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The Effects of Externality Distribution and Framing on Individual Vaccination Decisions: Experimental Evidence

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Abstract

This study examines behavior in a binary choice experiment, designed to characterize the individual vaccination decision. Subjects make choices in each of four one-shot games, differing in the payoff from the "vaccinate" option and the ability of all individuals to choose the "vaccinate" option. Two of the four games include subjects who do not have a choice and automatically receive the "not vaccinate" option. All four games are tested in three different frames: neutral, positive, and negative. In the neutral frame subjects' choices and associated payoffs are presented with no direct mention of the externalities they create. In the positive frame the instructions emphasize the positive externalities created by choosing the "vaccinate" option, and in the negative frame the instructions emphasize the negative externalities created by choosing the "not vaccinate" option. Initial results indicate that subjects choose the "vaccinate" option more often when it yields a certain payoff, or when some of the subjects cannot choose to "vaccinate". Overall, subjects choose to "vaccinate" most often in the negative frame, followed by the positive frame, and then the neutral frame.

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1. Introduction

Since 2010, the United States' Centers for Disease Control and Prevention (CDC) has recommended annual influenza vaccination for anyone at least six months of age.[1] It is estimated however, that during the 2017-2018 flu season only 57.9% of children and only 37.1% of adults actually received the influenza vaccine.[2,3] In addition, even though childhood vaccines have much higher participation rates (MMR: 83.4% - 97.5%, polio: 79.6% - 93.3%, DTaP: 82% - 94.7%, varicella- 81.8% - 96.8%)[4,5], they too fall below the recommended level of near 100%. Thus, it is critical that we understand behavior and incentives in these decision environments. In particular, we would like to identify factors contributing to under-vaccination, which may help to develop low-cost interventions aimed at increasing vaccination rates.

From an economic perspective, vaccination is an interesting decision environment. As with many decisions that we make, one's own consumption decision creates an externality for others. Whether this externality is positive or negative depends on your point of reference. On the one hand, we could think of choosing to vaccinate as creating a positive externality for others. When a person chooses to vaccinate, they reduce the likelihood that they themselves will get sick, which consequently also reduces the likelihood that they will get others sick. On the other hand, we could think of choosing *not* to vaccinate as creating a negative externality for others. When a person chooses not to vaccinate, they increase the likelihood that they will get sick, and the likelihood that they will get others sick. We may naturally view our own vaccination choices in one frame or the other, but it would be beneficial to know if one of these viewpoints tends to lead to higher vaccination rates. If it does, then adjusting the wording on vaccination campaigns could be an effective, low-cost intervention to increase vaccination rates. Laboratory experiments provide a way for us to test this in a controlled environment.

Additionally, the externality created (positive or negative depending on viewpoint), is unlike most standard externalities studied in the lab. The external benefits/costs of vaccinating/not vaccinating are received primarily by non-vaccinators. In fact, in the extreme case where a vaccine is fully effective (i.e. a vaccinated individual has zero chance of getting sick), only non-vaccinators receive external benefits/costs from others' choices. Even if the vaccine is not fully effective, it will still be the case that the external benefits/costs are greater for non-vaccinators than they are for vaccinators (since the vaccine provides at least some protection for vaccinators). This asymmetry in the recipients of the externality may affect the behavior of an individual who might otherwise be altruistic or have some other form of other-interested preferences. In the experiments that follow, I vary the effectiveness of the vaccine (and hence the distribution of the externality), to determine the impact this has on behavior. I also add a restriction in some environments that some individuals cannot receive the vaccine. This reflects the reality that, for various medical reasons, some people are unable to vaccinate. This does not alter the externality distribution (it is still the case that non-vaccinators receive

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[1] CDC. Prevention and Control of Influenza Practices (ACIP), 2010. MMWR 2010; 59 (No. RR-8)

[2] Estimates of Influenza Vaccination Coverage Among Children-United States, 2017-2018 Flu Season, www.cdc.gov/flu/fluvaxview/coverage-1718estimates-children

[3] Estimates of Influenza Vaccination Coverage Among Adults-United States, 2017-2018 Flu Season, www.cdc.gov/flu/fluvaxview/coverage-1718estimates

[4] www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/data-reports/index.html

[5] Vaccination rate ranges are the lowest and highest state vaccination rates in 2015.

greater external benefits/costs), however since some individuals are non-vaccinators not by choice, this may impact other-interested behavior for those with a choice.

