Hunger and the Gender Gap*

Yan Chen Ming Jiang Erin L. Krupka

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Abstract

Temporary changes in biological state can impact decision making differently for men and women. One such state is hunger. Food scarcity is correlated with a host of negative economic outcomes. Two explanations for this correlation are that hunger affects economic preferences directly or that hunger creates a mindset that focuses on scarcity management to the detriment of other decisions. To test these predictions, we conduct a lab-in-the-field experiment in a health screening clinic in Shanghai, recruiting participants who finish their annual physical exam either before or after they have eaten breakfast. We compare the hungry and sated groups on their risk, time and generosity preferences as well as their cognitive performance. Our results show that men and women respond to hunger in *opposite* directions, thus hunger eliminates the gender gap in decision quality, risk aversion and cognitive performance, but increases it in generosity. Finally, we examine several biomarkers and find that higher blood lipid levels are correlated with greater choice inconsistency, risk aversion and generosity. We contribute to emerging insights on the biological foundations for economic preferences and outcomes.

Keywords: hunger, scarcity, gender, risk preference, altruism

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1 Introduction

Temporary changes in biological state impact decision making differently for men and women. One such state is hunger. Individuals can experience short and long term scarcity in a number of different domains - scarcity of time, scarcity of money, scarcity of food - whenever they have less than they feel they need (Mullainathan and Shafir, 2013). This resource scarcity is associated with a host of negative outcomes. Those who experience scarcity are less likely to make wise financial investments, less likely to seek preventative health care, and more likely to play the lottery (Katz and Hofer, 1994; Blank and Barr, 2009; Kearney, 2005). Both experimental and survey results point towards robust gender differences in various decision-making tasks; the gap appears to have some roots in environmental and other roots in biological differences.

In this study, we focus on the impact of a temporary state of hunger and its differential impact on male and female decision making. Hunger is of particular interest because it affects about one-ninth of the world's population (Food and Organization, 2015). In addition, it is often a direct consequence of other forms of scarcity and has been linked with declines in both cognitive performance and productivity (Schofield, 2014; Baumeister and Vohs, 2007; Gailliot et al., 2007; Fonseca-Azevedo and Herculano-Houzel, 2012). Conversely, increasing the caloric intake among malnourished adults in India has been shown to increase cognitive performance and productivity (Schofield, 2014). Interestingly, even small increases in calories or glucose levels impact effortful cognitive processes that rely on the executive function (Askew et al., 1987; Gailliot et al., 2007). As such, hunger is an important form of resource scarcity to study in its own right; however, in doing so, we also contribute to a larger discussion of the role of scarcity on decision-making.

While women's and men's average levels of general intelligence are the same (Jensen (1998), chapter 13), economic research finds robust gender differences in risk and social preferences (such as generosity) and reaction to competition (Croson and Gneezy, 2009; Niederle, 2016). For example, both survey and experimental data find women are more risk averse in the laboratory, as well as in financial (Jianakoplos and Bernasek, 1998) and health decisions (Hersch, 1996; Jianakoplos and Bernasek, 1998). Several studies find that women don't enter competitive situations as often as men do (Gneezy et al., 2003; Gneezy and Rustichini, 2004; Niederle and Vesterlund, 2007). Finally, though there is no difference in overall generosity, male generosity is more responsive to changes in the cost of giving (Andreoni and Vesterlund, 2001). The emerging literature that explores the biological foundations of gender differences finds evidence that the gender gap changes with short-term biological differences induced through hormonal changes (Richardson, 1992; Chen et al., 2013; Pearson and Schipper, 2013; David Wozniak, 2014; Buser, 2012b,a). These results imply that temporary changes in an individual's biological state may affect males and females differently and may be important for economic decisions in strategic and non-strategic environments.

In understanding how hunger impacts economic decisions of men and women differently we focus on two prominent ideas related to how hunger impacts behavior; we then test whether males and females react differently. The first idea is that hunger has a direct effect on economic preferences. However, it is also possible that hunger forces the brain to focus its limited cognitive resources on managing the scarcity.[1] As a result, "scarcity-unrelated" decisions are neglected, leading to lower decision quality. This lower decision quality may manifest itself as a generalized decline in cognitive functions (such as getting a math problem wrong or obtaining a lower score on an IQ test) or the display of inconsistent choices (Haushofer and Fehr, 2014).[2]

To study the effect of hunger on males and females, we conduct a lab-in-the-field experiment with participants who are at a health clinic in Shanghai to obtain their annual physical exam. Because the participants are getting a physical, they are asked by their doctors to fast for eight hours prior to arrival. In a typical visit to this health clinic, a patient completes the health visit and then receives a voucher for a meal from an on-site cafeteria. We recruit participants as they arrive at the clinic in the morning and then randomize them to participate in our experiment either before or after they eat their cafeteria meal.

This design allows us to exploit naturally occurring hunger within the context of a controlled experiment. Specifically, we test the impact of hunger on participants' risk, time and altruism preferences through incentivized economic decision making tasks. We also test the impact of hunger on cognitive performance using a Cognitive Reflection Test with either a food- or non-food-framed set of questions (Frederick et al., 2002). By introducing the food frame, we make the task directly connected to the type of scarcity subjects are trying to manage. This allows us to test the scarcity-as-mindset hypothesis.

Our study provides several contributions to the literature. First, we provide a direct test of the effects of hunger on preferences as well as on choice consistency and cognitive performance all within one study. This provides insight to the stream of literature that examines the direct impact of scarcity more generally on economic preferences (Carvalho et al., 2016; Tanaka et al., 2010; Guiso and Paiella, 2008; Kuhn et al., 2014; Ashton, 2014). Second, we provide evidence that temporary changes in biological states (satiation and hunger) impact males and females differently. We do so by showing a heterogenous effect of hunger on male and female risk and altruism preferences, choice consistency, and cognitive performance. In the sated condition, we replicate the gender gaps found in several other streams of literature on risk preferences, price-sensitivity in giving,

[1]The brain consumes about 20% of the energy used by the body even though it accounts for only about 2% of the body's mass (Fonseca-Azevedo and Herculano-Houzel, 2012). For this reason it is considered one of the largest consumers of energy in the body.

[2]Another possible mechanism for why hunger could impact decision quality is that hunger creates stress. This stress, in turn, lowers decision quality (Haushofer and Fehr, 2014). In this paper, we explore the mind-set hypothesis in several ways but do not directly measure stress.

choice consistency and performance on the Cognitive Reflection Test (Niederle, 2016; Croson and Gneezy, 2009; Eckel and Grossman, 2008). We find that hunger *eliminates* the gender gap in choice consistency, risk aversion and cognitive performance, but creates a gender gap in generosity. Finally, we contribute to an emerging literature which introduces biological correlates into the social sciences. We do so by correlating our subjects' economic decisions with their biomarkers, measured right before our experiment, and find that higher blood lipid levels are correlated with greater choice inconsistency, risk aversion and generosity.

