ELICITING PREFERENCES OVER LIFE AND DEATH: EXPERIMENTAL EVIDENCE FROM ORGAN TRANSPLANTATION

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Optimal allocation of scarce, life-saving medical treatment depends on society's preferences over survival distributions, governed by notions of equality and efficiency. In a novel experiment, I elicit preferences over survival distributions in incentivized, life-or-death decisions. Subjects allocate an organ transplant among real cats with kidney failure. In each choice, subjects allocate a single organ based on the expected survival of each patient. The survival rates imply a price ratio, allowing me to infer the shape of indifference curves over survival bundles. I find that the vast majority (80%) of subjects respond to increases in total expected survival time, while a small minority display Leontief preferences, providing the transplant to the shortest-lived patient at all price ratios. Hypothetical decisions may not be reliable in this context: a large share (46%) of subjects allocate a hypothetical transplant differently than a real transplant, though estimates of aggregate preferences are the same across incentivized and unincentivized conditions. Finally, I show that aversion to wealth inequality is a good predictor of aversion to survival inequality.

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1. INTRODUCTION

The number of patients in need of an organ transplant in the US far exceeds the supply of deceased donor organs. In 2019, over 8,000 patients died waiting for an organ or became too sick to transplant; only about 40,000 transplants were performed while over 108,000 patients remain on the waitlist [OPTN, 2020]. Organ transplantation relies on the availability of donor organs, a scarce medical resource; deciding which patients should receive the limited supply of organ transplants is a key policy issue. Should we prioritize transplant patients according to medical urgency, survival benefit, or time spent on the waitlist? We face similar concerns when allocating other scarce medical resources, such as ventilators, hospital beds, and medical expertise in times of crisis. Optimal allocation fundamentally depends on society's preferences over patients' survival times — that is, preferences over the bundles of survival times that are achievable with the resources available.

In practice, regulatory bodies determine allocation rules for many medical resources, such as human organ transplants. By providing transplants for some patients and not others, these allocation rules imply a set of preferences over bundles of survival times for potential transplant recipients. For example, liver transplants in the US are allocated primarily according to medical urgency, without taking into account expected survival benefit.[1] Since preferences for high-quality organs are largely shared across patients, this system benefits the sickest patients at the expense of healthier patients who may benefit more from high-quality organs [Schaubel et al., 2008, Croome et al., 2012, Bittermann and Goldberg, 2018]. This allocation system implies a set of preferences over distributions of survival times: the regulatory body prefers to prevent the immediate death of the sickest patients rather than transplant healthier patients with a greater survival benefit.

One might wonder whether these rules would society's preferences more broadly, since the market is administered on behalf of the government and relies on donated organs provided by the public. The hypothesis that the social planner's rules do not match the social welfare function is supported by the variety of rules implemented for organ allocation. Deceased donor livers, kidneys, lungs, and hearts are each allocated using different

[1]In addition to medical urgency as determined by the Model for End-Stage Liver Disease (MELD) score, the liver priority system also includes geographic location and pediatric status.

rules, and the rules change frequently in response to technological change, regulatory change, and legal challenges. Further, rules vary significantly between countries.[2] Which (if any) of these rules reflect society's preferences is largely unknown.

One obstacle in assessing whether these rules accord with society's preferences is measuring individuals' preferences over survival times. How could we elicit such preferences? The ideal experiment would ask individuals to choose between different survival distributions and allow the experimenter to implement the preferred choice; however, ethical and legal concerns make this incentivized experiment all but impossible. We often rely on hypothetical scenarios and unincentivized surveys to study preferences when the stakes are too high to incentivize. However, hypothetical decision making can be unreliable in a variety of settings (see, for example, FeldmanHall et al. [2012], Grewenig et al. [2020], Trautmann and van de Kuilen [2015], Schlag et al. [2015], Vossler et al. [2012]).[3] Without empirical evidence comparing hypothetical and incentivized choices in life-and-death scenarios, we do not have the data to assess whether hypothetical decision making is a reliable indicator of underlying preferences.

In this paper, I use a novel experiment to compare choices in life-and-death decisions with and without incentives. I elicit preferences over survival time distributions for patients with organ failure, a life-threatening disease that can be treated with an organ transplant. In order to incentivize the experiment, subjects allocate a real organ transplant among cats suffering from kidney failure. To implement the subject's choices, I am working with veterinary centers to identify two potential transplant recipients who are unlikely to receive a transplant without financial support. After the experiment, one subject is randomly selected to allocate funding for one transplant to a patient that aligns with the subject's reported preferences.[4] Subjects also make hypothetical decisions on how

[2]For example, in the US, organ procurement organizations often require patients with alcoholic liver disease to demonstrate six months of sobriety before becoming eligible for a transplant. In the UK, no period of sobriety is required [Neuberger, 2016].

[3]Hypothetical responses are still predictive of incentivized decision making in many contexts. The reliability of hypothetical decision making depends on the experimental context, survey design, and individuals' strategic concerns [Carson and Groves, 2007]. In some contexts, incentivized experiments largely confirm the findings of hypothetical surveys (see, for example, Elías et al. [2019]).

[4]The random dictatorship design avoids strategic incentives for misreporting. The feline patient that aligns with the dictator's reported preferences will receive $12,000

they would allocate a transplant among human recipients and among feline recipients. This approach allows me to compare elicited preferences over life-and-death decisions, with and without incentives.

The experiment elicits subjects' preferences for allocating a transplant in two types of questions: *individual-patient* allocations, in which the subject chooses a transplant recipient from two patient profiles, and *rule-based* allocations, in which subjects choose guiding principles to select a patient on their behalf. The individual-patient questions — the primary measure of interest — are designed to elicit indifference curves over survival times, and allow subjects to express a wide range of preferences. However, these questions require exactly one patient to be selected in every comparison — subjects cannot express indifferences or signal a desire to randomize between patients, and they cannot opt to withhold the transplant from both patients.

The rule-based allocations help address these constraints, and let us assess how well simple rules represent subjects' preferences. The selection of rules to choose from includes includes an option to provide no transplant or to select a recipient at random. Other rules reflect different views of fairness and efficiency, such as Rawlsian equality (transplant the patient who will die first without a transplant), and total efficiency (transplant the patient with the greatest increase in survival time). The rules represent simplified versions of some current organ allocation systems — liver transplants, for example, are offered in order of medical urgency, akin to maximizing the minimum survival time in the patient pool. The rules allow us to validate the individual-patient allocations and examine the principles underlying the allocations.

Considering the incentivized transplant decisions, I find little support for prioritizing the sickest patients at the expense of patients with greater survival benefit, despite the prevalence of this allocation rule in practice.[5] While subjects do display a preference for survival equality, very few subjects (4.5%) allocate the organ to the patient who would die first without the transplant, regardless of the potential survival gains for the other patient. Most subjects (80%) respond to increases in total survival

toward cost of a kidney transplant. The transplant is planned for spring 2021. See Section 2 for a further discussion of the market for feline kidney transplants and related costs. See Appendix A for ethical considerations in the design.

[5]Allocation of deceased donor livers and hearts in the US is based on medical urgency and distance from the donor hospital. The process does not take survival benefit into account.

when the gains are large enough, even if those gains accrue to the longer-lived patient. A large share of subjects show lexicographic preferences over post-transplant survival time, preferring to maximize the amount of time the transplanted organ is used and ignoring the time the patients would survive without transplant. This suggests that some subjects have preferences over the appropriate use of the donated organ rather than over the survival of the two patients.

I classify subjects according to their allocation decisions, and find that I classify 25.7% differently based on their incentivized and unincentivized choices, suggesting that the transplant incentive matters to subjects. However, selections in the unincentivized condition are not systematically biased; societal preferences appear similar regardless of whether incentives are in place. Consequently, it seems that unincentivized responses are more prone to noise than incentivized responses. Together, these results indicate that responses to hypothetical questions may be reliable in the aggregate, but noisy at the individual level.

The experiment also allows us to study the relationship between preferences for equality across domains. I elicit preferences for equality in monetary payments using a series of individual allocation decisions analogous to those for allocating an organ. Subjects allocate payments to other experimental participants at different implied price ratios, forcing subjects to make tradeoffs between equality of payments and total payment amounts. I find that preferences for equality in payments are highly correlated with preferences for equality in survival times: 84% of subjects who favor equality of survival time in transplant decisions also favor equality in payments to other participants.

This research contributes to three bodies of economic research: first, the design of the market for organ transplantation; second, the economic understanding of fairness and equality; and third, the role of incentives in experimental design.

This paper provides the first experimental, incentivized evidence of preferences toward different transplant allocations, contributing to a growing literature on market design in the allocation of organ transplants. Over the past decade, the non-profit organization tasked by Congress with managing organ allocation in the US has made several changes to the process for determining waitlist priority for deceased donor organs, and has proposed additional changes for the near future. Many of these changes are promoted on the grounds of fairness and efficiency [UNOS, 2020]. Recently, economists have examined how to improve efficiency of organ allocation [Agarwal et al., 2019b,a] and how to increase the supply of donor organs, through organ exchange chains, donor compensation, prioritizing registered donors as recipients, and increasing the use of suboptimal organs [Roth et al., 2005, 2007, Kessler and Roth, 2012, Becker and Elías, 2007, Elías et al., 2019, Held et al., 2016, Tullius and Rabb, 2018].

This research also contributes to a robust literature on preferences for fairness and equality. Many economists have studied the role of fairness both in the lab and the field (see, among others, Kahneman et al. [1986], Fehr and Schmidt [1999], Fisman et al. [2007]). Preferences for equality play an important role in determining preferences for many government policies, such as redistribution [Kuziemko et al., 2015]. While economists have studied how individuals value the distribution of wealth in society, little is known about how individuals value possible distributions of survival times. This paper contributes to our understanding of preferences for equality by identifying distributional preferences over survival times and examining the relationship between preferences across domains.

In addition, this paper contributes a new methodology for incentivizing life-or-death decisions. The experimental design takes inspiration from Falk and Szech [2013], in which subjects can forego payments to save mice from death. Researchers have also studied ethical decision making in consumers using animal-based products [Boaitey and Minegishi, 2020, Albrecht et al., 2017]. A large body of literature suggests that incentivizing decisions in experiments yields more reliable results than hypothetical decisions (see, for example, FeldmanHall et al. [2012], Grewenig et al. [2020], Trautmann and van de Kuilen [2015], Schlag et al. [2015], Carson and Groves [2007], Vossler et al. [2012]). Thus, the ability to incentivize ethical dilemmas in high stakes environments may improve our understanding of ethical decision making.

Section 2 describes institutional details around feline kidney transplantation in the US. Section 3 introduces a conceptual framework. In Section 4, I describe the experimental design. Section 5 presents the results of the experiment; Section 6 concludes.

2. FELINE KIDNEY TRANSPLANTATION

Kidney disease is one of the most common causes of death in cats [O'Neill et al., 2015], and kidney transplantation is one of the few transplants commonly performed for treatment of animal diseases.[6] Only three veterinary transplant centers in the US — the University of Pennsylvania, the University of Georgia, and the University of Wisconsin — perform feline kidney transplants.

