An Experimental Test of the Efficacy of Simple Reputation Mechanisms to Solve Social Dilemmas

by

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ABSTRACT

The evolution of cooperation has been the focus of intense research in the social sciences, natural sciences (especially biology), and even computer science. It has long been recognized that the possibility of future consequences is crucial to the emergence of rational cooperation. It was thought that random pairwise matching (RPM)was isomorphic to one-sot play, but Kandori (1992) showed that a reputation labeling mechanism can be used to support cooperation in the RPM Prisoner Dilemma. We designed an experiment to test this result. We found that while the level of cooperation steadily declined without a reputation mechanism, with our color-coded reputation mechanism the level of cooperation steadily increased with time and experience. An econometric mixture model consisting of three reputation-conditioned strategies as well as a level-0 type was fitted to the data. We cannot reject the hypothesis that the majority of subjects used one of these strategies and learned with experience.

1. Introduction.

The evolution of cooperation has been the focus of intense research in the social sciences, natural sciences (especially biology), and even computer science. It has long been recognized that the possibility of future consequences is crucial to the emergence of rational cooperation. Trivers (1971) coined the phrase "reciprocal altruism" for this insight, and Friedman (1971) provided a rigorous proof that cooperation can be self-enforcing in the indefinitely repeated Prisoners' Dilemma if the players do not discount the future too much.

While humans are social animals, the assumption that the same players must interact repeatedly limits the application of repeated-game-theoretic results. There is an abundance of evidence of human cooperation among unrelated individuals with a very low incidence of repeated interactions (such as automobile driving). Attempts to explain such cooperation in what can be called "sporadically repeated" Prisoners' Dilemmas (SRPDs) rely on gimmicks. One well-known gimmick is the "green beard" (or secret handshake).[1] Suppose a subgroup develops a uniquely identifying characteristic which only they can detect, and suppose that subgroup adopts the strategy of choosing C if and only if matched with a fellow member. Then, this subgroup has a strict evolutionary advantage over everyone else. Unfortunately, this utopian outcome can be easily upset by a mutant with the same identifying characteristic but who always chooses D. In other words, the green beard approach begs the question of how and on what basis the subgroup distinguishes itself from others.

Recent attention has been given to the notion of "indirect reciprocity" facilitated by public reputations. Nowak and Sigmund (1988) develop a formal model in which all members of the population carry an indicator of reputation based on past choices. An implicit assumption is that reputations cannot be counterfeited, so unlike the case of mutants in the previous examples, defectors can be readily detected. In the simplest version of the Nowak and Sigmund model, a player's reputation is Good if the player's most recent choice was C, and Bad if the player's most recent choice was D. Further, there is a subgroup of "Sophisticates" who choose C when matched with a player with a Good reputation, and choose D otherwise. If the reproduction rates depend on the discounted stream of payoffs from each match, and if the discounting is not too great, then the subgroup of Sophisticates has an evolutionary advantage over the D-always types. However, if there are C-always types in the population, then the

[1] See, for example, Henrich (2004).

dynamics produce an endless cycle: as the Sophisticates begin to dominant, having driven the D-always types to near extinction, the C-always types gain the advantage over the Sophisticates. The reason for this reversal of fortunes is insightful: when the Sophisticates are matched with a D-always type (who have Bad reputations), they choose D and hence the Sophisticate's reputation switches to Bad, and in the likely event it is next matched with a Sophisticate, it will play C while the Sophisticate plays D, suffering a payoff of -c. In other words, the Sophisticate is punished for its prior act of legitimate punishing. The C-always types gain in the population over the Sophisticates until the D-always types can successfully feast upon them, and the cycle continues.

The problem with this model of indirect reciprocity is that it does not distinguish between plays of D that are defections against Good types and plays of D that are punishments against Bad types. To make such a distinction, the transition function from a player's current reputation into its future reputation would have to depend on both the current action and the reputation of one's opponent.

Kandori (1992) and Okuno-Fujiware and Postlewaite (1995) recognized this fact and proved that a labeling device is sufficient for a Folk Theorem result. Indeed, a simple two-stage reputation mechanism is sufficient to support cooperation in a random-pairwise-matching Prisoners' Dilemma, provided the players are sufficiently patient. Players are tagged with a *Good* or a *Bad* reputation. A player's reputation can change only when paired with a Good player, and then cooperation will yield a Good reputation for the future and defection will yield a Bad reputation for the future. The strategy to cooperate against a Good opponent and defect against a Bad opponent is subgame perfect for sufficiently patient players and yields maximal cooperation.

