Increasing Organ Donation via Changes in the Default Choice or Allocation Rule

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Abstract:

The supply of deceased donor organs is a limiting factor for transplantation based therapies. This research utilizes a laboratory experiment to evaluate the effectiveness of alternative public policies targeted at increasing the rate of deceased donor organ donation. The experiment includes treatments across different default choices (opt-in versus opt-out) and organ allocation rules (without versus with priority rule) inspired by the donor registration systems applied in different countries. Furthermore, the experiment includes a controlled treatment to measure the effects of a neutral versus descriptive framing of the decision task. Our results indicate that the opt-out system with priority rule generates the largest increase in organ donation relative to an opt-in only program. However, sizeable gains are achievable using either a priority rule or opt-out program separately, with the opt-out rule generating approximately 80% of the benefits achieved under a priority rule program.

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Between 2000 and 2009 the annual number of deceased organ donors within the United States (U.S.) increased from 5,985 to 8,022 (Scientific Registry of Transplant Recipients (SRTR) 2012). Although this represents a 34% increase in deceased donors, it has not kept pace with the rapidly risen waiting list. During this same time interval the number of patients waiting for an organ transplant has increased from 74,635 to 111,027 patients, a 49% increase (SRTR 2012). Both in absolute and relative terms there is an ever increasing gap between the number of deceased donor organs and those waiting for a transplant.[1] Despite the large need for transplantable organs, only 42.7% of residents in the U.S. over the age of 18 are registered organ donors.[2] Clearly, the current organ supply system in the United States fails to produce an adequate supply to satisfy the demand for transplantable organs and there is an increasing need to close this gap and increase human welfare. In this paper we experimentally investigate whether or not changes in the organ donation default choices as well as organ allocations can effectively increase organ donation and facilitate the closing of this gap.

The experimental design is inspired by different donor registration and organ allocation systems currently applied in other countries. The U.S. system serves as a baseline for comparison where current donor registration is an opt-in program and the organ allocation system does not assign priority to those who are willing to be donors themselves. We compare this institution to an opt-out donor registration system inspired by the current system in Spain and Austria, an opt-in with a priority allocation rule inspired by Israel and an opt-out with priority rule system inspired by Singapore. Our results indicate that the opt-out system with priority rule generates the largest donation rates, with the largest marginal gains arising from the priority rule allocation system. Our results are consistent with the findings of Kessler and Roth (2012) who found that a priority rule allocation program will increase donation rates, but we complement their finding to encompass the opt-out rule which is currently being utilized in other countries.

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[1] It is worth noting that the reported deaths while in the waiting list per 1,000 patient years at risks has decreased from 104.6 in 2000 to 84.5 in 2009 (SRTR 2012). This is primarily due the advancements in care for these patients and not a function of increased transplantation.

[2] Based on the 2012 National Donor Designation Report Card by the Donate Life America at http://donatelife.net/wp-content/uploads/2012/06/DLA-Report-Card-2012-350781.pdf

Although there are a large number of living donors within the U.S., there is currently 0.8 living donors for each deceased donor, we focus on deceased donation as the number of potential deceased donors is far above the number of current deceased donors and many types of organ transplantation rely exclusively on deceased donation.[3] Approaches to increase the organ supply from deceased donation broadly fall into two classes: improving the donation rates of eligible deceased donors and enlarging the pool of potential donors. The donation rates can be improved by increasing the consent rates from the potential donors' next-of-kin. Since first drafted in 1968, the Uniform Anatomical Gift Act (UAGA) provides that an individual's statement of intent to be an organ donor is legally binding (Bonnie et al., 2008). However, it is still common practice to ask the permission of the deceased's next-of-kin to donate their organs. Along this vein, the department of Health and Human Service (HHS) passed regulation that requires all hospitals to report all deaths to the Organ Procurement Organization (OPO).[4] This regulation increases the opportunity that the deceased's next-of-kin is contacted for organ donation.

Policymakers have made efforts to increase the donation rate through regulation and improvements to the organ procurement system. In the U.S. an organ procurement organization (OPO) is in charge of the procurement of deceased-donor organs. There are 58 such organizations from different regions throughout the U.S. and each regional OPO obtains direct contact with the deceased's next-of-kin. In April 2003, HHS launched the Organ Donation Breakthrough Collaborative to improve the donation rate.[5] The goal of the collaborative is to encourage adoption of "best practices" for increasing access to transplantable organs. Recent research suggests that the collaborative has increased organ donation within the U.S. (Howard et al., 2007; Shafer et al., 2008).

Another approach to increase the organ supply is to enlarge the pool of potential donors or generating a higher registration rate among the population. Our experiment is targeted at this

[3] While a live donor can give a kidney, or a portion of the liver, lung, intestine, or pancreas, it is essentially impossible for live donation of solid organs such as the heart, pancreas, and intestinal organs.

[4] This policy was announced in June 1998. HHS Announcement: http://archive.hhs.gov/news/press/1998pres/980617.html

[5] The Organ Donation Breakthrough Collaborative began in 2003 at the request of HHS Secretary Tommy G. Thompson.

mechanism for increasing the organ supply as we measure the relative effectiveness of potential policy changes that target increasing the number of potential donors. Our paper is novel in that we conduct a controlled lab experiment to compare policy regimes with different institutions surrounding organ donation registration that currently exist in the world today. Results from the experiment will inform the discussion of possible changes in public policy towards organ donation. We consider two highly publicized proposals: changing the default of organ donation registration and changing the organ allocation rule.

Changing the default option affects decision-making. Economists have highlighted the substantial role that defaults play in numerous areas, including health care plans (Samuelson and Zeckhauser, 1988), automobile insurance (Johnson et al., 1993), retirement saving plans (Madrian and Shea, 2001) and consent to online privacy policies (Johnson et al., 2002). Results show that people often choose the default option to which they are assigned, suggesting that changing the default choice of the organ donation question may influence donation decisions. The U.S. operates an opt-in policy regime so that the individual must self-select and register to be an organ donor. In other words, the current default choice in the U.S. is non-donor. One proposed policy alternative is to change the default option to being a donor, what is referred to as an opt-out system. Under an opt-out regime, an individual must self-select out of being an organ donor.

Altering the default choice influences donation decisions through various channels (Johnson and Goldstein, 2003). First, the default may be considered as the recommended action by the policy-maker. For example, if the default is that an individual has consented to be a donor, potential donors might believe being a donor is recommended by policy-makers. Second, accepting the default may involve less effort for the individual making decisions. Psychologically, the organ donation decision may induce stress from thoughts of dying or pain suffered by family members should their organs be donated. Researching the information about organ donation and filling out registration forms also involves time and physical effort. These costs are upfront burdens placed upon organ donation registration and intensified when the default option is non-donor (captured by the opt-in rule within our experiment).

