Eliciting Preferences over Life and Death: 
Experimental Evidence from Organ 
Transplantation

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Abstract

Optimal allocation of life-saving medical treatment depends on society’s preferences over bundles of survival times. I experimentally elicit preferences over survival time distributions in incentivized, life-or-death decisions by having subjects allocate a real organ transplant among cats with kidney failure. Allocations in the experiment identify indifference curves over survival bundles. Most subjects value both total survival time and equality of survival times; few prefer to save the shortest-lived patient at all costs, despite the prevalence of this approach in allocating transplants in practice. Aversion to monetary inequality strongly predicts 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. 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 & Goldberg, 2018). This particular allocation system implies that the regulatory body prefers to prevent the immediate death of the sickest patients rather than transplant healthier patients with a greater survival benefit.

Do these allocation rules reflect society’s preferences more broadly? Though the market is administered on behalf of the government and relies on organs donated by the public, the hypothesis that regulatory bodies’ rules do not match

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1In addition to medical urgency as determined by the Model for End-Stage Liver Disease (MELD) score, the liver priority system also favors pediatric patients and those living nearby.
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 rules, and the rules change frequently in response to technological change, regulatory change, and legal challenges. Further, rules vary widely between countries. 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? An ideal experiment would elicit choices between real bundles of survival times, then actually deliver the preferred bundle by manipulating survival times; 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 stakes are high or controversial. However, hypothetical decision making can be unreliable in a variety of settings (see, for example, FeldmanHall et al. (2012); Grewenig et al. (2020); Trautmann & van de Kuilen (2015); Schlag et al. (2015); Vossler et al. (2012)). 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 measure 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. Legal and ethical constraints prevent allocating a human organ transplant to incentivize subjects’ decisions.

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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 & Groves, 2007). In some contexts, incentivized experiments largely confirm the findings of hypothetical surveys (see, for example, Elías et al. (2019) in the context of paid organ donation).

4 The National Organ Transplant Act of 1984 regulates the use of human organs, outlawing the sale of organs in exchange for valuable consideration and establishing a legal framework for the allocation of deceased donor organs.
However, humans are not the only species to suffer from organ failure. Indeed, some veterinary transplant centers in the US regularly treat kidney failure in cats with a kidney transplant. To incentivize decisions in the experiment, one randomly selected subject allocates transplant funding for a real feline patient with kidney failure. Veterinary partners identify potential transplant recipients who are unlikely to receive a transplant without financial support, and the subject allocates $12,000 to the Small Animal Medicine and Surgery group at the University of Georgia College of Veterinary Medicine for kidney transplant surgery for the selected patient. Subjects also make hypothetical decisions on how 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.

In two experiments — a main experiment with 311 subjects and a replication experiment with 988 subjects — I elicit preferences for allocating a transplant in two types of questions: survival price lists, in which the subject chooses transplant recipients from a series of patient profiles, and rule-based allocations, in which subjects choose guiding principles to select a patient on their behalf. The survival price lists — the primary measure of interest — are designed to identify indifference curves over survival times, and allow subjects to express a wide range of preferences. In particular, questions are designed to identify subjects’ competing desires to increase total survival time in a patient population, and to decrease survival time inequality. 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 assess subjects’ attitudes toward commonly used transplant allocation systems. Subjects choose between five rules, each targeting a different objective: (i) to maximize the minimum survival time (i.e., transplant the sickest patient); (ii)
to maximize total survival time (i.e., transplant the patient who will receive the largest increase in survival time); (iii) to maximize the use of the organ (i.e., transplant the patient who will survive the longest after surgery); (iv) to give all candidates an equal chance (i.e., select a recipient at random); and (v) to provide no transplant. Each rule represents a different view of fairness and efficiency, and resembles a possible allocation system. For example, by prioritizing medical urgency, liver transplants in the US extend the minimum survival time in the patient pool. Kidney transplants, on the other hand, give higher priority to patients with a larger estimated survival benefit, suggesting a preference maximizing total survival time. Rule selections allow us to validate — and examine the principles underlying — choices in the survival price lists.

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. While subjects do display a preference for survival equality, very few subjects (3.9%) 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 (80.4%) respond to increases in total survival when the gains are large enough, even if those gains accrue to the longer-lived patient. However, most subjects do value both total survival time and equality; on average, subjects are willing to give up 6.1% of total survival time to shift from a very unequal survival distribution (where one patient lives twice as long as the other) to equality. A large share of subjects prefer to maximize the amount of time an organ is used, even if it provides little or no increase in survival to the patient. This surprising result indicates that some subjects’ preferences over the appropriate use of the donated organ go beyond its effect on patient survival times. Selections are highly consistent across incentivized and unincentivized conditions, suggesting that hypothetical responses are reliable indicators of preferences in this context.

The experiment also allows us to study whether equality preferences are consistent across the domains of survival time and money. I elicit preferences
for monetary equality by having subjects choose between bundles of payments for other subjects, making tradeoffs between equality of payments and total payment amounts. I find that a preference for equality in payments is strongly correlated with a preference for equality in survival times, suggesting that an individual’s inequality aversion may express itself similarly across domains.

This paper contributes to three bodies of economic research: first, the design of matching markets; 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 & Roth, 2012; Becker & Elías, 2007; Elías et al., 2019; Held et al., 2016; Tullius & 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 & Schmidt, 1999; Andreoni & Miller, 2002; Fisman et al., 2007; Cappelen & Tungodden, 2019). Preferences for equality play an important role in optimal taxation and redistribution policies; Kuziemko et al., 2015, for example, uses a randomized survey experiment to measure how tax and transfer policy preferences respond to information about inequality, growth, and tax incidence. 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 & 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 & 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 & van de Kuilen (2015); Schlag et al. (2015); Carson & 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. The incentive structure (described in Section 4.3) draws on methodology from Kessler et al. (2019) to provide real-stakes incentives to the evaluation of hypothetical scenarios. My experiment shows no significant differences in responses to incentivized and hypothetical questions, indicating that studying preferences in this context may not require expensive, high-stakes incentive schemes.

Section 2 describes institutional details around feline kidney transplantation in the US. Section 3 introduces a conceptual framework; Section 4 describes the experimental design; and Section 5 presents the results. Section 6 describes a replication experiment to address issues raised by the main experiment. Section 7 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. 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.

Feline kidney transplantation is a useful context for studying preferences over organ allocations in part due to key similarities with 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 human liver. As such, transplantation is the only available treatment, and failure to receive a transplant generally leads to death.\(^7\) 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 annually (University of Wisconsin-Madison School of Veterinary Medicine, 2012). 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.\(^8\) The transplant thus saves two lives: that of the sick cat, and that of the donor by providing a permanent home.

dogs who played the pivotal role as test subjects for the pioneer surgeons experimenting in transplantation in the early and mid-20\(^{th}\) 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 \( x_A^{\text{with}} \); without the transplant, she will survive for a period of \( x_A^{\text{without}} \). Thus, with one available transplant, the agent simply compares the utilities \( u \left( x_A^{\text{with}}, x_B^{\text{without}} \right) \) and \( u \left( x_A^{\text{without}}, x_B^{\text{with}} \right) \) and selects the bundle with higher utility.

Since each comparison involves a discrete allocation, we elicit a series of comparisons to map out subjects’ indifference curves. In particular, we fix three of the four pertinent survival times: \( x_A^{\text{with}}, x_A^{\text{without}}, \) and \( x_B^{\text{without}} \) in each question, and we find the value of \( x_B^{\text{with}} \) where the subject is indifferent between transplanting Patient A and Patient B. By eliciting survival bundles of equal utility to the agent (and adding parametric parametric assumptions described in Section 5.1), we can identify indifference curve passing through those two points. A schematic of this identification strategy is shown in Figure I.