While such a reputation mechanism is reminisant of Better Business Bureaus, there have been no laboratory tests of these theoretical predictions. Is such a reputation mechanism (and the accompanying reputation-conditioned strategy) natural (instinctive) to humans? Will typical laboratory subjects behave accordingly (without being explicitly taught)?

We designed an experiment to answer these questions. The experimental design is presented in section 2, and the data is presented in section 3. An analysis of the strategies employed is presented in section 4, and section 5 concludes with a discussion.

2. Experimental Design.

To create a SRPD, we used a pairwise random matching scheme that minimized repeated interactions and made repeated interactions unknowable to the subjects. The PD game was:

	G	P
G	80, 80	10, 90
P	90, 10	20, 20

An experiment session lasted about one hour and consisted of 4 or 5 rounds, and each round lasted 9-15 periods. Subjects were shown the outcome after each period, and a summary after each round. Cumulative points earned over all periods and all rounds were converted into dollars at the end of the experiment at the rate of one cent per point. Average payments were $25.

Subjects were recruited from University of Texas upper division undergraduate students and graduate students (excluding economics graduate students). A total of four sessions were conducted on February 13, February 28, March 29 and April 4, 2007, and had 24, 24, 24 and 20 subjects respectively. The instructions are provided in Appendix A.

The first round incorporated no reputation mechanism. Subjects were given verbal and visual instructions about the computer interface and the basic interaction (PD game). Then they played for 12 periods without any reputation mechanism. To avoid last-period anomalies and unraveling phenomena, the subjects were not told the exact number of periods, but rather that there would be a random number of periods. Following this first round, they viewed a period-by-period summary of their choices, the choices of the subjects they were paired with, the outcomes, and the cumulative points earned. They were also told the overall percentage of all choices in round 1 that were G and P.

Next, a color-coded reputation mechanism was introduced and explained, but without using behavior/ethical laden words (such as “good” and “bad”). All subjects began the round tagged with the color green. After the first round, their color depended on the choice they made the last time they were paired with a green participant: if they chose G, they would be green for the next period, and if they chose P, they would be purple for the next period. When paired with a purple participant, their color would not change. This information was provided verbally on their computer screen and was encoded in the payoff matrix: the row labels were in their color while the column labels were in the color of the participant with whom they were paired, and the payoffs were displayed in the color they would become given each choice. For example, when paired with a green participant, the G row payoffs were green while the P row payoffs were purple.

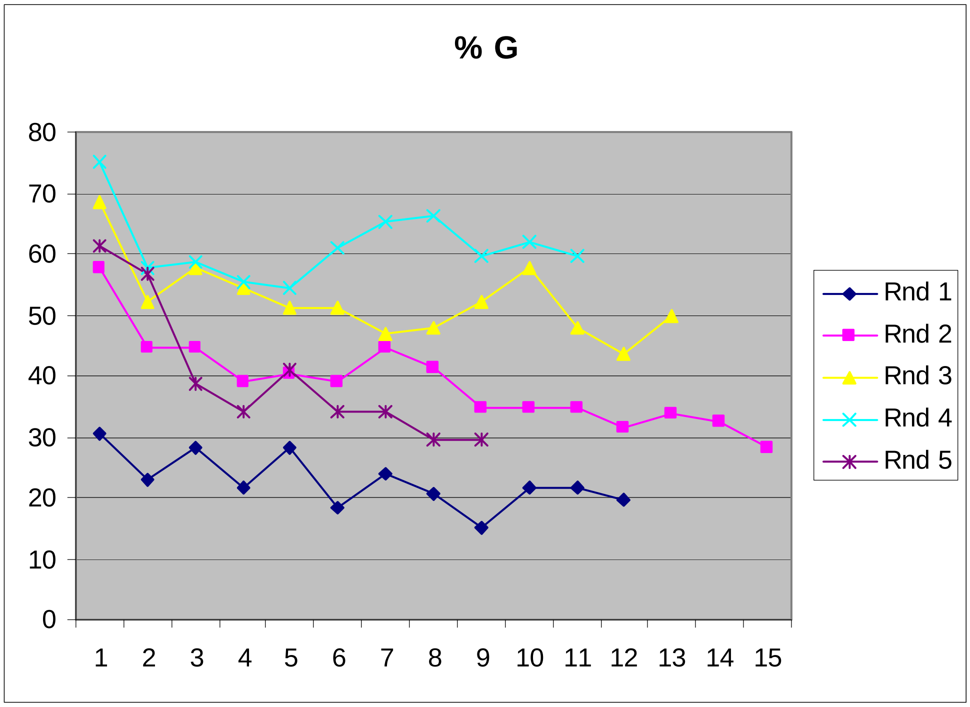
They played three rounds with this color-coded reputation mechanism. At the end of each round they viewed a summary of their choices, and were told (a) the overall proportion who were green in the round, (b) the overall proportion of choices that were G, and (c) the overall average payoff when green and when purple. At the beginning of each round everyone was green and told that there would be a random number of periods. The actual number of periods was 15, 13 and 11 in rounds 2, 3 and 4 respectively. The progressive decrease in the number of periods was intended to mitigate last-period effects.