Several empirical studies analyze the impact of framing on vaccination decisions, and overall, they have found mixed results. Gainforth et al. (2012) randomly assigned parents to one of three frames (gain, loss or mixed) regarding the HPV vaccine, and found some evidence that gain-framed messages increase mothers' interests in the vaccine. However, Abhyankar et al. (2008) find evidence that loss-framed messages increase mothers' intentions to obtain the MMR vaccine for their child. O'Keefe and Nan (2012) perform a meta-analysis, comparing gain-framed and loss-framed appeals towards vaccination. Overall, they find no significant differences between the two frames. The frames considered in much of this literature, however, relate to how the private incentives of vaccination are portrayed. That is, the "gains" are the private gains one gets by vaccinating, and the "losses" are the private losses one may face by not vaccinating. The experiments in this study are notably different, in that they alter the frame in which the *externality* created by vaccinating/not vaccinating is described. In addition to the vaccination literature, there is a substantial amount of research on framing effects in economics experiments, beginning with Kahneman and Tversky (1979) and Tversky and Kahneman (1981) with their development of prospect theory. Levin et al. (1998) disentangle some of the mixed results in the literature regarding the impact of positive and negative frames, noting that these differences can be attributed to differences in researchers' definitions of framing. They classify existing experimental literature into three different framing classifications and are able to resolve some of the otherwise contradictory results. Perhaps most closely related to the experiments in this study, Andreoni (1995) specifically looks at the frame given to externalities and its impact on behavior. Andreoni finds that in otherwise identical environments, subjects are more willing to cooperate when the environment is framed so that cooperating creates a positive externality, than they are when not cooperating creates a negative externality. This result helps to explain why public good provision in the laboratory is typically higher than equilibrium predictions (and closer to the social optimum), whereas behavior in oligopoly or common-pool resource problems is typically well predicted by the inefficient Nash equilibrium. If this result extends to the vaccination environment tested in this paper, then we might expect to see higher vaccination rates when vaccination is viewed as creating a positive externality, rather than not vaccinating creating a negative externality.

Initial results indicate that subjects choose the "vaccinate" option more often when it yields a certain payoff, and when some of the subjects cannot choose to "vaccinate". Contrary to prior experimental results, subjects choose to "vaccinate" most often in the negative frame, followed by the positive frame, and then the neutral frame.

The rest of the paper is organized as follows: section 2 contains the theoretical model, section 3 contains the experimental design, section 4 contains results, and section 5 concludes.

2. Theoretical Predictions

2.1 Model and Nash Equilibrium

Each of N agents start with an initial endowment of $z > 0$, and plays the following one-shot game. Agents have a binary action sets $A_i = \{0, 1\}$, with $a_i = 0$ representing a choice not to vaccinate, and $a_i = 1$ representing a choice to vaccinate. The cost of vaccinating is $c > 0$. Additionally, each agent may face a loss, with the size of this loss increasing in the number of non-vaccinating agents. This loss represents the agent's expected loss from getting sick. It is increasing in the number of non-vaccinating agents, to reflect the increased likelihood of getting sick when fewer people vaccinate. We assume that this loss is lower for vaccinating agents, reflecting either a decreased likelihood of getting sick, a decreased harm from getting sick, or both. Let $b > 0$ denote this loss for non-vaccinating agents, and $d \geq 0$ for vaccinating agents, with $b > d$.

Agent i's problem is to choose $a_i \in \{0, 1\}$ to maximize the following profit function:

$$\pi_i(a_1, \dots, a_n) = z - a_i c - (N - \sum_{j \neq i} a_j)((1 - a_i)b + a_i d) \quad (1)$$

The agent's profit is equal to their initial endowment minus any additional costs and losses they incur. If they choose to vaccinate, they pay the cost of the vaccine and potentially face an additional loss. When $d > 0$, a vaccinating agent faces an additional loss of $(N - \sum_{j \neq i} a_j)d$. Here $N - \sum_{j \neq i} a_j$ is the number of non-vaccinating agents plus one. So, even with all other agents vaccinating, agent i faces an additional loss of d, representing some risk of getting sick from an outsider or nature. Agent i's losses increase by d for each additional non-vaccinating agent, representing the increased likelihood of getting sick with a greater number of non-vaccinating agents. If instead the agent chooses not to vaccinate, they do not pay the cost of the vaccine, but they pay a greater cost per non-vaccinating agent, $b > d$. This represents the fact that, all else equal, non-vaccinating agents are more likely to get sick, and thus face a greater expected loss than vaccinating agents.[6]

