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DICE DISCUSSION PAPER

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How Much Priority Bonus Should be Given to Registered Organ Donors? An Experimental Analysis*

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December 2018

Abstract

Giving registered organ donors priority on organ waiting list can substantially increase the number of donors and save lifes. Evidence for these effects comes from recent experiments that implemented such priority rules in abstract laboratory environments. In these experiments, participants who registered as organ donors were fully prioritized over those who did not. In the field, however, registering as a donor is only one factor affecting the recipient's score. In this paper, we provide a comparative statics analysis of the priority treatment by varying the number of bonus periods that a registered person can skip on the waiting list. We find that behavior is monotonic: giving more priority to registered donors leads to higher registration rates. Our results also indicate that a medium sized bonus improves registration rates as much as absolute priority (used in the previous literature).

JEL Classification: C90, I10, I18

Keywords: organ donation; laboratory experiment; priority rule; waiting list

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1 Introduction

When it comes to improving registration rates for organ donation, innovative priority organ allocation schemes are a frequently—if controversially—discussed policy measure. While allocating the organ of a deceased donor, such rules give priority to citizens on the waiting list who have registered themselves as donors previously, over those who have not. Israel (Stoler et al., 2016), Singapore (Iyer, 1987), Chile (Quigley et al., 2012; Zuniga-Fajuria, 2015), and China (Jiang et al., 2015) have implemented priority allocation. It has also been proposed by the National Health Service Blood and Transplant (NHSBT) authority in the United Kingdom, which recently published a new and detailed strategy to improve organ donation (NHSBT, 2013). Authorities in other countries, including Germany, either disfavor priority systems, or do not even consider them as a potential policy.[1]

Recent laboratory experiments have demonstrated that priority rules can indeed increase the participant's willingness to register as organ donors substantially. Kessler and Roth (2012) were the first to analyze the impact that a priority rule has on the registration rates, in a laboratory experiment. Participants can decide whether to register as potential organ donors and (fictitiously) donate their organs in the case of brain death. Receiving an organ (say, a kidney) from a deceased donor enables participants to continue playing if their organs fail, such that enjoying priority on the waiting list for scarce organs entails an advantage. On the other hand, the commitment to donate at death comes at a monetary cost, which represents the psychological cost of donation decisions. Kessler and Roth (2012) find that giving priority to those on the waiting list who are themselves registered as donors, significantly increases donor registrations. Building on Kessler and Roth (2012), a number of experimental papers have shown the

[1] While German health economists argue in favor of a priority rule (DGGÖ, 2011), the German national ethics committee discussed the priority rule extremely briefly and did not consider it to be an option (Nationaler Ethikrat, 2007).

robustness of this result and have extended it in various dimensions.[2,3]

The applicability of the experimental data is, however, somewhat limited because the design of the priority rules in the lab differs from those in the field. In the laboratory, registered subjects in need of an organ were fully prioritized over non-registered subjects whereas, in the field, one's registration status is only one of several factors affecting the waiting list. Put differently, in the experiments, registered persons obtain what we henceforth call *absolute priority*, namely, they are always prioritized, no matter how long the non-registered subjects have been waiting for an organ. The waiting time only matters for allocation within the two groups.[4] In the field, organ donation systems prioritize, with respect to several criteria (waiting time, medical criteria, age, distance, etc.). Registered persons, then, obtain a bonus during their waiting time or are preferred only given otherwise identical conditions. Depending on the exact conditions, the quantitative effect of a bonus for registering as a donor compared to other criteria may be small. Generally, the quantitative incentive to register in the field seems weaker than it is with absolute priority.

Consider Israel, where a priority law was implemented in 2010, and became effective in 2012. Patients in need of a kidney, for example, receive two bonus points when they register as a donor, when compared to a maximum of 18 points and an average of 9.2 points for all criteria relevant for organ allocation (Lavee et al., 2010). Patients may receive more points depending on their first-degree relatives' behavior.[5] First empirical

[2]Kessler and Roth (2014a) nicely summarize this literature. Li et al.'s (2013) experiments show that an opt-out scheme with priority leads to the highest registration rates, and increased registration rates are achievable using either a priority rule or an opt-out program separately. They also compare a decontextualized frame with a contextualized frame. Kessler and Roth (2014b) experimentally investigate the priority regulations in Israel, where individuals can register and obtain priority but then avoid ever being in a situation involving actually donating after death. Our previous research (Herr and Normann, 2016) demonstrates that laboratory participants vote in favor of a priority system after having experienced phases, both, with and without a priority rule. Using a natural field experiment in California, Kessler and Roth (2014c) analyze registration when it is changed from an opt-in frame to an active-choice frame.

[3]Other mechanisms to increase registration rates include monetary incentives: when offered a €10 premium, subjects are more inclined to register (Eyting et al., 2016). They are also more likely to register after receiving information on the potential gains of receiving an organ in the experiment (Li, 2016).

[4]Absolute priority is, thus, similar to a club good where club members are preferred compared to outsiders (Nadel and Nadel, 2013).

[5]Patients receive points if the candidate's first-degree relative holds a donor card (1 point in the case of kidneys) or donated an organ after death (3 points) or was a non-designated donor while alive (5 points) (Lavee et al., 2010). Points for registration are allocated differently for lungs, heart, and liver, which follow different allocation schemes (National Transplant Center, 2016).

evidence from Israel (Stoler et al., 2016) shows that registration rates indeed increased as a result of the priority system,[6] but the question remains whether registration rates can be further improved with a bigger priority bonus or whether a smaller bonus would have achieved the same outcome. In any event, the priority system implemented in Israel differs from the absolute priority rule used thus far in the experimental literature.

In this paper, we provide a comparative statics analysis of the priority treatment in lab experiments. How much priority bonus is necessary for registration rates to improve? Is it necessary to give the subjects absolute priority on the waiting list, or is a moderate bonus of a more symbolic nature sufficient? Put differently, our research question is to quantitatively assess how different priority bonuses affect the registration rates. Experiments have the advantage of being able to test a comprehensive set of alternative settings. In the field, experiments with different organ allocation scenarios may not be desirable, or, may not match the requirements of the political decision process.

Our experimental design varies the number of bonus periods that registered donors receive. The existing literature has focused on the polar cases that we label as No-Priority (no bonus at all for registration) and Absolute-Priority (registered subjects are always prioritized). We add to these baseline treatments new variants where registered donors obtain a one-period, two-period or three-period waiting time bonus. For comparison, a priority bonus of six periods has the same effect as absolute priority does. In total, we thus have five treatments for our comparative statics analysis, called No-Priority, Priority-1, Priority-2, Priority-3, and Absolute-Priority.