In the last two sessions, a fifth round was added with the color-coded reputation mechanism turned off. Theory predicts that the behavior should revert to the dominant strategy P, but behavioral inertia might lead to a slow reversion.

3. The Data.

Naturally, the most interesting gross statistic to examine is the percentage of cooperation (G) by period and by round. Figure 1 displays these percentages averaged over all four sessions. Rnd 1 and 5 are for the initial round and the final round, both without the color-coded reputation mechanism. Rnd 2 to 4 are for rounds 2 to 4, all with the reputation mechanism. The lowest level of cooperation is in the first round, which starts with only 30% cooperation and declines to 20% after 12 periods. In round 2, with the reputation mechanism, the initial level of cooperation jumps up to 58%, and while it declines steadily to 28%, it remains an average of 18% above the level of cooperation in the first round. In round 3, the initial level of cooperation rises to 68% and ends at 50% after 13 periods, remaining an average of 12% above the level of cooperation in round 2. In round 4, the initial level of cooperation rises to 75% and ends at 60% after 11 periods, remaining an average of 8% above the level of cooperation in round 3. Thus, with the reputation mechanism, there is a clear increase in the level of cooperation, which increases with experience. In round 5, after the reputation mechanism is turned off, the initial level of cooperation declines to 61% (which is well above the level in round 1), but quickly declines to 30% after only 9 periods.

Figure 1. Aggregate Percentage of Cooperation



A similar figure could be produced for the percentage with Good reputations (i.e. labeled green) in rounds 2 to 4, but since the first period is always 100% green after which there is very little variation we simply report the levels averaged from period 2 onward in the following table.

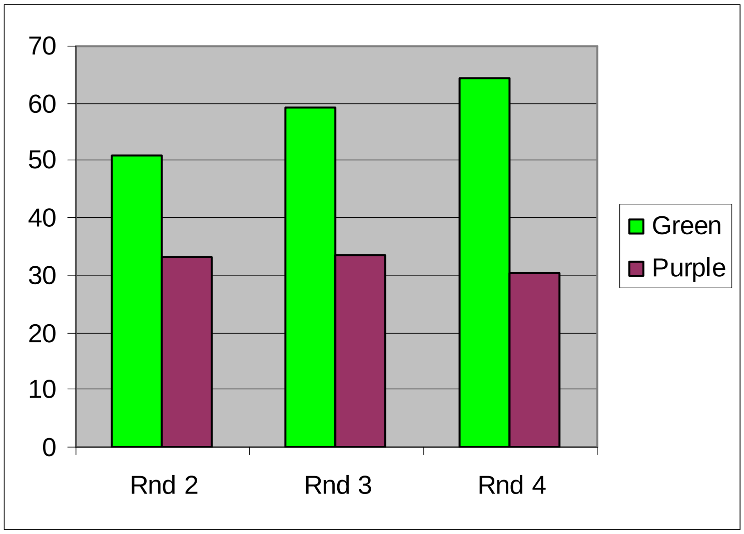
Table 1. Aggregate Percentage with Good Reputations.

Round 2	Round 3	Round 4
54.5%	66.6%	75.5%

Clearly, the percentage of participants with Good reputations increases with experience.

After each reputation round we reported the overall payoff when green and when purple. Figure 2 displays these payoffs averaged over the four sessions. Clearly the average payoff to a Good reputation (green) is significantly greater than the average payoff to a Bad reputation. Hence, this feedback between rounds may have contributed to learning and the increase in the level of cooperation.