There is a unique pure-strategy Nash equilibrium, up to reordering. To see this, assume that an agent vaccinates if their payoff from doing so is at least as great as their payoff from not vaccinating. That is, the agent will vaccinate if

$$z - c - (N - \sum_{j \neq i} a_j)\, d \geq z - (N - \sum_{j \neq i} a_j)b,$$

which simplifies to

$$c \leq (N - \sum_{j \neq i} a_j)(b - d). \quad (2)$$

Inequality (2) simply says that the agent will vaccinate if the benefit from doing so is at least as great as the cost. Depending on the parameterization of the model, the unique pure-strategy Nash equilibrium outcome is as follows:

1. No one vaccinates ($a_i^* = 0, \forall i$), $if\ c > N(b - d)$.
2. Everyone vaccinates ($a_i^* = 1, \forall i$), $if\ c \leq (b - d)$.
3. Exactly n^*agents vaccinate, with $0 < n^* < N$, and n^*satisfies $(N - n^*)(b - d) < c \leq (N - n^* + 1)(b - d)$.

2.2 Parameterizations

For the experiments that follow, there are four distinct decision environments, similar to the game described above. All four decision environments use the following parameterization: $N = 6, z = 25, c = 5, b = 1.2$. For decision environment 1 (DE 1), $d = 0$, and so the only loss that a vaccinating agent faces is the cost of the vaccine. This represents the case when the vaccine is fully effective. One can easily verify that this yield $n^* = 2$ agents vaccinating in equilibrium.

For decision environment 2 (DE 2), $d = 0.12$. Now agents who vaccinate do face an additional loss, above just the cost of the vaccine, and it is increasing in the number of non-vaccinating agents. This loss, however, is substantially less than if they had not vaccinated ($d =$

[6] The assumption that losses are both deterministic and linearly increasing in the number of non-vaccinators is a great simplification of the actual contagion process. However, it captures the key properties of a more accurately defined contagion model and is substantially easier to describe to students in the lab.

0.12 versus $b = 1.2$). This represents the case when a vaccine is not fully effective. Despite this change in d, the number of agents vaccinating in equilibrium is still $n^* = 2$.

The two additional decision environments (DE 3 and DE 4) are similar to the first two, except now one individual cannot receive the vaccine. This represents the case when some individuals cannot receive a vaccine for medical reasons. Theoretically, this is equivalent to one agent choosing not to vaccinate, and so the equilibrium predictions remain unchanged.

2.3 Social Optimum

In the game described above, the equilibrium outcome does not necessarily coincide with the socially optimal outcome. The socially optimal number of vaccinating agents is the number that maximizes total payoffs for everyone. That is, it maximizes the sum of equation (1) over all agents, *i*. For both parameterizations discussed above, the socially optimal number of vaccinating agents in each of the four decision environments is $n^{so} = 4$. This is easy to calculate, since there are only 7 possible outcomes.

3. Experimental Design and Procedures

This study is ongoing and began in the spring of 2016. Thus far, the data comes from three experimental sessions, with a total of 54 Southern Illinois University undergraduates from a variety of majors. Each session included 18 subjects and lasted 1 hour. Subjects were randomly assigned to a group of 6. Subjects were paid at an exchange rate of $1/point earned and were also given a $5 show-up fee. All experimental sessions were conducted on paper.

The experiments consist of a menu of four one-shot decision environments[7], as described in section 2. There are three versions of these four environments: neutral frame, positive frame, and negative frame. Each subject participates in all four environments, but only one frame.

In each decision environment, everyone starts with an endowment of 25 points. In DE 1 and DE 2, everyone must select exactly one of two options, Option A or Option B. For clarity, I will refer to Option A as *V* (vaccinate) and Option B as *NV* (not vaccinate), however during the experiments no references to vaccinations or diseases are ever made. In DE 3 and DE 4, the decision task is the same, except that one individual in each group is randomly selected to not have a choice and automatically receive *NV*. The random draws for DE 3 and DE 4 are independent. That is, it is not necessarily the same individuals in both decision environments who do not get a choice. In DE 1 and DE 3, individuals who have a choice and choose *V* must give up 5 points but keep 20 points with certainty. If an individual chooses or is assigned *NV*, then their payoff depends on how many of their group members choose/are assigned *NV*. They must give up at least 1.2 points (if all other group members choose *V*), and this loss increases by 1.2 points for each additional group member who chooses/is assigned *NV*. The exact payoffs corresponding to each choice/assignment and the choices/assignments of other group members are given in Table I below.