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.\(^9\)

4 Experimental Design

I recruit 311 subjects on Amazon’s Mechanical Turk to complete a 20–30 minute research survey. Subjects are paid $5 for completing the survey, and

\(^9\)The bundles presented do not include the agent’s own survival time. An agent’s willingness to give up her own survival for the benefit of others is an interesting line of inquiry, but not as useful for the design of organ allocation systems since most people will not be candidates for organ transplant. There is an analogous distinction in the literature on aversion to inequality of money (see, for instance, Fisman et al. (2007)).
have the opportunity to earn bonus payments based on their decisions and the choices of other participants. In addition, subjects are told that their choices may be used to allocate $12,000 toward a kidney transplant for one feline patient with kidney failure.

The structure of the experiment is as follows:

1. Consent

2. Risk & Time Preference Elicitation — 9 multiple price lists

3. Survival Tradeoff Elicitation
   (a) Unincentivized Cat — 4 survival price lists
   (b) Unincentivized Human — 4 survival price lists
   (c) Incentivized Cat — 4 survival price lists

4. Rule-Based Allocations
   (a) Unincentivized Cat Rules
   (b) Unincentivized Human Rules
   (c) Incentivized Cat Rules

5. Monetary Payments to Others

6. Hypothetical Ethical Dilemma

7. Demographics

All subjects progress through sections of the experiment in the same order. Since survival is a risky payout over time, subjects first respond to nine questions eliciting time and risk preferences through a series of multiple price lists (see Appendix Figures [B.3] and [B.4]). Subjects then progress to organ allocation decisions, beginning with a series of survival tradeoff elicitations. These choices (described in detail in Section [4.1]) identify subjects’ willingness to trade off the short-term survival of the shorter-lived patient for the
long-term survival of a longer-lived patient. Next, subjects make rule-based allocations (described in Section 4.2), where they rank a set of rules for allocating organs. All transplant allocation choices include both incentivized and unincentivized questions (incentives described in Section 4.3). After completing the transplant decisions, subjects make a series of incentivized, low-stakes decisions over payments to other study participants (described in Section 4.4). Finally, a brief exit survey collects information on ethical and political views and demographics.

4.1 Survival Tradeoff Elicitations

I elicit subjects’ willingness to trade off between the survival of shorter-lived and longer-lived patients using four “survival price lists,” as in Figure 11.

Each row of the list represents a different pair of patients, and each patient has two projected survival times: survival without transplant and survival with transplant. In each row, the subject selects one patient to receive the transplant. 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 select the point at which they would switch from allocating the transplant to Patient A to allocating the transplant to Patient B. Subjects may also select Patient A or Patient B in every row without switching.

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 to express indifferences between patients, a distaste for transplantation, or complex preferences with multiple switching points. For example, subjects with a strong taste for equality may prefer to forego a transplant that increases inequality. [Pisman et al. 2007] allow this kind of poorly behaved utility function in monetary payments by permitting free disposal in allocation decisions. The

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section address these concerns by providing insight into the guiding principles of subjects’ allocation decisions.

Survival times in the four questions were designed to distinguish between preferences for total survival and survival equality, while remaining within the realistic range of survival times for feline organ transplant candidates. Each allocation rule described below is consistent with a unique set of switching points in the four questions, allowing me to identify the rules that are most consistent with subject behavior. Parameter values in the four survival price lists are shown in Panel A of Appendix Table B.1.

11 As a check on subject comprehension, each question offers a weakly dominated transplant option, sometimes with no survival benefit to the recipient. The weakly dominated options are still consistent with maximizing the use of the transplanted organ; however, the non-dominated option would achieve the same use of the organ in all cases.

12 Section 6 discusses a between-subject replication experiment to eliminate order effects.

13 These assumptions help to identify preferences over final distributions of survival times rather than other factors such as beliefs, risk preferences, and other patient or owner characteristics. For example, we might be concerned that subjects use survival times to infer characteristics of patients and pet owners, such as age, in order to make allocation decisions along these dimensions. Restricting transplant candidates to adult patients reduces subjects’ ability to make these inferences.

4.2 Rule-Based Transplant Allocations

In rule-based questions, subjects rank five rules for allocating organs between two patients:

results in Section 5 indicate that this isn’t a major issue; very few subjects prefer to prevent transplants or to randomize between patients.
1. **No Transplant:** Perform no transplant

2. **Maximize the Increase in Survival Time:** 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 Use of the Organ:** Give the transplant to the patient who will live the longest with the transplant

4. **Maximize the Minimum Survival Time:** Give the transplant to the patient who will die first without the transplant

5. **Select Patient at Random:** Give each patient a 50% chance of receiving the transplant

Subjects first rank rules in unincentivized questions for feline and human patients, then in an incentivized question for allocating a transplant between two cats. These rules represent simple, commonly used priority rules for organ allocations. For example, deceased donor livers in the US 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. Note that with one organ transplant for two patients, maximizing the increase in survival is equivalent to maximizing total survival time. The selected rules can be used for both feline and human patients, allowing us to compare preferences across patient species. 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.\(^{14}\) The

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\(^{14}\)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. These interesting alternative criteria are beyond the scope of this paper.
rules identify subjects’ main criterion for allocation, and identify subjects who object to organ transplantation

4.3 Incentivizing Organ Transplant Allocations

The core of the experiment lies in incentivizing subject responses in life-and-death decisions. Subjects are instructed that one randomly selected subject’s responses will be used to allocate money for a real kidney transplant for a cat suffering from kidney failure. After the conclusion of the experiment, $12,000 was paid to the University of Georgia College of Veterinary Medicine for the costs of one transplant surgery under the direction of Dr. Chad Schmiedt of the Small Animal Medicine & Surgery group, who also recruited and evaluated transplant candidates.

In each incentivized question, subjects are reminded of the stakes and instructed in how their decisions might be implemented to allocate an organ transplant. Subjects are told that after the experiment, “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.” The allocation could be based on either the rule rankings or the survival price lists. If the rule-based allocations are randomly selected, two of the five allocation rules will be randomly selected, and the transplant allocated according to the higher ranked rule, incentivizing the full ranking of the rules. If the survival price lists are selected, “the cat who most closely matches your choices in this section” will receive a transplant. To implement this, I use each subjects’ responses to estimate their indifference curves and then use the estimates to select between the two transplant candidates. This follows the incentive structure of Kessler et al. (2019), eliciting preferences over a variety of hypothetical scenarios with the promise that re-

\[15\] 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.
Responses will be used in a real-stakes decision. Implementing any particular row of the survival price lists would require finding two transplant candidates fitting the exact survival profiles in the list; instead, we learn subjects’ preferences and later use the elicited preferences to select between the two eligible transplant candidates.

4.4 Payments to Others

To study equality preferences across the domains of survival and money, I ask subjects to select between bundles of low-stakes payments for future study participants (maximum $4.00). 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 for equality.

The four payment questions mimic the survival price lists, with one future participant receiving a high and another receiving a low payment. Payment values are similar to patient survival times in the survival price lists, at a rate of $0.10 per month. Payment recipients 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.

4.5 Risk & Time Preferences

Following Dean & Ortoleva (2019), I ask nine questions 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 survival price lists: subjects identify a switching point between a risky payment and a certain one.

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16 The estimation procedure is described in Section 5.1. 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. The stakes are described to subjects as shown in Appendix Figures B.6 and B.7.

17 See Panel B of Appendix Table B.1 for list values, Appendix Figure B.9 for instructions, and Appendix Figure B.10 for a sample question.
or between a near-term payment and a distant one (see Appendix B for additional details). One row from one question is randomly selected to determine the subject’s bonus payment.

5 Analysis & Results

The main subject sample consists of 311 Mechanical Turk workers recruited in October 2020. Table I shows summary statistics describing the study sample. Subjects range in age 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%)

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 social issues and 46.3% identifying as liberal on economic issues.

This section describes the results of the experiment. Section 5.1 examines subjects’ survival tradeoffs and rule-based decisions and estimates subjects’ preferences for efficiency and equality. 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 unincentivized decisions.