The incentive design takes advantage of some similarities between kidney transplantation and human liver transplantation. Dialysis is generally not available as a long-term treatment for feline kidney failure, and there is no equivalent of dialysis to replace the function of a failing liver. As such, transplantation is the only available treatment.[7] As in humans, many cats do not receive the life-saving transplant they need due to scarcity of resources. However, cat organ transplants are generally limited by cost rather than the availability of organs. The typical costs of feline kidney transplantation surgery range from $12,000–$18,000, with additional costs for post-transplant treatment and immunosuppression. Immunosuppressive drugs typically cost $500–$1,500 [University of Wisconsin-Madison School of Veterinary Medicine]. As described in Section 4, the experimental incentives allocate a $12,000 payment toward a transplant for one cat. After transplant, the owner of the transplant recipient is responsible for any follow-up treatments and immunosuppressive drugs.

Transplant centers recruit living kidney donors from local animal shelters. Cats can survive and live a normal life with one functioning kidney (as can humans). Donors, typically young and healthy, donate one kidney to the recipient. Following surgery, the donor cat is adopted by the recipient's owner and provided with a home. In practice, this means that — unlike with human kidney transplantation — there is no shortage of feline donor kidneys.[8]

Thus, by allocating funds toward the cost of the transplant, subjects choose which patient receives a transplant, with the knowledge that the other patient is unlikely to receive a transplant.

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[6] Transplants are not commonly used to treat kidney failure in dogs, in part because the genetic diversity in the species increases the risk of rejection. Interestingly, it was dogs who played the pivotal role as test subjects for the pioneer surgeons experimenting in transplantation in the early and mid-20th century [Mezrich, 2019].

[7] Some cases of acute kidney failure in cats can be treated with short-term dialysis which may allow the kidneys to recover.

[8] See Appendix A for a discussion of ethical considerations in the design of this study.

3. CONCEPTUAL FRAMEWORK

In this section, I introduce a conceptual framework for identifying subjects' preferences over organ allocations. An agent is tasked with allocating an organ transplant to one of two patients, A and B. Denote with x_A the survival time of patient A, and x_B the survival time of patient B. The agent derives utility $u(x_A, x_B)$ from the patients' survival times.

Suppose that we know all survival times with certainty. If Patient A receives the transplant, she will survive for a period of x_A^{with}; without the transplant, she will survive for a period of $x_A^{without}$. Thus, the agent can allocate the transplant to Patient A (resulting in survival bundle $(x_A^{with}, x_B^{without})$) or Patient B (resulting in $\left(x_A^{without}, x_B^{with}\right)$). The single transplant forms the agent's budget constraint, so the agent simply compares the utilities $u\left(x_A^{with}, x_B^{without}\right)$ and $u\left(x_A^{without}, x_B^{with}\right)$ and selects the bundle with higher utility.

This simple model assumes that each agent derives utility from the amount of time that others survive, and ignores potentially complex interactions with other sources of utility, such as the agent's own survival time.[9]

This framework is different from many allocation experiments in that the organ transplant is a discrete item rather than a continuous budget set. As such, each allocation decision is a comparison of two discrete points, and we can not rely on the tangency of the indifference curve for identification. Instead, as described in Section 4 below, we will fix one point in each question and elicit a switching point at which the subject is indifferent between transplanting Patient A and Patient B.

In particular, we will fix three of the four pertinent survival times: x_A^{with}, $x_A^{without}$, and $x_B^{without}$ in each question, and we will allow x_B^{with} to increase until the agent switches from transplanting Patient A to transplanting Patient B. Once we have identified the switching point where the agent is indifferent between transplanting A and B, we can make inferences about the shape of the indifference curve passing through those two points. A schematic of this identification strategy is shown in Figure 1.

[9] Another approach to survival inequality might examine agents' preferences toward survival distributions that include her own survival time. While understanding an agent's willingness to give up her own survival for the benefit of others could yield interesting results, the goal of this paper is to identify individuals' preferences over the survival times of others. There is an analogous distinction in the literature on aversion to inequality of wealth.

Figure 1: Sample Indifference Curve Estimation

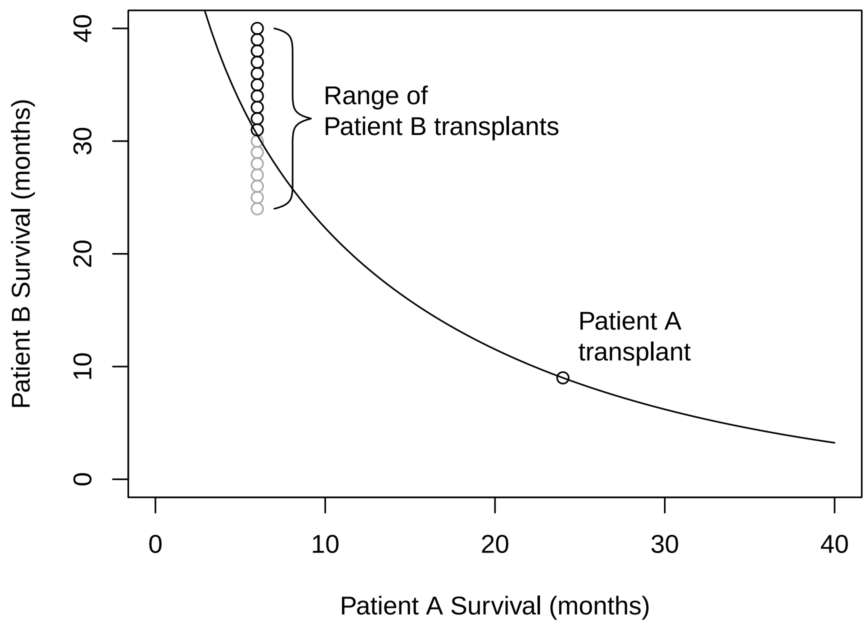

Figure shows the conceptual framework for identifying indifference curves from a series of binary allocation decisions. In this example, Patient A survives for 6 months without transplant and 24 months with transplant; Patient B survives 9 months without transplant. Each decision compares the point $(24, 9)$, representing the survival times of Patients A and B in case the transplant is provided to Patient A, against $(6, x)$, where x varies with possible survival times of Patient B with a transplant. The indifference curve passes through the the initial comparison point $(24, 9)$ and the switching point, where the agent switches from transplanting Patient A to transplanting Patient B. Points below the indifference curve (shown in gray) are possible survival bundles if Patient B received the transplant; these points are revealed to be less desirable than transplanting Patient A. The indifference curve shown here assumes constant elasticity of substitution.

4. EXPERIMENTAL DESIGN

In this section, I describe the experimental design, which employs both hypothetical decision making and high stakes incentives. I recruit 311 subjects on Amazon's Mechanical Turk to complete a 20–30 minute questionnaire. Subjects are paid $5 for completing the survey, and have the opportunity to earn bonus payments based on their decisions and the choices of other participants. In addition, one subject is selected to allocate $12,000 toward a kidney transplant for one feline patient with kidney failure.

Subjects first respond to nine questions eliciting time and risk preferences through choices between gambles and future payments. Each question is a multiple price list, eliciting a switching point between a fixed payment on the left and an increasing payment on the right. These questions determine the subject's bonus payments and give the subject a chance to become oriented with the multiple price list format in incentivized conditions. These questions also allow me to examine the relationship between risk and time preferences and organ transplantation preferences.

Subjects then progress to organ allocation decisions, beginning with a series of *individual-patient* organ allocation decisions. Subjects first make four hypothetical allocation decisions for feline patients and four hypothetical allocation decisions for human patients. Next, subjects must acknowledge a second consent form informing them that their remaining decisions may be used to allocate a real organ transplant to a cat with kidney failure (see Appendix B.1). Subjects then respond to the same four individual-patient allocation decisions, now under incentivized conditions. The hypothetical questions will allow me to evaluate the effect of incentives and the reliability of hypothetical decision making in this context.[10] Again following the multiple price list protocol, each question asks for a switching point between allocating a transplant to a short-lived patient on the left and allocating the transplant to a longer-lived patient on the right.

After the individual-patient decisions, subjects make *rule-based* allocations, where they rank a set of rules for allocating organs. Individual-

[10]Hypothetical questions come before incentivized questions based on the hypothesis that subjects will pay more attention to incentivized decisions. If subjects do not take hypothetical decisions seriously, they are likely to change their responses later when confronted with high stakes incentives. However, if incentivized questions come first, subjects are likely to follow stick with their incentivized decisions when making unincentivized choices.

patient decisions precede rule-based decisions in order to avoid increasing the salience of the rules. Again, hypothetical decisions for feline and human patients precede an incentivized decision which could be used to allocate a real transplant.

Once subjects have completed all transplant allocation decisions, they make a series of low-stakes decisions over payments to other study participants. All questions follow the multiple price list format, and all questions are incentivized with equal probability of implementation.

After completing all allocation decisions, subjects evaluate a hypothetical ethical dilemma, similar to the trolley problem, that is meant to separate consequentialist decision makers from those with deontological preferences. At the end of the survey, subjects answer a battery of questions (following Elías et al. [2019]) on age, gender, race and ethnicity, religious beliefs, political orientation on social and economic matters, and experience with organ transplantation. In addition, subjects identify their current pets. Finally, subjects are informed of their randomly selected bonus payment.

In the remainder of the section, I describe the the details of the experimental design, turning first to the primary outcomes of interest. In Sections 4.1 and 4.2, I describe the individual-patient and rule-based allocation decisions. In Section 4.3, I describe the incentive structure of the experiment. Section 4.4 describes the elicitation of preferences over monetary payments to other subjects. Finally, in Section 4.5, I describe bonus payments and the elicitation of time and risk preferences.

4.1. *Individual-Patient Transplant Allocations*

In individual-patient transplant allocation questions, subjects choose between two patients directly on the basis of the patients' projected survival times.