Figure 2. Average Payoff by Color



4. Analysis of Strategies.

Since the participants did not know the number of periods in each round, it is not unreasonable to model the experiment as having an infinite horizon (i.e. always some possibility of a future period). The theoretical possibilities for such a game are well known. Kandori showed that cooperation could be sustained with “community strategies” in which defection can be deterred by a punishment strategy that spreads like a virus throughout the (finite) population. Our results indicate that cooperation is not sustainable in a SRPD without a reputation mechanism. Duffy and Ochs (2006) report similar results.

In contrast, with the reputation mechanism, cooperation appears to be sustainable. While defection-always is still a Nash equilibrium of the SRPD, there are other Nash equilibria that can sustain cooperation provided the perceived probability of continuation is high enough (1/7 in our PD game). Specifically, the strategy to play cooperatively (G) when paired with a green (Good) participant, and play P otherwise, is a Markov perfect Nash equilibrium. To what extent do the participants in our experiment actually employ reputation-conditioned strategies like this?

There are four possible strategies: two constant strategies and two that condition on the reputation of the other player:

1. Play G always (GG).
2. Play P always (PP).

3. Play G when paired with a green (Good) participant, and play P otherwise (GP).
4. Play P when paired with a green (Good) participant, and play G otherwise (PG).

To allow for trembles, let ε denote the probability of an error, so with probability $1-\varepsilon$, a probabilistic Markov strategy (say 3 above) chooses according to that strategy, and with probability ε it chooses the opposite strategy. Let $P_k(t|\varepsilon)$, for $k = 1,\ldots,4$, denote the probability of choosing G in period t for the four probabilistic Markov strategies corresponding to the above list. In addition to these, we include as a benchmark the possibility of a level-0 type: $P_0 = ½$ in every period.[2]

For each type k, and for each participant, the joint probability of that participant's choices conditional on k is simply the product over all the periods of the probability of the choice made in each period using $P_k(t|\varepsilon)$. Let $\pi_k(i|\varepsilon)$ denote this joint probability for participant i.

Since ex ante we do not know what strategy a participant uses, let α_k denote the probability a participant is type k. Assuming the participant uses the same strategy in all periods,

$$L(i|\varepsilon,\alpha) \equiv \sum_{k=0}^{4} \alpha_k \pi_k(i\,|\,\varepsilon) \qquad (1)$$

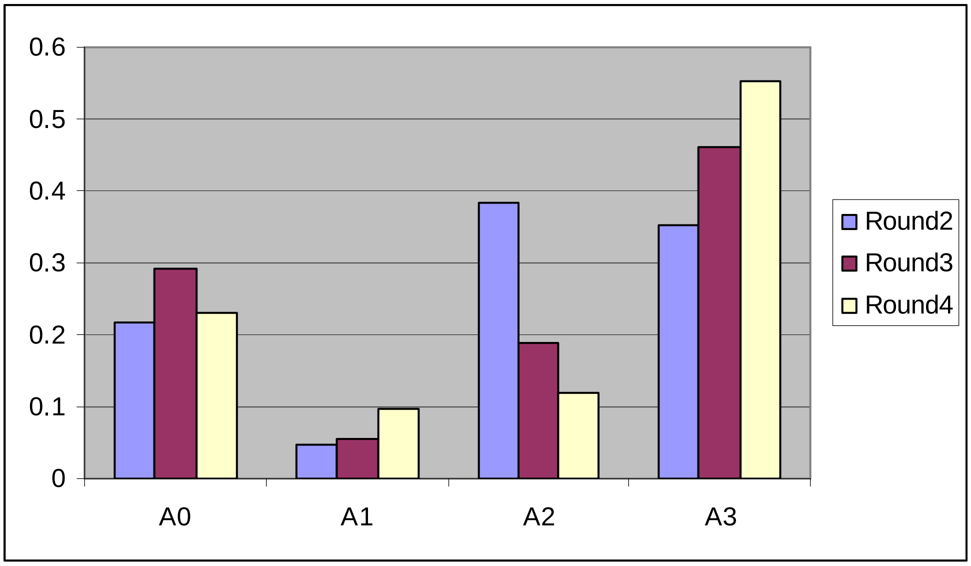
is the ex ante likelihood of participant i's choices. Then, the log-likelihood of the choices for all the participants is $LL(\varepsilon,\alpha) \equiv \sum_i \mathit{log}[\pi(i|\varepsilon,\alpha)]$.