Several European countries like Spain and Austria have adopted an opt-out system for organ donation, while some other European countries like Germany and the United Kingdom have opt-in default options. Using data reported in Gäbel (2002), Johnson and Goldstein (2003; 2004) compare donation registration rates across European countries with different default options. They find that the default has a large impact with opt-out countries having higher registration rates. One potential problem of this method is the assumption that all other observable characteristics can be controlled for and unobservable characteristics are not correlated with donation registration across countries. We provide support for these empirical results using a laboratory setting where outside confounders do not exist.

Changing the organ allocation rule is another potential way to increase the pool of registered donors. The current organ allocation system in U.S. is organized by the United Network for Organ Sharing (UNOS). UNOS maintains a national waiting list. Transplant candidates on the list are ranked, among other things, according to the candidate's health condition, physical compatibility between the donor and the candidate (i.e., the Human Leukocyte Antigen (HLA) matching),[6] their distance from the potential donor, the patient's preferences for particular donor types (i.e., is the patient willing to accept an Extended Criteria Donor (ECD) organ) and how long the candidate has been on the waiting list. When a transplantable organ becomes available, the opportunity goes to the highest-ranked person on the list. Under the current allocation system utilized by UNOS an individual is not given priority if they have elected to be a potential donor. A proposed change is to utilize a priority rule for allocation.[7]

A priority rule allocation system gives individuals who are on the organ waiting list and are registered organ donors precedence for transplantable organs. In other words, the priority rule establishes the top criterion for ranking on the waiting list by whether a person is registered as an organ donor or not. Individuals who are registered donors rank higher on the waiting list than those who are not, despite their medical condition or other differences. The supporters of the priority rule believe that the current organ allocation system in the U.S. does not provide enough incentive for organ donation by purely relying on altruism. The priority rule motivates an

[6] A zero HLA mismatch with a particular donor will automatically move a patient up the waiting queue.

[7] The final decision to utilize an organ is made by the transplant surgeon. However, changes in the allocation mechanism will alter the distribution of organ offers.

individual to donate by connecting the potential of helping others to the potential of helping one's self. The results from our experiment validate this motivation.

Israel and Singapore are examples of countries that have adopted a priority rule for their national donation system. Israel has been using the priority rule system since 2010 (Lavee et al., 2010).[8] However, Israeli citizens need to elect to be included as a registered donor to receive priority over those not willing to be donors. Singapore passed the Human Organ Transplant Act (HOTA) in 1987, which applies the priority rule with an opt-out system.[9] In Singapore, citizens are assumed to be organ donors, but any person who objects to HOTA can elect not to be included. If a person objects to donate his organs upon death, he automatically gives up priority for receiving an organ should they need one in future. Therefore, the policy currently implemented in Singapore combines all the features that may increase organ donation over the current U.S. paradigm.

Our experimental design complements the recent work of Kessler and Roth (2012). Kessler and Roth design a laboratory experiment to test for changes in the decision to register as a donor from alterations in allocation rule (i.e., priority rule) and the using of financial incentives (i.e., a rebate and discount). As mentioned earlier, Kessler and Roth illustrate that organ donation rates will increase if one elects to utilize a priority rule for organ allocation. Our research extends this research in two important dimensions. One, we investigate whether or not the results expressed in Kessler and Roth (2012) are a construct of the neutral framing used in their experiment as the terms organ and organ donation are not used. Secondly, we investigate whether or not the utilization of an opt-out versus an opt-in decision rule combined with a priority and no priority rule can yield further increases in organ donation. The later being extremely important as it investigates the marginal effects of other countries policies on the organ donation decision.

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[8] The new organ allocation policy was first suggested to the Israel National Transplant Council (INTC) in 2006. It was put into effect in January 2010. The new policy can be found as the Organ Transplant Law 5768-2008, Israeli Book of Laws (English translation provided by the Israeli Ministry of Justice).

[9] Details of the Human Organ Transplant Act can be found at http://statutes.agc.gov.sg/aol/search/display/view.w3p;page=0;query=DocId%3Adb05e985-f8a0-4d61-a906-9fd39f3b5ac9%20Depth%3A0%20ValidTime%3A02%2F01%2F2011%20TransactionTime%3A31%2F07%2F2005%20Status%3Ainforce;rec=0;whole=yes

Our research can be used to further inform the policy debate surrounding the current organ donation system. We not only compare the alternative policies (opt-out and priority allocation rule) to the current U.S. donation system, but we also test the relative effectiveness of different alternative policies in an effort to decompose their marginal effects. In addition, we further evaluate the combination of the opt-out and priority allocation rule. The opt-out with priority system, as discussed by Breyer and Kliemt (2007) and utilized by Singapore, provides a dual-incentive for donation: avoiding the cost of opting-out and receiving priority on the waiting list. A concern with combining the opt-out and priority allocation system is that the priority rule cannot prevent the free-rider problem if the introduction of opt-out system already generated sufficient organ supply (Breyer and Kliemt 2007). Investigating this using observational data would be infeasible but within our experiment we can investigate whether or not this concern is valid. Our result suggests that the combination of opt-out and priority rule is significantly more effective in increasing registration rates than each of the other policies.

An additional advancement we make is that the instructions to subjects in our experiment are stated in terms of organs. The framing choice that should be applied in the experimental study of policy evaluation is controversial. The reason we choose descriptive framing here is that we believe the organ donation decision involves significant psychological issues and costs that cannot be captured by abstract terms. To measure the impact of framing on experimentally-observed donation decision, we included an additional treatment, in which the instructions are stated in abstract terms. By doing this, we are able to discuss the impact on the decision to donate 'tokens' or donate 'organs'. Our results indicate that our findings are robust to the framing of the experiment.

In the following section, we present our behavioral hypotheses. In Section Two, we outline the experimental design we utilize to investigate our hypotheses on the impact that the opt-out versus opt-in and priority allocation rule have on the organ donation decision. In Section Three we discuss the results from the experiment and in the final section we summarize our findings.

I. Behavioral Hypotheses

We designed an incentivized laboratory experiment to evaluate the relative effectiveness of different organ donation mechanisms. We adopted a two-by-two design illustrated in Table 1 with the dimensions being the opt-in versus opt-out decision rule combined with the presence or absence of the priority allocation rule.

[Insert Table 1 here]

The *Control* treatment models the current status quo of the U.S. donation system, where subjects are non-donors by default and no one is granted priority for being a registered donor. The *Opt-out* treatment is different from the *Control* treatment only in the default choice of the donation decision. As we discussed, there are costs associated with making active organ donation decision. In our experiment, we model these costs as a simple monetary cost, which is charged if a subject deviates from the default. Being an organ donation in the *Opt-out* treatment is less costly than in the *Control* treatment. This leads to the first hypothesis:

Hypothesis 1: Ceteris paribus, changing the default choice of the donation decision from opt-in to opt-out increases the donation registration rate.