Subjects are shown a table with a pair of patients in each row, as in Figure 2. Each row of the table represents a different pair of potential transplant recipients, and each patient has two projected survival times: a without-transplant survival time and a with-transplant survival time. In each row, the subject selects one of the two patients to receive the transplant. Within a table, Patient B's post-transplant survival time increases in each row, while all other survival times (Patient A's survival with and without transplant, and Patient B's survival without transplant) remain fixed. As Patient B's post-transplant survival time increases, subjects al-

Figure 2: Sample Decision Table

PATIENT A		PATIENT B
NO TRANSPLANT: 4 MONTHS **TRANSPLANT: 5 MONTHS**	OR	**NO TRANSPLANT: 5 MONTHS** TRANSPLANT: 5 MONTHS
NO TRANSPLANT: 4 MONTHS **TRANSPLANT: 5 MONTHS**	OR	**NO TRANSPLANT: 5 MONTHS** TRANSPLANT: 6 MONTHS
NO TRANSPLANT: 4 MONTHS **TRANSPLANT: 5 MONTHS**	OR	**NO TRANSPLANT: 5 MONTHS** TRANSPLANT: 7 MONTHS
NO TRANSPLANT: 4 MONTHS **TRANSPLANT: 5 MONTHS**	OR	**NO TRANSPLANT: 5 MONTHS** TRANSPLANT: 8 MONTHS
NO TRANSPLANT: 4 MONTHS **TRANSPLANT: 5 MONTHS**	OR	**NO TRANSPLANT: 5 MONTHS** TRANSPLANT: 9 MONTHS
NO TRANSPLANT: 4 MONTHS TRANSPLANT: 5 MONTHS	OR	NO TRANSPLANT: 5 MONTHS **TRANSPLANT: 10 MONTHS**
NO TRANSPLANT: 4 MONTHS TRANSPLANT: 5 MONTHS	OR	NO TRANSPLANT: 5 MONTHS **TRANSPLANT: 11 MONTHS**
NO TRANSPLANT: 4 MONTHS TRANSPLANT: 5 MONTHS	OR	NO TRANSPLANT: 5 MONTHS **TRANSPLANT: 12 MONTHS**

A sample individual transplant allocation question with a response selected. Patient A's survival times and Patient B's survival without transplant remain constant in each row; Patient B's survival with transplant increases by one month in each row. Highlighted cells indicate the patient who would receive the transplant in that row based on the subject's decisions. Bolded text in each cell indicates the patient's survival time under the selected allocation scheme.

locate the transplant by selecting the point at which they would switch from allocating the transplant to Patient A to allocating the transplant to Patient B. This design allows at most one switching point from Patient A to Patient B as Patient B's post-transplant survival time increases. That is, if a subject prefers to transplant Patient B at some post-transplant survival time x, the subject must also prefer to transplant Patient B at post-transplant survival time $x' > x$ (holding constant Patient A's with-transplant survival time, Patient A's without-transplant survival time, and Patient B's without-transplant survival time).[11]

[11]Subjects are instructed that each row of the table represents a different pair of patients, in order to prevent subjects from attempting split their allocations between Patient A and Patient B. For example, if a subject wants to give each patient a 50% chance of receiving the transplant, a misguided subject may allocate to Patient A in half

The switching point design allows me to elicit preferences over a large number of survival distributions with only a small amount of effort on the part of the subject. However, this also constrains the expression of certain types of preferences. In particular, subjects are required to select exactly one recipient in each row, restricting subjects' ability express indifferences between patients or a distaste for transplantation. For example, if subjects have a strong preference for survival equality, they may prefer no transplant over other options that increase inequality by increasing one patient's survival time.[12] In addition, the single switching point may not accurately capture preferences with complex interactions between efficiency and equality. The rule-based allocations described in the next section address these concerns by providing insight into the guiding principles of subjects' allocation decisions.[13]

The survival times used in the four individual-patient allocation questions are shown in Table I. While the survival times are hypothetical, they were selected to be within within the realistic range of survival times for feline organ transplant candidates. In addition, they distinguish between the allocation rules. Each allocation rule is consistent with a unique switching point in each question, allowing me to identify the rules that are most consistent with subject behavior. Finally, the values were designed so that each question contained a weakly dominated option as a check on subject behavior. For each of these options, the subect could achieve at least the same degree of survival benefit, organ use, and equality by transplanting Patient A rather than Patient B in the first row. Two of the weakly dominated options (in questions #2 and #3 in Table I) provide no survival benefit to the recipient.[14]

In this design, we do not specify the source of patients' heterogeneous survival times. This allows for a flexible interpretation of the results. Post-

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of the rows and Patient B in the other half. While this approach would not effectively give the patients even odds, I provide this instruction out of an abundance of caution. Moreover, each row does in fact represent a different pair of patients, in the sense that any pair of real patients will match at most one row of any table.

[12]Fisman et al. [2007] allow free disposal in allocation decisions in order to measure preferences that may not be well behaved in the wealth domain.

[13]As described in more detail with the main results in Section 5, very few subjects prefer no transplant over other allocation rules.

[14]These options are are still consistent with maximum use of the transplanted organ; however, subjects could achieve the same use of the organ by selecting the non-dominated option in both cases, which would also be consistent with maximizing the minimum survival time and maximizing the increase in survival time.

Table I: Individual Allocation Question Parameters

Question	Patient A	Patient B Survival without Transplant	Patient B Minimum Survival with Transplant	Patient B Maximum Survival with Transplant
1	No Transplant: 1 month Transplant: 6 months	2 months	6 months	36 months
2	No Transplant: 1 month Transplant: 2 months	2 months	2 months	24 months
3	No Transplant: 4 month Transplant: 5 months	5 months	5 months	24 months
4	No Transplant: 6 month Transplant: 24 months	9 months	24 months	48 months

Table shows the parameters of the four individual transplant allocation questions presented to each subject. Within a question, the subject decides whether to allocate a transplant to Patient A or Patient B in a series of comparisons. Patient B's survival without transplant, and Patient A's survival with and without transplant remain constant in each comparison, while Patient B's survival with transplant varies between *Patient B Minimum Survival with Transplant* and *Patient B Maximum Survival with Transplant* shown in the table. Questions are presented in randomized order.

transplant survival heterogeneity may depend on patients characteristics (e.g., younger patients may survive longer than older patients after transplant), or from a *particular* transplant (e.g., due to donor-recipient compatibility or other interactions).[15] We can interpret the results of the experiment as applying to both sources of heterogeneity. Realistically, both levels of heterogeneity are at play in determining survival in human organ transplantation: the success of a particular transplant depends on the characteristics of both the donor and the recipient. Thus we can think of the individual patient allocations as capturing some realistic features of the general policy problem.[16]

[15]Note that heterogeneity in organ quality, such as the age of the donor, only leads to survival heterogeneity through donor-recipient interactions. Any characteristics of the donor organ that affects post-transplant survival uniformly for all potential recipients would not lead to heterogeneity.

[16]A fundamental aspect of this policy problem is assortative matching; that is, the fact that the sickest patients often receive the highest quality donor organs. As mentioned in the introduction, positive and negative assortative matching are areas of active policy debate.

Hypothetical Organ Transplant Allocations

Subjects also make hypothetical transplant allocation decisions for both human and feline patients. Hypothetical decisions follow the structure of the incentivized decisions, and use the same four questions based on Table I. The hypothetical allocation decisions serve several purposes. First, we can measure the effect of incentives by comparing responses across hypothetical and incentivized conditions. This contributes important evidence on whether we can rely on unincentivized survey responses when eliciting preferences over high-stakes policy questions. Second, if we find that responses to hypothetical questions are reliable, we can use subjects' responses in human organ transplant allocation questions to assess preferences over survival distributions in humans. Further, by comparing allocation decisions for (unincentivized) cats and humans, we can explore whether preferences over survival distributions are broadly relevant across species or if preferences for human survival distributions are unique.

As in the incentivized allocation questions, subjects are instructed to assume that all patients are adults (human patients are at least 18 years old, and feline patients are at least 18 months old); that we know survival times with and without the transplant with certainty; that survival times represent periods of good quality of life; and that no patient will have another opportunity for a transplant.

In each section of the experiment that includes hypothetical questions, the hypothetical questions precede incentivized questions. This is to ensure that subjects respond to the hypothetical questions without having determining their responses in high-stakes questions in advance.

4.2. *Rule-Based Transplant Allocations*

In *rules-based* questions, subjects rank five rules for allocating organs between two patients. Subjects first rank rules in unincentivized questions for feline and human patients, then in an incentivized question for allocating a transplant between two cats. Each rule was described to subjects as followed (shorthand names for the rules shown in **boldface** are for use in the paper only):

1. **No Transplant:** Perform no transplant
2. **Maximize Increase in Survival:** Consider how much longer each patient will live with the transplant than without the transplant

and give the transplant to the patient whose life will be extended more

3. **Maximize Organ Use:** Give the transplant to the patient who will live the longest with the transplant
4. **Maximize Minimum Survival:** Give the transplant to the patient who will die first without the transplant
5. **Equal Opportunity:** Give each patient a 50% chance of receiving the transplant

The rules are based only on survival times, and include total efficiency (**maximize increase in survival**), Rawlsian fairness (**maximize minimum survival**), and equal opportunity (**random egalitarianism**).[17] Of course, there are many other possible allocation rules; this list was selected to speak to the types of efficiency and fairness often addressed in the economics literature, and to reflect a simplified version of rules currently used for organ allocation.

For example, in the US, deceased donor livers are allocated primarily by the patient's expected survival time without transplant, akin to a rule that maximizes minimum survival time. The allocation of deceased donor kidneys, on the other hand, takes expected survival benefit into account, suggesting a desire to maximize the increase in survival caused by the transplant.

Rule selection provides less granular information over subject preferences than individual-patient allocation decisions. Subjects are not able to express nuanced preferences, such as a desire for efficiency and equality in different situations. In addition, subjects' beliefs about the distribution of patient survival times may influence their rule rankings if subjects prefer different rules in different scenarios. However, the rule rankings provide information that complements the individual-patient selections. Allowing subjects to choose "no transplant" helps identify subjects who may object to organ transplantation in general or feline transplantation in particular.[18] If subjects do not value transplantation, this may change

[17] Note that with one organ transplant for two patients, maximizing the increase in survival is equivalent to maximizing total survival time.

[18] Organ donation and transplantation is controversial in some religions and cultures (see, for example, Oliver et al. [2010], Kobus et al. [2016], and Alhawari et al. [2020]). Objections to feline kidney transplantation in particular may relate to the sourcing of donor organs and the inability of the donor to consent to surgery. In order to avoid these complications and to maintain a parallel between feline and human organ transplantation, subjects are not informed of the process for obtaining feline donor organs.

our interpretation of their other rule rankings and individual-patient allocations. Similarly, subjects who prefer to randomize between patients may not have sufficient freedom to express their full preferences in the individual-patient allocations.

Determining which, if any, of these simple rules aligns with population preferences can help in selecting an optimal allocation rule. We restrict our analysis to rules based on patient survival times. Other rules may take account of additional patient characteristics, such as time spent waiting for a transplant, or even the patient's appearance or the composition of a patient's family. While these alternative rules are interesting for study, they are beyond the scope of this paper. The selected rules can be used for both feline and human patients, allowing us to compare preferences across species below.

As in the individual-patient transplant allocation questions, hypothetical rule rankings precede the incentivized rule ranking to avoid ordering effects caused by investing effort in a high-stakes question first.

4.3. *Incentivizing Organ Transplantation Decisions*

The core of the experiment lies in the ability to incentivize subject responses in life-and-death decisions. I incentivize both individual-patient and rules-based allocation decisions with the possibility of determining the feline recipient of an organ transplant. Two potential transplant recipients will be recruited with the help of veterinary practices. One subject will be selected as the random dictator to determine which of the two cats will receive the transplant.[19] One section of the study — either individual-patient or rules-based questions — will be randomly selected, and the dictator's preferences reported in that section will determine which patient receives the organ. The transplant will be performed in spring 2021.