We first fit this model to the data for each session and each round with the color-coded reputation mechanism (rounds 2-4). Disaggregating by session allows for a different random draw of types for each session, and disaggregating by round allows for learning between rounds. For all sessions and all rounds, we found $\alpha_4 = 0$. In other words, there is no evidence that any participant used the strategy of playing P when paired with a green participant and playing G when paired with a purple participant. Henceforth, we drop this type from our analysis.

Figure 3 presents the maximum likelihood estimates (MLE) of the α_k averaged over the four sessions. The estimated proportion of Level-0 types (A0) is surprisingly high (22% to 29%). There is a clear trend of the proportion of always-defect (A2) declining and the conditional strategy (A3) increasing with experience. There is also a slight increase in the proportion of always-cooperate types (A1), perhaps due to free-rider incentives.

[2] For a complementary approach to identifying strategies, see Engle-Warnick, and Slonim (2004, 2006).

Figure 3. Average Estimated Proportions of Types.



We also find that the average MLE for ε declines with experience: 0.096, 0.056, and 0.040 for rounds 2-4 respectively. One interpretation of this decline is that ε captures both trembles and experimentation, and that experimentation declines with experience.

Table 2 presents the MLE of the parameters using the pooled data from all four sessions. These estimates are relevant to forecasting the behavior of a new group of participants, when we have no information that could refine our estimate of the proportions of types in the new group. These parameter values are essentially the same as the average of the estimates for each session.

Table 2. MLE Parameter Estimates from Pooled Data.

Round	ε	α_0	α_1	α_2	α_3
2	0.097	0.225	0.039	0.369	0.367
3	0.058	0.285	0.056	0.192	0.466
4	0.039	0.233	0.083	0.116	0.568

An assumption of the econometric model is that each individual is one type for all the periods in a round, although the individual may learn from experience and switch types between rounds. Using the estimated parameters in Table 2, we can compute the ex post probability that individual i is type k as:

$$p_k(i) = \alpha_k \pi_k(i|\varepsilon)/L(i|\varepsilon,\alpha). \tag{2}$$

Performing this calculation we find that 80% of the participants can be identified as having a posterior probability of at least 90% on just one type. In other words, we can say with 90% confidence that 80% of the participants behave as if they were one of the four types (k = 0,…,3) for all periods in a round.

Based on the computed posterior probabilities per round, we can also assess the transition matrix between types. Table 3 displays the transitions from round 2 to round 4.

Table 3. Transition Matrix

		Round 4					
		L0	**GG**	**PP**	**GP**	Totals	Change[3]
Round 2	**L0**	5	3	0	10	18	-13
	GG	1	0	0	2	3	-3
	PP	9	4	12	10	35	-23
	GP	5	0	0	31	36	-5
	Totals	20	7	12	53	92	-44
	Change	15	7	0	22	44	

First notice that no one appears to have switched to the always-defect strategy (PP), while 23 participants appear to have abandoned it. In contrast, 22 participants appear to have switched to the conditional strategy (GP), while only 5 appear to have abandoned it. Curiously, while 13 participants abandoned the level-0 random strategy, 15 participants switched to it, so the overall proportion using the level-0 strategy was nearly constant. That almost half (44/92) of the

[3] The Change column is computed as the diagonal element less the Totals column. For example, of the 18 participants identified as using L0 in round 2, only 5 continued to use L0 in round 4, implying that 13 switched away from L0. The Change row is computed as the Totals row less the diagonal element. For example, of the 20 participants identified as using L0 in round 4, only 5 used L0 in round 2, implying that 15 other participants switched to L0.

participants appear to have switched strategies from round 2 to round 4 is compelling evidence that some learning or experimentation occurred.

5. Discussion.

We designed an experiment to test whether college students in a laboratory experiment could effectively use a simple reputation mechanism to sustain cooperation in a SRPD. Indeed, we found that while the level of cooperation steadily declines without a reputation mechanism, with our color-coded reputation mechanism the level of cooperation steadily increases with time and experience.

We specified Markov strategies that conditioned on the reputation of the other player, and an econometric mixture model consisting of these strategies as well as a level-0 type was fitted to the data. The estimated proportion of types suggests that the rising level of cooperation was due to more subjects using the reputation-conditioned equilibrium strategy. Further, that 80% of the subjects could be identified with one type at the 90% confidence level supports the hypothesis that the vast majority of subjects used one of these strategies and learned with experience.