2 Literature Review

A number of studies have examined the impact of hunger on preferences, with mixed results (Mani et al., 2013; Kuhn et al., 2014). In one study, Ashton (2014) finds that subjects who have fasted for three hours prior to participating in an experiment appear more impatient than their controls who have not fasted. In another study, Kuhn et al. (2014) find a similar treatment effect when subjects are glucose deprived. Specifically, consuming a sugary beverage leads to more patient choices. Both studies draw on the convex-time-budget protocol developed by Andreoni and Sprenger (2012) and used in our study. However, each study attributes the treatment effects to different underlying mechanisms. Ashton (2014) interprets his findings as evidence of a strong present bias. By contrast, Kuhn et al. (2014) find that the treatment effect comes through the inter-temporal elasticity of substitution. Using simple risk elicitation tasks and a within-subject design, Levy et al. (2013) find that hunger is associated with financial risk tolerance. Furthermore, they find that hunger reduces risk preference heterogeneity.

Other studies find no impact of hunger on economic preferences. To test the effect of scarcity on time and risk preferences, Carvalho et al. (2016) exploit the natural variation in resources around payday for low income US households. Their results show no differences between before and after payday responses in the willingness to take risks and differences in impatience only with a task involving monetary rewards, but not one involving real effort. Finally, they find no differences in their measures of cognitive function. They conclude that because liquidity constraints cannot affect decisions about effort, their results suggest that underlying economic preferences are not affected by scarcity.

The evidence supporting the scarcity-as-mind-set hypothesis comes in two different ways: evidence demonstrating that subjects perform better on scarcity-related tasks or demonstrating that performance is worse on unrelated tasks. Radel and Clément-Guillotin (2012) and Aarts et al. (2001) deprive subjects of food or water respectively. When tasks are food/water related, they find that those who experience scarcity perform better on cognitive tasks than those who do not experience the scarcity (Radel and Clément-Guillotin, 2012; Aarts et al., 2001).

Examining the impact of scarcity on cognitive performance tasks, Schofield (2014) finds that increasing the caloric intake of a malnourished population in India results in substantial changes in cognitive performance across a broad range of measures. Similarly, Benton and Parker (1998) find that skipping breakfast is associated with poorer recall of a word list, a story from the Wechsler memory scale, or trigram consonants. These effects are reversed when subjects consume a drink containing glucose.[3] Furthermore, Gailliot et al. (2007) find that lower glucose levels inhibit both self-control (eg. thought suppression, emotion regulation, attention control) and social behaviors (like helping, coping with thoughts of death and stifling prejudice during an interracial interview). Finally, using non-food treatments to experimentally induce scarcity, Mani et al. (2013) and Shah et al. (2012) find that scarcity reduces cognitive performance.

Relatively few studies on scarcity have examined heterogeneous treatment effects, but the evidence available suggests that hunger may affect men and women differently (Haier and Benbow, 1995). Using glucose deprivation, Dickinson et al. (2014) find that subjects in a diet-lemonade (no glucose) condition are significantly more likely to choose in a manner inconsistent with Bayes' rule. Further, they find that this effect is greater for men. This suggests that males and females may react differently to hunger.

In summary, both laboratory and field experiments indicate that hunger negatively affects cognitive performance on un-related tasks but improves performance on food-related tasks. Results also suggest that these effects may be different for sub-populations. Studies find mixed evidence for a direct effect of hunger on preferences. This previous work also suggests three hypotheses. The first is that hunger causes greater risk taking and impatience. However, there is no directional prediction with respect to altruism. The second hypotheses is that scarcity reduces decision quality on unrelated tasks. By contrast, it improves performance on related tasks. Finally, the previous work suggests that there may be heterogeneous effects of scarcity for male and female sub-populations.

Our study contributes to an emerging literature which brings different conceptions of biology into social science research. In particular, we are interested in the relationship between blood lipid levels and economic decision making. In a large-scale Chinese survey, researchers find that a higher blood lipid level is positively correlated with glucose, total cholesterol, and BMI, and negatively correlated with physical exercise (Wang et al., 2001). Several studies have examined the link between lipid levels and cognitive impairement at older ages. The Women's Health Study (Devore et al., 2004) measured the cholesterol of over 4,000 study participants and followed up with the oldest women in the sample (65+ years) 3 to 8 years later to assess cognitive performance.

[3]The body's quantity of glucose increases with eating, and as such, we include glucose manipulations as part of our review. Here, we focus on those studies where glucose levels are manipulated experimentally with food or liquid intake.

Participants were divided into quintiles on the basis of their lipid levels, and the relative risk of cognitive impairment was assessed with the lowest quintile of lipids as the reference group. The study found that high-density lipoprotein (HDL) cholesterol levels were strongly associated with cognitive function and that those in the highest quintile of HDL cholesterol had a relative risk for cognitive impairment of 0.5 relative to those in the lowest quintile. This finding, that high lipid levels are associated with declines in cognitive function in later years, is found in several other studies as well (Kalmijn et al., 2000; Whitmer et al., 2005; Kivipelto et al., 2001). Thus, there seems to be an emerging link between blood lipid levels and behavioral and social phenomena.

3 Methods

To obtain our participants, we draw from individuals visiting one of the health screening clinics of the company MeiNian (located in Shanghai) for their annual employer-sponsored health check-up.[4] Prior to their visit, we contact all customers with appointments between April 3rd and April 11th, 2014 via email through their employer's HR department to explain the study and the opportunity to participate on the day of their physical. During the study window, we station a team member in a clearly visible area just inside the entrance to the health clinic. Customers have the opportunity to sign up on a voluntary basis with the team member when they arrive for their physical.

To ensure the reliability of the blood test results, customers are asked by the clinic to fast from the time after dinner the evening before their physical. Our out-of-sample survey indicates 100% compliance rate for fasting (Section 3.5). Customers receive a voucher for breakfast at the on-site cafeteria after completing the physical. The voucher is a standard amenity associated with the physical, which is stamped by the cafeteria cashier when it is redeemed. Those customers who sign up for the experiment are randomly assigned to a session that takes place either before or after they redeem their breakfast voucher. This randomized assignment to pre- or post-breakfast sessions constitutes our hunger manipulation. We used the unstamped (stamped) voucher to verify the status of all subjects in our hunger (sated) condition.

After being placed into a session, each subject completes three separate tasks that elicit time, risk, and altruism preferences, respectively. Each subject completes all three tasks but the order in which the three tasks are presented is based on the Latin Square Design. Table 1 summarizes the features of our experimental design.