In each section and each question, subjects are reminded of the stakes and instructed in how their decisions might be implemented to allocate

[19]Impossibility theorems in the social choice literature restrict the possible methods for selecting the cat who will receive the actual transplant. In particular, the Gibbard-Satterthwaite theorem suggests that in order to guarantee that no subject has an incentive to dissemble her preferences through tactical voting, the decision rule must be dictatorial. Since the main goal of the incentivized survey is to elicit preferences in a way that encourages subjects to tell the truth, the random dictatorship is a pivotal design feature. At the same time, this approach may induce stress for subjects. For a discussion of this and other design choices with regard to ethical considerations and protections of subjects, see Appendix A.

an organ transplant. To avoid strategic behavior, subjects are instructed that their choices cannot influence which cats are selected as candidates for transplant. A veterinary expert will estimate the life expectancy of the two cats with and without the transplant with sufficient precision to break any ties. The specific incentives and instructions for the individual-patient and rules-based questions are described below.

Incentives in the individual-patient transplant allocations are similar to those in a traditional multiple price list elicitation. Typically, the researcher randomly selects one row of the list and implements the subject's decision in that row. In this context, that would require a large number of potential transplant recipients with widely varying survival times. Instead, I instruct subjects that two potential transplant recipients will be selected, and "the cat who most closely matches your choices in this section" will receive a transplant.[20] Following the incentive structure of Kessler et al. [2019], I elicit preferences over a variety of hypothetical patient profiles with the promise that the responses will be used in a real-stakes decision.[21] Thus, we can transplant a cat whose life span doesn't exactly match the conditions in the question; by learning subjects' preferences based on a range of scenarios, we can select a recipient on the subject's behalf.

An alternative approach would be to find a number of current transplant candidates and ask subjects to choose between them. However, my implementation offers many benefits. First, it permits the researcher to elicit preferences over a large range of survival distributions, while requiring only two real transplant candidates. Second, the researcher can tailor the survival profiles for identification purposes, rather than relying on the true distribution of survival times. Finally, this approach decouples the timing of the experiment and the transplant. Since an effective transplant often must occur shortly after diagnosis of kidney failure, the window for performing a real-time allocation experiment would be quite short.[22]

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[20]Section instructions are provided in the appendix in Figure 13; question instructions are provided in Figure 14.

[21]In Kessler et al. [2019], real employers evaluated resumes of hypothetical job candidates, and machine learning was used to recommend real job candidates based on each employer's responses. Hypothetical candidate profiles allow the researcher to randomize candidate characteristics, while the real-stakes matching provides incentives for subjects to evaluate profiles carefully.

[22]In order to avoid overcomplicating the decision, subjects are not told how their responses will map to a selection if the real candidate cats do not directly match the conditions in any decision. The clear drawback to this approach is that subjects' these

Subjects are told that if the rule-based allocations are randomly selected for implementation, two of the five allocation rules will be randomly selected, and the transplant will be allocated according to the higher ranked rule. This approach ensures that every pair of rules must be reported in the subject's preferred order, resulting in the correct ranking of all rules.

In order to identify preferences over survival distributions cleanly, I also take precautions to prevent subjects from making inferences about the patient by limiting patients' age ranges and providing no additional information beyond survival times. I also attempt to eliminate concerns about uncertainty over the patients' outcomes and the probability of receiving a transplant later in order to remove the role of risk in the decision process. In particular, I ask subjects to assume: *(i)* All patients are adults (at least 18 months old for feline patients; at least 18 years old for hypothetical human patients); *(ii)* We know exactly how long each patient will survive; *(iii)* Patients have a good quality of life whenever they are alive; and *(iv)* Patients will not have another opportunity for a transplant if they do not receive one as a result of this survey. Together, these assumptions simplify the subject's decision and limit as much as possible the role of uncertainty and subject beliefs.

4.4. *Preferences Over Payments to Others*

In order to study how preferences over survival distributions relate to preferences over monetary payments, I ask subjects to select between bundles of payments to be made to future study participants. The payments to others are incentivized, but the stakes are low with a maximum payment of $4.00. This will allow us to understand whether allocative preferences are constant across domains of survival and wealth. In addition, if low-stakes payments are sufficient for predicting preferences elicited with a high-stakes organ transplant, we may be able to rely on simpler and cheaper incentives to elicit preferences.

The four payment allocation questions mimic the individual-patient transplant allocation decisions as closely as possible. Rather than an organ transplant, subjects are asked to allocate payments, under the condition that one future participant will receive a *high* payment (analogous to an organ transplant) and the other will receive a *low* payment (analogous to

beliefs about the mapping algorithm are not tightly controlled. However, foregoing this explanation made it possible to keep the experiment short and clear, in hopes of better subject concentration and higher quality responses.

no transplant). Questions are formatted exactly as in the organ transplant allocation questions, asking subjects to allocate the *high* payment in each row by selecting a single switching point above which they would allocate the *high* payment to Participant A and below which they would allocate the *high* payment to Participant B. Figure 3 shows a sample question. Table II shows the parameters used in the four payment allocation questions. Most question parameters are designed to map payment amounts directly to months of survival in the transplant allocation questions at a rate of $0.10 per month.[23] Instructions shown to subjects are provided in Appendix Figure 17.

To protect anonymity, subjects receiving additional payments are not given any information about the additional payment (such as which row was selected or whether they were selected as Participant A or Participant B) or the subject who made the selection.

Figure 3: Sample Payment Allocation Table

PARTICIPANT A		PARTICIPANT B
LOW: $0.60 HIGH: $2.40	OR	LOW: $0.90 HIGH: $2.40
LOW: $0.60 HIGH: $2.40	OR	LOW: $0.90 HIGH: $2.50
LOW: $0.60 HIGH: $2.40	OR	LOW: $0.90 HIGH: $2.60
LOW: $0.60 HIGH: $2.40	OR	LOW: $0.90 HIGH: $2.70
LOW: $0.60 HIGH: $2.40	OR	LOW: $0.90 HIGH: $2.80
LOW: $0.60 HIGH: $2.40	OR	LOW: $0.90 HIGH: $2.90
LOW: $0.60 HIGH: $2.40	OR	LOW: $0.90 HIGH: $3.00

A sample *payment allocation* question with no response selected. Participant A's payments and Participant B's *low* payment remain constant in each row; Participant B's *high* increases by $0.10 in each row. Upon selection, one cell is highlighted in each row to indicate the participant receiving the *high* payment, and text in each cell becomes boldfaced to indicate whether the participant is receiving the *high* or *low* payment.

[23]Maximum high payments to Participant B do not follow this exchange rate.

Table II: Payment Allocation Question Parameters

Question	Participant A	Participant B Low Payment	Participant B Minimum High Payment	Participant B Maximum High Payment
1	Low: $0.10 High: $0.60	$0.20	$0.60	$1.20
2	Low: $0.10 High: $0.20	$0.20	$0.20	$1.00
3	Low: $0.40 High: $0.50	$0.50	$0.50	$1.50
4	Low: $0.60 High: $2.40	$0.90	$2.40	$4.00

Table shows the parameters of the four *monetary payment* questions presented to each subject. Within a question, the subject decides whether to allocate a *high* payment to Participant A or Participant B in a series of comparisons. Participant B's *low* payment, and Participant A's *high* and *low* payments remain constant in each comparison, while Participant B's *high* payment varies between *Participant B Minimum High Payment* and *Patient B Maximum High Payment* shown in the table. Questions are presented in randomized order.

4.5. *Risk & Time Preferences*

I elicit risk and time preferences using incentivized choices over lotteries and bonus payment timing. Following Dean and Ortoleva [2019], I ask nine question to establish each subject's aversion to risk, discount rate in short-term payoffs, and discount rate in long-term payoffs. Question structure follows that of the individual-patient allocation questions: subjects identify a switching point between a risky payment and a certain one, or between a near-term payment and a distant one. One row from one question is randomly selected as the subject's bonus payment. For additional details on the risk and time preference elicitation, see Appendix B.

5. ANALYSIS & RESULTS

As described in Section 4, each subject decided how to allocate a real organ transplant between two feline patients based on the patients' expected survival times. In *individual-patient* decisions, subjects allocated the transplant directly to one of the two patients; in *rules-based* decisions, subjects reported their preferred allocation rules to determine which patient would receive the transplant. In addition, subjects make allocation

Table III: Summary Statistics

	N	Mean	SD
Age	311	37.1	10.8
Female	309	41.4%	0.493
Asian	311	5.8%	0.2354
Black	311	10.3%	0.304
White	311	76.5%	0.425
Multiracial, prefer not to say, other	311	7.4%	0.262
Hispanic	309	6.8%	0.252
Pet Owner	311	71.1%	0.454
Cat Owner	311	37.6%	0.485
Liberal on social issues	311	59.8%	0.491
Liberal on economic issues	311	46.3%	0.499

Table shows the means and standard deviations of experimental subjects' demographic and personal characteristics.

decisions over money, as well as hypothetical organ allocation decisions for human and feline patients.

The main subject sample consists of 311 Mechanical Turk workers recruited in October 2020. In order to improve data quality, I restricted participation to US-based workers having completed at least 500 previous tasks with an approval rate of at least 99%.[24] Workers were paid $5 for participation, with additional bonus payments based on responses in monetary decisions.

Table III shows summary statistics describing the study sample. Subject ages range from 20 to 73 years old, with a mean of 37.1 years. Subjects are more likely to be male (58.6%) than female (41.4%), with most subjects identifying as white (76.5%) and smaller groups identifying as Black (10.4%) or Asian (5.8%).[25] Most subjects (71.1%) identify as pet owners, with 37.6% of subjects owning at least one cat. Subjects represent a mix of political positions, with 59.8% identifying as liberal on economic issues and 46.3% identifying as liberal on economic issues.

This section describes the results of the experiment. Section 5.1 exam-

[24] I also conducted two experimental pilots with different sample restrictions.

[25] Two subjects either did not identify as male or female or did not report their gender.

ines subjects' decisions in individual-patient and rule-based decisions, and estimates subjects' preferences for efficiency and equality based on their allocation decisions. Section 5.2 explores allocative preferences across domains of survival and wealth. Finally, Section 5.3 examines the effect of the real transplant incentives on behavior by comparing incentivized and hypothetical decisions.

5.1. *Individual-Patient and Rules-Based Allocations*

5.1.1. *Individual-Patient Allocations*

We first examine switching points in the individual-patient allocation questions. Very few subjects are deontological in allocating organs to the shorter-lived patient: only 3.9% of subjects consistently transplant the shorter-lived patient. The vast majority of people (80%) consistently respond to increased efficiency by switching from the shorter-lived patient with a small increase in survival to the longer-lived patient with a large increase in survival.

A small share of subjects (4.2%) always allocate to the longer-lived patient. While preferences are generally well behaved, a small number of subjects selected allocations that added no survival benefit. Recall that two individual-patient allocation questions include a weakly dominated option; 8.7% of subjects select one of these dominated options.

Estimating Indifference Curves

We can use a more formal analysis to describe subjects' individual-patient allocations with a single parameter by estimating an indifference curve. Following the theoretical framework described in Section 3, we can consider each row of an individual-patient question as a comparison of two survival bundles. In the first bundle A, Patient A receives the transplant and Patient B does not. Thus, the survival bundle can be denoted as $(x_A^{with}, x_B^{without})$. The subject compares this survival bundle against the second bundle, B, located at $(x_A^{without}, x_B^{with})$. The subject selects a switching point, $B\prime$, where the subject prefers to allocate the organ to Patient B rather than to Patient A. Then, the subject's indifference curve passes through A and $B\prime$.