The only difference between the *Control* treatment and the *Priority* treatment is the organ allocation rule. In the *Priority* treatment, subjects who are registered donors receive priority when they need an organ, while non-donors are only able to access available organs when the needs of the registered donors on the waiting list are satisfied. Under the priority rule, donors can jump in front of non-donors on the waiting list. That is, the priority rule increases the probability that donors who need an organ will receive one if they are registered donors. This leads to our second hypothesis:

Hypothesis 2: Ceteris paribus, changing the organ allocation rule by adding donors' priority increases the donation registration rate.

In addition to comparing each alternative mechanism with the current status quo, we are also interested in the relative effectiveness of changing the default choice and changing the organ allocation rule. More formally, we test the following hypothesis:

Hypothesis 3: Ceteris paribus, changing the current status quo to the opt-out system yields the same level of increase in the donation rate as changing to the priority rule system.

The *Opt-out with Priority* treatment combines the effect of changing both the default choice (reducing the cost of donation registration) and changing the organ allocation rule (increasing the benefit of donation). It would be expected that the dual-incentives working congruently will be more effective than in the singular case. There is some concern, however, that if the change to an opt-out default choice increases donation registration significantly such that individuals are gaining very little from the priority allocation rule, then the combination of the policies may not result in higher donation rates. In this case, the dual-incentives will not be more effective. We test the following hypothesis on the combination of the opt-out and priority allocation rule:

Hypothesis 4: Ceteris paribus, changing the default choice and the organ allocation rule together generates the same level of increase in donation registration rate as changing only one of them.

The framing of the decision task may impact the decision to be donor or not within the experiment. An additional advantage of our experiments is the ability to formally investigate the framing effect. We conducted an additional treatment, a neutral framing of the *Control* treatment (opt-in combined without priority), to investigate the impact that our contextual framing of the decision process had on subject behavior. This generates our last research hypothesis:

Hypothesis 5: Ceteris paribus, subjects behave the same when the experiment is framed in abstract terms as when the experiment is framed in term of organs.

II. Experimental Design

There were 30 rounds in each session of the experiment and a finite number of periods in each round. Subjects were unaware of the number of rounds, but they were informed at the beginning of the experiment that only one round would be randomly selected to be paid at the end of the experiment. Each subject was a virtual human in the lab who had one A organ and two B organs.[10] In each period, subjects had a 10% probability of an A organ failure and a 20%

[10] Kessler and Roth (2012) have the design of one A units with two B units, where A represents brain and B

probability of a B organ failure (both B organs fail together).[11] If a subject encountered an A organ failure, she ceased to participate in that round. Whenever a subject's B organs failed, she was placed on a waiting list to receive one B organ donated by another subject.[12] Subjects waiting for a B organ were not subjected to the probability of an A organ failure. Each subject with a B organ failure had up to 5 periods to stay on the waiting list. If she did not receive a B organ within this time period, she ceased to participate in that round.

At the beginning of each round, subjects were asked to make a decision about whether they wanted to register as an organ donor (the opt-in rule) or withdraw from the donor registry (the opt-out rule). Since we only focus on the donation registration decision not the procurement process, we utilized a strong version of donation in our experiment, in which registering as a donor implies being a donor upon death in the experiment.

Subjects were told that they would earn $3 in each period that they had one active A organ and at least one active B organ. However, subjects were not able to earn any money when they were on the waiting list or no longer actively participating in the round. All donation decisions were made at the beginning of each period before knowing whether or not they would have an organ failure. All subjects were told that if they chose to be a donor and their A organ failed first each of their B organs would be donated to one of the subjects who were on the waiting list in that period. However, if their B organs failed first, their active A organ could not be donated. In addition, if they received a B organ from others, the donated B organ could not be donated again.

There were costs involved with the donation decision.[13] Subjects were told that they had to pay $0.75 to make an active donation decision (override the default choice). This cost can be thought as the psychological and physical costs associate with overriding the default choice,

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represents kidney. We keep the consistent design so that the results of our experiment are comparable.

[11] These parameters are identical to those have been used by Kessler and Roth (2012). We also conducted additional sensitivity analyses, discussed in Appendix A, specific to our design to ensure they are appropriate.

[12] The assumption here is that a subject can function normally with one B organ donated by another subject.

[13] Obviously, these costs associated with organ donation cannot be measured. Here we impose these costs merely to model the incentives involved in organ donation. Since the costs vary as the default choice changes, we divide the costs into two parts, the cost of overriding the default and the cost of donation act.

which was charged regardless of the donation outcome. Subjects were also told that the act of donating organs would cost them $2.25. This donation cost can be thought as the psychological costs of organ procurement. Thus, one's payoff for each round is equal to the earnings in that round minus the costs they incurred for overriding the default decision as well as donating organs. At the end of the experiment, only one round was randomly selected for payment. Subjects were told at the beginning of the experiment that if in the selected round their payoff was negative, the extra costs would be charged from their $10 show-up fee.

After making the donation decision at the beginning of each round, subjects observed their outcome for each period, their earnings of each period, and their accumulated earnings for that round. After experiencing a B organ failure, the subject began to receive the waiting list information. The waiting list information provide subjects with information on how many periods they had been waiting, their rank on the waiting list and whether they received a B organ in that period. A screenshot of the information screen presented to the subjects is shown in Figure 1. Subjects who ceased to participate in the round were not able to observe any more information until a new round started.

[Insert Figure 1 here]

To investigate our five experimental hypotheses we conducted four organ-framed treatments — the *Control* treatment, the *Opt-out* treatment, the *Priority* treatment and the *Opt-out with Priority* treatment — and one neutral-framed treatment. In the following, we provide more detail on the five different treatments used in the experiment.

Control Treatment

In this treatment, subjects were not organ donors by default. Those who wished to register as donors were charged $0.75 to change their status. Subjects were told that being an organ donor might potentially affect others' earnings. The donation decision was described in the experiment as follows:

> "In this round, you are <u>not</u> an organ donor by default. If you want to change your status to be a donor, please check the box below; otherwise, please leave it empty.

> □ I hereby agree to donate my organs after I cease to participate in this round."

Subjects were also told that if they chose to be an organ donor, after their A organ failed, their active B organs would be donated to those in need in the order of their rank on the waiting list. The rank on the waiting list was determined by the length of time the subjects had been waiting for a B organ. Subjects who had been waiting longer were ranked higher. The rank of subjects who had the same waiting time was randomly determined. For example, if there were two subjects on the waiting list and subject 1 had been waiting for 4 periods and subject 2 had been waiting for 3 periods, subject 1 ranked higher than subject 2.