All instructions are translated into Chinese (and then back into English to check the quality

[4]One of the unique features of China's health insurance system is that annual health checkups and other preventive health care procedures are not covered by the national health insurance. Instead, they are provided by employers as part of an employee's benefit package. On the supply side, private health clinics provide these annual health checkups. The largest of these private health clinic chains is our research partner, MeiNian.

Table 1: Features of experimental design

Hungry	Order of tasks	Number of Sessions	Number of Subjects
Yes	Time-Altruism-Risk	3	32
Yes	Risk-Time-Altruism	3	36
Yes	Altruism-Risk-Time	3	36
No	Time-Altruism-Risk	3	34
No	Risk-Time-Altruism	3	34
No	Altruism-Risk-Time	3	32
Total		18	204

of the translation) and all choices are framed in terms of Chinese Yuan (CNY).[5] The English translation of the instructions is included in Appendix A.

3.1 Eliciting Altruism Preferences

To elicit subjects' altruism preferences, we use the modified dictator game developed by Andreoni and Miller (2002) (see Appendix A, Part II, for instructions). In this game, subjects are asked to make a series of choices about how to divide a set of tokens between themselves and a randomly-matched anonymous person in the room. There are eight decisions in total and each decision varies the number of tokens that can be divided and the value of the tokens for the individual and her match respectively (see Table 2). Consequently, the price of giving varies across the eight decisions. Subjects make their decisions anonymously and privately; they are told that at the end of the session half of them will be randomly selected as token dividers and, if selected, that their decision will be used to determine the respective payoffs for themselves and their match. They are told the results of this section at the very end of the experiment.

Table 2: Choices in the altruism task

Number of tokens (ω)	Token value for self (v_s)	Token value for other (v_o)	Relative price of giving ($p = v_s/v_o$)
75	0.5	1.0	0.5
40	0.5	1.5	0.33
75	1.0	0.5	2.0
60	0.5	1.0	0.5
40	1.5	0.5	3.0
60	0.5	0.5	1.0
100	0.5	0.5	1.0
60	1.0	0.5	2.0

[5]The exchange rate at the time of the experiment was $\$1 = 6.25$ CNY.

In our analysis, we first test whether a subject's own token allotment differs by treatment. Second, we test whether hunger impacts the proportion of subjects whose decisions violate the generalized axiom of revealed preferences (GARP). Finally, we test whether the distribution of preference types differs by treatment.

3.2 Eliciting Risk Preferences

To elicit risk preferences, we use the Holt and Laury (2002) lottery game (see Appendix A, Part III, for instructions). In this game, subjects face ten choices, each containing an A and B option. Each option has a high and low payment but the A option always has a smaller difference between the high and low payment than the B option. The high/low payment pairs are each realized with a certain probability. The probability of receiving the high payment increases from 10% in the first choice to 100% in the last choice. The ten choices only vary in the probability of receiving the payoffs. Decision #10 is unique in that subjects must choose between receiving 30 or 40 with 100 percent probability. In decision #10, even the most risk averse subject should choose option B. For each of the ten decisions, subjects indicate which lottery (the A or B option) they want to play by circling either option A or option B.

We use the responses in two ways in our analysis. We measure risk as the switch-over point (when a subject switches from choosing option A to choosing option B) and compute the implied risk parameter(s) from this switch point. We also test the impact of hunger on decision consistency by calculating the proportion of subjects with multiple switching points and the proportion of those who fail to choose B in the last choice.

3.3 Eliciting Time Preferences

To elicit subjects' time preferences, we use the Convex Time Budget (CTB) procedure developed by Andreoni et al. (2015) (see Appendix A, Part I, for instructions). In this procedure, a single instrument captures both discounting and the concavity of the utility function. The CTB allows us to estimate both the aggregate and individual preference parameters. It also avoids potential confounding of the utility function curvature with the time preference measures. The key innovation of the CTB design is to allow a subject to choose any convex combination of two payments in a particular time frame. The CTB has been used in other studies to test present bias among those who are hungry (Ashton, 2014) and those who are low in glucose (Kuhn et al., 2014).[6]

[6]Several comments have been published regarding this measure (Cheung, 2015; Harrison et al., 2013; Epper and Fehr-Duda, 2015; Miao and Zhong, 2015). These authors note that one major empirical challenge with CTB is that the majority of observations are at the edges of the choice set. This response pattern is not well suited to the nonlinear least squares modeling approach used for data analysis. It also suggests that subjects may not fully comprehend the task.

In this experiment, we give subjects four sheets of paper with six rows of choices (they make 24 choices in total). Appendix A (Part I) contains the instructions. The choices in each row ask a subject to pick when they will receive a cash payment. This payment comes in two installments: at a sooner and at a later date. Each sheet varies the timing of the installments such that the first sheet pays out the two installments "today and five weeks from today"; the second sheet pays them out "today and nine weeks from today"; the third pays them out "five weeks from today and ten weeks from today"; and the fourth pays them out "five weeks from today and fourteen weeks from today." Each sheet has six rows of choices that vary the interest rate associated with getting paid out more of the installment at the later date. For each of the six rows, a subject must indicate how much of the payment he wishes to receive at the sooner versus later date.

In our analysis of this part of the experiment, we can estimate the long run discount rate, the present bias, and the curvature of the utility function. We test whether these preference parameters vary by treatment. We also test the impact of scarcity on decision quality. In particular, we characterize a subject's response as inconsistent if a subject's response in a row lies to the left of the choice made in the previous row. We refer to this as a switch-back and test whether the fraction of respondents with one or more switch-backs differs by treatment.

3.4 Cognitive Reflection Test

In addition to examining the impact of hunger on preferences, we are interested in examining how it impacts cognitive performance. To do so, we measure cognitive reflection, or "the ability or disposition to resist reporting the response that first comes to mind," using the Cognitive Reflection test (Frederick, 2005). This measure is correlated with numerous standardized tests, such as the SAT, the ACT, and the IQ tests, as well as with time and risk measures (Frederick, 2005). In this context, we use it to test the "scarcity as mind set" model, which predicts that activities unrelated to scarcity will receive less attention while activities related to managing scarcity will receive increased mental attention.

For a randomly assigned half of our subjects we use the standard questions used for the CRT. These include the "bat and ball," "5 machines 5 minutes" and the "lily pads" questions. However, for the other half of the subjects we reframe the questions using objects related to (Chinese) food.[7] Our reframed items read as follows: "A piece of flatbread and a piece of fried flourstick cost 1.10 in total. The flatbread costs 1.00 more than the flourstick. How much does the flourstick cost?"; "if it takes 5 chefs 5 minutes to make 5 buns, how long would it take 100 chefs to make 100

[7] A bat and a ball cost 1.10 in total. The bat costs 1.00 more than the ball. How much does the ball cost?; If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?; In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

buns?"; "There are a lot of eggs in a chicken farm and every day the number of eggs doubles. If the warehouse is full in 48 days, then how many days will it take to make it half full?" (see Appendix A, End-of-the-Study section, for instructions). Based on the scarcity-as-mind-set hypothesis, we predict improved accuracy when the questions are reframed as food items (Haushofer and Fehr, 2014; Mullainathan and Shafir, 2013).