Following Fisman et al. [2007], we assume a constant elasticity of substitution (CES) utility function with equal weight on the survival of the two patients:

$$u(x_A, x_B) = (x_A^\rho + x_B^\rho)^{\frac{1}{\rho}}$$

The CES utility function is flexible enough to capture a wide rang of preferences, nesting perfect substitutes and Leontief preferences under different values of ρ.

Distribution of Indifference Curves

The distribution of curvature parameter ρ for each subject is shown in Figure 4. The average ρ, -.26, belies a bimodal distribution: 64.1% of subjects — those with $\rho > 0$ — demonstrate a preference for increasing total survival time, while the remaining 35.9% show a preference for reducing survival disparities. 17.8% of subjects maximize total life years by substituting perfectly between patients ($\rho \approx 1$). Only 12 subjects (4.7%) have behavior suggesting a Cobb-Douglas utility function ($\rho \in [-0.1, 0.1]$).

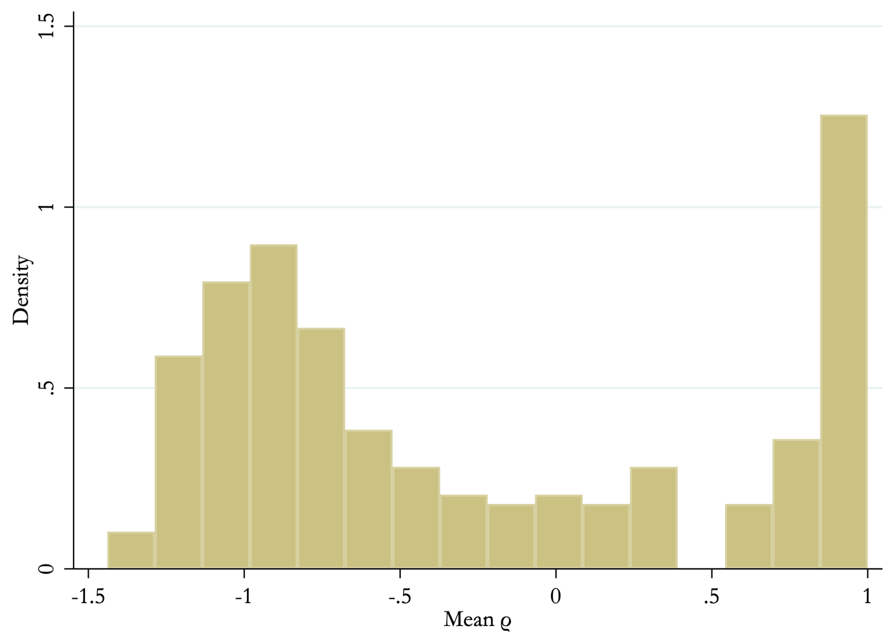
5.1.2. *Rules*

The CDF of subject rule rankings is shown in Figure 5. Almost all subjects prefer to transplant some patient; only 10% of subjects rank **no transplant** above the lowest rank. Subjects prefer to use transplants to maximize the increase in survival (ranked first by 40% of subjects) and to maximize the use of the organ (ranked first by 36% of subjects). Random allocation is the least popular way to allocate a transplant, ranked in fourth place by most subjects (above no transplant).

The popularity of maximizing the use of the transplant is surprising from the point of view of survival time efficiency. Since this rule ignores patient survival without transplant, a use-maximizing allocation may not contribute to patient welfare. However, the frequency with which subjects choose this rule suggests that individuals care not only about the patients, but also about the appropriate use of a valuable organ donation. A related sentiment may contribute to ongoing debates in human organ allocation: transplant centers generally restrict liver transplants for alcoholic patients in part due to concerns about the misuse of a donated organ. Aside from a sense that any valuable organ should be used as long as possible, there may be other reasons that account for the popularity of this rule. Maximizing use of the organ may be a heuristic for maximizing the increase in survival.[26] If subjects are used to thinking of potential

[26]Note that if all potential transplant recipients had the same without-transplant

Figure 4: Distribution of ρ in Transplant Allocations



Distribution of subject-level averages of indifference curve parameter ρ. Sample: 256 subjects with decisions consistent with CES preferences. Averages are taken across all four individual-patient transplant allocation decisions. ρ cannot exceed 1 by design. $\rho = 1$ represents perfect substitution between the two patients; $\rho \to -\infty$ represents Leontief preferences.

transplant recipients as being in urgent need of transplant, maximizing organ use may be a proxy for maximizing total survival time. In addition, maximizing organ use is reasonable if a transplant is associated with an increase in quality of life. While the instructions explicitly inform subjects to assume that quality of life is high whenever a patient is alive, subjects' beliefs about the actual quality of life of cats suffering from kidney failure may drive the popularity of this rule.

5.1.3. *Relationship Between Rules and Switching Points*

The allocation rules do not adequately capture subjects' choices in the individual-patient decisions. While each rule is associated with switching points in each individual-patient allocation question, only 27% of subjects follow any particular rule in all four decisions, with the largest group of subjects (17.7%) choosing switching points that maximize the use of the organ. 5.5% of subjects consistently maximize the increase in patient survival time, while 3.9% of subjects maximize the minimum survival time. Many subjects (36.3%) never select a switching point that is consistent with any rule, while the rest either choose consistent with one rule (21.55%) or switch between rules in different questions (15.11%).

While the rules don't capture the full dynamics of individual-patient allocation decisions, responses to the two types of questions are related. Figure 6 shows the distribution of curvature parameter ρ estimated from individual-patient allocation decisions separately by subjects' rule rankings.[27] Subjects who prefer rules representing some form of equality — *Maximize Minimum Survival Time* and *Select Patient Randomly* — are also more equality-seeking in their individual allocation choice. Subjects who prefer *Maximize Increase in Survival Time* are also efficiency-seeking in their individual allocations (mean(ρ)= -0.01 and mean(ρ)=-0.43; $p < 0.001$). Subjects who choose *Maximize Organ Use* are significantly more likely to make individual allocations that cannot be explained by any CES parameter (14.5% versus 23.4%; $p = 0.024$).[28] These findings

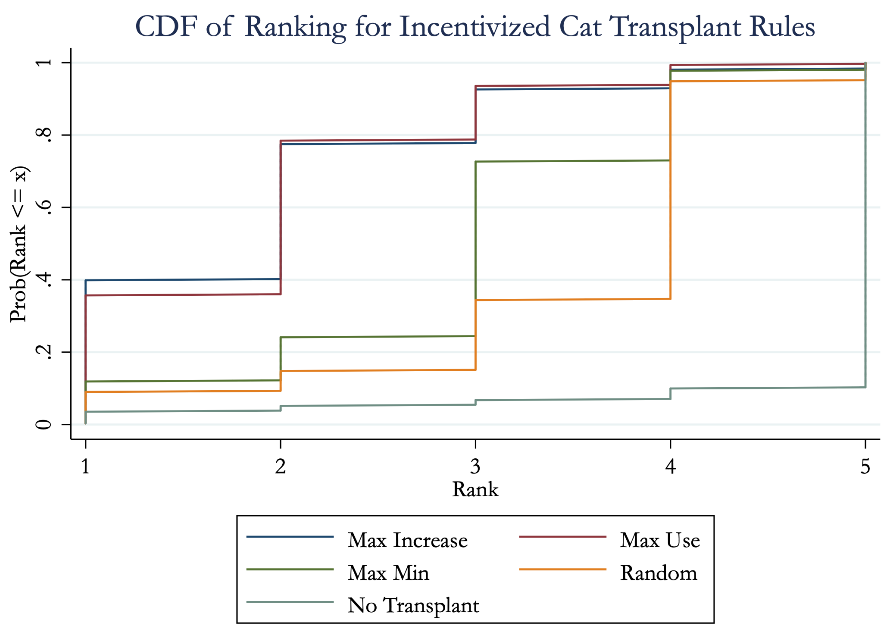
survival, maximizing organ use would be equivalent to maximizing the increase in survival.

[27]Since the vast majority of subjects rank *Perform No Transplant* as their least preferred rule, the figures combine subjects ranking each rule as their fourth or fifth choice.

[28]Note that maximizing the use of the organ implies lexicographic preferences over post-transplant survival, rather than CES preferences. In fact, no value of ρ would fit decisions that maximize the use of the organ.

suggest that subjects are consistent in their preferences across the two types of allocation decisions.

Figure 5: Rule Rankings

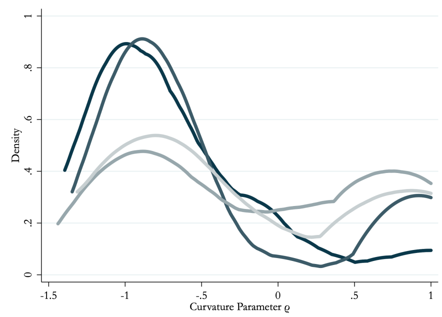


Cumulative distribution function (CDF) of subject rankings of allocation rules. The five rules include *Maximize the Increase in Survival Time*, *Maximize Use of the Organ*, *Maximize the Minimum Survival Time*, *Select Patient Randomly*, and *Perform No Transplant*. Sample: 311 subjects.

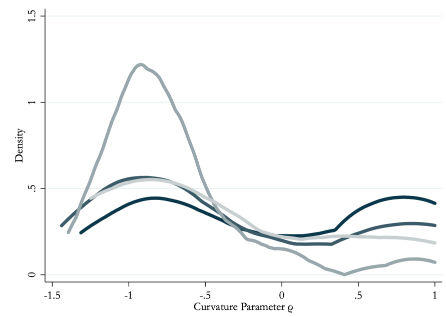
5.2. *Inequality Preferences Across Domains*

Following the analysis above, we can estimate a curvature parameter ρ using subjects' selections between payments for other survey participants. Eighty-four subjects (27%) make selections inconsistent with CES preferences; the distribution of ρ for the remaining subjects is shown in Figure 7. As in the transplant allocation decisions, subject preferences show a bimodal distribution: 71.4% of subjects display equality-seeking preferences, while the remaining 28.6% have efficiency-seeking preferences. 12.8% have

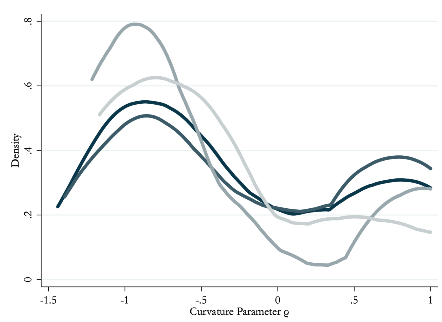
Figure 6: Distribution of Indifference Curve Parameters by Rule Rankings