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[7] The menu format allows us to have own-subject control over alternative decision environments. Additionally, these one-shot settings are similar to many naturally occurring decisions, including most vaccination decisions.

Table I: DE 1 and DE 3 payoffs in points

	Number of *other* *group members who choose/are assigned NV*					
	0	1	2	3	4	5
V payoff	20	20	20	20	20	20
NV payoff	23.80	22.60	21.40	20.20	19.00	17.80

In DE 2 and DE 4, individuals who have a choice and choose *V* now face a loss in addition to the 5 points they give up in DE 1 and DE 3. They must give up at least 0.12 points (if all other group members choose *V*), and this loss increases by 0.12 points for each additional group member who chooses/is assigned *NV*. The exact payoffs corresponding to each choice/assignment, and the choices/assignments of other group members are in Table II below.

Table II: DE 2 and DE 4 payoffs in points

	Number of *other* *group members who choose/are assigned NV*					
	0	1	2	3	4	5
V payoff	19.88	19.76	19.64	19.52	19.40	19.28
NV payoff	23.80	22.60	21.40	20.20	19.00	17.80

The three versions of these four decision environments vary only in the language that is used to describe them (the "frame"), and each subject participates in only one version. The first version, "neutral frame", simply describes individuals' choice options and the corresponding payoffs. It does not explicitly mention how one's own choices may affect the payoffs of others.

The second version, "positive frame", highlights the positive externality created by a choice of *V*. For example, in DE 1 subjects are explicitly told that if they choose *V*, they will increase the payoff of each individual who chooses *NV* by 1.2 points.

The third version, "negative frame", highlights the negative externality created by choosing *NV*. For example, in DE 1, subjects are explicitly told that if they choose *NV*, they will decrease the payoff of each individual who chooses *NV* by 1.2 points.

Each subject is given an instruction packet, a decision sheet, and a pencil. The instruction packets contain general instructions, as well as instructions for each of the four decision environments for that session. It also contains group and member number assignments. There are 6 subjects per group, yielding a total of 3 groups per session. Group and member numbers are private information, and subjects are instructed not to share this information at any time.

The general instructions (included in the appendix) are read out loud by the experimenter. After these initial instructions, subjects are told to read the instructions for DE 1. These are also displayed on a screen at the front of the room. Subjects then answer a short quiz to test their understanding of the decision environment. Any questions are answered privately. Once all questions are answered, subjects make their selection for DE 1 and record it on their decision sheet. At this time, and throughout the session, subjects are reminded that they may change and/or review their choices at any point in the decision-making process.

Once all subjects make a selection for DE 1, they are instructed to turn to DE 2, and begin reading. Again, the instructions are displayed on the screen at the front of the room. Subjects complete an additional short quiz. Subjects then make a selection for DE 2.

After reading the instructions and completing the quiz for DE 3, the experimenter selects a volunteer to draw from a shuffled deck of cards numbered 1 through 6. The number on the card corresponds to the member in each group who does not get a choice and is automatically given *NV*. All other subjects then make a selection for DE 3. A similar process is followed for DE 4. Subjects are given time between each decision environment and at the end of the experiment to review their choices.

Although subjects participate in all four decision environments, they are only paid for a randomly selected one. Again, the experimenter chooses a volunteer to select from a shuffled deck of cards numbered 1 through 4. Subjects are paid only for the decision environment corresponding to the number drawn. All decisions and earnings are private information. At the end of each session, subjects are only informed of their group members' decisions for the decision environment that is selected for payment.

4. Results

Table III contains the percentage of subjects in each decision environment and each frame who chose *V*. Recall that the Nash equilibrium is for 2 out of 6 subjects (33.3%) to choose *V*. The social optimum is for 4 out of 6 subjects (66.7%) to choose *V*. The entries in Table III with a superscript "N" are not significantly different at standard levels from the Nash prediction, and entries with a superscript "S" are not significantly different at standard levels from the social optimum.[8]

Table III: Percentage of individuals who chose *V* by DE and Frame

	Neutral Frame	Positive Frame	Negative Frame
DE 1	50.0%$^{N, S}$	50.0%$^{N, S}$	50.0%$^{N, S}$
DE 2	16.7%^{N}	27.8%^{N}	44.4%^{N}
DE 3	38.9%^{N}	50.0%$^{N, S}$	61.1%^{S}
DE 4	27.8%^{N}	27.8%^{N}	55.6%^{S}