We provide simulations in order to assess the quantitative gain from the various priority bonuses. These simulations suggest that behavior is monotonic in the bonus. That is, the larger the bonus, the larger the monetary gain from registering—and thus the more often participants register. Having said that, one might also expect a discrete drop-off between absolute and partial priority. This is because of a qualitative difference between treatments: in our partial priority treatments, registered subjects may not receive an

[6] The increase was even higher after public awareness campaigns about the priority law started in 2010. Stoler et al. (2016) find that registration rates further improved in the two months leading up to a program deadline, after which priority was granted only with a three-year delay. Further, the ease of registration is reported to be important.

organ, while non-registered participants actually get one. With absolute priority, this can never occur.

Our results are as follows. We find that behavior is monotonic almost throughout in that giving more priority to registered donors leads to a more substantial improvement in registration rates (although not all comparisons are statistically significant). A system giving just one period of priority on the waiting list improves registration rates by only very little. Granting three periods of waiting time has the same effect as absolute priority. The latter finding confirms that the results in Kessler and Roth (2012) and the literature following them are robust. This also implies an important policy conclusion, which is that absolute priority is not a necessary requirement for improved registration rates.

2 Experimental design

Our design largely builds on Kessler and Roth (2012). We used their z–Tree (Fischbacher, 2007) code and adopted several modifications as explained below.

Participants played Kessler and Roth's (2012) organ donation game over sixteen rounds. All rounds started with subjects having an active A organ (brain) and two active B organs (kidneys). At the beginning of a round, subjects had to decide whether to register as an organ donor in that round at a cost, or not. The experimental rounds were partitioned into several periods. In each of these periods, the subject's A organ had a 10% probability of failing and the B organs had a 20% chance of failing (if so, both B organs failed together). The round ended for the subject when his or her A organ failed (representing brain death) or when the B organs failed and the subject did not receive a B organ from a donor during the five periods after the B failure (representing death after a phase of dialysis). A new round started when all participants in the group were dead. As in Li et al. (2013) and in our previous paper (Herr and Normann, 2016), we employed a contextualized frame (using terms like "organ" rather than "unit").

Donor registration and organ transplantation were conducted as follows. Subjects were asked whether they wanted to register as a donor at the beginning of each round. The cost of registering for donation was €0.6, which corresponds to the mean cost of Kessler and Roth (2012) where half of the subjects bore costs of $0.40 and the other half $0.80.[7] A subject's two B organs were donated in some period if that subject's A organ failed, and if he or she had registered as a donor in that round. Subjects could receive a B organ from a deceased player if that player's A organ had failed while his or her two B organs were still active. A received B organ could not be donated again.

The allocation procedure for organs assigned different levels of priority for registered donors. In the treatment labeled No-Priority, the participants with the longest waiting time received a B organ—if an organ from a deceased donor was available. In the priority treatments, subjects who had registered as donors received a bonus in terms of periods on the waiting list. In treatment Priority-t, registered donors were counted as having t more periods on the waiting list when compared to a non-registered participant with the same actual waiting time. Since subjects died after five periods without a B organ, a bonus of six periods corresponds to Absolute-Priority. Any organs available were then given to the participants with the longest waiting time, taking into account the priority bonus. Whenever two or more subjects had the same waiting time, a random computer move decided on the allocation of the organ. There was no information on within-group registration rates, survival time, earnings, or on how many other subjects had received organs. We did not provide a history of the player's decisions and outcomes, either.

[Table 1 about here]

Subjects played the organ donation game in two parts. Each part lasted eight rounds.[8] The two parts differed in terms of the degree of priority that registered donors received, see Table 1. The first part (phase 1) started with No-Priority or Priority-1. In phase 2, we increased the priority bonus for registered donors. We conducted three sessions

[7] Li et al. (2013) modify this setup and introduce a cost when subjects register as an organ donor ($0.50) and a separate cost when the actual donation took place ($2.50). Hawley et al. (2016) further vary these cost levels and analyze the effect of the cost differences in the presence of income inequality ("high earners" and "low earners" with different endowments and earnings per round).

[8] In Kessler and Roth (2012), subjects played 15 rounds in each phase which we shortened to eight, as did Herr and Normann (2016).

in phase 2, each, for Priority-1, Priority-2, and Priority-3. As for phase 1, we had five and four sessions for No-Priority and Priority-1, respectively. Note that the data of the treatment in the top row is part of our companion paper. Those sessions were conducted under the same protocol and by the same experimenter as the treatments in this paper.[9]

Our within-subjects design may have given rise to different order effects, which we discuss below. Generally, we decided not to reverse the treatment order because the previous literature has already explored reversed sequences. Both, Kessler and Roth (2012) and Herr and Normann (2016) found that the difference in registration rates is even more pronounced when subjects first play Absolute-Priority followed by No-Priority.

Payoffs in each round were calculated as follows. Each participant started a round with a €2 endowment. Once they died (all subjects died eventually, in every round), the subjects lost €1, regardless of their decision to register. For subjects who registered as donors, the cost of registration (€0.6) was subtracted. As long as the A organ and at least one B organ were active, subjects earned €1 in each period. If the B organ(s) failed, the subjects survived a maximum of five periods on the waiting list without earning any money. If they received an organ, they again earned €1 in each following period. Each B organ could be donated only once but a subject could receive multiple B organs within the same round.

The 384 participants were allocated to groups and sessions as follows. Subjects played repeatedly in groups of 12. We always had two groups of 12 in one experimental session, as did Kessler and Roth (2012). In total, we conducted 16 sessions, with 24 participants each. Among these, seven sessions (168 subjects) were already part of the data in our previous paper (Herr and Normann, 2016) and nine sessions (with 216 subjects) were newly conducted for this research.[10] Table 7 in the Appendix provides some descriptive statistics about our subjects.

After they had played the donation game, we asked participants (non-incentivized)

[9]In Herr and Normann (2016), we had a voting stage, which may suggest that treatments are not directly comparable. The vote, however, occurred (and was mentioned to the participants) only after phases 1 and 2 had been completed.

[10]Neither the subject characteristics nor registration rates in the No-Priority treatment differ between the two subject pools. Statistical results are available upon request.

whether they “supported the implementation of a priority rule” in the field. We did not specify which particular rule was supposed to be implemented and, of course, by then, the participants had been exposed to different rules.

Payments were made immediately and in cash at the end of the experiment. We randomly selected two rounds for payment, one round from each part. Subjects were told about the rules for payment in the instructions (see Appendix). Average earnings were €16.33 (approximately $18), including an €8 participation fee. The earnings ranged from €8.80 to €38.40. Sessions lasted around 90 minutes.[11]

3 Simulations

In this section, we provide quantitative assessments of how different priority bonuses may affect payoffs. Owing to the stochastic nature of the game, formal solutions are complicated. Like Kessler and Roth (2012, section III), we employ simulations. Our simulations vary the priority bonus and the number of registered donors. We report simulation results based on 10 million iterations, where the priority bonus corresponds to our treatments of Priority-1, Priority-2, Priority-3, and Absolute-Priority.