Opt-out Treatment

In the *Opt-out* treatment, subjects were registered organ donors by default. Those who wished to withdraw their donor registry were charged $0.75 to opt out. The choice of this treatment was described as follows:

> "In this round, you are an organ donor by default. If you want to change your status to be a non-donor, please check the box below; otherwise, please leave it empty.
>
> □ I hereby object to donate my organs after I cease to participate in this round."

Unless a subject responded that he or she did not want to be considered a potential organ donor, their active B organs were donated after an A organ failure occurred. Organs were provided to those in need according to their rank on the waiting list. Subjects on the waiting list were ranked by the length of time they had been waiting on the list, and subjects who had been waiting longer were ranked higher.

Priority Treatment

The *Priority* treatment is different from the *Control* treatment only in the ranking rule used for the waiting list. In this treatment, the default option for the donation decision was not to be an organ donor. Before making the donation decision, all subjects were informed that those who chose to be an organ donor would be given priority ranking on the waiting list. Therefore, subjects on the waiting list in this treatment were ranked on the basis of two criteria: first their donation decision, and second the length of time they had been waiting on the list. For example, if subject 1 is a non-donor who had been waiting for 4 periods and subject 2 is a registered donor who had been waiting for 3 periods, subject 2 ranked higher than subject 1.

Opt-out with Priority Treatment

The *Opt-out with Priority* treatment is different from the *Control* treatment in both the default option and the ranking rule on the waiting list. In this treatment, subjects were registered organ donors by default. Before making the donation decision, all subjects were informed that those who withdraw their donor registration would automatically give up their priority ranking on the waiting list. Transplantable organs would be provided to registered donors before non-donors.

The description of the decision environment to the subjects in the four treatments above was stated in terms of organ donations. We conducted an additional treatment, in which the instructions to subjects were neutrally-framed, to control the effect of the experiment framing.

Neutral Treatment

In the *Neutral* treatment, we adopted the same default option and ranking rule on the waiting list as the *Control* treatment. The only difference is that the experiment description was phrased in abstract terms, not in terms of organs. Subjects were informed that they would be assigned three tokens in each round: one A token and two B tokens. In each period, each subject had a 10% probability of losing their A token and a 20% probability of losing both B tokens. Subjects would earn $3 in each period that they had one A token and at least one B token. The donation decision in this treatment was described as follows:

> "In this round, you are <u>not</u> a donor by default. If you want to change your status to be a donor, please check the box below; otherwise, please leave it empty.
>
> □ I hereby agree to donate my B tokens after I cease to participate in this round."

We conducted eighteen experimental sessions with 15 subjects in each session. In twelve sessions, subjects played 15 rounds in one of the organ-framed treatments followed by 15 rounds of another one of the organ-framed treatments (for example, subjects participated in the *Control* treatment for rounds 1-15 and then the *Opt-out* treatment for rounds 16-30). In these sessions, subjects were stopped after round 15 and told that they would start a new treatment. Subjects were handed the instruction of the new treatment and the experimenter clearly explained all changes in the rules.

In three of the remaining sessions, subjects played the *Control* treatment in all 30 rounds, while in the last three treatments subjects played the *neutral* treatment in all 30 rounds. In these sessions, subjects were also stopped after round 15. They were told that they would start a new treatment, but there were no changes in the rules of the game. The experimenter reviewed all the rules of the game. All types of treatment combination are shown in Table 2. Lastly, the selection of which session to conduct among the eighteen sessions was randomly determined.

[Insert Table 2 here]

At the end of each session, the subjects were presented with a brief questionnaire on their demographic characteristics and their involvement with organ donation in their own lives. They received payment after they completed the questionnaire.

III. Results

The experiment was performed at the Georgia State University Experimental Economics Center (ExCEN). Subjects were recruited from the undergraduate student body using a recruiting program that randomly invites registered subjects to participate in the experiment. A total of 270 subjects participated in the experiment and the average payment was $18.03.[14] Table 3 presents the descriptive statistics for the experiment. There are 8100 observations at the subject-round level. The average donation registration rate for all treatments is 41.5%. The average donation rates by treatment were as follows: *Opt-out with Priority* (70.8%), *Priority* (61.3%), *Opt-out* (48.8%), *Control* (25.3%), and *Neutral* (17.8%). The descriptive statistics clearly indicate that

[14] The experiment was conducted using the experimental software z-Tree 3.3.6 (Fishbacher 2007).

the highest average donation rates arise when the priority rule is utilized. This finding is consistent with that of Kessler and Roth (2012), but the descriptive statistics also illustrate that substantial gains can be achieved using just an opt-out policy.

[Insert Table 3 here]

Figure 2 shows the percentage of subjects who were registered organ donors (those who either opted in or did not opt out) in each round of the experiment for each treatment. The line breaks indicate that subjects were stopped after round 15 in each session and restarted a new treatment from round 16 through 30. Figure 2 suggests that changing the default option and/or altering the organ allocation rule has a significant positive impact on the donor registration rate across all 30 rounds. The *Control* treatment lies beneath the three other organ-framed treatments regardless of being played in the first or last 15 rounds. Figure 2 also suggests that the experiment framing plays an important role. The organ-framed treatment generates higher average donation registration rate than the neutral-framed treatment. This difference in registration rate across treatment is even more notable in the last 15 rounds.

[Insert Figure 2 here]

To more rigorously investigate the treatment differences a series of Wilcoxon rank sum tests were conducted comparing the donation decisions of subjects across treatments. The results from these tests are illustrated in Table 4. The test statics are conducted using three different data partitions. The first pools all of the data across rounds, the second focuses on the first 15 rounds in the experiment and the third partition is for the last 15 rounds. The results from all of the Wilcoxon rank sum tests clearly indicate that the donation decisions across treatments are statistically different from one another. They are also consistent with the observation that the donation rate is highest in the *Opt-out with Priority* treatment and the lowest is the *Neutral* treatment.

[Insert Table 4 here]

We additionally conducted a series of probit regressions to investigate the marginal effect of different mechanisms on organ donation decisions. The results are illustrated in Table 5. The independent variables in the probit regressions include four treatment dummy variables *Opt-out*, *Priority*, *Opt-out/priority*, and *Neutral* corresponding with the different cells of the experimental design (Model 1). The reference group is the donation decision in the *Control* treatment, which is the opt-in system currently used in the U.S. We further control whether a decision is made in the first 15 rounds or in last 15 rounds of the experiment using a dummy variable interaction term (Model 2). The dummy variable *Second Treatment* equals to 1 if a treatment is played in the last 15 rounds and it is interacted with the four primary treatment dummies in Model 1. Regression Models 3 and 4 control for the effect of information in the previous round on the donor registration decision. *Earnings Last Round* represents earnings from the previous round (Model 3). *Received an Organ Last Round* is a dummy variable which equals to 1 if the subject received an organ donated by others in the previous round. *Benefit of Organ Received Last Round* captures the earnings from the previous round after receiving an organ (Model 4). Lastly, regression Model 5 includes demographic control variables *Male*, *White*, and *Donor in Real Life*. The following of this section provides more detailed results from the experiment broken down by our five primary research hypotheses.