To avoid the possibility of influencing behavior by suggestive words, we used colors to code reputations instead of "good" and "bad". Consequently, it was not initially obvious to the participants that the colors could be interpreted as good and bad reputations respectively. None the less, the majority of participants eventually appeared to see that interpretation and condition their choices on the colors. Still, 22% appeared clueless and behaved randomly, and 13% chose the defect action almost always. We speculate that we would have observed more cooperation if the labels "good" and "bad" would have been used.

In a prior pilot experiment, we introduced the reputation mechanism at the beginning for the first round, followed by one round without the reputation mechanism, and then a final round with the reputation mechanism. The level of cooperation in the first round was only 33.1%, declined to 16.7% in the second round, and reached only 26.6% in the third round. Given our abstract implementation of the reputation mechanism, it is reasonable to conjecture that many participants did not comprehend its potential usefulness at the beginning, and resorted to playing the dominant strategy. Since everyone was green at the beginning, a large proportion of participants were paired with someone who chose P, and thereby negatively impacting their belief that it pays to be green. With this discouraging experience from the beginning of round 1, followed by round 2 without the reputation mechanism, by round 3 most participants were resigned to accepting the lack of cooperation. The reputation mechanism was not as transparent to our participants as we had hoped.

In contrast, when the first round did not involve the reputation mechanism, their experience with the lack of cooperation may have induced enough to attempt to use the colors to get to a more cooperative outcome, and indeed they succeeded. Furthermore, the average payoff information given between rounds (Figure 2) reinforced the value of having a Good (green) reputation.[4]

Thus, it appears that, given sufficient motivation, a majority of humans can learn to use a reputation mechanism to solve a social dilemma, but not always. When the Kandori labeling mechanism is not transparently about reputations and the participants have insufficient cues to seeing it as a reputation mechanism, then it may fail to support cooperation.

[4] Such information was not given in the pilot experiment, but we doubt that would have changed the outcome dramatically, since the premium for being green was only 6.0 in contrast to an average premium of 17.7 after round 2 of the regular experiment.

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Appendix

Instructions for RMPD Experiment NRRRN

[PLEASE DO NOT TOUCH THE MOUSE OR KEYBOARD UNTIL TOLD TO DO SO!]

WELCOME.

[Introduce self and helpers. Say how everyone was recruited.]

This is an experiment about economic decision-making. If you follow the instructions carefully you might earn a considerable amount of money. This money will be paid at the end of the experiment in private and in cash. [***Wave cash***.]

Your computer will assign you an ID number, and at the end of the session you will be given an envelope with that ID number on it containing your money earnings. The person handing you your envelope will not know how much money is in the envelope. Thus, absolute anonymity and privacy will be maintained.

It is important that during the experiment you remain SILENT. If you have any questions, or need assistance of any kind, RAISE YOUR HAND but DO NOT SPEAK. One of the experiment administrators will come to you and you may whisper your question to him. If you talk, laugh, or exclaim out loud, you will be asked to leave and will not be paid. We expect and appreciate your adherence to these rules.

You will be making choices using the computer mouse. You may reposition the mouse pad so it is comfortable for you. Do NOT click the mouse buttons until told to do so. [*The screen will show a START button – don't click on it yet.*]

The experiment will last about 1 hour. First, I will give an overview of the experiment, and then I will show you how the computer interface works, and how to make choices. This instruction phase will be followed by a random number of periods of decision-making.

All periods will be alike. In each period, everyone will be divided into pairs, and each pair will interact in a decision task whose payoff depends on the choices of that pair only.

We have designed a computerized random pairing scheme so **no two people knowingly interact more than once**, thus simulating a large population with anonymous pairwise interactions. You will never interact with the same participant in successive periods, and you will never learn the identity of any participant you are paired with either during or after the experiment. Hence, it will be <u>as if, in each and every period, you are paired with an entirely new person</u>.

Next, I will describe the decision task you will face. Each member of the pair will choose between two options labeled G and P. All the possible outcomes can be represented by a matrix with two rows and two columns as follows (show overhead):

	G	P
G	80	10
P	90	20

Your choice is represented by a row, while the choice of the other participant is represented by a column. Your token payoffs are displayed in each cell of the matrix. In this <u>example</u>, if you chose G, then your payoff would be 80 tokens if the other participant chose G and 10 tokens if the other participant chose P. On the other hand, if you chose P, then your payoff would be 90 tokens if the other participant chose G and 20 tokens if the other participant chose P.

At the end of the experiment, your cumulative token earnings will be converted into dollars at the rate of <u>one cent per token</u>.

Let's now look at a demo of the computer screen. Click on START.