We calculate the *expected gain from registering* for donation as follows. For each priority bonus level and any integer number $n \in \{0, 1, ..., 11\}$ of *other* registered subjects in a group of 12, we work out the expected payoff (based on a player's expected number of periods to live) when a player registers as a donor and when he or she does not. The expected gain of registering as a donor is defined as his or her payoff as a prioritized donor minus his or her payoff as a non-donor. This gain of registering as a donor is (weakly) positive, as a player cannot suffer from priority. The gain is exactly zero when there are no other registered donors ($n = 0$) as a single donor can never receive his or her own organ. To calculate the net payoff from registering, the registration cost of 0.6 needs to be subtracted.

[11] In Herr and Normann (2016), which comprised three phases, sessions lasted around 120 minutes and the average payment was €20.40 (approximately $23).

[Figure 1 about here]

Figure 1 shows the results of the simulations. A higher priority bonus monotonically increases the gain of registering as a donor. Whereas a bonus of three periods on the waiting list hardly seems to make a difference to receiving absolute priority, the gain in Priority-1 is substantially reduced compared to Absolute-Priority.

The figure further illustrates that a higher number of registered donors monotonically increases the gain of registering as a donor. This is intuitive: with few registered donors, those who do register obtain the priority bonus, and climb the waiting list. However, as there are also only few organs available for transplantation, these may be allocated to non-registered participants because of the longer waiting time. As a result, if there are not many donors around, registering does not help much. A strategic player anticipating this may thus decide to abstain from registering. We also note that, for six or more other registered donors in the group, the relative gap between the lines is virtually constant (see Figure 1). Starting with Absolute-Priority, Priority-3 reduces the gain from registering by about 5%, Priority-2 reduces it by about 12%, and Priority-1 by about 30%. Therefore, we expect a decline in registration rates in Priority-1 and possibly also in Priority-2 when compared to Absolute-Priority.

In all treatments, the gain of registering as a donor is smaller than the cost of 0.6, throughout. It follows that registering cannot be a best response and thus, everyone not registering is the equilibrium (as is the case in Kessler and Roth (2012) who use Absolute-Priority).

[Figure 2 about here]

Figure 2 shows how utilitarian welfare (the sum of payoffs in a group of 12 minus the total cost of the registrations) behaves in the number of registered subjects. Although total donation costs are highest, all 12 players registering is the welfare-maximizing outcome. Welfare is concave in the number of registrations, that is, the welfare increase for each additional registered subject declines. Everyone who registers constitutes the utilitarian welfare optimum in all treatments because the priority rules only change the allocation of organs and not the overall welfare of the group.

4 Results

While analyzing the data, we take into account the possible correlation of observations at the subject and at the session levels, and we consider order effects. We decided to be conservative and cluster the data at the subject level. All statements about statistical significance remain valid when we cluster at the session level. As for sequencing effects, Priority-2 and Priority-3 were conducted in phase 2, either following No-Priority or Priority-1. For this reason, we split the sample according to the two phase 1 treatments. A second potential order effect that we take into account is that Priority-1 was run in both, phase 1 and phase 2.

The next section provides a descriptive overview of the data. Section 4.2 analyzes the phase 2 data when No-Priority is the phase 1 treatment, and section 4.3 when Priority-1 was played in phase 1. Both sections include regression analyses and report which of the observed effects are statistically significant. Section 4.4 reports on the data from phase 1 and analyzes the potential order effects. Finally, Section 4.5 summarizes the results with a comprehensive figure based on the estimated coefficients of the different models.

4.1 Descriptive overview

Table 2 is a descriptive summary statistics of the share of subjects who registered as a donor. The table reports the average registration rates in phase 2 for each priority treatment. No matter whether we take all data into account (column "all data") or condition on the phase 1 treatment (columns "No-Priority" and "Priority-1"), we see a clear monotonicity result (to be statistically validated below). Using all data and starting off with an average of 45% in No-Priority, every single additional bonus period on the waiting list increases registration rates. One or two periods added to the waiting list lead to registration rates of 48 and 59%, respectively. Already with Priority-3, there is an increase of more than half compared to No-Priority. Priority-3 and Absolute-Priority lead to registration rates of almost 70%, exceeding the overall average of 55%. We also observe monotonically increasing registration rates when we distinguish between No-Priority and Priority-1 as the phase 1 treatment. More priority bonus translates into improved registration.

[Table 2 about here]

4.2 Treatment effects with No-Priority in phase 1

We now provide in in-depth analysis of our treatments (played in phase 2) when No-Priority is the phase 1 treatment. Figure 3 shows the registration rates over time in phase 2 for this subsample. We observe that the number of priority periods monotonically affects the registration rates also over time. In almost all rounds, a bigger priority bonus results in a higher likelihood to register. The quantitative effects are already strong in round 1, where subjects register with a likelihood of only 70% in Priority-1 and Priority-2 as opposed to 83% with Absolute-Priority. The difference with No-Priority in the first round (44%) is even bigger. The effects are less strong in the following rounds, but remain substantial over time. The monotonic effect of priority comes to an end, however, for the borderline treatments. Figure 3 shows that the difference between Priority-3 and Absolute-Priority is small, as suggested by our simulations. Further, Priority-1 and No-Priority do not differ much.

[Figure 3 about here]

The likelihood to register declines over time, in all treatments. This was also observed in previous experiments and is consistent with not registering being the equilibrium. It is remarkable that the priority treatments increase registration rates despite this downward trend.[12]

We now conduct regression analyses in order to statistically validate these findings. We

[12] Compared to Kessler and Roth (2012), our findings suggest slightly higher registration rates. On average, across 16 rounds, they found registration rates around 36% (between 45% and 30%) in the No-Priority treatment and 54% (from 80% down to 50%) in the Absolute-Priority treatment. We explain the higher registration rates in our data by the fact that our experiment is framed in terms of "organs" instead of "units" (Li et al., 2014). Furthermore, we have fewer rounds of play, such that the decrease over time is of a lesser magnitude.

estimate several multivariate models using probit regressions. The model specifications build on Kessler and Roth (2012) and Li et al. (2013). We explain the probability of registering as a donor with experiences within the experiment, the order of treatments, as well as with socio-demographic characteristics, and personal attitudes. In all models, standard errors are clustered at the subject level and the unit of observation is the subject-round level. Owing to the (potential) restart effects at the beginning of phase 2, we coded the rounds in the second phase as 1 to 8.

[Table 3 about here]

We start with the model that is based on the sample with No-Priority in phase 1, shown in columns (1) to (4) of Table 3, where (4) adds all control variables. The estimation results confirm that the probability to register as an organ donor increases in the number of waiting periods assigned for registration. Table 3 also shows that Priority-1 and Priority-2 do not significantly increase registration rates when compared to No-Priority. For the two treatments with a higher bonus (Priority-3 and Absolute-Priority), the likelihood of registration increases significantly by 21 and 23 percentage points, when compared to No-Priority. We conclude that Priority-3 has a similar effect on registration rates as Absolute-Priority.[13]

As is immediate also from Figure 3, the regressions indicate that every round played decreases the likelihood to register by two percentage points (*Round within treatment*). The other control variables show that the earnings of the previous round per se are not significantly correlated with registration. However, an increase in survival by one period (and correspondingly higher earnings) after having received a B organ (*Earnings if recv. organ in previous round*) is significantly correlated with a higher likelihood to register in the next round by 2.6 percentage points.