Looking at the entries in Table III, there is a substantial amount of variation in rates of choosing *V* across frames and decision environments. Overall, however, most of them are not statistically different from the Nash prediction and are significantly less than the social optimum. A few of the entries, while not significantly different from the Nash prediction, are also not significantly less than the social optimum, falling somewhere between the two. These include DE 1 for all frames, and DE 3 for the positive frame. Notably, two of the outcomes for the negative frame (DE 3 and DE 4) are significantly greater than the Nash prediction, and are not significantly less than the social optimum. These differences across frames and decision environments will be discussed in more detail below.

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[8] Standard binomial tests were used to compare the observed percentage of subjects choosing *V* to the Nash prediction and the social optimum.

First, we will compare decision environments that differ only in their payoffs from vaccinating. That is, DE 1 versus DE 2, and DE 3 versus DE 4, where payoffs from vaccinating depend on others' actions in DE 2 and DE 4 only. In terms of externalities, in DE 1 and DE 3 only non-vaccinators receive the positive externality from others vaccinating (negative externality from others not vaccinating). In DE 2 and DE 4, all individuals receive externalities from others' choices. Looking at the comparisons in Table IV, we can clearly see that vaccination rates tend to be higher in the environments where *V* payoffs are certain and do not depend on others' actions (DE 1 and DE 3), in relation to their comparable decision environments.[9]

Table IV: Percentage of individuals who chose *V* by DE and Frame

Frame	DE 1 %V	Sign comparison	DE 2 %V	DE 3 %V	Sign comparison	DE 4 %V
Neutral	50.0%	>*	16.7%	38.9%	>	27.8%
Positive	50.0%	>	27.8%	50.0%	>	27.8%
Negative	50.0%	>	44.4%	61.1%	>	53.6%

* denotes significance at the 0.10 level

Next, we will look at comparisons between DE 1 and DE 3, and between DE 2 and DE 4. The only difference within these pairs is the restriction that in DE 3 and DE 4 one person in each group does not get a choice and is automatically given *NV*. If more individuals choose *V* in DE 3 versus DE 1, or in DE 4 versus DE 2, this could be an indication that individuals are more altruistic when their decisions also impact this one individual without a choice. Looking at Table V below, we see mixed results. In the neutral frame, DE 1 yields a greater percentage of individuals choosing *V* than DE 3, but this is reversed when comparing DE 2 and DE 4, and neither is statistically significant. In the positive frame, the percentages of individuals choosing *V* in DE 1 and DE 3 are identical, as are these percentages in DE 2 and DE 4. In the negative frame however, the restriction that one individual does not have a choice appears to increase choices of *V* in both DE 3 and DE 4, with this increase being statistically significant in DE 3. Thus, making people aware of both the presence of individuals who cannot vaccinate, as well as the negative external effects of a choice not to vaccinate, may increase vaccinating rates.

Table V: Percentage of individuals who chose *V* by DE and Frame

Frame	DE 1 %V	Sign comparison	DE 3 %V	DE 2 %V	Sign comparison	DE 4 %V
Neutral	50.0%	>	38.9%	16.7%	<	27.8%
Positive	50.0%	=	50.0%	27.8%	=	27.8%
Negative	50.0%	<*	61.1%	44.4%	<	53.6%

* denotes significance at the 0.10 level

[9] Statistical significance is noted and determined based on McNemar's test for matched pairs (McNemar 1947). This test requires that the same individuals participate in each of the decision environments being compared. Because of the menu format of this experiment, we have own-subject control across decision environments for a given frame, and McNemar's test allows us to take advantage of this.

Now we will examine in more detail, comparisons between the three different frames. In particular, we would like to know if highlighting the positive externality from vaccinating or the negative externality from not vaccinating increases vaccination rates above those of the neutral frame. Looking again at Table III, there are clearly no differences in behavior across frames for DE 1. For further comparison of frames for decision environments 2, 3, and 4, consult tables 6 and 7 below.[10] There is a general trend of the negative frame producing the highest vaccination rates, followed by the positive frame, and then the neutral frame. This observation is counter to both theoretical predictions and previous framing experiments (Andreoni 1995), indicating again that emphasizing the negative external costs of not vaccinating may be a good way of increasing vaccination rates. Although the only frame comparison that is statistically significant is between the negative and neutral frames, this may be due to the limited amount of data collected thus far.