5.1 Survival Tradeoffs and Rule Selections

5.1.1 Survival Tradeoffs

We first examine switching points in incentivized survival price lists. Only 3.9% of subjects consistently transplant the shorter-lived patient, suggesting that few subjects prefer to save the shorter-lived patient at all costs. Instead, the vast majority (80.4%) consistently switch from the shorter-lived to the

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18 I restricted participation to US-based workers having completed at least 500 previous tasks with an approval rate of at least 99%. I also conducted two experimental pilots with different sample restrictions.

19 Two subjects did not select either male or female when asked their gender.
longer-lived patient when the gains to the longer-lived patient are sufficiently high.\footnote{While preferences are generally well behaved, a small share of subjects (4.2\%) always allocate to the longer-lived patient, including in allocations that added no survival benefit. Recall that two survival price lists include an option that provides no survival benefit to the recipient; 8.7\% of subjects select at least one of these dominated options.}

Following the framework described in Section \cite{3}, I estimate indifference curves by treating each row of a survival price list as a comparison between two survival bundles. Following Fisman et al. (2007), I assume a constant elasticity of substitution (CES) utility function with equal weight on the survival of the two patients:

$$u(x_A, x_B) = \left( \frac{1}{2} x_A^\rho + \frac{1}{2} x_B^\rho \right)^{\frac{1}{\rho}}$$

The equal weight of each patient’s survival time in the utility function amounts to an assumption that the agent’s utility does not depend on which patient is labeled A or B. The CES utility function is flexible enough to capture a wide range of preferences, nesting perfect substitutes and Leontief preferences under different values of $\rho$. When $\rho$ approaches $-\infty$, the utility function approaches Leontief utility; when $\rho$ approaches 0, the utility function approaches Cobb–Douglas utility; and when $\rho = 1$, the utility function is linear, suggesting the survival times of the two patients are perfect substitutes.\footnote{Appendix Figure C.1 shows a variety of indifference curves described by different values of $\rho$.}

To aid in interpreting the results, I reparameterize $\rho$ and define a 2:1 fairness discount. The 2:1 fairness discount (or 2:1 $FD$) measures the share of total payoffs an agent would forego in order to move from an unequal, 2:1 distribution of payoffs (i.e., where one person receives twice as much as the other) to an equal distribution. That is, if an agent is indifferent between an outcome bundle $(66\frac{2}{3}, 33\frac{1}{3})$ and $(45, 45)$, the agent is willing to forego 10 units of the 100 total units in the first bundle to reach an equal distribution; a 2:1 $FD$ of 10\%. This measure is a simple transformation of the parameter $\rho$ with CES indifference curves.\footnote{The fairness discount can be calculated for any payoff ratio; I selected 2:1 for ease of interpretation. To find the fairness discount transformation, note that we are looking for a}
patient in every case would imply a 2:1 fairness discount of 12.1%.

The distribution of subject-level average 2:1 fairness discounts in incentivized transplant allocations is shown in Figure III. On average, subjects are willing to give up 6.1% of total survival time to shift from a 2:1 survival ratio to equality, but most subjects fall in the extremes: 23.5% of subjects have a strong preference for increasing total survival time, viewing survival times for each patient as near-perfect substitutes (2:1 FD < 1%) and 40.5% have strong preferences for survival time equality (2:1 FD > 9%).

5.1.2 Rule-Based Allocations

Almost all subjects prefer to transplant some patient; 90.0% of subjects rank the no-transplant option last among available rules. Subjects prefer to use transplants to maximize the increase in survival (ranked first by 39.9% of subjects) and to maximize the use of the organ (ranked first by 35.7% of subjects). Maximizing the minimum survival time is the third most popular, ranked first by 11.9% of subjects. Random allocation is the least popular way to allocate a transplant, ranked in fourth place by most subjects (above no transplant). The CDF of subject rule rankings is shown in Figure IV.

The popularity of maximizing the use of the transplant is surprising from the point of view of survival time efficiency, since it can lead to transplants that provide little survival benefit (i.e., transplanting a patient who would have survived a long time even without a transplant). However, the popularity of

\[ \text{fraction } \alpha \text{ that makes the agent indifferent between an uneven split of some amount } x \text{ and an even split of } \alpha x. \]

Let the uneven split be represented by the bundle \((\lambda x, (1 - \lambda)x)\) where \(\lambda \in [0, 1]\). Setting \(u(\lambda x, (1 - \lambda)x) = u(\alpha x/2, \alpha x/2)\) and solving for the fairness discount \(1 - \alpha\) with symmetric CES preferences yields

\[ 1 - \alpha = 1 - \left(\frac{\lambda^\rho + (1 - \lambda)^\rho}{2^{1 - \rho}}\right)^{\frac{1}{\rho}}. \]

I use a 2:1 fairness discount in these analyses, which sets \(\lambda = \frac{1}{3}\).

\[ \text{Subjects’ 2:1 fairness discounts are calculated based on the average CES curvature parameter } \rho \text{ in four questions of the same type. Forty-four percent of subjects make at least one selection that suggests an outward-bending indifference curve or that matches no symmetric CES indifference curve, corresponding to transplanting the longer-lived patient even when it reduces the total survival time in the system. I interpret these decisions as suggesting a strong preference for efficiency, and therefore assign CES parameter } \rho = 1 \text{ and 2:1 fairness discount of 0. Results are largely robust to alternative aggregation methods; see Appendix Section C.3 for robustness checks and Figure C.8 for the distribution of unadjusted 2:1 fairness discounts.} \]
the rule suggests a real preference among subjects. Whether this is driven by a sense of obligation to the donor, a misapplied heuristic (such as assuming all patients are equally in urgent need of transplant), or the association between a transplant and an increased quality of life is beyond the scope of this experiment.  

5.1.3 Relationship Between Survival Tradeoffs and Rules

Subjects’ choices in survival price lists do not adhere to the five allocation rules. While each rule is associated with switching points in each survival price list question, only 27.0% 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 make a subset of decisions consistent with one rule (21.5%) or switch between rules in different questions (15.1%).

While the rules don’t fully capture the dynamics of the survival tradeoffs, subjects are generally consistent in their preferences for equality or total survival across the two types of questions. Figure V shows average 2:1 fairness discounts by subjects’ top-ranked rule. Fairness discounts are significantly lower among subjects who prefer rules favoring the longer-lived patient (Maximize the Increase in Survival Time and Maximize Use of the Organ) compared to subjects who prefer equality-oriented rules (Maximize the Minimum Survival Time and Select Patient at Random).

Debates around providing liver transplants to patients with alcoholic liver disease may reflect a similar sentiment. Transplant centers typically restrict transplant to patients with a history of alcohol abuse, in part due to concerns about the misuse of a donated organ.

See Appendix Figure C.3 for the full distribution of 2:1 fairness discounts by subjects’ top-ranked rules.
5.2 Preferences Across Domains

To measure equality preferences over money, we can calculate 2:1 fairness discounts using subjects’ payment to other survey participants. As in the transplant allocation decisions, subject preferences are approximately bimodal: 32.2% of subjects have a 2:1 fairness discount of less than 1%, substituting almost perfectly between payments to low-pay and high-pay participants; 25.7% of subjects have a 2:1 fairness discount of at least 9%, suggesting a strong preference for equality.

Aversion to inequality in payments predicts aversion to survival time inequality, suggesting that preferences for redistribution are correlated across domains. Figure VI shows average 2:1 fairness discounts in transplant decisions for different fairness discounts in monetary payments; regression results are shown in Appendix Table C.3. While these equality preferences are correlated, they are not identical: 11.9% of subjects display preferences for total payoffs (2:1 FD less than 1%) in either payments or survival, while holding strong preferences for equality (2:1 FD greater than 9%) in the other dimension.

