. Then you press the "Continue" button to proceed. You will face the same decisional situation as in the previous period, but **with a person selected at random from the set of participants you were assigned to**. Remember that there are four participants in each set.

Before making your choice, you may review all the outcomes in previous periods of the cycle by scrolling down the "Summary of Results" table. The table shows your history and the past choices of the persons who happened to be your match in the period. You then choose either Y or Z in stage 1 and NO or YES in stage 2. Your choice and the choices of your match this period are recorded and added to the Summary of Results table in the lower portion of your screen. You record the outcome and your point earnings for the period.

If the number drawn is greater than 95 then the cycle ends. When a cycle ends, you will be notified in a new screen. There will be a total of five cycles. The rules in the following cycles are the same as in the first, but you will interact with different persons. More precisely, after each cycle, new sets of persons will be formed. This assignment does not depend on actual choices. **A participant will never interact with a person for more than one cycle.**

Earnings

The points you earned in each period are added up. For every 10 points that you earn you will receive 13 cents ($.13). Therefore, the more points you earn the more money you earn. In addition, you will receive a $5 show-up fee. You will be paid your earnings in cash and in private at the end of today's session.

Final Comments

First, do not discuss your choices or your results with anyone at any time during the experiment.

Second, your ID# is private. Do not reveal it to anyone.

Third, since there is a 95% chance that at the end of a period the cycle will continue, you can expect, on average, to interact for 20 periods in a given cycle. However, since the stopping decision is made randomly, some cycles may be much longer than 20 periods and some others may be much shorter.

Fourth, remember that after each period you will be matched randomly to someone in the set you were assigned to. As there are four people in the set, the probability of you being matched with the same person in two consecutive periods of a cycle is 1/3. You are not told the identity of your match.

Fifth, the rules are the same in all five cycles. After a cycle, you will never meet again the same participants.

Questions?

Now is the time for questions. Does anyone have any questions before we begin?

QUIZ

1. The total number of **cycles** is _____

2. You are at the beginning of the cycle. How many **periods** do you expect the cycle will last, on average? _____

3. You are in period 15 of the cycle. How many additional **periods** do you expect, on average? _____

4. The number of **participants** in the experiment (total in the room) is_____

5. In a given **cycle** with how many participants could you interact with (i.e. number of people in a set)? _____

6. In a given **period** with how many participants do you interact with? _____

7. Other than your match, will you know at the end of the period the actions taken by people **in your set**? _____

8. Will you know at the end of the period the actions taken by participants **outside your set**? _____

9. Before choosing an action, will you know the **ID** of your match? _____

10. If ID 5 is in your set this cycle, is there any chance that ID 5 will be your match in future cycles? _____

11. How many points do you earn if both you and your match choose **Y**? _____

12. If the experiment lasts 100 periods and everybody always chooses **Y**, how many dollars are your going to earn? _____

13. How many points do you earn if you and your match choose **Z**? _____

14. If the experiment lasts 100 periods and everybody always chooses **Z**, how many dollars are your going to earn? _____

ID ____ DATE ______________

RECORD SHEET

Cycle	Period	Stage 1		Stage 2		Your earnings	Cumulative earnings
		Your choice (Y/Z)	Choice of your match (Y/Z)	Your choice (no/yes)	Choice of your match (no/yes)		