Table VI: Frame comparisons

	Neutral Frame %V	Sign comparison	Positive Frame %V	Sign comparison	Negative Frame %V
DE 2	16.7%	<	27.8%	<	44.4%
DE 3	38.9%	<	50%	<	61.1%
DE 4	27.8%	=	27.8%	<	55.6%

Table VII: Frame comparisons

	Neutral Frame %V	Sign comparison	Negative Frame %V
DE 2	16.7%	<*	44.4%
DE 3	38.9%	<	61.1%
DE 4	27.8%	<	55.6%

5. Conclusions

This study examines behavior in a binary-choice experiment, designed to characterize the individual vaccination decision. Subjects make choices in four one-shot games, differing in the payoff from the "vaccinate" option and the ability of all individuals to choose the "vaccinate" option. All four games are tested in three different frames: neutral, positive, and negative.

Initial results indicate that subjects choose the "vaccinate" option more often when it yields a certain payoff, or when some of the subjects cannot choose to "vaccinate". Overall, subjects choose to "vaccinate" most often in the negative frame, followed by the positive frame, and then the neutral frame. This is in contrast to the results of Andreoni (1995), where he finds greater cooperation in positively framed environments. These seemingly opposite results may be

[10] Statistical significance was calculated using Fisher's exact test for pairwise comparison between decision environments for different frames. Since each subject only participated in one of the three frames, we lose own-subject control here, and so we can no longer use McNemar's test.

due to the differences in the decision environments in Andreoni (1995) (classic public good and common pool resource games) and the environments in this paper.

The results indicate that public health campaigns emphasizing the negative external costs of not vaccinating may be a good way of increasing vaccination rates. This study has significant limitations, however, in the amount of data that has been collected thus far. Clearly further experiments are needed to solidify any observations I have made.

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Appendix A:

Experiment Instructions

General Instructions

No Talking. If you have any questions after reading the instructions, please raise your hand. Your questions will be answered privately.

The experiment consists of *two* stages. To complete it you will receive the following four documents:

- Instructions for Stage 1 (this document)
- Decision sheet for Stage 1 where you will answer quizzes and make your decisions.
- Additional copy of payoff tables for Stage 1.
- Instructions and Decision sheet for Stage 2.

Earnings

You will receive a **show-up payment of $5** for participating in this experiment. Your additional cash earnings will depend on your decisions and the decisions of the five other participants in your group. Detailed instructions are given below.

Every individual has been randomly assigned to groups of 6 people. Within each group, every individual receives a member number 1 through 6. **Your group number and member number have been recorded on your decision sheet for Stage 1.** These numbers are private information – do not share them with anyone.

Your decisions and earnings are private information. We will record your decisions and earnings by your group and member numbers only. You will only be informed of the decisions of the other participants in your group for the decision environment that is chosen for computing earnings. You will not be informed of the names or participant numbers of the other members in your group.

All decision environments are described in points. At the end of the experiment you will be paid in cash at a rate of **$1 for every point you earn**.

Overview

The experiment will last approximately 1.5 hours. You are free to leave at any point during the experiment, but if you decide to leave before the end of the experiment you will only be paid the show-up payment.

Stage 1 Instructions

In Stage 1 you will make choices in **4 independent decision environments**. After both stages of the experiment are over, we will **randomly choose one of these four decision environments, and award cash earnings for that decision environment only**: When the decision-making ends, the monitor will collect your decision sheets and will **randomly pick one of the four decision environments for computing earnings** by drawing a card out of a shuffled deck of cards numbered from 1 to 4. The drawing will be made in public, at the front of the room.

You will answer short quizzes after each set of instructions for each decision environment. These must be answered on your decision sheet. The quizzes are designed to check your understanding of the decision environments. Your performance on the quizzes **will not affect your cash earnings**. We will provide solutions to each quiz after all participants have finished and questions will be answered privately before proceeding.

After each quiz, you will be given time to make a decision for that decision environment. Once everyone has made a selection, we will move to the next decision environment. You may review and/or change any of the choices that you have already made at any point during the decision-making process. Once all participants have finalized their decisions, Stage 1 ends and you may no longer change your decisions.

<u>Decision Environment 1</u>

Initial Endowment: Each individual begins with *25 points*.