3.5 Post-experiment Tasks

At the end of the three tasks, we ask for three volunteers to come to the front of the room and for each to draw a card from a different deck. The card number drawn from the first deck determines which decision in the altruism task counts, the card number drawn from the second deck determines which decision in the risk task counts and the card number drawn from the third deck determines which decision in the time preference task counts. A fourth volunteer is asked to throw a ten-sided die to determine the outcome of the risk lottery. While the experimenter calculates payment for each subject, we have subjects answer their assigned CRT questions and fill out two survey questions regarding their patience and risk attitudes (Dohmen et al., 2011).

In addition, to verify our hunger condition, we conduct an out-of-sample paper-and-pencil survey on a similar group of 275 customers at the same clinic in December 2015. In this survey, we ask the respondents the following three questions: (1) When did you eat last? (2) When did you last drink? (3) On a 1 to 10 scale, rate how hungry you are right now (1 being not hungry at all and 10 being extremely hungry). We find 100% compliance on fasting, with 89.09% who consumed their last meal before 8pm on the day before the visit, and 10.91% who ate after 8pm but before 11pm. The last liquid intake for the majority of respondents was the day before (66.91%), with some drinking liquid on the day of the health exam (33.09%). Finally, when asked how hungry they were, respondents stated that they were somewhat hungry (on a scale of 1 "not at all" and 10 "extremely": the mean response was 4.8 (s.d. 2.92) and the median was 5).

3.6 Experimental Procedure and Payment

We conduct our experiment at one of the MeiNian health clinics in Shanghai. The health clinic cooperated with us by allowing us to recruit subjects, giving us a room in which to conduct the experiments and providing health data from our consenting subjects. Three daily sessions were conducted in a lounge in the clinic for six days. The first session started at 8:30 a.m. and the last session ended at 11:30 a.m. Each session lasted between 45 minutes and an hour. Because subjects finished their physicals at various times, we asked them to wait in the cafeteria near where the experiment was conducted until it was time for their session to begin. A session started once there were at least eight people in the waiting area.

Sessions were conducted using paper and pencil. Subject responses were collected at the end of each preference elicitation task (risk, altruism and time preferences). At the end of each session, the decision tasks that were used for payment were selected. The average payment was 199.77 CNY, slightly higher than the average daily salary in Shanghai in 2014.[8] Subjects received cash payments for the altruism and risk preference decisions at the conclusion of the experiment. Subjects received their time preference payments delivered by their employers to their work address using either a self-addressed envelope or bank transfer (if requested by the subject). If the earlier installment was scheduled for "today," then the payment was delivered later that day. Any payment to take place in the future was delivered by the employer (or bank transfer) in an identical manner.

3.7 Summary

A total of 204 subjects participated in our experiment. For 201 subjects, we have complete data, including their experiment responses as well as their health records from that visit. We obtain their health records by extracting their data based on their health clinic customer ID (which they gave us in their survey responses). In our experiment, we have 103 participants in the Hungry condition (46.6% male) and 98 in the Sated condition (52.04% male). Table 3 provides the descriptive statistics for several health related measures obtained from subjects' health records. Using t-tests, we find no statistical differences ($p \geq 0.10$ for all tests) in the health measures across treatments, suggesting that our randomization worked.

Our three primary indicators of health in the annual physical include blood glucose (sugar), blood pressure, and blood lipid (fat). Fasting blood glucose is used to check for (pre)diabetes and is measured after a person has not eaten for at least 8 hours. Blood pressure is used to indicate a person's risk for heart disease, kidney failure, and stroke and is measured in terms of the systolic (maximum) pressure over diastolic (minimum) pressure. Finally, blood lipids are used to indicate a person's risk for cardiovascular disease and cognitive impairment.

Appendix A contains the English translation of our experimental instructions. Our research protocol was approved by the University of Michigan IRB (HUM00087030). We obtained informed consent from every participant. Anonymized data and code will be available from the open ICPSR data repository.

[8] According to the Shanghai Municipal Human Resources and Social Security Bureau, in 2014, the average monthly salary in Shanghai was 5,451 CNY. Source: http://www.12333sh.gov.cn/201412333/xxgk/flfg/gfxwj/ldbc/bcfp/201504/t20150401_1199449.shtml, last retrieved on July 16, 2015.

Table 3: Descriptive statistics

	Mean	SD	Median	Min	Max	10^{th}-percentile	90^{th}-percentile
Hungry							
Age	32.12	7.44	30.60	21.69	53.45	24.27	43.24
Blood Lipid	1.48	1.42	1.16	0.40	12.53	0.56	2.79
Blood Glucose	4.89	1.55	4.65	4.00	15.72	4.15	5.32
Blood Pressure,s	116.45	12.11	116.00	96.00	159.00	102.00	132.00
Blood Pressure,d	74.54	10.65	73.00	60.00	101.00	61.00	90.00
Heart Rate	72.58	7.91	74.00	60.00	96.00	62.00	80.00
Height (cm)	166.46	8.29	166.00	150.00	184.00	155.80	176.50
Sated							
Age	30.84	6.25	29.76	20.27	48.58	23.90	39.50
Blood Lipid	1.33	0.74	1.08	0.45	4.40	0.47	3.12
Blood Glucose	4.73	0.54	4.66	3.91	7.65	4.21	5.18
Blood Pressure,s	116.53	12.72	114.00	93.00	150.00	101.00	134.00
Blood Pressure,d	73.76	10.52	72.00	55.00	115.00	62.00	88.00
Heart Rate	71.46	9.17	70.00	60.00	100.00	60.00	82.00
Height (cm)	167.01	8.64	166.00	148.00	184.50	156.10	179.70

Note: Age is calculated to a fraction of a year from the difference between the session date and the birth date.

4 Results

We present our analysis of risk, generosity and cognitive performance in the main text, and relegate the results for time preference into Appendix B. We relegate the time preference results because the estimate of risk preference parameters, which is jointly measured with time in the instrument, and the pattern of response inconsistency replicates what we find in the Risk Preferences task. We also do so because there are no significant treatment difference in measured time preferences.[9])

4.1 Risk

We first present the results of our tests of the impact of hunger on response consistency and risk preferences. Regarding consistency, in our sample, 36.3% of our subjects either exhibit multiple switching points or choose option A in Decision #10 (the dominated choice).[10] Figure 1 plots the

[9]Several comments have been published regarding this measure (Cheung, 2015; Harrison et al., 2013; Epper and Fehr-Duda, 2015; Miao and Zhong, 2015). These authors note that one major empirical challenge with CTB is that the majority of observations are at the edges of the choice set. This response pattern is not well suited to the nonlinear least squares modeling approach used for data analysis. It also suggests that subjects may not fully comprehend the task.