Risk preferences and temporal discounting also predict aversion to survival inequality — this is comforting, since preferences over survival are fundamentally preferences over risky outcomes realized over time. Subjects who display a higher preference for short-term payments also show a preference for saving the lives of shorter-lived patients in the short term; subjects who demonstrate present bias (a disproportionate preference for immediate payments over future payments) display an even stronger preference for saving shorter-lived patients (see Appendix Table C.1 for regression results). Demographics, political leaning, and pet ownership are not predictive of survival time inequality aversion (see Appendix Table C.2).

The distribution of 2:1 fairness discounts is shown in Appendix Figure C.5. Fifty-seven percent of subjects make at least one selection that suggests an outward-bending indifference curve. This corresponds to giving the high payment to the wealthier subject, even when it reduces the total amount of payments. As in transplant allocations, I interpret these decisions as suggesting a strong preference for efficiency, and therefore assign CES parameter $\rho = 1$ and 2:1 fairness discount of 0.
5.3 The Effect of Incentives

Are hypothetical responses reliable in this context? Recall that subjects respond to the same questions under unincentivized and incentivized conditions, allowing us to examine the effect of incentives by comparing responses under the two conditions.

In the aggregate, rule rankings and survival tradeoffs are nearly identical across conditions (see Figure VII for the CDFs of rule rankings, and Appendix Figure C.4 for the distribution of 2:1 fairness discounts in the three treatment conditions). However, many individual subjects do change their reported preferences: 46% of subjects rank rules differently under incentivized and unincentivized conditions. This result — consistency across treatments in the aggregate, coupled with high churn across treatments at the individual level — suggests noisy decisionmaking may be driving individual-level variation. We explore this hypothesis in the replication experiment described in the next section.

6 Replication Experiment

In the aggregate, the results of the main experiment are strikingly similar under hypothetical and incentivized conditions, and in transplants for humans and cats. One may be concerned that correlations between treatment conditions are overstated due to subjects’ desire to be consistent in their decisions. To what extent are these results driven by the within-subject design?

The experimental results also highlight a large share of subjects who change responses between the unincentivized and incentivized conditions. Random decisionmaking could generate similar results: individual-level variation across treatments, but small differences on average between treatments. To what extent do these results represent substantive differences in preferences, and how much could be explained by simple noise in the decision process? To answer these questions, I conducted a replication experiment with a hybrid between/within subject design, allowing me to rule out cognitive dissonance
as the main driver of similarities across treatments, and to estimate the role of noise in subjects’ decisions.

6.1 Replication Design

The replication experiment employs a hybrid between- and within-subject design. Subjects were randomized into one of three treatments: Incentivized Cat, Unincentivized Cat, or Unincentivized Human. In each treatment, subjects made choices of only one type: subjects in the Incentivized Cat treatment made choices only for the real cat transplant, while subjects in the unincentivized were asked only about hypothetical transplants. Decisions in the incentivized treatment had a probability of being used to allocate a real feline transplant, as in the main experiment. The questions were identical to those in the main experiment, and included both survival price lists and rule selection. This design alleviates concerns that cognitive dissonance drives similar responses across treatments. Instead, comparing responses in incentivized and unincentivized conditions identifies the effect of providing life-and-death stakes, while comparing unincentivized responses between Unincentivized Human and Unincentivized Cat treatments demonstrates how preferences differ across the species of the transplant recipient.

To address noise in the decision process, I repeat each question twice in a given treatment. This within-subject element of the hybrid design allows me to measure pure decision noise: how often do subjects change their selections when faced with the same question? Changing responses in repeated questions would suggest inconsistent preferences or indifferences; consistent responses would suggest that patient species and question stakes drive differences between treatments.

6.2 Replication Results

The replication sample includes 988 new subjects from Mechanical Turk (after discarding 12 ineligible or incomplete responses), randomized to one of three treatments. Appendix Table C.4 shows summary statistics of demographics
information for each treatment group, demonstrating that characteristics are balanced across treatments.

As in the main experiment, subjects show remarkably consistent preferences across treatments. Shares of subjects selecting each rule are almost identical across treatments, and they closely match selections in the main experiment (CDFs of rule rankings are shown in Figure VIII). Maximizing the increase in survival time and maximizing the use of the organ remain the most popular rules in all treatments, with maximizing the minimum survival most often ranked third. The least popular options in all treatments are randomizing between recipients and performing no transplant.\footnote{Since subjects rank rules twice in repeated questions, I use each subject’s initial rule ranking in this analysis. Appendix Figure \ref{fig:rule_rankings} shows that these results are robust to analyzing subject’s second rule ranking in repeated questions. Survival price list choices are also similar across incentivized and hypothetical treatments, as shown in Appendix Figure \ref{fig:price_lists} and described in Appendix \ref{appendix:incentives}.}

In the main experiment, subjects display a surprising degree of variation in their responses across treatments. In the replication experiment, 41–44% of subjects in each treatment change their rule rankings in repeated questioning (compared to 46% changing responses across treatments in the main experiment). Inconsistency rates are similar across treatments, both in rule rankings and survival price lists.\footnote{Incentives cause no significant difference in the share of subjects who change responses in repeated survival price lists (78.7\% in unincentivized questions versus 79.5\% in incentivized questions; $p$-value=0.81) or the magnitude of the changes ($p$-value=0.67). See Appendix Table \ref{table:incentives} for various measures of decision inconsistency in the replication experiment.}

To summarize, consistency across treatments in the main experiment is not driven by the within-subject design; subjects display the same distributional preferences for survival times of humans and cats, and under incentivized and unincentivized conditions, in the replication experiment. However, decisionmaking is noisy: subjects change responses frequently in repeated questions. Decision noise could account for essentially all individual-level differences across treatments observed in the main experiment.
7 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 choose between possible bundles of survival times by setting allocation rules, how well their decisions reflect society’s preferences has been largely ignored in research. In this paper, I introduce an experimental methodology for identifying preferences 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 trading off between total survival time and equality.

The results indicate a gap between public preferences and the practice of organ transplant allocation in the US. Most experimental subjects respond to increases in total survival, providing the transplant to the patient with the largest gain in survival time, even if those gains accrue to the longer-lived patient. About 80% of subjects prefer to transplant a longer-lived patient when the gains from transplant are sufficiently high; a plurality of subjects (40%) prefers a rule that maximizes the increase in survival time over all other available rules. Only a small share (3.9%) of subjects prefer to give the transplant to the shorter-lived patient at the expense of longer-lived patient in every case; 12% of subjects choose this as their most preferred rule. These results suggest that Rawlsian equality aimed at helping the worst-off patient may not be a good model of society’s preferences over survival. In the US, priority on the liver transplant waitlist is based primarily on medical urgency, and ignores the potential benefit from transplant; this approach does not seem to align well with society’s preferences for increasing total patient survival.

Lexicographic preferences over post-transplant time are common, with a large share of subjects choosing to maximize the amount of time the transplanted organ is used. Thirty-seven percent 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 get utility out of the appropriate use of a valuable organ donation, aside from the survival time that the transplant generates. Ongoing controversies in organ transplantation, such as whether to provide transplants to patients suffering from alcoholic liver disease, may reflect the view that the “appropriate” use of an organ is as important as the increase in survival time that the transplant makes possible.

While fairness and equality have been studied in both the lab and the field, most economic treatments of these issues are limited to the monetary domain. 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 money and organ transplants, but decisions in one domain predict decisions in the other.

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.