As for the additional controls, gender does not play a significant role. Belonging to the highest age quartile (28 years or above) increases registration rates by 10.4 percentage

[13] As mentioned in the introduction, the monotonicity result is somewhat surprising. One might expect a discrete drop-off between absolute and partial priority, as in partial priority non-registered subjects may receive an organ even if a registered subject is waiting. However, it appears that only the quantitative effects, as reflected in the monotonicity result, are important, but not the qualitative differences between absolute and partial priority.

points, which can possibly be explained by more life experience. Medical students show a higher likelihood to register per se (12.4 percentage points) than subjects from other fields, which may reflect both, experiences with people and need, and the selection of more altruistic persons into this field of study. Students of economics or business register less often than others (-5.8 percentage points) but the difference is not statistically significantly different from zero. Finally, subjects who indicate after the experiment that they would "support a priority rule" in the field, exhibit a 9.1 percentage point higher inclination to register. On average, almost two-thirds of the participants supported a priority rule in the field. This is consistent with Li (2016) who finds that subjects who are actually registered donors in real life are more likely to register in the experiment.

We can also analyze how Priority-1, Priority-2 and Priority-3 compare with each other when No-Priority is the phase 1 treatment. Table 4 provides the results of the Wald tests (p-values in brackets) on the differences in the coefficients of the priority treatments. It shows that Priority-2 differs from Absolute-Priority alone, whereas Priority-3 differs from Priority-1 and No-Priority. Absolute-Priority leads to higher increases in registration rates than all other treatments, except for Priority-3. This confirms the previous conclusion that Priority-3 resembles Absolute-Priority in its effect on the registration rates.

[Table 4 about here]

4.3 Treatment effects with Priority-1 in phase 1

What happens when Priority-1 is the phase 1 treatment? Figure 4 shows the corresponding average donation rates across rounds in phase 2. The differences across treatments are smaller than when No-Priority in the phase 1 treatment and range from 71 to 56 percent for Priority-1, 73 to 58 percent for Priority-2 and 75 to 63 percent for Priority-3, across the eight rounds. While the three treatments show similar registration rates in the beginning, Priority-3 averages are the highest among the three treatments after round 3.

[Figure 4 about here]

Table 5 presents the estimation results of the sample when Priority-1 is played in phase 1. Results are similar with respect to the significant effect of Priority-3 (increase of 10.7 to 11.6 percentage points) and the decreasing rate across rounds. Coefficients are slightly smaller and the other explanatory variables do not play a significant role here, possibly because of the smaller sample size. A post-estimation Wald-test shows that Priority-2 and Priority-3 do not differ significantly from each other when Priority-1 is played in phase 1. This is in line with the results when No-Priority is the phase 1 treatment.

[Table 5 about here]

4.4 Phase 1 data and order effects

First, we compare No-Priority to Priority-1 when both are played in phase 1. We can compare these treatments without the need to control for order effects because both are done without any preceding variant. Figure 5 shows that Priority-1 makes a noticeable difference when played in phase 1. This difference is about ten percentage points between periods 2 and 7 and even larger in the first and last periods. The phase 1 averages of 57% in Priority-1 versus 45% in No-Priority differ statistically from each other (t-value 6.15). Furthermore, probit regression analysis (in Table 6, column (1)) confirms that Priority-1 increases the probability to register by 10.5 percentage points compared to No-Priority.

[Figure 5 about here]

[Table 6 about here]

Second, we need to consider two kinds of order effects. First, Priority-1 was played both in phase 1 and in phase 2 (after eight rounds of No-Priority). Second, while Priority-2 and Priority-3 were always run in phase 2, they followed either No-Priority or Priority-1 as the phase 1 treatment. We analyze these order effects in turn.

Regarding Priority-1, we already saw in Figure 5 and Table 2 that registration rates are lower when this treatment is played in phase 2 compared to phase 1. A probit regression shows that this effect is statistically significant (-11.3 percentage points, compare Table 6, column (2)). In phase 2, Priority-1 registration rates (48%) are rather close to the rates in No-Priority (45%). Our interpretation is as follows. Subjects are inexperienced in phase 1, so Priority-1 can have a positive impact. Participants appreciate the bonus and are more inclined to register. When Priority-1 is played in phase 2, subjects have learned from experience that organs are scarce and we see a particularly pronounced decline in registration rates (from 69% to 47%) from round 1 to round 2.

For Priority-2, we also find a similar order effect in average registration. When Priority-2 follows No-Priority, registration rates are about 10 percentage points lower than after Priority-1. One way of interpreting these data is that Priority-2 gives a similar *absolute increase* in registration rates in both cases when compared to Priority-1, namely +5 percentage points when conducted after No-Priority and +6 percentage points after Priority-1. This is confirmed in Table 6, column (3), showing that the marginal effect of Priority-2 after Priority-1 is not significantly different from the effect of Priority-2 after No-Priority. In the Priority-3 treatment, there is no order effect (compare average registration rates in Table 2 and an empirical test in Table 6, column (4)). Priority-3 outperforms both, No-Priority and Priority-1, independent of the registration rates in phase 1.

4.5 Summary

Figure 6 summarizes the main estimation results of all three samples. It shows the coefficient estimates and 95% confidence intervals of the different treatment effects, when all covariates are included. As above, we distinguish whether No-Priority or Priority-1 was the phase 1 treatment.

[Figure 6 about here]

The figure shows that, conditional on the phase 1 treatment, a bonus of three or more points increases registration rates significantly throughout. Priority-1 can have an effect when run in phase 1. As in the previous literature, Absolute-Priority significantly raises registration rates.

5 Conclusion

A series of laboratory experiments (Kessler and Roth, 2012, 2014b; Li et al., 2013; Li, 2016; Herr and Normann, 2016) shows that prioritizing registered donors on the waiting list can substantially increase the willingness to register for organ donation. While several details matter (for example, contextualized frame, opt-in vs. opt-out, order effects), all experiments report substantially improved registration rates.

A major caveat of these studies is that a registered subject in need of an organ obtains absolute priority over all non-registered subjects on the waiting list. In the field, however, organ donation systems prioritize with respect to several criteria (waiting time, medical criteria, age, location, etc.), and registered donors then obtain a bonus which competes with these other criteria. To our knowledge, what we call absolute priority has never been considered for implementation in the field. We presume that allocating organs first and foremost to people who registered previously is not considered to be ethically feasible. If absolute priority is not an option in the field, it is perhaps not so clear as to what policy conclusions can be drawn from this literature.