Decision Task: Each individual must choose one of the following two options:

<u>Option A</u>: If an individual chooses Option A, they will give up 5 points and keep 20 points.

<u>Option B</u>: If an individual chooses Option B, the number of points they get to keep depends on the choices of their group members, as given in Table 1 below.

Table 1:

	Number of ***other*** group members who choose ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of points an individual who chooses ***Option A*** keeps	20	20	20	20	20	20
Number of points an individual who chooses ***Option B*** keeps	23.80	22.60	21.40	20.20	19.00	17.80

Examples:

- If an individual chooses Option A, and all other group members choose Option B, that individual will give up 5 points and keep 20 points.

- If an individual chooses Option B, and three other group members choose Option B, that individual will give up 4.80 points and keep 20.20 points.

- If an individual chooses Option A, and two group members choose Option B, that individual will give up 5 points and keep 20 points.

On your decision sheet, answer Quiz 1 now.

Once you have been provided with the quiz solutions you may then make a selection for Decision Environment 1. Clearly mark your choice on your decision sheet.

<u>Decision environment 2</u>:

Initial Endowment: Each individual begins with *25 points*.

Decision Task: Decision Environment 2 is similar to Decision Environment 1. Each individual must again choose one of two options**. The difference between Decision Environments 2 and 1 is that now Option A payoffs also depend on your group members' choices.** Each individual must choose one of the following two options:

<u>Option A</u>: If an individual chooses Option A, the number of points they get to keep depends on the choices of their group members, as given in Table 2 below.

<u>Option B</u>: If an individual chooses Option B, the number of points they get to keep depends on the choices of their group members, as given in Table 2 below.

Table 2:

	Number of *other* group members who choose ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of points an individual who chooses ***Option A*** keeps	19.88	19.76	19.64	19.52	19.40	19.28
Number of points an individual who chooses ***Option B*** keeps	23.80	22.60	21.40	20.20	19.00	17.80

Examples:

- If an individual chooses Option A, and two group members choose Option B, that individual will give up 5.36 points and keep 19.64 points.

- If an individual chooses Option B, and three other group members choose Option B, that individual will give up 4.80 points and keep 20.20 points.

On your decision sheet, answer Quiz 2 now.

Once you have been provided with the quiz solutions you may then make a selection for Decision Environment 2. Clearly mark your choice on your decision sheet.

<u>Decision environment 3</u>:

Initial Endowment: Each individual begins with *25 points*.

Decision Task: Decision Environment 3 is similar to Decision Environment 1. **The difference between Decision Environments 3 and 1 is that now one individual in your group does NOT have a choice, and is automatically given Option B.** Except for this one individual, every other individual must choose one of the following two options:

<u>Option A</u>: If an individual chooses Option A, they will give up 5 points and keep 20 points.

<u>Option B</u>: If an individual chooses or is assigned Option B, the number of points they get to keep depends on the choices of their group members, as given in Table 3 below.

After the quiz the individual that is automatically given Option B will be selected at random; the monitor will draw a card from a shuffled deck of cards numbered 1 to 6. This number corresponds to the member number of the individual automatically assigned Option B. The member number chosen will be the same for every group. Every individual has the same chance of being selected.

Table 3:

	Number of ***other*** group members who choose/are assigned ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of points an individual who chooses ***Option A*** keeps	-----	20	20	20	20	20
Number of points an individual who chooses/is assigned ***Option B*** keeps	-----	22.60	21.40	20.20	19.00	17.80

Note: There are no entries under "0 other group members who choose/are assigned Option B", since one individual in your group does not have a choice and is automatically given Option B.

Examples:

- If an individual has a choice and chooses Option A, and all other group members with a choice choose Option B, that individual will give up 5 points and keep 20 points.
- If an individual has a choice and chooses Option B, and two other group members with a choice choose Option B, that individual will give up 4.80 points and keep 20.20 points (a total of three other group members receive Option B, the two that choose it and the one that does not have a choice).
- If an individual has a choice and chooses Option A, and one other group member with a choice chooses Option B, that individual will give up 5 points and keep 20 points.

On your decision sheet, answer Quiz 3 now.

Once you have been provided with the quiz solutions we will select the member number of the individual who is automatically given Option B. If your member number was NOT selected, you may then make a selection for Decision Environment 3. If your member number WAS selected, place an "X" on your decision sheet for Decision Environment 3.

<u>Decision environment 4</u>:

Initial Endowment: Each individual begins with *25 points*.