Li (2017) argues that economists should evaluate policies from a position of “informed neutrality between reasonable ethical positions” (Li 2017, p. 707), rather than advocating for a particular ethical framework. However, not all Pareto-efficient outcomes are equal, and choosing an optimal outcome requires understanding society’s preferences. This paper demonstrates a path for using incentivized experiments to improve allocations constrained by challenging ethical tradeoffs.
Figure I: 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 when 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 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.
Figure II: Sample Decision Table

<table>
<thead>
<tr>
<th>PATIENT A</th>
<th>PATIENT B</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO TRANSPLANT: 4 MONTHS</td>
<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
<tr>
<td>TRANSPLANT: 5 MONTHS</td>
<td>TRANSPLANT: 5 MONTHS</td>
</tr>
<tr>
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<td>OR</td>
</tr>
<tr>
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<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
<tr>
<td>TRANSPLANT: 5 MONTHS</td>
<td>TRANSPLANT: 6 MONTHS</td>
</tr>
<tr>
<td>OR</td>
<td>OR</td>
</tr>
<tr>
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<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
<tr>
<td>TRANSPLANT: 5 MONTHS</td>
<td>TRANSPLANT: 7 MONTHS</td>
</tr>
<tr>
<td>OR</td>
<td>OR</td>
</tr>
<tr>
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<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
<tr>
<td>TRANSPLANT: 5 MONTHS</td>
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</tr>
<tr>
<td>OR</td>
<td>OR</td>
</tr>
<tr>
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<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
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<td>OR</td>
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<tr>
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<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
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<td>TRANSPLANT: 5 MONTHS</td>
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</tr>
<tr>
<td>OR</td>
<td>OR</td>
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<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
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<td>TRANSPLANT: 5 MONTHS</td>
<td>TRANSPLANT: 11 MONTHS</td>
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<tr>
<td>OR</td>
<td>OR</td>
</tr>
<tr>
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<td>NO TRANSPLANT: 5 MONTHS</td>
</tr>
<tr>
<td>TRANSPLANT: 5 MONTHS</td>
<td>TRANSPLANT: 12 MONTHS</td>
</tr>
<tr>
<td>OR</td>
<td>OR</td>
</tr>
</tbody>
</table>

A sample survival price list with a response selected. Each row represents a pair of patients. 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.
Figure III: 2:1 Fairness Discounts in Incentivized Transplant Allocations

Distribution of subject-level averages of 2:1 fairness discount in incentivized cat survival tradeoff elicitation decisions. Averages are taken across all four survival price lists; fairness discount is bounded below at 0. A 2:1 fairness discount of 0 indicates no aversion to inequality; high fairness discounts indicate large aversion to inequality. Mean: 6.1%. Sample: 311 subjects in main experiment.
Figure IV: CDF of Ranking for Incentivized Cat Transplant Rules

Cumulative distribution function (CDF) of subject rankings of incentivized cat transplant allocation rules. The five rules include *Maximize the Increase in Survival Time* (Max Increase), *Maximize Use of the Organ* (Max Organ Use), *Maximize the Minimum Survival Time* (Max Min), *Select Patient at Random* (Random), and *Perform No Transplant* (No Transplant). Sample: 311 subjects in main experiment.
Bar heights indicate the average 2:1 fairness discount in incentivized cat survival price lists for subjects ranking each rule as most preferred in incentivized cat rule rankings. Higher fairness discounts indicate larger aversion to inequality. The five rules include *Maximize the Increase in Survival Time* (Max Increase — n = 124), *Maximize Use of the Organ* (Max Use — n = 111), *Maximize the Minimum Survival Time* (Max Min — n = 37), *Select Patient at Random* (Random — n = 28), and *Perform No Transplant* (No Transplant — n = 11). Spikes represent 95% confidence intervals. Sample: 311 subjects in main experiment.
Figure VI: 2:1 Fairness Discounts in Payment and Transplant Allocation

Binned scatter plot of subject-level averages of 2:1 fairness discount in payment allocation questions and incentivized cat transplant allocation questions. Higher fairness discounts indicate a larger aversion to inequality. Regression results in Appendix Table C.3 show that a 10 percentage point increase in payment fairness discount is associated with 4.1 percentage point increase in survival time fairness discount. Sample: 311 subjects in main experiment.
Figure VII: Distribution of Rule Rankings Across Treatment Conditions

(a) Maximize Increase in Survival Time
(b) Maximize Minimum Survival Time
(c) Maximize Use of the Organ
(d) Select Patient at Random
(e) Perform No Transplant

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 the Increase in Survival Time, Maximize the Minimum Survival Time, Maximize Use of the Organ, Select Patient at Random, and Perform No Transplant. Sample: 311 subjects in main experiment.
Figure VIII: Rule Rankings Across Treatment Conditions, Between Subjects

(a) Maximize Increase in Survival Time
(b) Maximize Minimum Survival Time
(c) Maximize Use of the Organ
(d) Select Patient at Random
(e) Perform No Transplant

CDFs of first-decision rule rankings under Incentivized Cat, Unincentivized Cat, and Unincentivized Human conditions in the between-subject replication experiment. Each figure shows the distribution of rankings for one of the five allocation rules (Maximize the Increase in Survival Time, Maximize the Minimum Survival Time, Maximize Use of the Organ, Select Patient at Random, and Perform No Transplant) based on the first set of rankings submitted by each subject. Sample: 988 subjects in replication experiment.
Table I: Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Female</td>
<td>0.41</td>
<td>0.49</td>
</tr>
<tr>
<td>Asian</td>
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</tr>
<tr>
<td>Black or African American</td>
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</tr>
<tr>
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<td>0.42</td>
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<tr>
<td>Multi-racial or other</td>
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</tr>
<tr>
<td>Hispanic</td>
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<td>Pet Owner</td>
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<tr>
<td>Cat Owner</td>
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<td>Liberal on Social Issues</td>
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<td>0.49</td>
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<tr>
<td>Liberal on Economic Issues</td>
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</tr>
<tr>
<td>Observations</td>
<td>311</td>
<td></td>
</tr>
</tbody>
</table>

Table shows the means and standard deviations of experimental subjects’ demographic and personal characteristics in the main sample.
References

URL http://www.aeaweb.org/articles?id=10.1257/aer.20180771

URL http://www.nber.org/papers/w25607


URL http://www.jstor.org/stable/2692289

URL http://www.jstor.org/stable/2692289

URL https://www.aeaweb.org/articles?id=10.1257/jep.21.3.3


Eliciting Preferences over Life and Death: Experimental Evidence from Organ Transplantation

Colin D. Sullivan

APPENDICES

Three appendices describe the ethical considerations of the experiment (Appendix A), the experimental design and survey materials (Appendix B), and additional results (Appendix C).

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.

The financial and methodological reasons for providing only one 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.

\footnote{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.}
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 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. 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

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30 So-called “no-kill shelters” are relatively rare in the US, and even in these shelters up to 10% of animals may be euthanized.
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. 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?**

As part of the experiment, we contribute $12,000 toward a transplant, making it possible to save the life of a cat who would otherwise die. This donation will ease the financial burden of transplant without eliminating it completely; 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. 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 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.

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31. Note in particular that although one cat receives a medical treatment and the other does not, 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.

32. Even in “no-kill” shelters, up to 10% of animals are euthanized.
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 & 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 & 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
The burden of decision shouldn’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 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.
B Experimental Design Appendix

This appendix provides details on the design of the experiment. After accepting the Human Intelligence Task (HIT) on Amazon’s Mechanical Turk, workers interested in participating in the study were directed to the primary and secondary consent forms (Figures B.1 and B.2). The secondary consent form was required to alert subjects to the high stakes of the organ transplantation decisions.

B.1 Time & Risk Elicitation

After acknowledging the consent forms, subjects begin the experiment by making nine decision designed to elicit their preferences over temporal discounting and risk. Subjects respond to six questions in which I elicit indifferences between payments in different time periods. Each question elicits a value $x$ at which the subject is indifferent between payment $y$ in $s$ weeks and payment $x$ in $t$ weeks. The values $\{t, y, s\}$ in each question follow those used by Dean & Ortoleva (2019). Three questions with parameter values $\{5, 6, 6\}$, $\{6, 8, 7\}$ and $\{5, 10, 7\}$ are used to elicit future discounting, and three questions with parameter values $\{0, 6, 1\}$, $\{0, 8, 1\}$ and $\{0, 10, 2\}$ elicit present discounting. Indifferences are elicited using multiple price lists, as shown in Figure B.3.