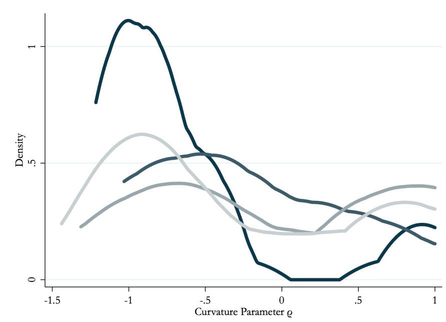
(a) Maximize Minimum Survival Time



(b) Maximize Increase in Survival Time



(c) Maximize Use of Organ



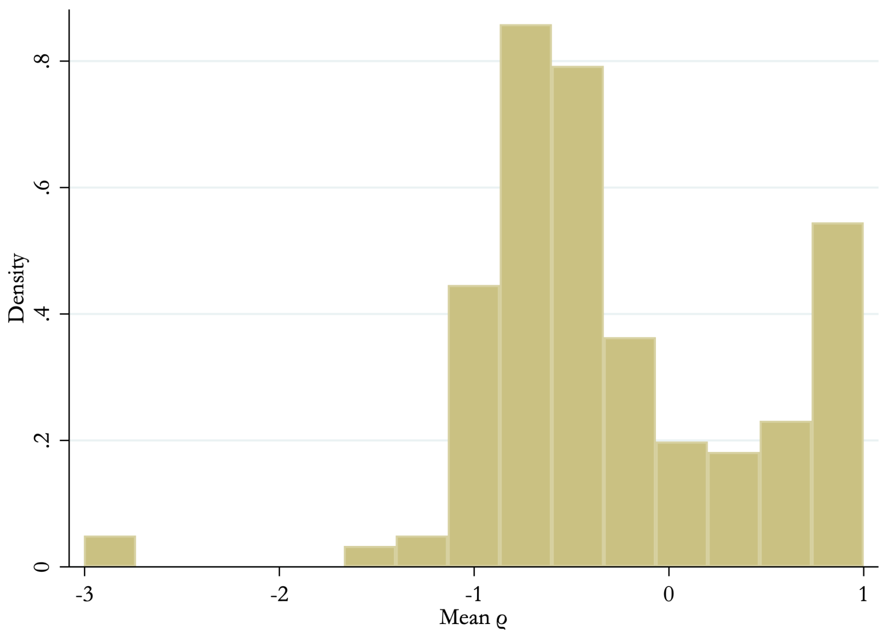
(d) Select Patient Randomly

Distribution of curvature parameter ρ by allocation rule rankings. Each figure shows the distribution of ρ by the rank of one allocation rule: 6a — *Maximize Increase in Survival*; 6b — *Maximize Minimum Survival Time*; 6c — *Maximize Use of Organ*; and 6d — *Select Patient Randomly*. Histogram of the final rule, *Perform No Transplant*, has been omitted due to small sample sizes at most ranks. Figures combine subjects who rank the rule fourth and fifth due to small sample sizes with fifth-place ranking. Sample: 256 subjects with a ρ consistent with CES preferences.

perfect substitute preferences ($\rho \approx 1$).

Preferences over payment allocations are closely related to preferences over transplant allocation. Figure 8 shows this relationship in a binned scatterplot, showing the average ρ estimated from transplant decisions

Figure 7: Distribution of ρ in Payment Allocation



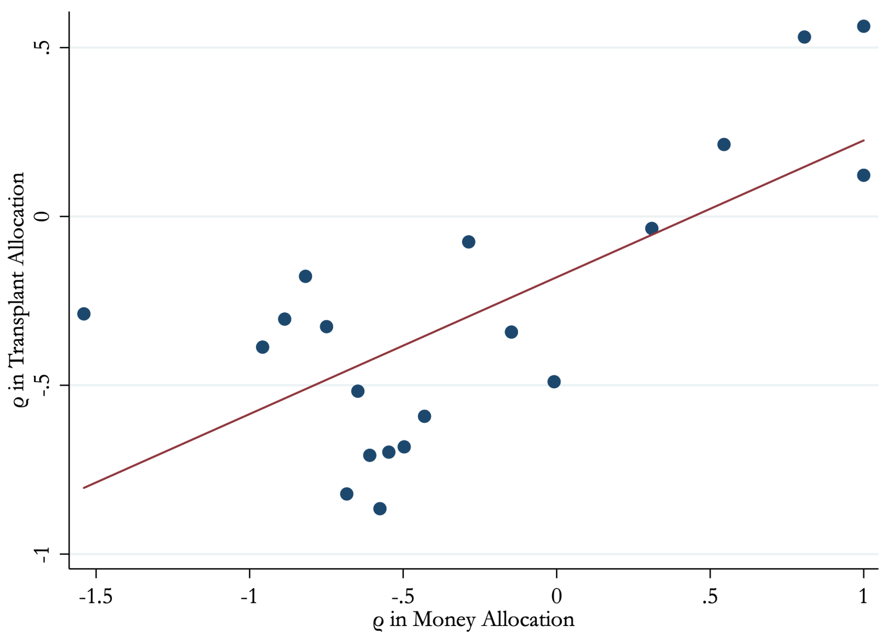
Distribution of subject-level averages of indifference curve parameter ρ in allocating payments to other experimental subjects. Sample: 227 subjects with allocations consistent with CES preferences.

for subjects with different values of ρ estimated from payment allocation decisions. Regression results are shown in Table IV. ρ estimated from payment decisions is a good predictor of ρ in transplant allocation decisions, though the two measures are not perfect substitutes. In fact, 28% of subjects switch from showing equality-seeking behavior in one case to efficiency-seeking behavior in the other.

5.3. *The Effect of Incentives*

One question is whether hypothetical responses are reliable in this context, and whether asking subjects to allocate a real cat transplant leads to different responses. Recall that subjects respond to the same questions under hypothetical and incentivized conditions, allowing us to examine

Figure 8: Relationship Between ρ in Payment and Transplant Allocation



Binned scatter plot of subject-level averages of indifference curve parameters ρ in payment allocation questions and transplant allocation questions. Sample: 200 subjects with allocations consistent with CES preferences in both payment allocation and transplant allocation questions.

Table IV: ρ in Payment and Transplant Allocation Decisions

	Transplant ρ
Payment ρ	0.405***
	(0.0875)
Constant	-0.180**
	(0.0546)
Observations	200
Adjusted R^2	0.123

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table shows OLS regression of ρ estimated from transplant decisions on ρ estimated from payment allocation decisions. Robust standard errors are reported in parentheses. R^2 is indicated. Sample includes 200 subjects with choices consistent with CES preferences in both transplant and payment allocation decisions.

the effect of incentives by comparing responses under the two conditions.

The transplant incentive compels many subjects to change their reported preferences over allocation rules: 46% of subjects rank rules differently under incentivized and hypothetical conditions. These changes are not restricted to the lower end of the rankings: only 7.4% change their least preferred rule, whereas 25% change their most preferred rule. However, reported preferences in the two conditions do not appear to change systematically. Figure 10 shows the CDF of rankings of each rule across treatments.The aggregate ranking of rules does not change between conditions, and the share of subjects preferring each rule is essentially constant.

Similarly, a large share of subjects report preferences differently in incentivized and unincentivized individual allocation problems. 83.3% of subjects respond differently to at least one individual-patient allocation question, while 25.7% of subjects respond sufficiently differently in enough questions that the estimated indifference curve parameter ρ switches signs. However, aggregated decisions are consistent across treatments. A similar number of subjects go from equality-seeking to efficiency-seeking behavior under the different conditions as go the opposite direction, resulting in similar distributions of ρ (mean(ρ) in incentivized decisions $= -0.29$; mean(ρ) in unincentivized decisions $= -0.32$; $p = 0.50$. See Figure 9).

Recall that subjects also evaluated a hypothetical scenario similar to the trolley problem in order to classify subjects as more deontological (i.e., holding sacred values) or consequentialist (i.e., evaluating the morality of actions based on their results). I find little support for the hypothesis that subjects classified as deontological are less responsive to changes in the survival ratio. Consequentialist and deontological subjects behave similarly in rule-based and individual-patient allocation decisions. This contrasts with evidence from previous work identifying correlations across broad ethical positions. For example, Elías et al. [2019] find that individuals with more deontological beliefs tend to oppose payments for kidney donors, regardless of how the supply of transplants increases with payments.[29] These findings suggest that hypothetical scenarios are not always good predictors of ethical behavior in incentivized conditions. More work must be done to understand the relationship between ethical decisions in different contexts.

Table V: Relationship of Utility Parameters in Incentivized and Unincentivized Allocation Decisions

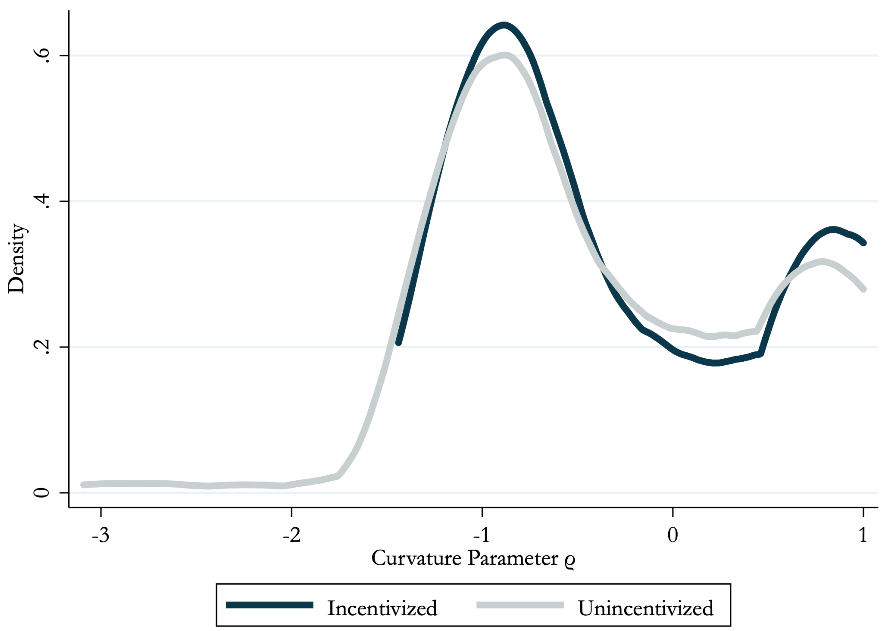
	Payment ρ
Transplant ρ, unincentivized	0.138
	(0.0905)
Transplant ρ	0.228*
	(0.0948)
Constant	-0.168**
	(0.0599)
Observations	191
Adjusted R^2	0.139

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table shows OLS regression of ρ estimated from transplant decisions on ρ estimated from payment allocation decisions. Robust standard errors are reported in parentheses. R^2 is indicated. Sample includes 200 subjects with choices consistent with CES preferences in both transplant and payment allocation decisions.

[29]Most questions in Elías et al. [2019] were hypothetical, though the researchers also elicited subjects' willingness to donate to a foundation supporting payments for organ donors.

Figure 9: Distribution of ρ in Incentivized and Unincentivized Transplant Decisions



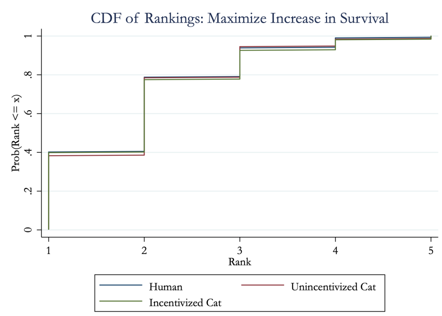
Distribution of subject-level averages of indifference curve parameter ρ in allocating organ transplants in incentivized and unincentivized decisions. Sample: 244 subjects with transplant allocations consistent with CES preferences in both incentivized and unincentivized conditions.