Decision Task: Decision Environments 4 is similar to Decision Environment 2. **The difference between Decision Environments 4 and 2 is that now one individual in your group does NOT have a choice, and is automatically given Option B.** Except for this one individual, every other individual must choose one of the following two options:

<u>Option A</u>: If an individual chooses Option A, the number of points they get to keep depends on the choices of their group members, as given in Table 4 below.

<u>Option B</u>: If an individual chooses or is assigned Option B, the number of points they get to keep depends on the choices of their group members, as given in Table 4 below.

After the quiz the individual that is automatically given Option B will be selected at random using the same mechanism outlined under Decision Environment 3.

Table 4:

	Number of ***other*** group members who choose/are assigned ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of points an individual who chooses ***Option A*** keeps	-------	19.76	19.64	19.52	19.40	19.28
Number of points an individual who chooses/is assigned ***Option B*** keeps	---------	22.60	21.40	20.20	19.00	17.80

There are no entries under "0 other group members who choose/are assigned Option B", since one individual in your group does not have a choice and is automatically given Option B.

Examples:

- If an individual has a choice and chooses Option A, and two group members who also have a choice choose Option B, that individual will give up 5.48 points and keep 19.52 points (a total of three group members receive Option B, the two that choose it and the one that does not have a choice).

- If an individual has a choice and chooses Option B, and three other group members who have a choice choose Option B, that individual will give up 6.00 points and keep 19.00 points (a total of four other group members receive Option B, the three that choose it and the one that does not have a choice).

On your decision sheet, answer Quiz 4 now.

Once you have been provided with the quiz solutions we will select the member number of the individual who is automatically given Option B. If your member number was NOT selected, you may then make a selection for Decision Environment 4. If your member number WAS selected, place an "X" on your decision sheet for Decision Environment 4.

Stage 1 Tables

Table 1: Decision Environment 1

	Number of ***other*** group members who choose ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of ECU an individual who chooses ***Option A*** keeps	20	20	20	20	20	20
Number of ECU an individual who chooses ***Option B*** keeps	23.80	22.60	21.40	20.20	19.00	17.80

Table 2: Decision Environment 2

	Number of ***other*** group members who choose ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of ECU an individual who chooses ***Option A*** keeps	19.88	19.76	19.64	19.52	19.40	19.28
Number of ECU an individual who chooses ***Option B*** keeps	23.80	22.60	21.40	20.20	19.00	17.80

Table 3: Decision Environment 3

	Number of ***other*** group members who choose/are assigned ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of ECU an individual who chooses ***Option A*** keeps	-----	20	20	20	20	20
Number of ECU an individual who chooses/is assigned ***Option B*** keeps	-----	22.60	21.40	20.20	19.00	17.80

Table 4: Decision Environment 4

	Number of ***other*** group members who choose/are assigned ***Option B***					
	0	**1**	**2**	**3**	**4**	**5**
Number of ECU an individual who chooses ***Option A*** keeps	-------	19.76	19.64	19.52	19.40	19.28
Number of ECU an individual who chooses/is assigned ***Option B*** keeps	---------	22.60	21.40	20.20	19.00	17.80

Stage 1 Decision Sheet

Your group number _____________ **Your member number ____________**

Quiz 1:

1. You begin Decision Environment 1 with _______ points.
2. If you choose Option A, you will keep ______ points.
3. If you choose Option B, and four other individuals in your group choose Option B, you will keep _________ points.

Quiz 2:

1. You begin Decision Environment 1 with _______ points.
2. If you choose Option A, and four individuals in your group choose Option B, you will keep ______ points.
3. If you choose Option B, and four other individuals in your group choose Option B, you will keep _________ points.

Quiz 3:

1. You begin Decision Environment 1 with _______ points.
2. If you are the individual who does NOT have a choice, and two other members of your group choose Option B you keep _______ points.
3. If you have a choice and choose Option A, you keep ______ points.
4. If you have a choice and choose Option B, you keep at most ______ points and at least _______ points.

Quiz 4:

1. You begin Decision Environment 1 with _______ points.
2. If you are the individual who does NOT have a choice, and two other members of your group choose Option B you keep _______ points.
3. If you have a choice and you choose Option A, you keep at most _______ points and at least ________ points.
4. If you have a choice and you choose Option B, you keep at most ______ points and at least _______ points.

Your decisions

Decision Environment	**Option Choice** Clearly indicate **A** or **B**
1	___________
2	___________
3	___________
4	___________