[Insert Table 5 Here]

Focusing on our first research hypothesis the results for the experiment validate our hypothesis that the opt-out rule generates a higher donor registration rate than the opt-in rule. Figure 2 illustrates that the opt-out rule has a significant positive impact on the donor registration rate in all rounds. Across all rounds, the *Opt-out* treatment has an average donation rate of 48.8%, which is almost twice the average donation rate of 25.3% in the *Control* treatment. Over the first 15 rounds, the *Opt-out* treatment had an average donation rate of 53.8%, while the *Control* treatment had a much lower average rate of 27.7%. Over rounds 16-30, the *Opt-out* treatment had a rate of 43.9%, while the *Control* treatment only had a rate of 22.9%. Results from the non-parametric tests in Table 4 are consistent with the observation that the *Control* treatment had a statistically significant lower donor registration rate than the *Opt-out* treatment regardless of being played in the first or last 15 rounds. The Wilcoxon rank-sum tests are -14.988, -11.493 and -9.713 for pooled data, first 15 rounds and last 15 rounds of the experiment respectively when comparing the *Control* treatment with the *Opt-out* treatment.

The probit regressions in Table 5 also support our first research hypothesis. The positive and highly statistically significant coefficient on the *Opt-out* dummy variable in regression Model 1 indicates that subjects are about 25% more likely to register as a donor in the *Opt-out* treatment than in the *Control* treatment across all 30 rounds. Furthermore, this finding is robust to the additional controls used in the other econometric specifications (Models 2 through 5). This represents an almost 100% increase in the donor registration rate over the 25.3% donor registration rate observed in the *Control* treatment. This finding suggests a significant increase in donation rate can be achieved by just introducing the opt-out rule.

In order to test our second research hypothesis we must compare the *Control* treatment (the baseline opt-in without priority system) with the *Priority* treatment as well as the *Opt-out* treatment with the *Opt-out with Priority* treatment. A statistically significant and higher donor registration rate for the *Priority* and *Opt-out with Priority* treatments will support our second research hypothesis. Figure 2 illustrate that the *Priority* treatment has a higher average donation registration rate than the *Control* treatment in all rounds. The average donation rate for the *Priority* treatment is 61.3% over all rounds, 59.6% over the first 15 rounds, and 63.0% over the last 15 rounds. A higher donation rate is also observed in the *Opt-out with Priority* treatment when compared to the *Opt-out* treatment. The average donation rate for this treatment was 70.8% over all rounds, 73.2% for the first 15 rounds and 68.4% for last 15 rounds.

The Wilcoxon rank sum tests also demonstrate that the *Control* treatment generates statistically significantly lower donation registration rates than the *Priority* treatment over all rounds as well as in rounds 1-15 and rounds 16-30 separately. The test statistics are -22.309, -13.895, and -17.680 when comparing the *Control* treatment with the *Priority* treatment for all the rounds, rounds 1-15 and rounds 16-30 respectively. The results comparing the *Opt-out* treatment with the *Opt-out with Priority* treatment are similar to those observed when comparing the *Control* treatment with the *Priority* treatment, adding the priority allocation rule increases the rate of organ donation. The Wilcoxon rank sum test statistics are -11.656, -7.402 and -9.102 when comparing the total rounds, rounds 1-15 and rounds 16-30 respectively. This said, the marginal differences between the *Opt-out* treatment and the *Opt-out with Priority* treatment are not as large as when comparing the *Control* treatment with the *Priority* treatment since the donor registration rate increased only 45% whereas it increased by 142% when comparing the *Control* treatment with the *Priority* treatment.

The probit results also illustrate the treatment differences as the statistically significant and positive coefficient on *Priority* indicates that the donation rate increases by between 31.5% and 36.5%, depending on the model assumptions. The statistically significant and positive coefficient on *Opt-out with Priority* indicates that the donation rate increases by between 42.8% and 45.1%, depending on the model assumptions. Both of these coefficients are interpreted relative to the *Control* treatment so the relative gains observed under the *Opt-out with Priority* treatment must be purged of the *Opt-out* effect solely to be comparable to the *Control* versus *Priority* treatment. Both of these results are consistent with those observed in Kessler and Roth (2012) as it is clearly evident that changing the allocation rule to a priority rule will increase the donor registration rate. This said, these comparisons do raise the question of whether or not just using the rule *Opt-out* is capable of providing a similar gain as that observed when altering the allocation rule. This is more formally investigated under our third research hypothesis.

Our previous research hypotheses have illustrated that altering either the organ allocation rule, using a priority rule system, or the default choice, going from an *Opt-in* to an *Opt-out* program, will increase the organ donor registration rate. The results from our Wilcoxon sign rank tests as well as the probit regressions clearly indicate that the organ donation rate is greater when comparing either the *Opt-out* treatment or the *Priority* treatment with the *Control* (opt-in) treatment. From a public policy perspective it may be of interest whether or not the relative gains are comparable, as both policies require different forms of administrative change that may or may not be more palatable for different administrations and the populous. On average going from the *Control* treatment to the *Opt-out* treatment increased the organ donation rate from 25.3% to 48.8% whereas going to the *Priority* treatment increased it to 61.3%. This provides the first evidence that does not support our third research hypothesis that they generate equivalent marginal gains in the organ donor rate. Our regression results further confirm this observation. Comparing the coefficient on the *Opt-out* treatment with the *Priority* treatment illustrates that in all the models estimated the *Priority* treatment coefficient is statistically significant and greater than the *Opt-out* treatment coefficient ($p<0.01$). Therefore, our third research is not supported. However, it is important to note that changing the default choice, going from an *Opt-in* to an

Opt-out system, is able to generate approximately 80% of the gains achievable when altering the allocation rule. Therefore, although it is not a 1-to-1 equivalent the gains are significant enough that policy makers may wish to consider changing just the default option versus the allocation rule if default option is a more palatable public policy.