[10]Our proportion of participants exhibiting inconsistent responses is in line with that obtained in studies using non-college-student samples in developing countries, e.g., in Rwanda and Peru (55% and 52% for risk measures) (Jacobson and Petrie, 2009; Ashraf et al., 2006). In comparison, the proportion of individuals displaying inconsistent behavior in US populations ranges from 8% to 30% (Holt and Laury, 2002; Prasad and Salmon, 2013; Dave et al., 2010).

proportion of subjects displaying inconsistency by gender and by treatment. We see that hunger (again) has an opposite effect on choice consistency for males and females.

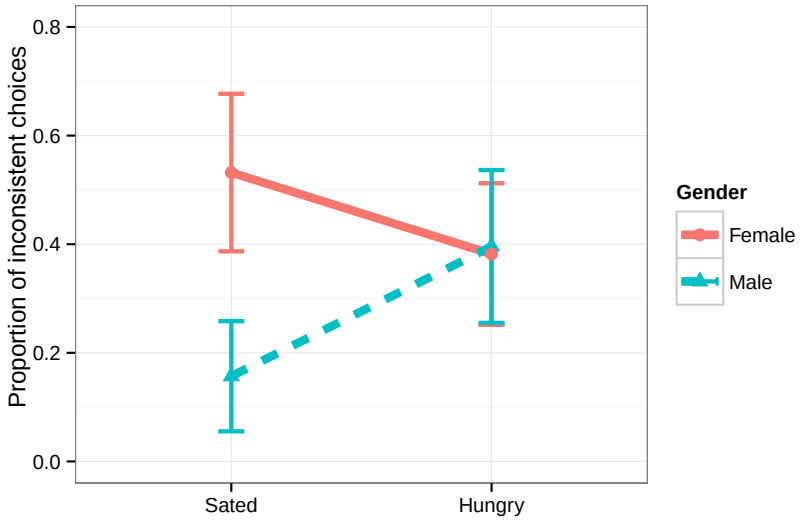

Figure 1: Proportion of choice inconsistency (with 95% confidence interval) by treatment and gender

More formally, we investigate the treatment effect on choice consistency using four Probit specifications and present the results in Table 4. The dependent variable is a dummy variable that takes the value of 1 if a subject provides one or more inconsistent responses. The independent variables (omitted) include hungry (sated), female (male), an interaction term, the same set of biological variables as in Table 7, and lastly, the number of wrong answers in the CRT. Our results show no significant treatment effect on the likelihood of displaying inconsistency in decisions (0.052, $p > 0.10$, specification 1).

Examining our results by gender, we find that sated females are 36.2 percentage points more likely to make inconsistent choices compared to their male counterparts. We also find that males are 26.3 percentage points more likely to be inconsistent when they are hungry versus sated ($p < 0.01$). Consequently, hungry females are no more likely than males to be inconsistent ($p > 0.10$ in all three specifications). Regarding biological factors, we find that a one mmol/L increase in blood lipid level is associated with a 7.8 percentage point increase in the likelihood of inconsistent choices ($p < 0.10$ in (3) and $p < 0.05$ in (4)). We summarize our results below.

Result 1 (Inconsistency in risk preference)**.** *When sated, females are 35 percentage points more likely to make inconsistent choices compared to males. Hunger reduces female inconsistency by 36 percentage points. In comparison, hungry males are 26 percentage points more likely to be*

Table 4: Impact of hunger on consistency of risk preferences: Probit

Dependent Var.	Having at least one inconsistent choice(s)			
	(1)	(2)	(3)	(4)
Hungry	0.052	0.238***	0.247***	0.263***
	(0.068)	(0.087)	(0.086)	(0.091)
Female		0.375***	0.443***	0.348***
		(0.087)	(0.090)	(0.095)
Female × Hungry		-0.394***	-0.380***	-0.362***
		(0.123)	(0.136)	(0.134)
Age			-0.003	-0.003
			(0.005)	(0.005)
BMI			0.005	0.000
			(0.012)	(0.011)
Blood glucose			-0.049	-0.070*
			(0.039)	(0.042)
BP, systolic			-0.009*	-0.009*
			(0.005)	(0.005)
BP, diastolic			0.010*	0.010*
			(0.006)	(0.005)
Blood lipid			0.076*	0.078**
			(0.043)	(0.036)
# of wrong CRTs				0.122***
				(0.029)
Observations	201	201	171	171
Female + Female × Hungry		-0.014	0.063	-0.014
		(0.096)	(0.110)	(0.107)
Hungry + Female × Hungry		-0.150	-0.133	-0.100
		(0.098)	(0.103)	(0.097)

Notes: Subjects without blood tests are dropped in (3) and (4). Standard errors in parentheses are clustered at the individual level; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. Average marginal effects are reported; the marginal effects for interaction terms are the difference between the average marginal effect (AME) of the dummy Hungry for female and male; the standard errors are calculated using the Delta method (Ai and Norton, 2003), and hypotheses are tested using the Wald test; Female + Female × Hungry stands for the marginal effect of Female at Hungry = 1; Hungry + Female × Hungry stands for the marginal effect of Hungry at Female = 1.

inconsistent compared to sated males. Consequently, the gender gap in consistency disappears in the hunger treatment. Furthermore, an additional mistake in CRT increases the likelihood of being inconsistent by 12 percentage points. Lastly, a one mmol/L increase in blood lipid level is associated with a 7.8 percentage point increase in the likelihood of making inconsistent choices.

Support. *Specification (4) in Table 4 shows that the coefficient for Female is 0.348 ($p < 0.01$), for Female $\times$ Hungry is -0.362 ($p < 0.01$), for Hungry is 0.263 ($p < 0.01$), for the # of wrong CRTs is 0.122 ($p < 0.01$), and for Blood lipid is 0.078 ($p < 0.05$).*

In sum, we conclude that hunger has heterogenous effects on decision consistency. Specifically, we find that male decision consistency declines while female decision consistency improves in the hunger condition. These effects thus reduces the gender gap in decision consistency found in the sated condition. Finally, our finding that an increase in blood lipid level is correlated with a sizeable increase in the likelihood of decision inconsistency is in line with prior research that finds that blood lipid levels are negatively correlated with cognitive performance (Devore et al., 2004).

To test the impact of our treatment on risk preferences, we use the sub-sample of participants who make consistent choices in the lottery choice task (63.7%). Figure 2 plots the fraction of subjects who choose the safe option for each of the ten questions by treatment and gender (recall that a higher switch point corresponds to greater risk aversion).