In this paper, we assess how much priority registered donors need to obtain, such that registration rates increase in the experimental setting. With waiting time being the only criterion available in the lab, our experimental design varies the number of bonus periods that registered subjects receive. The existing literature has focused on the cases of "no priority" and "absolute priority," and we add variants where registered donors obtain a one-period, two-period, or three-period waiting time bonus. For comparison, absolute priority corresponds to a bonus of six periods in the experiments.

Our findings are as follows. First, behavior is by and large monotonic. Although not all pair-wise comparisons are statistically significant, a higher number of bonus periods yields higher registration rates. Second, monotonicity holds up to a certain level in that a bonus of three periods has the same effect as absolute priority. At the bottom end, a small bonus of just one period (when succeeding a phase of no priority) is insufficient to boost registrations and leads to the same outcome as having no priority scheme at all. Confirming Herr and Normann (2016), we also identify a subject pool effect, where medical school students register more frequently as donors than the participants from other fields of study.

One implication of our data is that the results in Kessler and Roth (2012) and the literature following them are robust in that lab participants do not need to obtain absolute priority. A potential argument against the experiments—that organ allocation systems with absolute priority might not be implementable in the field—is not valid.

How much priority bonus is needed to obtain improved registration rates, and how does such a threshold relate to existing priority schemes in the field? We find that a bonus of three periods suffices. Since three periods correspond to half the maximum time that participants in need might have to wait in our setup, this is a rather substantial bonus when compared to priority allocation systems in the field. In the scheme proposed by Nadel and Nadel (2013), individuals who register as organ donors would receive up to two bonus points (depending on the time since registration) while waiting for a kidney themselves, while the actual scores of kidney recipients in the U.S. vary between 10 and 25 points.[14] Our results also suggest that a mere *ceteris paribus* rule, which prioritizes registered donors only if other criteria (or the points summarizing them) are equal, is not sufficient.[15] The variant where we give one bonus period to registered donors is stronger than a *ceteris paribus* rule but it increases registrations significantly only if it is not preceded by a system without priority.

Of course, comparisons of our results to existing priority schemes in the field raise questions of external validity, and a number of caveats seem to be in order to discuss regarding the comparability of the lab and the field. In the experiment, we keep the number of people per group constant, and everybody has the same probability of organ failure and the same cost of registration. In the field, the lack of organs depends, for exam-

[14] Nadel and Nadel (2013) also propose a bonus of 4 points if someone in need made a living donation himself or herself, previously.

[15] In Israel, a *ceteris paribus* rule applies when two patients in need have exceeded a specific number of points. In that case, a registered donor will be prioritized (Lavee et al., 2010).

ple, on the health of the population, the financing of the transplantation, the quality of medical care, the cultural view of organ donation (the body is supposed to stay intact in Japan, for example), and many other factors. Such factors reflect differences in the cost of registration and transplantation. While the simplicity of the experimental setup is an advantage when looking for causal explanations, the complexity of the field makes comparisons difficult. Research about the Israeli system further suggests that the success of a priority rule also depends on other factors, such as, for example, the way of implementation and advertising campaigns (Lavee et al., 2010) or a bonus given to relatives. These things may bring in awareness about the need of organs and decrease information asymmetries, and thereby, individual costs of registering. Altogether, we acknowledge that the cost and benefit, and therefore, the success, of any priority scheme in the field depend on factors other than the bonus given to registered persons. We trust, nevertheless, that our comparative statics exercise can contribute to the debate about priority systems by illustrating the quantitative incentives that such systems may bring along.

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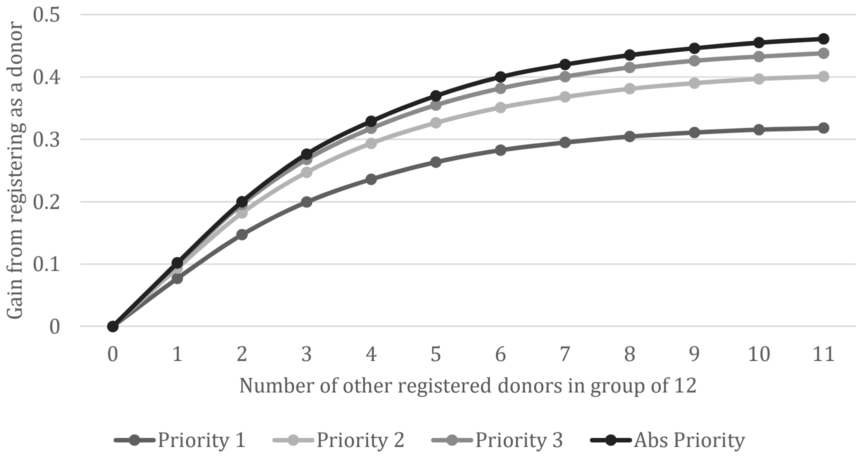
Tables and figures

Table 1: Session overview

Phase 1	Phase 2	# Sessions	# Subjects	# Observations
No-Priority	Absolute-Priority	7	168	1,344[a]
No-Priority	Priority-1	3	72	552[b]
No-Priority	Priority-2	1	24	192
Priority-1	Priority-2	2	48	384
No-Priority	Priority-3	1	24	192
Priority-1	Priority-3	2	48	312[c]

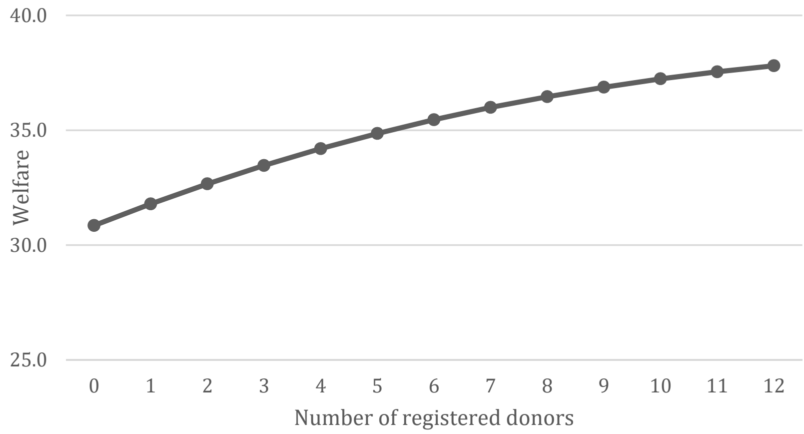
Notes: (a) sessions were part of the experiments reported in Herr and Normann (2016); (b), (c) due to technical problems, we had to terminate two of the sessions in phase 2 after seven (b) and five (c) out of eight rounds, respectively.

Figure 1: The gain from registering as a donor



Note: Expected gain from registering as a donor, conditional on there being 0–11 other registered donors in a group of 12. The gain from registering shown in the figure is smaller than the cost (0.6) throughout.