Risk preferences are also elicited following Dean & Ortoleva (2019). Subjects select certainty equivalents of three 50/50 lotteries using multiple price lists: $6 and $0, $8 and $2, and $10 and $0. A sample multiple price list is shown in Figure B.4.

B.2 Transplant Allocation

After the initial elicitation of time and risk preferences, subjects make a series of decisions on allocating organ transplants. This segment of the experiment begins with a brief introduction to the issue of organ transplantation in humans and felines (Figure B.5). Subjects make two types of transplant allocation decisions (survival price lists and rule-based) under three different
conditions (hypothetical feline patients, hypothetical human patients, or real feline patients). Subjects complete survival price lists before rule-based allocations. Within each condition, subjects respond to four questions varying in the survival time of each patient. Section-level instructions and question-specific instructions are shown below for the survival tradeoff elicitation for real feline patients (Figures B.6 and B.7).

Subject next make rule-based allocation decisions by ranking the five available rules in preference order. A sample rule-based question is shown in Figure B.8

B.3 Payments to Others

Subjects make four decisions allocating funds between two other participants in the study. One of the four questions is randomly selected for implementation. Payment amounts follow the survival times in the survival price lists, with one month of survival translating to $0.10. Instructions are shown in Figure B.9, and a sample question is shown in Figure B.10

B.4 Ethical Scenario

In a final hypothetical question, subjects are asked to consider an ethical dilemma in a hypothetical scenario. The question (derived from Elías et al. (2019)) is shown in Figure B.11. 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.
### Table B.1: Price List Parameters

**Panel A: Transplant Allocation**

<table>
<thead>
<tr>
<th>Question</th>
<th>Patient A Survival</th>
<th>Patient B Survival</th>
<th>Without Transplant</th>
<th>Min. with Transplant</th>
<th>Max. with Transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Without Transplant: 1 month With Transplant: 6 months</td>
<td>2 months</td>
<td>6 months</td>
<td>36 months</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Without Transplant: 1 month With Transplant: 2 months</td>
<td>2 months</td>
<td>2 months</td>
<td>24 months</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Without Transplant: 4 months With Transplant: 5 months</td>
<td>5 months</td>
<td>5 months</td>
<td>24 months</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Without Transplant: 6 months With Transplant: 24 months</td>
<td>9 months</td>
<td>24 months</td>
<td>48 months</td>
<td></td>
</tr>
</tbody>
</table>

**Panel B: Payments to Others**

<table>
<thead>
<tr>
<th>Question</th>
<th>Participant A Payment</th>
<th>Participant B Payment</th>
<th>Low</th>
<th>Min. with High</th>
<th>Max. with High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low: $0.10</td>
<td></td>
<td>$0.20</td>
<td>$0.60</td>
<td>$1.20</td>
</tr>
<tr>
<td></td>
<td>High: $0.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Low: $0.10</td>
<td></td>
<td>$0.20</td>
<td>$0.20</td>
<td>$1.00</td>
</tr>
<tr>
<td></td>
<td>High: $0.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Low: $0.40</td>
<td></td>
<td>$0.50</td>
<td>$0.50</td>
<td>$1.50</td>
</tr>
<tr>
<td></td>
<td>High: $0.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Low: $0.60</td>
<td></td>
<td>$0.90</td>
<td>$2.40</td>
<td>$4.00</td>
</tr>
<tr>
<td></td>
<td>High: $2.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table shows the parameters of the survival tradeoff elicitation transplant and monetary allocation questions presented to each subject. In each question, the subject chooses to allocate a valuable item to one of two potential recipients in a series of comparisons. In transplant questions, the subject allocates an organ transplant to Patient A or Patient B, while Patient B’s survival without transplant, and Patient A’s survival with and without transplant remain constant in each comparison, and Patient B’s survival with transplant varies between the minimum and maximum given in columns 4 and 5. In monetary questions, the subject allocates a high value payment to either Participant A or B. 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 the minimum and maximum given in columns 4 and 5.
Primary consent form displayed to all subjects before beginning the experiment.
Figure B.2: 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 B.3: Sample Time Preference Question

<table>
<thead>
<tr>
<th>OPTION A</th>
<th>OR</th>
<th>OPTION B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$0.00 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$0.10 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$0.20 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$0.30 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$0.40 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$0.50 IN 6 WEEKS</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$7.70 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$7.80 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$7.90 IN 6 WEEKS</td>
</tr>
<tr>
<td>$8 IN 7 WEEKS</td>
<td>OR</td>
<td>$8.00 IN 6 WEEKS</td>
</tr>
</tbody>
</table>

Screenshot of a sample question eliciting preferences over payments made at different times. Ellipsis indicates additional omitted rows. Subjects select a switching point between the long-term payment on the left and the short term payment on the right by clicking a cell. The selected option in each row changes color to make the selections clear.
Figure B.4: Sample Risk Preference Question

<table>
<thead>
<tr>
<th>OPTION A</th>
<th>50% CHANCE OF $2; 50% CHANCE OF $8</th>
<th>OR</th>
<th>100% CHANCE OF $2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50% CHANCE OF $2; 50% CHANCE OF $8</td>
<td>OR</td>
<td>100% CHANCE OF $2.10</td>
</tr>
<tr>
<td></td>
<td>50% CHANCE OF $2; 50% CHANCE OF $8</td>
<td>OR</td>
<td>100% CHANCE OF $2.20</td>
</tr>
<tr>
<td></td>
<td>50% CHANCE OF $2; 50% CHANCE OF $8</td>
<td>OR</td>
<td>100% CHANCE OF $2.30</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% CHANCE OF $2; 50% CHANCE OF $8</td>
<td>OR</td>
<td>100% CHANCE OF $7.80</td>
<td></td>
</tr>
<tr>
<td>50% CHANCE OF $2; 50% CHANCE OF $8</td>
<td>OR</td>
<td>100% CHANCE OF $7.90</td>
<td></td>
</tr>
<tr>
<td>50% CHANCE OF $2; 50% CHANCE OF $8</td>
<td>OR</td>
<td>100% CHANCE OF $8.00</td>
<td></td>
</tr>
</tbody>
</table>

Screenshot of a sample question eliciting preferences over risky payments. Ellipsis indicates additional omitted rows. Subjects select a switching point between the 50/50 gamble on the left and the certain payment on the right by clicking on a cell. The selected option in each row changes color to make the selections clear.
Figure B.5: Introduction to Organ Transplantation

Organ Transplantation in the United States

Currently, over 100,000 human patients are waiting for an organ transplant in the US, and more than 6,200 people die each year while waiting for a transplant. Surgeons can save lives by transplanting kidneys, livers, heart, and lungs into sick patients.

Organ failure can affect cats the same way it affects humans. Three veterinary transplant centers in the US provide life-saving kidney transplants for sick cats.

This survey will ask your opinions about allocating organ transplants for humans and for cats.

You may see similar questions multiple times. Please read the instructions in each section carefully and answer each question as best you can.

Subjects view a short description of human and feline organ transplantation in the US before making allocation decisions.
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 B.7: Survival Price List 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.

Before each survival price list, subjects are reminded of the stakes, the possible implementation of their choice, and the instructions for the task. The figure shows a screenshot of the instructions preceding a survival price list in the incentivized cat condition.
In rule-based questions, subjects are asked to rank five rules that could determine how to allocate a single organ transplant between two candidates. Subjects are also reminded of the stakes and implementation method before each question.
Figure B.9: Instructions for Payments to Others

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. Before each question, subjects are reminded of the stakes, possible implementation, and instructions to complete the task.
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.
Figure B.11: 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 unconscious 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

Subjects react to an ethical scenario based on the common “trolley problem.” This formulation of the scenario is based on that used in [Elias et al. (2019)]. There are no payments or incentives involved in this question.
C Results Appendix

This appendix provides supplementary results from the main experiment (Section C.1) and replication experiment (Section C.2), as well as robustness checks on the main results C.3.