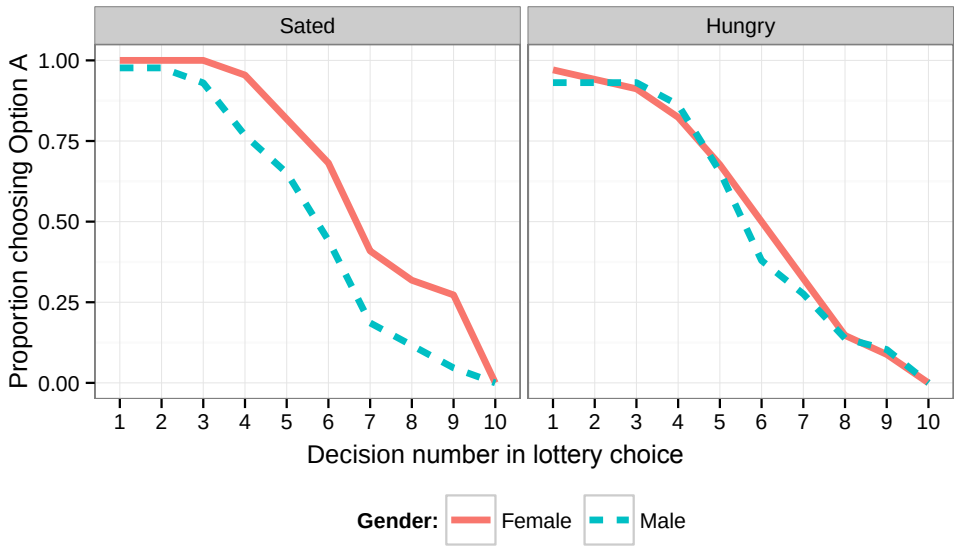

Figure 2: The proportion of males and females choosing the safe option by treatment; numbers on x-axis indicate the decision number in the lottery choice task.

The graphs in Figure 2 show that women are more risk averse than men when they are sated,

but that this risk aversion decreases when they are hungry. These results are supported by the OLS regressions reported in Table 5. Here, the dependent variable is the switching point, with a later (greater) switching point indicating greater risk aversion. Specification (1) includes the treatment dummy, Hunger, which is not significant. Specification (2) investigates heterogeneous treatment effects. We again control for biological factors (3), and the number of wrong answers in the CRT (4). Across specifications (2)-(4), we find a positive and significant coefficient for Female. However, we find a negative albeit insignificant coefficient for Female $\times$ Hungry. Consequently, the gender difference disappears in the hunger treatment. We summarize our results below.

Result 2 (Risk preference)**.** *When sated, women are significantly more risk averse than men. However, this gender gap disappears in the hunger treatment as women become less risk averse.*

Support. *Specification (4) in Table 5 shows that the coefficient for Female is 1.826 ($p < 0.01$). The coefficient for Female + Female $\times$ Hungry is 0.668 ($p > 0.10$).*

Our finding of gender differences in risk preference under the sated condition is well documented in the literature (Croson and Gneezy, 2009; Eckel and Grossman, 2008). However, we find that this difference disappears under our hunger condition, as women become less risk averse. Result 2 is consistent with the main finding of Levy et al. (2013) that the heterogeneity of risk preferences collapses when subjects are food deprived in a within-subject laboratory experiment. It also offers suggestive evidence that gender differences in preferences might have biological roots (Bertrand, 2010). Related to our study, Cassar et al. (2016) find that the gender gap in competitiveness disappears when women compete for a bookstore voucher (instead of cash), which can be used to benefit their children.

4.2 Generosity

We begin by testing the impact of hunger on decision consistency in altruism. To do so, we test whether the fraction of subjects whose responses violate GARP differs by treatment. Our results show that 4.5% of our subjects provide responses that can be classified as GARP violations, with no differences across treatments ($p = 0.79$, two-sided proportion test). Note that our fraction of GARP violators is greater than the 1.7% that Andreoni and Miller (2002) obtained in their study with college students. This may be due to the fact that most of our subjects do not have a college eduction.

We next test whether the *distribution* of preference types differs by treatment. Given our random assignment of subjects, we expect no differences in the distribution of types by treatment. Table 6 shows the number of subjects classified into three prototypical utility types (Selfish, Leontief or Perfect Substitutes) by treatment. A χ^2 test finds no differences in preference type distribution

Table 5: The impact of hunger on risk aversion: OLS

Dependent Variable	Switch point among consistent subjects			
	(1)	(2)	(3)	(4)
Hungry	-0.252	0.114	0.230	0.193
	(0.373)	(0.499)	(0.567)	(0.569)
Female		1.362**	1.666**	1.826***
		(0.544)	(0.640)	(0.663)
Female × Hungry		-1.186	-1.143	-1.157
		(0.756)	(0.880)	(0.881)
Age			-0.061*	-0.062*
			(0.032)	(0.032)
BMI			-0.007	-0.004
			(0.076)	(0.076)
Blood glucose			-0.143	-0.132
			(0.148)	(0.148)
BP, systolic			-0.005	-0.001
			(0.029)	(0.029)
BP, diastolic			0.023	0.020
			(0.035)	(0.035)
Blood lipid			0.552	0.593
			(0.360)	(0.363)
# of wrong CRTs				-0.188
				(0.201)
Constant	6.554***	6.093***	6.741**	6.554**
	(0.262)	(0.316)	(2.611)	(2.620)
Observations	128	128	111	111
R-squared	0.004	0.052	0.105	0.113
Female + Female × Hungry		0.175	0.523	0.668
		(0.524)	(0.630)	(0.649)
Hungry + Female × Hungry		-1.072	-0.913	-0.964
		(0.568)	(0.654)	(0.656)

Notes: Only consistent subjects are included. Those without blood tests are dropped in (3) and (4). Standard errors in parentheses are clustered at individual level; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$; hypotheses for combinations of coefficients are tested using t-tests.

by treatment ($p = 0.656$). Lastly, a χ^2 test of equality of distributions between our pooled sample and Andreoni and Miller's (2002) sample of U.S. collge students indicates that the distributions are significantly different ($\chi^2_5 = 59.91$, $p < 0.01$). In particular, over half of our participants are Leontief types, whereas nearly half of the Andreoni and Miller's sample are classified as Selfish.

Table 6: Number of subjects classified with prototypical utility types

Type	Hungry	Sated	Pooled	AM (2002)
1: Strong Selfish	4.9%	7.1%	6.0%	22.7%
2: Weak Selfish	13.6%	11.2%	12.4%	24.4%
3: Strong Leontief	5.8%	8.2%	7.0%	14.2%
4: Weak Leontief	45.6%	45.9%	45.8%	16.2%
5: Strong Perfect Substitute	14.6%	8.2%	11.4%	6.3%
6: Weak Perfect Substitute	15.5%	19.4%	17.4%	16.2%
Total	103	98	201	176

Notes: A χ^2 test of equality of distribution between the Hungry and Sated conditions yields $\chi^2_5 = 3.29$, $p = 0.656$.