Figure 2: The welfare effects of registering as an organ donor



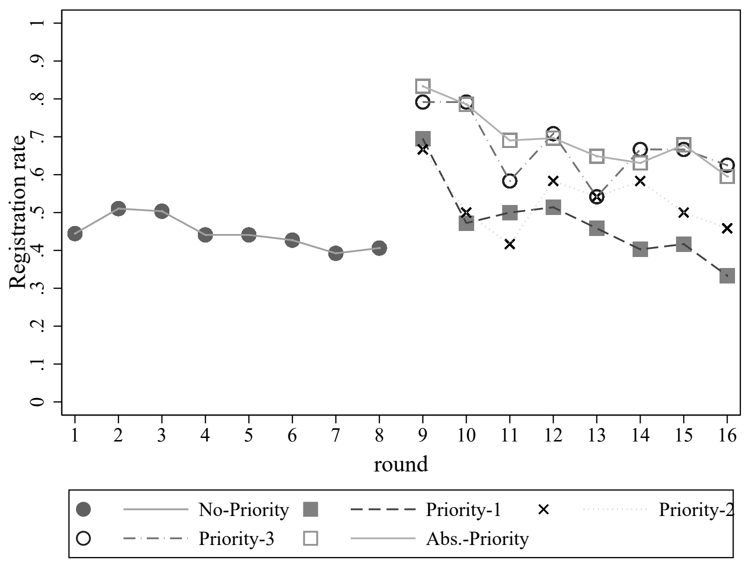
Note: Expected (net) utilitarian welfare from registration as an organ donor for a group of 12, including a cost of registration of 0.6 for each registered donor. Welfare is the same in all treatments.

Table 2: Average registration rates in phase 2

Phase 2 treatment	All data		Phase 1 treatment			
			No-Priority		Priority-1	
	mean	N	mean	N	mean	N
No-Priority	0.45	2,304	0.45	2,304	-	
Priority-1	0.53	1,320	0.48	552	0.57	768
Priority-2	0.59	576	0.53	192	0.63	384
Priority-3	0.68	504	0.67	192	0.68	312
Absolute-Priority	0.69	1,344	0.69	1,344	-	
All treatments	0.55	6,048	0.54	4,584	0.61	1,464

Notes: Average registration rates in phase 2 (rows) for all data and conditional on the phase 1 treatment (columns). N: Number of period-subject observations. Participants: 384, No-Priority in phase 1: 288 subjects, Priority-1 in phase 1: 96 subjects.

Figure 3: Registration rates in phase 2 over time when No-Priority is the phase 1 treatment



Note: Average registration rates (across subjects) per round and treatment. 288 subjects.

Table 3: Probability to register as an organ donor in phase 2 when No-Priority is the phase-1 treatment

P(register=1)	(1)	(2)	(3)	(4)
Priority-1	0.002	-0.001	0.008	0.012
	(0.040)	(0.040)	(0.039)	(0.039)
Priority-2	0.064	0.064	0.058	0.061
	(0.080)	(0.079)	(0.079)	(0.078)
Priority-3	0.205	0.205	0.222	0.230
	(0.077)**	(0.077)**	(0.075)**	(0.073)**
Absolute-Priority	0.227	0.227	0.214	0.211
	(0.026)***	(0.026)***	(0.026)***	(0.026)***
Round within treatment		-0.020	-0.019	-0.019
		(0.003)***	(0.003)***	(0.003)***
Earnings in previous round			-0.003	-0.003
			(0.002)	(0.002)
Received organ in previous round			-0.026	-0.025
			(0.032)	(0.032)
Earnings if recv. organ in prev. round			0.028	0.026
			(0.006)***	(0.006)***
Male			-0.032	-0.014
			(0.036)	(0.036)
Age 28 or older			0.123	0.104
			(0.045)**	(0.047)*
Supporting priority in the field			0.091	0.091
			(0.037)*	(0.037)*
Medical student				0.124
				(0.066)
Econ/business student				-0.058
				(0.039)
Observations	4,008	4,008	4,008	4,008

Marginal effects; Standard errors in parentheses; Probit regression with s.e. clustered at subject level. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. 288 subjects. (d) for discrete change of dummy variable from 0 to 1. Base group: No-Priority in phase 1.

Table 4: Differences in treatment coefficients in phase 2, No-Priority played in phase 1

	No-P	Priority-1	Priority-2	Priority-3	Abs-Priority
No-Priority	–	0.012	0.061	0.230	0.211
	–	(0.767)	(0.433)	(0.002)	(<0.001)
Priority-1		–	0.049	0.218	0.199
		–	(0.575)	(0.009)	(<0.001)
Priority-2			–	0.157	0.138
			–	(0.115)	(0.069)
Priority-3				–	-0.092
				–	(0.806)
Absolute-Priority					–

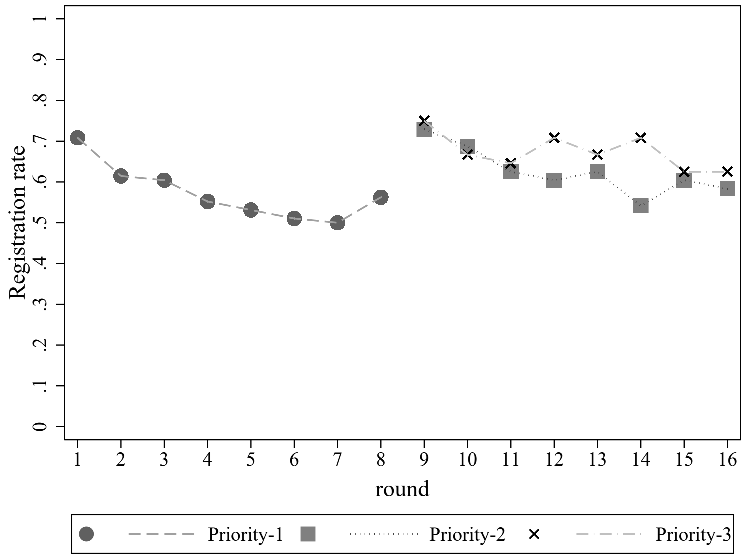
Line *No-Priority* shows the estimated coefficients of column (4), Table 3 and the respective p-values in (). Lines *Priority-1* to *Absolute-Priority* show the differences in coefficients with respect to the corresponding column treatment (upper line) and the p-values of post-estimation Wald tests on differences in the coefficients in () below.