C.1 Supplementary Results in Main Experiment

Figure C.1 demonstrates a range of indifference curves available under the assumption of constant elasticity of substitution with equal weight on the survival times of the two patients. Figure C.2 shows the distribution of individual-level parameter $\rho$, describing the curvature of the indifference curve; the 2:1 fairness discount described in the main results is a reparameterization of $\rho$. Figure C.3 shows the distribution of 2:1 fairness discounts separately by the subjects’ most preferred rule: subjects who select the rule maximizing the minimum survival time also display higher 2:1 fairness discount, while subjects who select the rule maximizing the increase in survival time show low 2:1 fairness discounts in the survival price lists. The distributions of 2:1 fairness discounts shown in Figure C.4 demonstrates that allocations are almost identical across patient species and between incentivized and unincentivized conditions.

Table C.1 shows the relationship between survival equality tradeoffs and risk and time preferences, regressing 2:1 fairness discounts in incentivized survival price lists on risk aversion, discount rate, and present bias. On the other hand, Table C.2 shows that demographics and other personal characteristics do not predict fairness discounts.

Figure C.5 shows the distribution of 2:1 fairness discount in monetary payments. Table C.3 shows the relationship between 2:1 fairness discounts in survival times and monetary payments, indicating that a 10 percentage point increase in 2:1 FD in payments is associated with a 4.1 percentage point increase in 2:1 FD in survival times.
Table C.1: 2:1 Fairness Discounts and Preferences over Risk and Time

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Aversion</td>
<td>-0.0214 (0.00686)</td>
</tr>
<tr>
<td>Temporal Discount Rate</td>
<td>0.00305 (0.00144)</td>
</tr>
<tr>
<td>Present Bias</td>
<td>0.0150 (0.00494)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0570 (0.00377)</td>
</tr>
</tbody>
</table>

Observations: 311
Adjusted $R^2$: 0.053

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

Table shows OLS regression of 2:1 fairness discounts estimated from transplant decisions on parameter estimates for risk aversion and temporal discounting estimated from incentivized bonus payment decisions. Risk Aversion is the individual-level average degree of risk aversion displayed over three different questions comparing lotteries against certain payments; Temporal Discount Rate is the individual-level average discount rate calculated from six questions, including three questions about discount from the present versus the future, and three questions about comparing the value of payments at different future dates, with higher values of Temporal Discount Rate indicating more weight on short-term payoffs relative to long-term payoffs; Present Bias is an indicator variable for whether the discount rate displayed in questions involving immediate payouts is higher than the rate in the questions comparing payments at different future dates. Robust standard errors are reported in parentheses. $R^2$ is indicated. Sample: 311 subjects in main experiment.
Table C.2: 2:1 Fairness Discount and Subject Demographics

<table>
<thead>
<tr>
<th></th>
<th>2:1 Fairness Discount in Incentivized Survival Decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>-0.000802</td>
</tr>
<tr>
<td></td>
<td>(0.00543)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.000458</td>
</tr>
<tr>
<td></td>
<td>(0.000259)</td>
</tr>
<tr>
<td>Asian</td>
<td>-0.0145</td>
</tr>
<tr>
<td></td>
<td>(0.0109)</td>
</tr>
<tr>
<td>Black or African American</td>
<td>-0.00185</td>
</tr>
<tr>
<td></td>
<td>(0.00891)</td>
</tr>
<tr>
<td>Multi-racial or other</td>
<td>-0.00402</td>
</tr>
<tr>
<td></td>
<td>(0.00893)</td>
</tr>
<tr>
<td>Cat Owner</td>
<td>0.00275</td>
</tr>
<tr>
<td></td>
<td>(0.00539)</td>
</tr>
<tr>
<td>Liberal on Economic Issues</td>
<td>0.00158</td>
</tr>
<tr>
<td></td>
<td>(0.00675)</td>
</tr>
<tr>
<td>Liberal on Social Issues</td>
<td>0.000317</td>
</tr>
<tr>
<td></td>
<td>(0.00695)</td>
</tr>
<tr>
<td>Trolley Problem Consequentialist</td>
<td>-0.00477</td>
</tr>
<tr>
<td></td>
<td>(0.00688)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0865***</td>
</tr>
<tr>
<td></td>
<td>(0.0162)</td>
</tr>
<tr>
<td>Observations</td>
<td>311</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.020</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table shows OLS regression of 2:1 fairness discount estimated from incentivized transplant decisions on subject characteristics. Robust standard errors are reported in parentheses. $R^2$ is indicated. Sample includes 311 experimental subjects in main experiment.
C.2 Replication Results

This section describes supplementary results from the replication experiment. Table C.4 shows summary statistics for the experimental sample, demonstrating balance of observable characteristics across treatment groups. The distribution of 2:1 fairness discounts estimated from incentivized survival price lists is very similar to that estimated from unincentivized decisions (see Figure C.6). Figure C.7 plots the CDFs of rule rankings across treatments for subjects’ second responses in repeated questions, demonstrating that the similarity of rankings across species and incentive conditions is consistent in repeated questions. Various measures of decision noise in repeated questions are shown in Figure C.5.

C.3 Robustness Checks

Results are largely robust to alternative aggregation methods and sample restrictions. Figure C.8 shows 2:1 fairness discounts in incentivized survival tradeoff elicitation with no adjustments for outward-bending utility functions. Negative fairness discounts indicate that a subject has outward-bending indifference curves, preferring an increase in survival to the longer-lived patient over an increase of the same size to the shorter-lived patient.

Limiting the sample to subjects who passed all comprehension tests with no errors leads to small changes in the main results. About a quarter of subjects (25.1%) fail at least one comprehension check on the first try. Subjects who make a mistake in the comprehension checks are more equality-seeking in their allocations, with an average 2:1 fairness discount of 7.7% compared to 5.6% among subjects with no mistakes (p-value < 0.01; see Figure C.9). This difference appears to be driven by meaningful differences in preferences, rather than confusion: subjects who failed at least one comprehension check are more likely to pick maximizing the minimum survival time as their top-choice rule than other subjects (21.7% versus 8.5%, p-value < 0.01), and less likely to choose the rule maximizing the increase in survival times (24.4% versus 45.1%, p-value < 0.01). However, this group has a relatively small effect on the
overall results, and removing subjects who fail a comprehension check doesn’t change the ranking of rules (see Figure C.10).
Sample indifference curves possible with constant elasticity of substitution and equal weight on the survival times of the two patients. As in the example in Figure I, Patient A lives for 24 months with a transplant, and Patient B lives for nine months without a transplant. The point representing this survival bundle is plotted at (24, 9). The figure shows three possible indifference curves passing through this point, representing $\rho \in \{-3, 0.1, 1\}$. 
Figure C.2: Distribution of $\rho$ in Incentivized Transplant Allocations

Distribution of subject-level averages of CES indifference curve parameter $\rho$ in incentivized survival price lists. Averages are taken across all four survival price lists. $\rho$ cannot exceed one by design. $\rho = 1$ represents perfect substitution between the two patients; $\rho \to -\infty$ represents Leontief preferences. Sample: 311 subjects in main experiment.
Figure C.3: Distribution of 2:1 Fairness Discounts by Top-Ranked Rule

Kernel density plot of estimated 2:1 fairness discounts by subject’s top-ranked allocation rule in incentivized cat condition. The five rules include 
*Maximize the Increase in Survival Time* (Max Increase), *Maximize Use of the Organ* (Max Use), *Maximize the Minimum Survival Time* (Max Min), *Select Patient Randomly* (Random), and *Perform No Transplant* (No Transplant). Sample: 311 subjects in main experiment.
Figure C.4: Distribution of 2:1 Fairness Discount by Treatment Condition