We next investigate whether a subject's allocation of tokens differs by treatment or by subsample and report the results of four OLS regressions in Table 7. The dependent variable is the share of the endowment a participant keeps and the independent variables (omitted) include a dummy for whether a subject was in the hungry (sated) condition; the price of giving; the endowment in tokens; whether a subject is female (male); interaction terms; biological variables such as age, BMI, blood glucose, blood pressure, and blood lipid measurements; and lastly, the number of wrong answers in the CRT. Specification (1) investigates the average treatment effect while controlling for game-specific parameters. On average, our results show no effect of hunger on token allotments. Consistent with rational decision making and prior findings (Andreoni and Miller, 2002), we find that participants keep 4.4% more tokens for themselves when the price of giving increases by 100%.[11] Furthermore, a participant with an additional token keeps 0.3% more tokens. Both effects persist in subsamples (specification 2) and when we control for biological factors (specification 3) as well as CRT correctness (specification 4).

Interestingly, we find that allotment behavior differs when we examine the results for our subsamples. Figure 3 displays the heterogenous treatment effects of hunger on the proportion of endowment kept by males and females. Here we see that males keep fewer tokens for themselves, i.e., they become less selfish, when they are hungry, while females keep more. The regressions in Table 7 formally present these heterogeneous treatment effects (specification 2), controlling for

[11] Recall that the price of giving is defined as the ratio of one's own token value to the other's token value.

Table 7: The impact of hunger on the share of endowment kept: OLS specifications

Dependent Variable	Share of endowment kept			
	(1)	(2)	(3)	(4)
Hungry	-0.024	-0.104**	-0.099*	-0.099**
	(0.043)	(0.047)	(0.050)	(0.050)
Price of giving	0.044***	0.073***	0.060**	0.060**
	(0.017)	(0.022)	(0.025)	(0.025)
Endowment	0.003***	0.003***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Price × Hungry	0.004	0.008	0.014	0.014
	(0.028)	(0.028)	(0.030)	(0.030)
Female		0.032	0.046	0.037
		(0.051)	(0.055)	(0.057)
Female × Hungry		0.147***	0.111**	0.114**
		(0.046)	(0.049)	(0.049)
Female × Price		-0.060**	-0.047	-0.047
		(0.028)	(0.030)	(0.030)
Age			-0.002	-0.002
			(0.002)	(0.002)
BMI			0.007*	0.007
			(0.004)	(0.004)
Blood glucose			0.000	-0.000
			(0.005)	(0.005)
BP, systolic			-0.003	-0.003
			(0.002)	(0.002)
BP, diastolic			0.004*	0.004*
			(0.002)	(0.002)
Blood lipid			-0.028**	-0.028***
			(0.011)	(0.011)
# of wrong CRTs				0.010
				(0.012)
Constant	0.449***	0.434***	0.412**	0.417**
	(0.035)	(0.044)	(0.164)	(0.163)
Observations	1,608	1,608	1,368	1,368
R-squared	0.082	0.108	0.115	0.117
Female + Female × Hungry		0.179***	0.157***	0.151***
		(0.047)	(0.053)	(0.053)
Hungry + Female × Hungry		0.043	0.012	0.014
		(0.050)	(0.053)	(0.053)
Price + Price × Female		0.013	0.012	0.012
		(0.022)	(0.023)	(0.023)
Price + Price × Hungry	0.049***	0.081***	0.074***	0.074***
	(0.019)	(0.027)	(0.028)	(0.028)

Notes: Standard errors are in parentheses and clustered at the individual level; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$; hypotheses for combinations of coefficients are tested using t-tests.

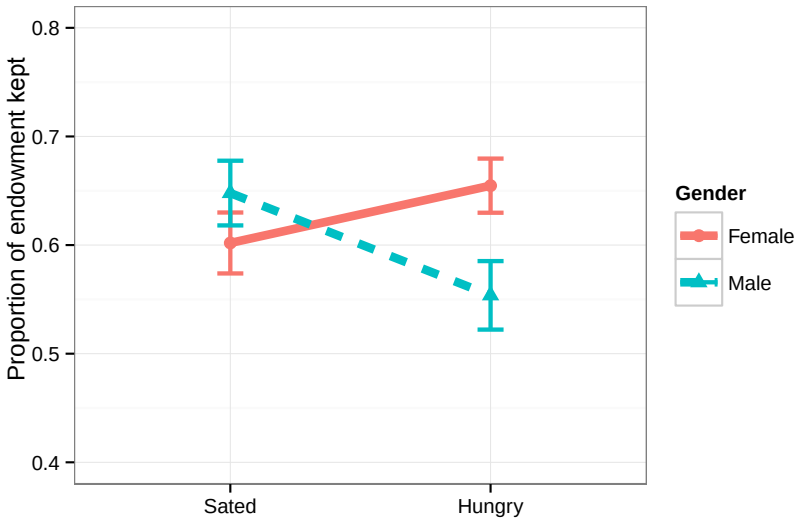

Figure 3: Average proportion of endowment kept in the altruism task; error bars show 95% confidence interval.

biological factors (specification 3) and the number of wrong answers in the CRT (specification 4). Specifically, the results show that males keep 10% fewer tokens for themselves when they are hungry, whereas females keep 15% *more* tokens for themselves when they are hungry ($p < 0.01$ in all three specifications). Consistent with Andreoni and Vesterlund (2001), we find no differences across genders in our sated group. Regarding price sensitivity, we find that sated women are less price sensitive compared to men (-0.060, $p < 0.05$), but that this result is insignificant after controlling for the biological factors. Of the biological factors, we find that a one mmol/L increase in blood lipid level is associated with a 2.8% decrease in the number of tokens kept ($p < 0.05$ in (3) and $p < 0.01$ in (4)). We summarize our findings below.

Result 3 (Generosity)**.** *When hungry, males (females) keep 10% fewer (11% more) tokens for themselves, compared to the sated condition. Consequently, females keep 15% more tokens than do males when hungry, creating a gender gap which is not present in the sated condition. Furthermore, a one mmol/L increase in blood lipid level is associated with a 2.8% decrease in share of tokens kept.*

Support. *Specification (4) in Table 7 shows that the coefficient for Hunger is -0.099 ($p < 0.05$); that for Female + Female $\times$ Hungry is 0.151 ($p < 0.001$); and that for blood lipid is -0.028 ($p < 0.001$).*

Taken together, Result 3 indicates that hunger makes males more generous and females less generous. As a result, we find a significant and sizeable gender gap in the hunger condition, even

though there is none in the sated condition. However, we find no significant treatment effect on GARP violations or preference type distributions.