Table 5: Probability to register as an organ donor in phase 2 when Priority-1 is the phase-1 treatment

P(register=1)	(1)	(2)	(3)	(4)
Priority-2	0.056	0.056	0.043	0.038
	(0.049)	(0.049)	(0.049)	(0.049)
Priority-3	0.114	0.107	0.112	0.116
	(0.054)*	(0.055)+	(0.054)*	(0.054)*
Round within treatment		-0.013	-0.013	-0.013
		(0.007)+	(0.007)+	(0.007)+
Earnings in previous round			0.000	-0.000
			(0.005)	(0.005)
Received organ in previous round			0.057	0.053
			(0.051)	(0.051)
Earnings if received organ in previous round			0.012	0.012
			(0.011)	(0.011)
Male			0.074	0.072
			(0.064)	(0.067)
Age 28 or older			-0.055	-0.040
			(0.072)	(0.072)
Supporting priority in the field			0.071	0.079
			(0.066)	(0.066)
Medical student				0.162
				(0.127)
Econ/business student				0.021
				(0.069)
Observations	1,272	1,272	1,272	1,272

Marginal effects; Standard errors in parentheses; Probit regression with s.e. clustered at subject level. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. 96 subjects. (d) for discrete change of dummy variable from 0 to 1. Base group: Priority-1 in phase 1.

Figure 4: Registration rates in phase 2 over time when Priority-1 is the phase 1 treatment



Note: Average registration rates (across subjects) per round and treatment. 96 subjects.

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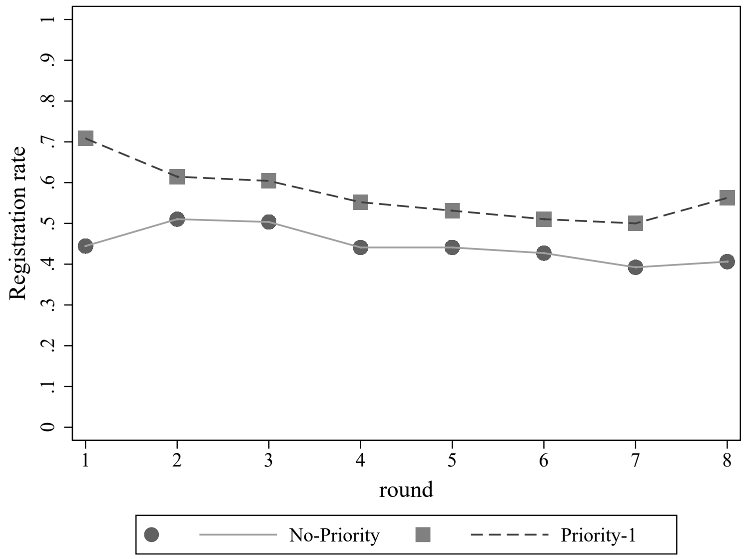
Figure 5: Registration rates in phase 1 over time: No-Priority vs. Priority-1



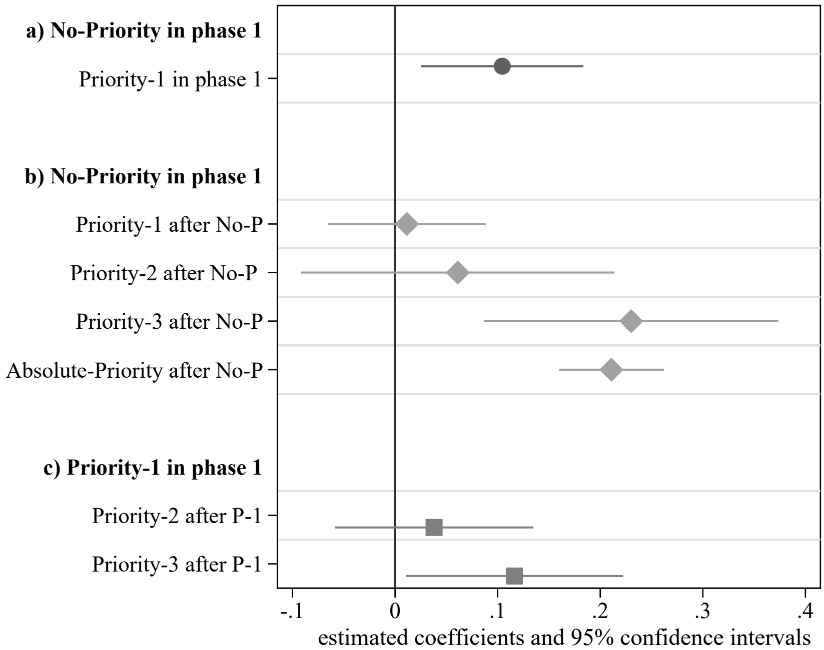
Note: Average registration rates (across subjects) per round and treatment. 384 subjects.

Table 6: Phase 1 data and order effects: Probability to register as an organ donor. (1) compares the phase 1 data (Priority 1 vs. No-Priority (base)), (2) is about Priority-1 run in phase 2 vs. in phase 1 (base), (3) and (4) concern the order effects in Priority-2 and -3 run after Priority-1 vs. after No-Priority (base)

P(register=1)	(1)	(2)	(3)	(4)
Priority-1 in phase 1 vs. No-Priority in phase 1	0.105 (0.040)**			
Priority-1 in phase 1 vs. Priority-1 after No-Priority		-0.113 (0.054)*		
Priority-2 after No-Priority vs. Priority-2 after Priority-1			0.081 (0.101)	
Priority-3 after Priority-1 vs. Priority-3 after No-Priority				0.041 (0.094)
Observations	2,688	1152	504	432
Subjects	384	168	72	72
Control variables	yes	yes	yes	yes

Marginal effects; Standard errors in parentheses; Probit regression with s.e. clustered at subject level. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. (d) for discrete change of dummy variable from 0 to 1.

Figure 6: Treatment effects on registration rates: Coefficient estimates and confidence intervals by sample



Note: Coefficient estimates and 95% confidence intervals of the different treatment effects (all covariates included) by sample. a) No-Priority in phase 1 vs. Priority-1 in phase 1 from Table 6, b) No-Priority in phase 1 vs. Priority-{1,2,3} and Absolute-Priority in phase 2 from Table 3, and c) Priority-1 in phase 1) vs. Priority-{2,3} in phase 2 from Table 5.

Online Appendix

Table 7: Descriptive statistics of subject pool

Variable	mean	sd
Male	0.46	0.50
Age	25.59	6.48
Aged 28 or older	0.23	0.42
Supporting priority in the field	0.63	0.48
Student	0.95	0.21
Medical student	0.10	0.31
Econ/business student	0.31	0.46

Descriptive statistics based on survey data from 384 subjects collected after the experiment. Support of priority in the field was asked without specifying the bonus or any details with respect to implementation.

Table 8: Timing and duration of sessions

First Part	Second Part	Third Part[a]	Dates	Duration
No-Priority	Abs-Priority	Abs-Priority	27.06.2014, 07.07.2014 (2 sessions), 09.07.2014 (3 session), 22.07.2014	120 min
No-Priority	Priority-1	-	11.11.15 (2 sessions), 02.12.2015	90 min
No-Priority	Priority-2	-	25.11.2015	90 min
No-Priority	Priority-3	-	02.12.2015	90 min
Priority-1	Priority-2	-	25.11.2015 (2 sessions)	90 min
Priority-1	Priority-3	-	04.11.2015 (2 sessions)	90 min

[a] The third part took place after voting where all groups voted for Absolute-Priority.