Investigating our third research hypothesis illustrated that sizable gains are achievable by changing either the allocation rule or the default choice, with the allocation rule outperforming the default choice by a small margin. Our fourth research hypothesis investigates whether or not using either of these changes in isolation yields the same result as combining them and utilizing an *Opt-out with Priority* program. Figure 2 clearly illustrates that *Opt-out with Priority* treatment outperforms both the *Opt-out* treatment and the *Priority* treatment separately, as it generated the highest donation rate of all the treatments. This does not support our fourth research hypothesis, as it is clear that combining both changes exceeds either of them individual. Overall all the rounds the average donation rate was 70.8% for the *Opt-out with Priority* treatment, compared with 48.8% and 61.3% observed under the *Opt-out* and *Priority* treatments respectively. This is also true when comparing the results from rounds 1-15 and rounds 16-30. Over the first 15 rounds, the *Opt-out with Priority* treatment had an average donation rate of 73.2%, while the *Opt-out* treatment was 53.8% and the *Priority* treatment was 59.6%. Over the last 15 rounds, the *Opt-out with Priority* treatment had an average donation rate of 68.4% while *the Opt*-out treatment was 43.9% and *the Priority* treatment was 63.0%.

The non-parametric test indicates that the *Opt-out with Priority* treatment outperforms all the other treatments and that the results are statistically significant. It also shows that the *Opt-out with Priority* treatment generates statistically significantly higher donation registration rates than all the other treatments no matter if played first (rounds 1-15) or last (rounds 16-30). The test statistics comparing the *Opt-out* treatment and the *Priority* treatment with the *Opt-out with Priority* treatment concretely invalidates our fourth research hypothesis, as it evident that in all cases the combined effect of the *Opt-out with Priority* treatment exceeds the constituent changes separately. Results from the parametric tests in Table 5 are also consistent with this observation. The coefficient on *Opt-out/priority* in regression (1) is positive and highly statistically significant, representing that subjects are about 45% more likely to donate in the *Opt-out with Priority* treatment than in the *Control* treatment. Using estimates from regression (1), we find that *Opt-*

out/priority also performs better than either *Opt-out* ($p<0.01$) or *Priority* ($p<0.01$) treatments separately.

As mentioned earlier, our experiment is fundamentally different from Kessler and Roth's (2012) experiment as it investigates the separable and combined effects of changing the allocation rule as well as the default option and it contextualizes the decision environment. Our fifth and final research hypothesis investigates whether or not the abstract and contextual framing generate the same donor registration rates. Our experimental results indicate that the contextual framing leads to a larger donor registration rate than a neutral framing. Evidence of this can be seen in Figure 2, where the neutral framing donation rates are on average lower than those observed in the contextual framing treatment. However, the differences are not as clear over rounds 1-15 as they are over rounds 16-30.

The Wilcoxon rank sum tests and the probit regression results clarify this treatment effect. The non-parametric tests demonstrate that the *Control* treatment generates statistically significantly higher donation registration rates than the *Neutral* treatment. This result is still statistically significant for all rounds and if we only focus on the first 15 rounds or the last 15 round; the test statistics are 5.376, 2.362 and 5.431 for the respective partitions of the data. The parametric tests estimate the likelihood of donation in each treatment. The significant negative coefficient on *Neutral* in regression Model 1 indicates that subjects are about 10% less likely to register as a donor in the neutral-framed treatment than in the organ-framed treatment across all 30 rounds. When controlling for other covariates in the experiment, Models 2 through 5, this percentage decreases to around 5%. Therefore using a neutral framing, as was conducted by Kessler and Roth (2012), will generate a lower rate of donor registration.

Robustness of Results

Table 5 also report results from probit regressions with controls for order effects, information of the previous round and demographic dummies. Results are qualitatively the same when we add additional controls. Regression (2) includes a control variable *Second Treatment* and its interactions with the treatment variables. The significant negative coefficient on *Second Treatment* shows that subjects are 6% less likely to register when they played the *Control* treatment in the last 15 rounds. The significant positive coefficient on the interaction term

*Second Treatment*Priority* indicate that the *Priority* treatment has an even stronger impact on the registration rate when it was played after subjects have participated in another organ-framed treatment.

Regression (3) controls for the effect of earnings in the previous round on donation registration. The significant positive coefficient on *Earnings Last Round* suggests earnings in the previous round have a positive impact on the donation decision. Although subjects played multiple rounds in the experiment, only one round was randomly selected for payment at the end of each session. Subjects' donation decision should not be affected by their previous earnings. However, subjects could get information about others' donation decision through receiving a B organ when needed in a previous period of the experiment. We further included variables *Received an Organ Last round* and *Benefit of Organ Received Last Round* in regression (4). The significant positive coefficient on *Received an Organ Last Round* shows that subjects are 5% more likely to donate if they received a B organ in previous round. Since receiving a B organ leads to additional earnings, earnings of the previous round, especially earnings after receiving a B organ, affect the likelihood of donation (*Received an Organ Last Round* and *Benefit of Organ Received Last Round* are positive and significant at 10% level). Regression (5) controls for demographic information of the subjects. Among our selected subjects, whites are 8% more likely to register as a donor than all non-white races. Subjects who were self-reported as organ donor in real life are 5% more like to register as a donor. These two results are statistically significant.

IV. Conclusion

A fundamental limitation of the success of transplantation-based medical treatments is the supply of organs. Although there have been sizeable gains in the development of immunosuppressant drugs that have increased the pool of potential candidates for a donated organ, there still exists an ever widening gap between the number of organ donors and the number of patients on the waiting list. Recently, the transplantation community has made sizable gains in the utilization of donated organs (Howard et al., 2007; Shafer et al., 2008), but future changes in public policy may be required to increase the rate of organ donation within the United States in order to save more lives. Drawing from the experiences in other countries, changes in public policy can arise from either changing the allocation rule to provide priority for those who are registered donors or from changing the default choice from a standard opt-in to an opt-out system. Furthermore, as is the case in Singapore, it is possible to combine both changes in the allocation rule and default choice. The results from our experiment provide the first rigorous investigation of changing both the allocation rules and default choice separately as well as jointly.

Our results are consistent with those previously observed in Kessler and Roth (2012), in that changing the allocation rule to a priority rule system yields a sizable increase in the organ donation rate. We further extend this finding to illustrate that the priority rule generates a larger marginal gain than altering the default choice from an opt-in to an opt-out public policy. In addition, we find that combining both an opt-out and priority rule policy will provide the largest gains in the organ donation rate and that gains are substantially different from the individual effect of each public policy change. We further find evidence that the context of the experiment used to investigate the organ donation decision does matter with a contextualized decision environment yielding an increase in organ donation rates of around 5%.