At the top of the screen, there is a line that says "This is a Demo". Below that it says: "To make your choice, click on **G** or **P**."

	G	P
G	**80**	**10**
P	**90**	**20**

To make a choice you must click on one of the rows. When you do this successfully, the entire row will become highlighted in yellow. Try this now, but do NOT click the Submit button. Everyone should have a row highlighted in yellow. Please raise your hand if you don't have a row highlighted in yellow.

If you click on a row by mistake or if you want to change your choice for any reason, simply click on the other row. Try this now. When you are content with your choice, click the SUBMIT button at the bottom of your screen. Do this now. You cannot change your choice after clicking the Submit button.

You are now looking at a demo of the results screen. The outcome is stated in words and also shown as a highlighted yellow cell in the matrix. After each period, you will be shown a screen like this.

If you have any questions, please raise your hand but do not speak out. Someone will come to you and you may whisper your question to them.

<u>Round 1</u>.

We are now ready to start round 1 which will consist of a random number of periods. In each period you will make one choice like in the Demo period.

At the bottom of your screen there is a small textbox labeled PASSWORD. Please enter **_____** in the password box. When the new screen appears, begin thinking about your options, click on a row to make your choice, and when satisfied, click the Submit button. Once you have clicked the Submit button, the text inside the button will change to "wait"; please wait patiently until all participants have made their choices.

[If someone hasn't submitted a choice after 15 seconds, prompt them. After all have submitted choices, the interim outcome screen will appear. After 5 seconds, prompt them to click on the NEXT button to proceed to the next period.]

[At the end of round 1, they will see a SUMMARY button instead of a NEXT button. Prompt them to click the Summary button. Don't click on Next until told to.]

[Go to the server and read the results of the percentage of GP choices.]

In addition to the summary shown on your screen, I can tell you that ___% of all choices in this round were G and ____% were P.

Given the random pairing scheme alone, you had no information about the past choices of any of the participants with whom you were paired. This no-information condition is representative of some real-world interactions. However, in many real-world situations, you have some information about the past choices of the people you are dealing with, and your behavior might be affected by that information. In this experiment, we want to see how one specific kind of information affects your behavior.

Each participant will be tagged with a color – green or purple. For the first period, everyone is tagged with green. However, after the first period, your color will **reveal the choice you made the last time you were paired with a green participant**. Specifically, if you chose G the last time you were paired with a green participant, then you are tagged green for the next period, and if you chose P the last time you were paired with a green participant, then you are tagged purple for the next period.

When paired with a Green participant.

Your Choice:	Your New Color:
G	Green
P	Purple

On the other hand, your color does not change when you are paired with a purple participant,

When paired with a Purple participant.

	Your New Color	Your New Color
Your Choice:	= Current Color	= Current Color
G	Green	Purple
P	Green	Purple

so your color conveys nothing about what you did the last time you were paired with a purple participant. Your color can change only when you are paired with a green participant, and hence it conveys what you did only the last time you were paired with a green participant.

Thus, after the first period, when you find yourself paired with a green participant, you can infer that they chose G the last time they were paired with a green participant, and when you find yourself paired with a purple participant, you can infer that they chose P the last time they were paired with a green participant.

Be mindful that because your color reveals information about your past choices, the choices of the participants with whom you are paired may depend on your color. Thus, your current choice could affect not only your current payoff, but also your future payoffs through the color you become.

Let's now look at a demo of the computer screen. Click on START.

At the top of the screen, there is a line that says "This is a Demo". Below that is a sentence that tells your color and the color of the participant with whom you are paired, and below that it says: "To make your choice, click on **G** or **P**."

	G	P
G	**80**	**10**
P	**90**	**20**

[Show four versions on room screen.]

The G and P **row labels** are in your current color, and the G and P column labels are in the current color of the participant with whom you are paired. Your **payoffs** are given in the color you will become for the period following that choice. That is, if you are purple, you can become green by choosing G when paired with a green participant.

To make a choice you must click on one of the rows. Do this now, and also click the Submit button.

If you have any questions, please raise your hand but do not speak out. Someone will come to you and you may whisper your question to them.

Round 2.

We are now ready to start round 2 which will consist of a random number of periods. In each period you will make one choice like in the Demo period.

Recall that everyone will be green for the first period of this round. At the bottom of your screen there is a small textbox labeled PASSWORD. Please enter _____ in the password box. When the new screen appears, begin thinking about your options, click on a row to make your choice, and when satisfied, click the Submit button. Once you have clicked the Submit button, the text inside the button will change to "wait"; please wait patiently until all participants have made their choices.