We can also separately analyze the responses of the 117 subjects (38% of the subject pool) who own cats. We may speculate that cat owners are more likely to take the incentives seriously, so large differences in the behavior of cat owners and non–cat owners would suggest that subjects are not invested in the survival of a cat. However, responses of cat owners and non–cat owners are very similar in their ranking of rules and their allocation in individual-patient decisions.

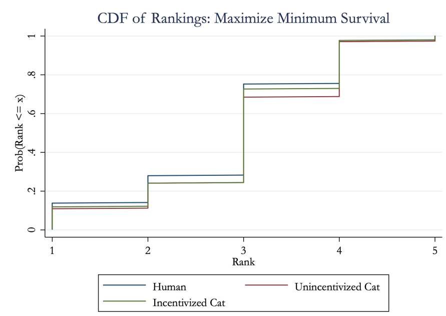
Finally, we examine whether incentivized and unincentivized transplant allocation decisions are equally predictive of payment allocation decisions. We can regress ρ from payment decisions on ρ in incentivized and unincentivized decisions to assess the explanatory power of the unincentivized and incentivized decisions. Table V shows the results: ρ from incentivized decisions is significantly different from zero, while ρ from unincentivized decisions provides no additional explanatory power after controlling for incentivized ρ.

Together, the evidence suggests that incentivizing decisions with a real transplant leads to significantly different allocation decisions at the individual level. While these differences do not appear to bias inferences at the aggregate level, incentivized decisions appear to be more informative and reliable for understanding individual decision making.

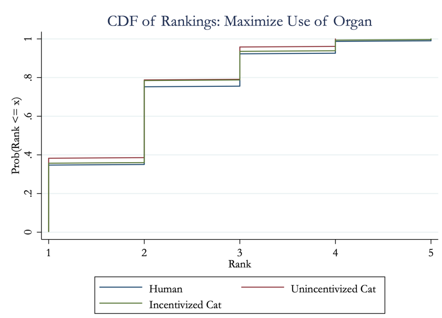
Figure 10: Distribution of Rule Rankings Across Treatment Conditions



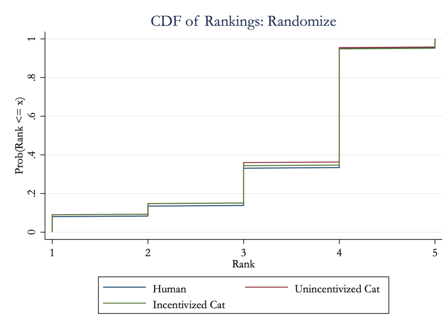
(a)



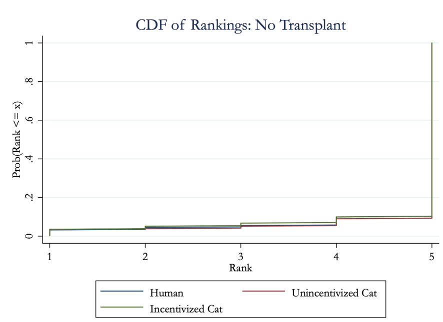
(b)



(c)



(d)



(e)

CDFs of rule rankings under *Incentivized Cat*, *Unincentivized Cat*, and *Unincentivized Human* conditions. Each figure shows the distribution of rankings for one of the five allocation rules: *Maximize Increase in Survival*, *Maximize Minimum Survival Time*, *Maximize Use of Organ*, *Select Patient Randomly*, and *Perform No Transplant.*

6. CONCLUSION

The allocation of scarce, life-saving medical treatments like organ transplants requires difficult decisions determining who lives and who dies. While panels of medical experts often make these decisions, little is known about how well their decisions reflect society's preferences over patients' possible survival times. In this paper, I introduce an experimental methodology for identifying the social welfare function over survival distributions with real life-or-death incentives. Subjects select one feline patient to receive a real kidney transplant by making a series of decisions that map out indifference curves between survival bundles, and by ranking allocation rules selected to represent elements of efficiency and equality.

I find that most subjects respond to increases in total survival, even if those gains accrue to the longer-lived patient. About 40% of subjects prefer a rule that maximizes the increase in survival time, and 80% of subjects switch from allocating the transplant to the shorter-lived patient to the longer-lived patient when the gains from transplant are sufficiently high. Only a small number of subjects prefer to give the transplant to the shorter-lived patient, regardless of efficiency gains to the longer-lived patient. This suggests that Rawlsian equality aimed at helping the worst-off patient is not a good model of society's preferences over survival. In the US, priority on the liver transplant waitlist is based primarily on medical urgency; this approach does not seem to align well with society's preferences for increasing total patient survival.

A large group of subjects show a lexicographic preference over post-transplant survival time, preferring to maximize the amount of time the transplanted organ is used. 37% of subjects rank this as their most preferred rule, and many subjects behave consistently with this preference when deciding between individual patients. By ignoring without-transplant survival time, this rule does not conform to our usual notions of equality or efficiency, but suggests individuals value the appropriate use of a valuable organ donation. If individuals derive utility from the use of the organ itself — rather than from the survival of the patient who receives it — it may give us new insight into views on controversial topics, such as transplanting patients with alcoholic liver disease.

While fairness and equality have been studied in both the lab and the field, most economic treatments of these issues are limited to discussions of income and wealth. This experiment contributes to the economic literature on equality by comparing preferences for inequality across the domains of money and survival. I find that preferences toward the distribution of wealth are closely correlated with preferences toward the distribution of survival. Subjects vary greatly in how they choose to allocate both wealth and organ transplants, but decisions in one domain predict decisions in the other.

Finally, the experiment suggests that incentives are valuable for eliciting preferences in high-stakes decisions. The transplant allocation incentives appear to reduce noise in experimental responses, and allow analysis of subject-level preference parameters. However, I also find that hypothetical responses do not show any systematic bias in the aggregate. This provides some support for those who argue that we can rely on hypothetical survey responses to understand society's preferences broadly, though we still may prefer incentivized experiments to understand decision making at the individual level.

The crux of the experiment — using a novel incentive structure in life or death decisions to elicit preferences and disentangle mechanisms in a tightly controlled laboratory experiment — could be used in other settings as well. The success of feline transplantation makes it a particularly good setting for economists to learn about organ allocation preferences, but other health behaviors, such as decisions whether or not to pursue medical treatment, obstacles to vaccination, and adherence to health regimens, might also benefit from a similar design.

This experiment suggests that incentivized experiments can be a powerful tool to elicit and understand ethical positions. As Li [2017] points out, economics does not have a monopoly on ethical thinking. However, economics is not limited to applying mathematical tools from a position of "informed neutrality between reasonable ethical positions." Economists need not simply map out the tradeoffs along the Pareto frontier; we can use experiments to identify society's preferences over these tradeoffs.

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APPENDIX

APPENDIX A: ETHICAL CONSIDERATIONS

This appendix addresses ethical considerations in the design of this experiment, using a question-and-answer format.

Does this research cause the death of a cat?

No, this experiment does not cause the death of a cat. Instead, the experiment provides funding for a life-saving organ transplant to one cat. One subject in the experiment is selected at random, and his or her choices are used to determine which of two candidate cats will receive a transplant.

Why are you withholding treatment for one of the cats? Is that ethical?

It is important to emphasize that nothing in this experiment prevents any cats from getting a transplant. While I provide funding for only one transplant, the owner of the other cat may still pursue a transplant.

Even so, it may seem unfair that one cat receives a transplant while the other (most likely) does not. There are both financial and methodological reasons for this necessary part of the experiment. The financial reason is that my research budget is limited, and I can only afford one transplant. It would be impossible for me to provide medical care to every cat, but at least one cat benefits from a necessary medical procedure as a result of the experiment. While this increases inequality among cats, it does so by extending one cat's life, not by harming any cat.

Methodologically, the experiment relies on the fact that resources are scarce. If transplants were provided for every cat in need, there would be no incentives for subjects to report their preferences truthfully, since their reports could have no effect on the final allocation. That is, the design of this experiment takes advantage of a limited budget to ensure that even while we can't provide treatment to every sick patient, we can learn something useful about allocating limited resources.[30]

The financial and methodological reasons for providing only on transplant both reflect the fact that scarcity is reality in allocating medical treatments. Medications, hospital beds, medical devices such as ventilators, and the expertise of doctors are all available in limited supply. This experiment is designed to study this empirical reality, and to help us understand how to allocate these scarce goods.

A cat cannot consent to participate in an economics experiment. How can you recruit subjects without their consent?

Cats are not subjects in this experiment. Instead, the subjects are the human workers on Mechanical Turk, who participate in the experiment after providing informed

[30] In theory, the methodology does not require exactly one transplant for two cats; it simply requires that there be fewer transplants than cats. With a larger budget, we could provide more than one transplant, but at least one cat would still not receive a transplant.

consent. The kidney transplant is the incentive for the human subjects to consider their decisions carefully.

Cats cannot consent to be living organ donors. Is it ethical to take organs from donor cats?

The donor cat is recruited from an animal shelter and adopted by the transplant recipient's owner after the procedure. The concern is that donor cats are unable to agree to this arrangement, and are being exploited for their organs.

This is a valid concern: it's true that cats cannot consent explicitly to this procedure. However, the donor cats would otherwise die in the shelter.[31] While the transplant does not benefit the donor directly, the arrangement extends the donor's life and improves the donor's quality of life by providing a home with a caring owner. For these reasons, transplant surgeons presume consent from the donor cat.

This is common practice in feline transplantation, and is not unique to this experiment. While I believe reasonable people could disagree on this issue, this approach has been approved by the regulatory agencies, veterinary surgeons, and by the consensus of veterinary ethicists, so I follow their lead in my experimental design.

I oppose medical testing on animals. Is this animal medical testing?

No, this is not animal medical testing. Animal medical testing refers to carrying out experimental medical procedures on animals in order to test the efficacy of the treatment. Kidney transplantation is not experimental; it is a well established treatment for kidney disease in cats. Moreover, the goal of the transplant is not for research on the efficacy of transplantation as a treatment. Instead, the transplant is intended to treat the recipient's kidney failure.[32] The experimental outcome of interest is not the survival of the two cats, but how the subjects of the experiment allocate scarce resources.

Could donating money for transplant lead to a transplant with follow-up treatment that the owner can't afford, resulting in a lower quality of life for the cat?

Thank you for raising these points. As part of the experiment, we will contribute $12,000 toward a transplant, making it possible to save the life of a cat who would otherwise die. According to most estimates, the cost range for the surgery itself is $12,000-$18,000 (see, for example, the link below). This $12,000 donation will ease the financial burden of transplant without eliminating it completely.