Distribution of subject-level average 2:1 fairness discounts by treatment condition in main experiment. Fairness discounts are calculated as the average across four questions in a treatment condition. Sample: 311 subjects in main experiment.
Figure C.5: Distribution of 2:1 Fairness Discount in Payment Allocation

Distribution of subject-level averages of 2:1 fairness discounts in allocating payments to other experimental subjects. Fairness discounts are calculated as the average across four multiple price lists. Fairness discounts are bounded below at zero to avoid outward-bending indifference curves. Mean 2:1 $FD$: 4.9%. Sample: 311 subjects in main experiment.
Table C.3: 2:1 Fairness Discount in Payment and Transplant Allocation Decisions

<table>
<thead>
<tr>
<th>2:1 Fairness Discount in Money</th>
<th>0.411***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.0591)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0408***</td>
</tr>
<tr>
<td></td>
<td>(0.00392)</td>
</tr>
<tr>
<td>Observations</td>
<td>311</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.140</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table shows OLS regression of subjects’ average 2:1 fairness discounts estimated from transplant decisions on 2:1 fairness discounts estimated from payment allocation decisions. Robust standard errors are reported in parentheses. Adjusted $R^2$ is indicated. Sample: 311 subjects in main experiment.
<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>Hypothetical Cat</th>
<th>Incentivized Cat</th>
<th>Hypothetical Human</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>41.44</td>
<td>41.64</td>
<td>41.52</td>
<td>41.13</td>
</tr>
<tr>
<td></td>
<td>(12.67)</td>
<td>(12.58)</td>
<td>(12.31)</td>
<td>(13.16)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>0.48</td>
<td>0.51</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
</tr>
<tr>
<td><strong>Asian</strong></td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td>(0.24)</td>
<td>(0.24)</td>
<td>(0.26)</td>
</tr>
<tr>
<td><strong>Black or African American</strong></td>
<td>0.06</td>
<td>0.07</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.25)</td>
<td>(0.22)</td>
<td>(0.26)</td>
</tr>
<tr>
<td><strong>White</strong></td>
<td>0.82</td>
<td>0.82</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>(0.39)</td>
<td>(0.38)</td>
<td>(0.39)</td>
<td>(0.39)</td>
</tr>
<tr>
<td><strong>Multi-racial or other</strong></td>
<td>0.06</td>
<td>0.05</td>
<td>0.08</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>(0.23)</td>
<td>(0.22)</td>
<td>(0.27)</td>
<td>(0.20)</td>
</tr>
<tr>
<td><strong>Hispanic</strong></td>
<td>0.08</td>
<td>0.06</td>
<td>0.10</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.27)</td>
<td>(0.24)</td>
<td>(0.30)</td>
<td>(0.26)</td>
</tr>
<tr>
<td><strong>Pet Owner</strong></td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>(0.43)</td>
<td>(0.43)</td>
<td>(0.43)</td>
<td>(0.44)</td>
</tr>
<tr>
<td><strong>Cat Owner</strong></td>
<td>0.39</td>
<td>0.36</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>(0.49)</td>
<td>(0.48)</td>
<td>(0.49)</td>
<td>(0.49)</td>
</tr>
<tr>
<td><strong>Liberal on Social Issues</strong></td>
<td>0.52</td>
<td>0.53</td>
<td>0.54</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
<td>(0.50)</td>
</tr>
<tr>
<td><strong>Liberal on Economic Issues</strong></td>
<td>0.39</td>
<td>0.42</td>
<td>0.39</td>
<td>0.37</td>
</tr>
<tr>
<td></td>
<td>(0.49)</td>
<td>(0.49)</td>
<td>(0.49)</td>
<td>(0.48)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>988</td>
<td>329</td>
<td>341</td>
<td>318</td>
</tr>
</tbody>
</table>

Table shows the means and standard deviations of experimental subjects’ demographic and personal characteristics in the replication sample. Standard deviations are shown in parentheses.
Distribution of subject-level average 2:1 fairness discounts by treatment condition in replication experiment. Fairness discounts are calculated as the average across four questions in a treatment condition. Mean 2:1 fairness discounts are 4.8% in the incentivized treatment, and 4.6% in the unincentivized treatment; a $t$-test fails to reject the null hypothesis that mean fairness discounts in the two treatment conditions are equal ($p$-value: 0.63). Sample: 670 experimental subjects in the replication experiment (341 in the incentivized condition, 329 in the unincentivized condition).
CDFs of second-decision rule rankings under *Incentivized Cat*, *Unincentivized Cat*, and *Unincentivized Human* conditions in the between-subject replication experiment. Each figure shows the distribution of rankings for one of the five allocation rules (*Maximize the Increase in Survival Time*, *Maximize the Minimum Survival Time*, *Maximize Use of the Organ*, *Select Patient at Random*, and *Perform No Transplant*) based on the second set of rankings submitted by each subject. Sample: 988 subjects in replication experiment.
Table C.5: Decision Noise in Rule-Based Allocation Decisions

<table>
<thead>
<tr>
<th></th>
<th>Hypothetical Cat</th>
<th>Incentivized Cat</th>
<th>Hypothetical Human</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inconsistent Ranking of Any Rule</td>
<td>0.43</td>
<td>0.42</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Inconsistent Ranking of Top-Ranked Rule</td>
<td>0.26</td>
<td>0.24</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Inconsistent Ranking of Second-Ranked Rule</td>
<td>0.29</td>
<td>0.27</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.02)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Inconsistent Ranking of Third-Ranked Rule</td>
<td>0.31</td>
<td>0.28</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.02)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Inconsistent Ranking of Fourth-Ranked Rule</td>
<td>0.24</td>
<td>0.24</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Inconsistent Ranking of Fifth-Ranked Rule</td>
<td>0.11</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Number of Inconsistencies Among Inconsistent Subjects</td>
<td>2.81</td>
<td>2.72</td>
<td>2.84</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.05)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Observations</td>
<td>329</td>
<td>341</td>
<td>318</td>
</tr>
</tbody>
</table>

Table shows rates of inconsistent rule rankings across treatments in the replication experiment. Standard errors are shown in parentheses. *Inconsistent Ranking* measures whether a subject submitted a different rank order of the available rules in repeated questions. *Number of Inconsistencies Among Inconsistent Subjects* measures how many rules change position among inconsistent rankings; note that for any inconsistent ranking, at least two rules much change position. Sample: 988 subjects in replication experiment.
Figure C.8: Distribution of 2:1 Fairness Discounts, Unadjusted

Distribution of subject-level average 2:1 fairness discounts, with no adjustments for outward-bending indifference. Fairness discounts are calculated as the average across four questions in a treatment condition; responses that are incompatible with any equally weighted CES utility function are treated as missing. Mean 2:1 $FD$: 6.2%. Share of subjects with 2:1 $FD < 0$: 16.8%. Sample: 298 experimental subjects in main experiment with at least one CES-compatible response in an incentivized survival price list.
Figure C.9: Distribution of 2:1 Fairness Discounts by Instruction Comprehension

Distribution of subject-level average 2:1 fairness discounts in incentivized cat survival price lists by performance on comprehension checks. Fairness discounts are calculated as the average across four questions in a treatment condition. Sample: 311 experimental subjects in main experiment (78 who respond incorrectly to at least one comprehension check, 233 who respond correctly in every comprehension check).
Cumulative distribution function (CDF) of subject rankings of incentivized cat transplant allocation rules among subjects who successfully passed all comprehension checks on the first try. The five rules include *Maximize the Increase in Survival Time* (Max Increase), *Maximize Use of the Organ* (Max Organ Use), *Maximize the Minimum Survival Time* (Max Min), *Select Patient at Random* (Random), and *Perform No Transplant* (No Transplant). Sample: 233 subjects in main experiment with correct initial responses in every comprehension check.