[If someone hasn't submitted a choice after 15 seconds, prompt them. After all have submitted choices, the interim outcome screen will appear. After 5 seconds, prompt them to click on the NEXT button to proceed to the next period.]

[At the end of round 2, they will see a SUMMARY button instead of a NEXT button. Prompt them to click the Summary button. After they click on Summary, tell them not to click on Next until told to. Go to the server and read the results of the percentage of GP choices and average payoffs.]

In addition to the summary shown on your screen, I can tell you that ___% of all choices in this round were G and ___% were P. Further, averaging over all periods and all participants, the average payoff when green was _____, and the average payoff when purple was _____.

[After 15 seconds, prompt them to click on Next, for a demo of the next round.]

Round 3.

Please click on Next. You are now looking at a demo of the choice screen for the next round. In round 3 as in round 2, there will be a random number of periods and each participant will be tagged with a color – green or purple. For the first period, everyone is tagged with green. Please make a choice on the Demo screen and click on the Submit button.

At the bottom of your screen there is a small textbox labeled PASSWORD. Please enter _____ in the password box. When the new screen appears, begin thinking about your options, click on a row or column to make your choice, and when satisfied, click the Submit button.

[If someone hasn't submitted a choice after 15 seconds, prompt them. After all have submitted choices, the interim outcome screen will appear. After 5 seconds, prompt them to click on the NEXT button to proceed to the next period and .]

[At the end of round 3, they will see a SUMMARY button instead of a NEXT button. Prompt them to click the Summary button and wait. Go to the server and read the results of the percentage of GP choices and average payoffs.]

In addition to the summary shown on your screen, I can tell you that ___% of all choices in this round were G and ___% were P. Further, averaging over all periods and all participants, the average payoff when green was _____, and the average payoff when purple was _____.

[After 15 seconds, prompt them to click on Next, for a demo of the next round.]

Round 4.

You are now looking at a demo of the choice screen for the next round. In round 4 as in rounds 2 and 3, there will be a random number of periods and each participant will be tagged with a color – green or purple. For the first period, everyone is tagged with green. Please make a choice on the Demo screen and click on the Submit button.

At the bottom of your screen there is a small textbox labeled PASSWORD. Please enter _____ in the password box. When the new screen appears, begin thinking about your options, click on a row or column to make your choice, and when satisfied, click the Submit button.

[If someone hasn't submitted a choice after 15 seconds, prompt them. After all have submitted choices, the interim outcome screen will appear. After 5 seconds, prompt them to click on the NEXT button to proceed to the next period and .]

[At the end of round 4, they will see a SUMMARY button instead of a NEXT button. Prompt them to click the Summary button and wait. Go to the server and read the results of the percentage of GP choices and average payoffs.]

In addition to the summary shown on your screen, I can tell you that ___% of all choices in this round were G and ___% were P. Further, averaging over all periods and all participants, the average payoff when green was _____, and the average payoff when purple was _____.

Prompt them to click the Next button for a Demo of the next Round.

Round 5.

You are now looking at a demo of the choice screen for the next round. Note that the labels and token payoff numbers are all in black instead of colors. In this round, participants will no longer be tagged with a color. To make a choice, click on a row. Do this now, and also click the Submit button. *[Pause]*

We are now ready to start round 5 which will consist of a random number of periods. In each period you will make one choice like in this Demo period. At the bottom of your screen there is a small textbox labeled PASSWORD. Please enter _____ in the password box, and proceed to make your choices.

[If someone hasn't submitted a choice after 15 seconds, prompt them. After all have submitted choices, the interim outcome screen will appear. After 5 seconds, prompt them to click on the NEXT button to proceed to the next period.]

This concludes the experiment.

At the bottom of your screen is a button labeled Payoff. Click on that to see your total earnings in tokens and dollars for the entire experiment. All money payoffs have been rounded off to a whole dollar amount. We are passing out a receipt for you to fill out. **Please sign the receipt**, so I can get reimbursed for these payments – otherwise it comes out of my pocket.

Do NOT click on the Quit button until you have been handed an envelope with your dollar earnings.

We are also passing out a Post-Experiment Questionnaire to help us in the design of experiments like this. While we put your dollars earnings in envelopes, please fill out this Questionnaire. **Be sure to write your ID No. on the Questionnaire.** We will match that ID No. to a numbered envelope with your dollar earnings.