As you point out, pursuing a kidney transplant will still require significant financial resources from the owner. The annual cost of immunosuppressant drugs is about $500-1500, depending on the specific drug regimen followed. This cost is significantly less than the cost of the transplant itself (if we estimate that the average life expectancy of a cat after transplant is about three years), and does not require a large upfront payment.

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[31] So-called "no-kill shelters" are relatively rare in the US, and even in these shelters up to 10% of animals may be euthanized.

[32] Note in particular that although there is one "treated" cat and one "control" (untreated) cat, this is not a randomized control medical trial. The treatment status of the two cats is not random; it is determined by the choice of the subjects of the experiment.

We anticipate that there are many owners with the ability to care for a second cat and the means to pay for follow-up treatment, but who would otherwise choose not to pay the large lump-sum cost of the surgery itself. Of course, the owner will also be free to refuse the surgery (and the financial donation) if they deem it is not in the best interest of the cat.

We will rely on the primary care veterinarians and the veterinary transplant center to screen potential transplant recipients. These centers have screening mechanisms in place to determine whether the surgery would be ethical as well as practical for the owner and the patient, and they would not perform a surgery that they deem inappropriate.

Of course, the well-being of the donor cat should also be taken into consideration. If the transplant does not occur, the donor cat is likely to be killed in a shelter.[33]

Owners who pursue transplant for their cats are clearly dedicated to the health and well-being of their pets. Many consider these animals to be part of their family. The screening procedures already in place and the owner's significant financial investment ensure that the owners are invested in providing a high quality of life for the cats. If the IRB is concerned about the welfare of the cats, donating money for a transplant will result in improved quality of life for both cats. Providing one cat with medical treatment and another with a loving home, rather than letting both die, seems like an ethical choice.

Is there any precedent for this type of experiment?

This style of experiment is not common in the economics literature, but there is some precedent for using animal lives to study subject preferences over life and death. In one related study, Falk and Szech [2013] ask subjects to pay to save the lives of lab mice who would otherwise be euthanized. A branch of economics literature has looked at consumers' willingness to pay for the welfare of animals. Most of these studies focus on living conditions for farm animals and elicit willingness to pay through hypothetical or real valuations for animal products with different characteristics (for an overview, see Boaitey and Minegishi [2020]). These products are generally already commercially available, so even the real choice experiments do not directly affect the welfare of animals except through their demand for animal products.

To my knowledge, this is the first study to use animal organ transplants to study human preferences toward survival. A more detailed review of the economic literature is provided in Section 1 in the main body of the paper.

Are there any concerns for the well being of the human subjects in this study?

Human subjects are asked to answer a series of questions at a computer terminal. To protect subjects from psychological stress, I ensure that subjects are well informed about the stakes of the study in general and the stakes of each question. Subjects are able to end their participation in the study at any point.

The burden of decision shoudn't fall on one subject alone. Why do you randomly select one subject and implement her choices, rather than aggregating all subjects' choices?

Aggregating subjects' preferences — for example, by asking subjects to vote on each potential transplant recipient, and providing a transplant to the candidate with the

[33] Even in "no-kill" shelters, up to 10% of animals are euthanized.

most votes — may undermine the incentives of the study. Implementing the choices of one randomly selected subject (commonly called a Random Dictatorship) is a standard approach in economics and preserves incentives for subjects to consider the question carefully and respond with their true preferences.

Did an Institutional Review Board (IRB) approve this study?

Yes, this study received "Expedited" review and was approved by the Stanford University IRB.

APPENDIX B: EXPERIMENTAL DESIGN APPENDIX

B.1. *Consent*

B.2. *Transplant Allocation*

B.3. *Time & Risk Elicitation*

Time and risk preferences are elicited following the values in [Dean and Ortoleva, 2019].

B.4. *Payments to Others*

B.5. *Ethical Scenario*

In a final hypothetical question, subjects are asked to consider an ethical dilemma in the following scenario (derived from Elías et al. [2019]). This scenario is intended to distinguish between subjects with deontological preferences — that is, a set of values or a code of conduct based around an action rather than its consequences — and those with consequentialist (utilitarian) preferences. Subjects with deontological views in other domains may be less responsive to total

Figure 11: Primary Consent Form

Stanford

This is a consent form for research participation. It contains important information about this study and what to expect if you decide to participate. Please save or print this page for your records.

Your participation is voluntary. Please consider the information carefully. Feel free to ask questions before making your decision whether or not to participate.

This study does not involve deception. All choices and bonus payments will be implemented in the manner described in the study.

Description: The survey you are participating in today is part of a research study on decision-making in the context of organ transplantation. The research study is designed to analyze individual preferences over priorities for organ transplants. You will be asked to read several pages of instructions. Then you will be asked to make several choices (by using a computer terminal) that will determine the precise amount you will be paid. After these choices, you may be asked to answer several survey questions.

Risks and Benefits: There are no anticipated risks involved in this study. We cannot and do not guarantee or promise that you will receive any benefits from this study. However, your participation may allocate funding that will assist other individuals and organizations. In addition, your participation may benefit society by improving our understanding of behavior and preferences toward organ allocation.

Duration: Your participation in this survey will take approximately 20 minutes.

Payments: You will receive on average $20 per hour as payment for your participation, based on the actions that you select. All subjects will be paid. The minimum payment is the $5 show-up fee. You will receive payment after responses have been validated (within 48 hours); the exact amount and timing of bonus payments will depend on your responses to the survey.

Subjects' Rights: If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. You have the right to refuse to answer particular questions. The results of this research study may be presented at scientific or professional meetings or published in scientific journals. Your individual privacy will be maintained in all reports and published data resulting from the study.

Contacts and Questions: For questions, concerns, or complaints about the study you may contact Dr. Colin Sullivan (cdsulliv@stanford.edu) in the Stanford University Department of Economics. Independent Contact: If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the Stanford Institutional Review Board (IRB) to speak to someone independent of the research team at (650)-723-2480 or toll free at 1-866-680-2906. You can also write to the Stanford IRB, Stanford University, Stanford, CA 94305-5401.

If you agree to participate in this study, please continue. If you do not wish to participate, please close this window and your session will end.

Primary consent form displayed to all subjects before beginning the experiment.

Figure 12: Additional Consent Form for Organ Transplant Decisions

Stanford

The responses to some questions in this survey will be used to allocate one kidney transplant to a cat in need. After all respondents have completed the survey, one respondent will be selected at random, and the transplant will be allocated based on the answers selected in the survey.

Statement of Understanding

I understand that if my survey is randomly selected, my survey responses and mine alone will determine how an organ transplant is allocated. I understand that if I choose not to participate, I can exit my browser to end my session at any time.

○ Yes, I understand and I wish to participate.

Secondary consent form, informing subjects of the non-monetary incentives of the study.

Figure 13: Individual-Patient Transplant Allocation Section Instructions

Stanford

In this section, you will be asked four questions. Each question will ask you how you would allocate a single organ transplant between two feline patients in need of a transplant.

When making your choices, you can assume that:

- All patients are adults (at least 18 months old).
- We know exactly how long each patient will survive.
- Patients have a good quality of life whenever they are alive.
- Patients will not have another opportunity for a transplant if they do not receive one based on your choice.

Your responses in this section may be used to allocate a real transplant to one of two cats in need of a transplant.

If this section is randomly selected, we will partner with veterinary practices to identify two cats in need of a transplant that are unlikely to receive a transplant without financial support, and we will pay for a transplant for one of them.

You cannot influence which cats are selected as candidates for the transplant, but if this section is randomly selected, your answers and yours alone will determine which of the two cats receives the transplant.

We will rely on the judgment of a veterinary expert to determine the life expectancy of the two cats with and without the transplant. The cat who most closely matches your choices in this section will receive the transplant.

Figure 14: Individual-Patient Transplant Allocation Question Instructions

Stanford

Real Cat Transplant

Stakes: This section may be randomly selected. If randomly selected, **your responses will determine which of two cats in need of a transplant receives the transplant.**

How your response may be used: We will identify two cats in need of a transplant, and we will allocate a transplant to the cat who most closely matches your choices in this section based on estimates of life expectancy with and without a transplant.

Task: Each row below represents a different pair of potential transplant recipients. Indicate which patient you would prefer to receive the transplant in each row by clicking on the row where you would like to switch from choosing Patient A on the left to choosing Patient B on the right. Recall that both Patient A and Patient B are **cats**.

Figure 15: Sample Time Preference Question

OPTION A		OPTION B
$8 IN 7 WEEKS	OR	$0.00 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$0.10 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$0.20 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$0.30 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$0.40 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$0.50 IN 6 WEEKS
	...	
$8 IN 7 WEEKS	OR	$7.70 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$7.80 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$7.90 IN 6 WEEKS
$8 IN 7 WEEKS	OR	$8.00 IN 6 WEEKS

Screenshot of a sample question eliciting preferences over payments made at different times. Ellipsis indicates additional omitted rows.

Figure 16: Sample Risk Preference Question

OPTION A		OPTION B
50% CHANCE OF $2; 50% CHANCE OF $8	OR	100% CHANCE OF $2.00
50% CHANCE OF $2; 50% CHANCE OF $8	OR	100% CHANCE OF $2.10
50% CHANCE OF $2; 50% CHANCE OF $8	OR	100% CHANCE OF $2.20
50% CHANCE OF $2; 50% CHANCE OF $8	OR	100% CHANCE OF $2.30
	...	
50% CHANCE OF $2; 50% CHANCE OF $8	OR	100% CHANCE OF $7.80
50% CHANCE OF $2; 50% CHANCE OF $8	OR	100% CHANCE OF $7.90
50% CHANCE OF $2; 50% CHANCE OF $8	OR	100% CHANCE OF $8.00

Screenshot of a sample question eliciting preferences over risky payments. Ellipsis indicates additional omitted rows.

Figure 17: Instructions for Payments to Others

Stanford

In this section, you will be asked four questions. Each question will ask you how you would allocate extra payments to two future participants in this study.

One participant will receive a *Low* payment, and the other will receive a *High* payment. The *Low* and *High* payments are different for each participant.

Within each question, Participant B's *High* payment increases in each row. The other three payments stay the same.

One question in this section will be randomly selected to determine extra payments to two participants in this study; all questions are equally likely to be selected.

Instructions for allocating funds to other study participants.

Figure 18: Hypothetical Ethical Scenario

Stanford

Now we want to ask a different type of question that helps us better understand how you think about decisions involving life and death. Please consider the following hypothetical scenario:

Casey is a crewperson on a marine-research submarine traveling underneath a large iceberg. An onboard explosion has damaged the ship, collapsing the only access corridor between the upper and lower parts of the ship. The upper section, where Casey and most of the crew are located, does not have enough oxygen for all of them to survive until the submarine has reached the surface. There is enough oxygen in the lower section, where the only remaining crewmember is unconscious.

There is an emergency access hatch between the upper and lower sections. If released, it will allow oxygen to reach Casey and the others, but the hatch will fall to the deck and crush the unconcious crewmember below. If Casey does not release the hatch, the unconscious crewmember will recover and survive, but Casey and the rest of the crew will all certainly die.

Is it appropriate for Casey to release the hatch and crush the crewmember below to save himself and the other crewmembers?

Source

Yes ○ No ○