An important public policy finding is that our results illustrate that approximately 80% of the gains observed under a priority allocation rule are achievable by switching from an opt-in to an opt-out public policy. This is extremely important from a public policy perspective as the costs, both pecuniary and psychological, associated these two possible changes may be substantially different. A change in the allocation rule redefines the rules of whom is to receive priority for an organ which post-transplantation may invoke concepts of fairness and equality as enforcement of this rule may still rely on the deceased donors next-of-kin being amenable to their deceased's donation preferences. On the other hand, an opt-out policy redefines the rule of who owns a deceased's individuals organs from the next-of-kin to the government. The choice of which option is more appropriate is subject to the policy maker's discretion and the constituents that they represent.

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Tables and Figures

Table 1: Two-by-Two Experimental Design

	Opt-in	Opt-out
Without Priority Rule	*Control Treatment*	*Opt-out Treatment*
With Priority Rule	*Priority Treatment*	*Opt-out with Priority Treatment*

Table 2: Number of sessions for each treatment combination

Treatment Rounds 1-15	**Treatment Rounds 16-30**				
	Control	*Opt-out*	*Priority*	*Opt-out with Priority*	*Neutral*
Control	3 Sessions	1 Session	1 Session	1 Session	No Sessions
Opt-out	1 Session	No Sessions	1 Session	1 Session	No Sessions
Priority	1 Session	1 Session	No Sessions	1 Session	No Sessions
Opt-out with Priority	1 Session	1 Session	1 Session	No Sessions	No Sessions
Neutral	No Sessions	No Sessions	No Sessions	No Sessions	3 Sessions

Table 3: Descriptive statistics for the experiment

Variable	Obs	Mean	Std. Dev.	Min	Max
Round Profit	8100	9.216	9.83	-3	87
Round Cost	8100	0.582	0.90	0	3
Payment	8100	18.033	9.28	7	63.25
Flier	8100	0.211	0.41	0	1
Donation Registration Rate	8100	0.415	0.49	0	1
Control Treatment					
Donation Registration Rate	2700	0.253	0.43	0	1
Opt-out Treatment					
Donation Registration Rate	1350	0.488	0.50	0	1
Priority Treatment					
Donation Registration Rate	1350	0.613	0.49	0	1
Opt-out with Priority Treatment					
Donation Registration Rate	1350	0.708	0.45	0	1
Neutral Treatment					
Donation Registration Rate	1350	0.178	0.38	0	1

Table 4: Wilcoxon rank-sum tests

Pooled Data				Rounds 1-15				Rounds 16-30			
Treatment		Treatment	Test Statistic	Treatment		Treatment	Test Statistic	Treatment		Treatment	Test Statistic
Control	vs	*Opt-out*	-14.988***	*Control*	vs	*Opt-out*	-11.493***	*Control*	vs	*Opt-out*	-9.713***
Control	vs	*Priority*	-22.309***	*Control*	vs	*Priority*	-13.895***	*Control*	vs	*Priority*	-17.680***
Control	vs	*Opt-out with Priority*	-27.818***	*Control*	vs	*Opt-out with Priority*	-19.491***	*Control*	vs	*Opt-out with Priority*	-19.897***
Control	vs	*Neutral*	5.376***	*Control*	vs	*Neutral*	2.362**	*Control*	vs	*Neutral*	5.431***
Opt-out	vs	*Priority*	-6.498***	*Opt-out*	vs	*Priority*	-2.141**	*Opt-out*	vs	*Priority*	-7.036***
Opt-out	vs	*Opt-out with Priority*	-11.656***	*Opt-out*	vs	*Opt-out with Priority*	-7.402***	*Opt-out*	vs	*Opt-out with Priority*	-9.102***
Priority	vs	*Opt-out with Priority*	-5.241***	*Priority*	vs	*Opt-out with Priority*	-5.298***	*Priority*	vs	*Opt-out with Priority*	-2.121**

Note: *** significant at 1% level, ** significant at the 5% level.

<u>Table 5:</u> Probit regression on the decision to be a donor or not within the experiment; all variables are expressed as marginal values.

	Probit Estimation				
	(1)	(2)	(3)	(4)	(5)
Opt-out	0.249***	0.269***	0.258***	0.248***	0.252***
	(0.016)	(0.023)	(0.024)	(0.024)	(0.024)
Priority	0.365***	0.323***	0.322***	0.311***	0.315***
	(0.015)	(0.022)	(0.023)	(0.023)	(0.023)
Opt-out/priority	0.451***	0.450***	0.437***	0.428***	0.431***
	(0.014)	(0.020)	(0.021)	(0.021)	(0.021)
Neutral	-0.098***	-0.058**	-0.055**	-0.055**	-0.052**
	(0.017)	(0.024)	(0.025)	(0.025)	(0.025)
Second Treatment		-0.058***	-0.062***	-0.062***	-0.065***
		(0.020)	(0.021)	(0.021)	(0.021)
Second Treatment*Opt-out		-0.038	-0.030	-0.029	-0.023
		(0.033)	(0.033)	(0.033)	(0.034)
Second Treatment*Priority		0.094***	0.092***	0.090***	0.100***
		(0.035)	(0.035)	(0.035)	(0.036)
Second Treatment*Opt-out/priority		0.005	0.014	0.010	0.014
		(0.035)	(0.035)	(0.035)	(0.036)
Second Treatment*Neutral		-0.091**	-0.093**	-0.088**	-0.085**
		(0.035)	(0.035)	(0.036)	(0.036)
Earnings Last Round			0.003***	0.001*	0.001*
			(0.001)	(0.001)	(0.001)
Received an Organ Last Round				0.047**	0.047**
				(0.021)	(0.021)
Benefit of Organ Received Last Round				0.003*	0.003*
				(0.001)	(0.001)
Male					0.011
					(0.012)
White					0.076***
					(0.019)
Donor in Real Life					0.050***
					(0.012)
N	8100	8100	7830	7830	7801
Chi2	1375.02	1425.66	1388.24	1416.61	1466.78
Pseudo R2	0.1250	0.1297	0.1306	0.1333	0.1385