Instructions

The following instructions are taken from one session where the subjects played Priority-1 in phase 1 and Priority-3 in phase 2. For the instructions of the sessions with No-Priority followed by Absolute-Priority compare the online Appendix of Herr and Normann (2016).

Instructions for the first part

Welcome

If you have a question after reading these instructions, please raise your hand at any time during the experiment. An experimenter will answer your question in your cubicle.

Instructions 1 of 5

This experiment is a study of decision making and behavior. In today's experiment you will decide on hypothetical organ donations. You will play a game in a group of 12 people. You will play this game a number of times in the same group. The rules of the game will change during your course of play, and you will be informed if they do.

The experiment consists of two parts. To determine your earnings, one round will be randomly drawn from each of the two parts. You have no possibilities to influence which rounds will be selected. You will be paid the sum of your earnings in the two randomly selected rounds of the experiment plus a participation fee of 8 euro. Money earned will be paid to you in cash at the end of this experiment.

Instructions 2 of 5

The Game:

At the start of each play of the game, you will have € 2 and a virtual life will be allocated to you. A virtual life consists of one A organ and two B organs. Each round of the game has a limited number of periods in which you can earn money. In each period of one round in which you have one active A organ and at least one active B organ you earn € 1.

Instructions 3 of 5

The Game:

In each period of each round, there is a 10% chance that your A organ will fail. If your A organ fails, you cannot earn any more money in that round of the game.

In each period of each round, there is a 20% chance that your B organs will fail (your B organs operate or fail together). If your A organ is still active, you can operate for up to five periods without an active B organ. In these periods you will not earn any money. If in one of these periods you receive a B organ from someone else, you can start earning money again. If you do not receive a B organ in those five periods, your A organ will fail and you cannot earn any more money in that round of the experiment.

Instructions 4 of 5

The Game:

When your A organ fails, you lose €1 and you cannot earn any more money in that round. When none of the 12 people in your group can earn more money, that round of the game ends.

Instructions 5 of 5

The Game:

Before the play of the game begins you must decide whether, if your A organ fails, you would like to donate your B organs to other players in your group. Up to two waiting players may receive your organs. A player with an active A organ and failed B organs can receive one B organ. If you decide to donate your B organs, this will cost you €0.60. This will, however, give you priority with respect to subjects who are not willing to donate by adding one waiting period in the allocation of B organs if you need one. The maximum waiting time of five periods is unaffected by this additional waiting period.

If your A organ fails and if you are willing to donate, each of your active B organs will go to a person with failed B organs if such a person is operating in that period and has had five or fewer periods without an active B organ. Each donated B organ will go to the person who has been waiting for a B organ the longest without receiving one. Persons who also registered as donors get one additional waiting period credited (priority).

Once a B organ has been donated, it cannot be donated again.

Summary

The important things to remember are:

1. At the beginning of each round, you get €2 and a virtual life with an active A organ and two active B organs.
2. If you have one active A organ and at least one active B organ, you earn €1 in each period.
3. At the start of play, you can register as a donor of your B organs to people who might need them in the event that you have an A organ failure.

4. Registering as a donor of your B organs costs € 0.60 and gives you priority in terms of adding one waiting period for the allocation of B organs if you need one.
5. Each donated B organ will go to the person who has been waiting for a B organ the longest (maximal 5 periods). Persons who also registered as donors get one additional waiting period credited (priority).
6. You will be paid the sum of your earnings in two randomly selected plays of the whole experiment plus the participation fee.
7. Earnings and decisions are all private information and will not be published.

Decision for this play of the game

You currently have € 2. If you decide to donate your B organs, it will cost you € 0.60. If your A organ fails, each of your active B organs will go to the person who has been waiting for a B organ the longest.

Persons who also registered get one additional waiting period credited.

Agreeing to donate your B organs puts you higher up on the priority list to receive an active B organ by one period in the event of a B organs failure.

By agreeing to donate your B organs in case of an A organ failure, you are helping people who are in need, just as you may be helped by people who agree to donate their B organs.

In addition, you are particularly helping people who are also willing to help those in need.

Please decide whether you - in case of an A organ failure - would like to donate your two B organs at a cost of € 0.60 or not (zero costs).

- Yes, I would like to donate my B organs.
- No, I do not like to donate my B organs.

Instructions for the second part

Any changes to the game are described in the following.

As before:

Before the play of the game begins, you must decide whether, if your A organ fails, you would like to donate your B organs to other players in your group. A player with an active A organ and with failed B organs can receive one B organ. If you decide to donate your B organs, this will cost you € 0.60. Once a B organ has been donated, it cannot be donated again.

Now with three periods additional waiting time (priority) on the waiting list:

Persons who registered will now receive three periods additional waiting time (priority).

Agreeing to donate your B organs puts you higher up on the priority list to receive an active B organ in the event of a B organ failure and thus gives you a priority of three waiting periods compared to a person who is not willing to donate.

The maximal waiting time of five periods is unaffected.

Summary

The important things to remember are:

1. At the beginning of each round, you get €2 and a virtual life with an active A organ and two active B organs.
2. If you have one active A organ and at least one active B organ, you earn €1 in each period.
3. At the start of each round, you can register as a donor of your B organs to people who might need them, in the event that you have an A organ failure.
4. Donating - if applicable - your B organs costs €0.60 and gives you priority for receiving a B organ by adding three waiting periods in the event that you need one.
5. Each donated B organ will go to the person who has been waiting for a B organ the longest (maximal five periods). Persons who also registered as donors get three additional waiting periods credited on the waiting list (priority). The maximal waiting time of five periods is unaffected.
6. You will be paid the sum of your earnings in two randomly selected plays of the game across the whole experiment plus the participation fees.
7. Earnings and decisions are all private information and will not be published.

Decision for this play of the game

You currently have €2. If you decide to donate your B organs, this will cost you €0.60. If your A organ fails, each of your active B organs will go to the person who has been waiting for a B organ the longest. Persons who registered get three additional waiting periods credited.

Agreeing to donate your B organs puts you higher up on the priority list to receive an active B organ by three periods in the event of a B organs failure. By agreeing to donate your B organs in the event of an A organ failure, you are helping people who are in need, just as you may be helped by people who agree to donate their B organs. In addition, you are particularly helping people who are also willing to help those in need.

Please decide whether you –in case of an A organ failure– would like to donate your two B organs at a cost of €0.60 or not (zero costs).

- Yes, I would like to donate my B organs.
- No, I do not like to donate my B organs.

Questionnaire

Please fill in the following questionnaire.

1. Please indicate your age:
2. Please indicate your gender: Male, Female
3. Please, indicate whether you are a student: Yes, No
4. Please state your field of studies / your profession (if both apply choose the main activity):
5. Imagine that in Germany a priority rule for those willing to donate organs comes under debate. Would you vote for a priority rule for the allocation of organs in Germany? Yes, No

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