Figure 1: Illustration of the decision screen used in the experiment

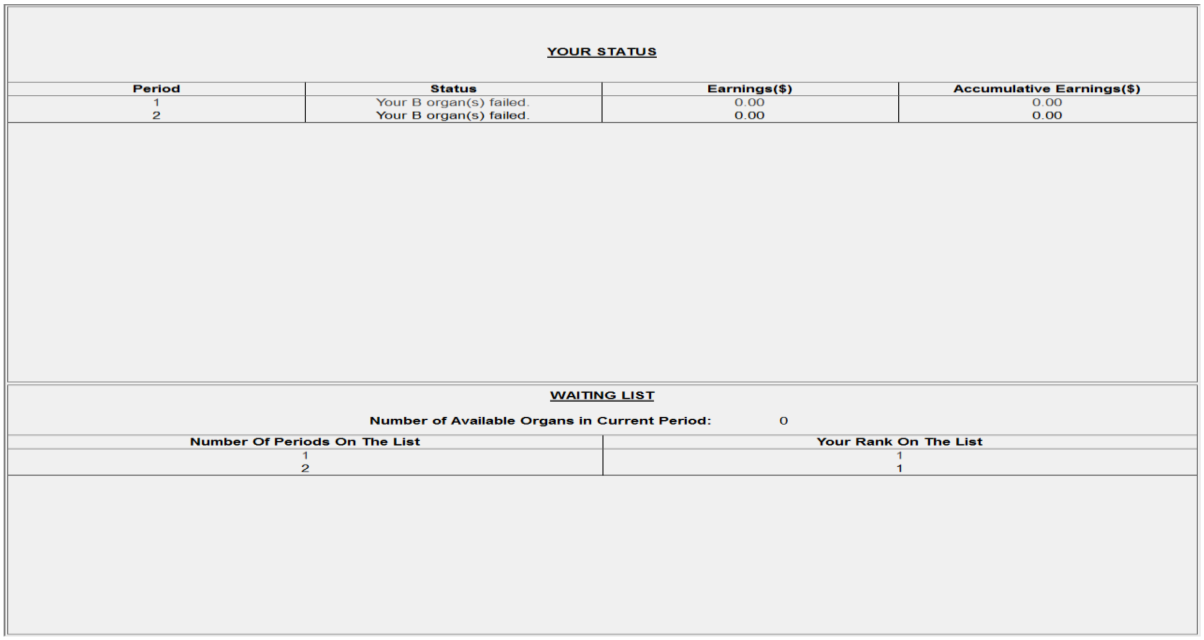
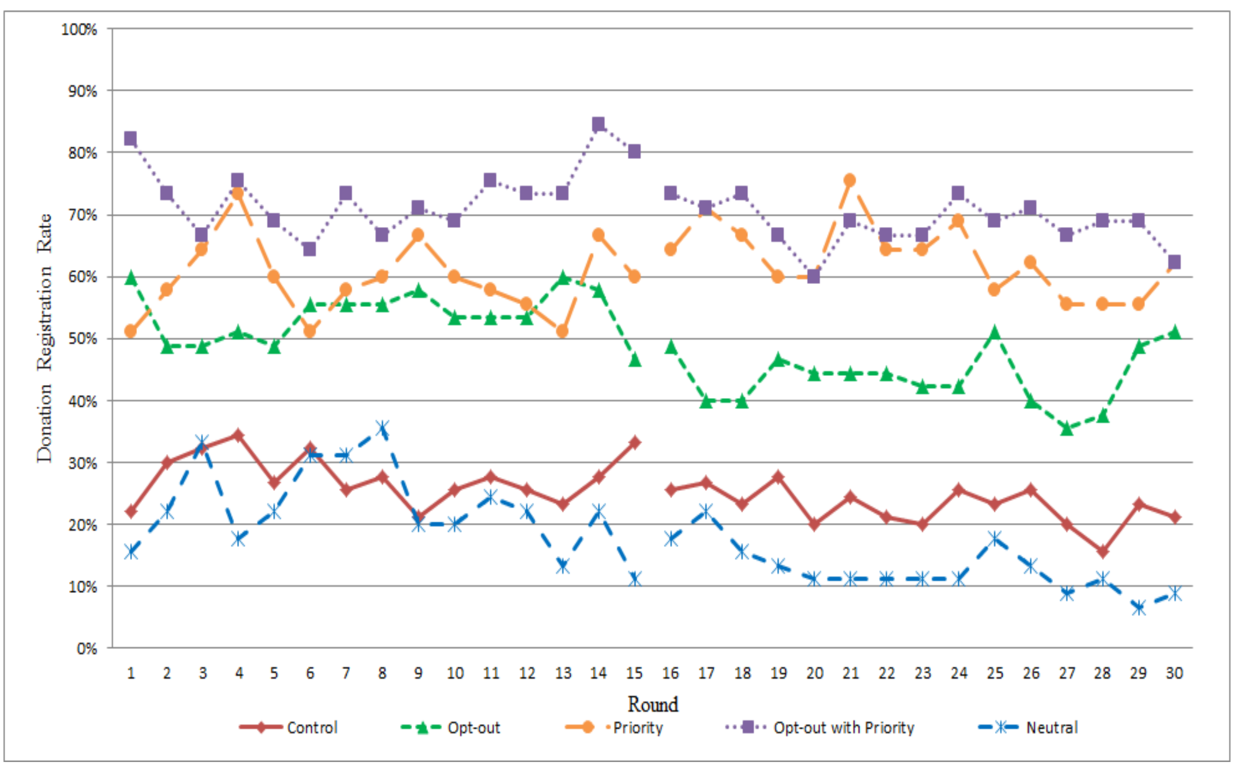


Figure 2: Percentage of donors in each treatment reported by round of the experiment.



Appendix A: Experimental Parameters

Given the complexity of the decision environment we elected to simulate the decision environment to inform our parameterization of the experiment. The most critical parameter in our experiment is the probability of organ failure. There are two types of organ failure in our experiment. Subjects with an A organ failure potentially provide transplantable organs for subjects with a B organ failure. The ratio of the probability of B organ failure to the probability of A organ failure should be high enough to keep the scarcity of transplantable organs high, but it also cannot be too high because it will cancel out the incentive to donate in the *Priority* treatment. Figure A.1 shows the expected payoff difference between donors and non-donors for different parameter values in both the *Control* treatment and the *Priority* treatment (based on 100,000 simulations of donation rate from 0% to 100% for each set of parameters). The parameter values vary the ratio of the probability of B organ failure to the probability of A organ failure (Beta in Figure A.1).

In Figure A.1, the teal blue line represents the expected payoff difference with the parameters actually used in the experiment (Beta=2), consistent with those used by Kessler and Roth (2012). In the *Control* treatment, being a donor is more costly that being a non-donor, which would predict no donation in the game. Non-zero donation in the *Control* treatment would be the expression of altruistic motivation. In the *Priority* treatment, the payoff difference is increasing with the donation rate. It is worth noting that once Beta exceeds two the payoff difference start to fall off again and the benefits of being a donor are reduced. The reason for these results is an increase in Beta generates an overwhelming gap between organ demand and supply. Due to the high odds of having a B organ failure and the insufficient organ supply, the probability of dying while waiting for a B organ increases even for donors who have priority on the waiting list. The incentive to donate provided by priority rule is canceled out, since having priority on the waiting list does not generate benefit any more.

Figure A.1: Simulations payoff difference between being a donor and a non-donor for both the *Control* treatment (left panel) and *Priority* the treatment (right panel) while varying the percentage of donors (x-axis) as well as the ratio of the A organ failure to B organ failure (Beta).