4.3 Cognitive Reflection Test

To test whether subjects in the hungry state are more likely to make mistakes in the CRT than those in the sated state, and whether that likelihood changes with the framing of the questions, we run three separate probit specifications for the food and non-food frame, respectively. Table 8 reports the results of those regressions. In all specifications, the dependent variable is a dummy variable which equals one if a subject makes at least one mistake, and zero otherwise, whereas the independent variables include the same set of variables as in previous regressions.

The results in Table 8 show that females are more likely to get at least one non-food-related question wrong, either in the hungry or sated state. This result is consistent with prior findings that men score significantly higher than women, even after controlling for SAT math scores (Frederick, 2005). Interestingly, when the same set of questions are food-framed, the gender difference disappears.

Result 4 (CRT framing effect)**.** *When the CRT questions are non-food framed, females are 38- (37-) percentage points more likely to make mistakes than their male counterparts in the sated (hungry) condition. However, when the questions are food-framed, this gender gap disappears.*

Support. *In specification (3) in Table 8, the coefficients for Female and Female + Female $\times$ Hungry are 0.384 and 0.371, respectively ($p < 0.001$ in both cases). In comparison, In specification (6), the coefficients for Female and Female + Female $\times$ Hungry are 0.162 and -0.088, respectively ($p > 0.10$ in both cases).*

When the CRT questions are non-food framed, Result 4 replicates the gender gap in CRT correctness in the sated condition, and provides new evidence that this gender gap persists in the hungry treatment. However, this gender gap disappears when questions are food-framed, providing support for the scarcity-as-mind-set hypothesis.

5 Discussion

In summary, we focus on the impact of a temporary state of hunger and its differential impact on male and female decision making. We find that hunger impacts both economic preferences as well as decision quality. In particular, our results suggest that scarcity affects men and women in opposite directions and on different dimensions. Specifically, we find that hunger leads to a decline (an improvement) in male (female) decision quality, as measured by inconsistency in their

Table 8: Treatment effects on the likelihood of wrong answers to CRT: Probit

Dependent Var.	Having at least one answer wrong					
	Non-food frame			Food frame		
	(1)	(2)	(3)	(4)	(5)	(6)
Hungry	-0.087	-0.120	-0.053	-0.033	0.042	0.087
	(0.084)	(0.134)	(0.151)	(0.072)	(0.113)	(0.121)
Female		0.249**	0.384***		0.131	0.162
		(0.099)	(0.119)		(0.098)	(0.109)
Hungry × Female		0.020	-0.013		-0.143	-0.250
		(0.157)	(0.165)		(0.144)	(0.170)
Age			0.003			-0.003
			(0.008)			(0.007)
BMI			0.049***			0.003
			(0.019)			(0.015)
Blood glucose			-0.023			0.121
			(0.023)			(0.113)
BP, systolic			0.006			-0.001
			(0.007)			(0.006)
BP, diastolic			0.004			-0.000
			(0.007)			(0.008)
Blood lipid			-0.061*			-0.025
			(0.035)			(0.065)
Observations	99	99	81	102	102	90
Female + Female × Hungry		0.269**	0.371***		-0.012	-0.088
		(0.122)	(0.121)		(0.105)	(0.134)
Hungry + Female × Hungry		-0.101	-0.066		-0.102	-0.163
		(0.083)	(0.071)		(0.089)	(0.113)

Notes: Probit regression, standard errors in parentheses clustered at individual level; *** p<0.01, ** p<0.05, and * p<0.10. Average marginal effects are reported; the marginal effect for the interaction term is the difference between the average marginal effect (AME) of the dummy Hungry for female and male, the standard errors are calculated using the Delta method (Ai and Norton, 2003), and hypotheses are tested using the Wald test; Female + Female × Hungry stands for the marginal effect of Female at Hungry = 1; Hungry + Female × Hungry stands for the marginal effect of Hungry at Female = 1.

responses to risk. While we replicate the robust gender gap in risk aversion and price-sensitivity in giving in the sated condition, the gender gap disappears in the hungry condition. Furthermore, we find that males (females) become more (less) generous when they are hungry, leading to females giving significantly less than males in the hungry condition.

These results, together with the newly generated empirical results testing the impact of scarcity on preferences and decision quality in the literature, suggest that scarcity has a more nuanced effect. Future research could examine the differential impact of scarcity on sub-populations as well as on different dimensions of choice (the quality of a decision compared to the economic preference itself). Our results provide partial support for the "scarcity as mindset" model: though we do not observe increased focus (and therefore higher decision quality) we do see increased performance on food-related CRT questions, especially for women.

Our study is among the first which associates biomarkers with economic preferences and decision quality. In our measurements, an increase in blood lipid level is associated with a decrease in decision quality, such as choice consistency, and an increase in risk aversion and generosity. This also presents a possible venue for future research on the effect of scarcity.

Lastly, our results contribute to the critical research exploring gender differences in behavior. While both experimental and survey results point towards robust gender differences in decision-making tasks, our understanding of the relative impact of environmental versus biological factors in determining those differences is still very much evolving. These results join research findings that point to temporary biological factors (such as hunger or the menstrual cycle) as co-determinants along with long-term social (e.g. differing expectations for women and men), environmental (e.g. differential preference for a gender) and biological factors (e.g. biomarkers). These results imply that temporary changes in an individual's current biological state may be important for economic decisions in strategic as well as non-strategic environments.

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Appendix A. Experimental instructions for online publication

We include the complete set of experimental instructions for the order, Time-Altruism-Risk. Other orders have identical instructions for each part, and differ only in the order in which they are presented.

ID: _____ Date: _____

Study Instructions Cover

ID: _____ Date: _____

Study Instructions Overview

Welcome!
This is a study about decision making. This is a paid study. Your earnings will depend on the decisions that you and the other participants make.
This study consists of three parts. After you have completed all three parts, you will have answered a total of 42 questions.
In one part of the study, your total earnings will be sent to you in two separate installments.
In a second and third part, your total earnings will be paid out in cash at the end of the study today.
You will be paid RMB50 for participating, and you have the opportunity to earn additional money based on you answers today.
A fourth part is a few short questions that will conclude our study.

Study Payments Overview

At the end of the study, after I have collected your responses, I will determine your payment for each part of the study. To explain how I determine your payment, I will need an assistant .

Three parts of this study consist of 24, 10 and 8 questions respectively.

Here are three decks of 24, 10 and 8 cards.

In the third part of the study there are 10 questions. Each card has a number on it from 1-10 which the assistant has verified. At the end of the study I will shuffle the cards and then draw a card which I will read out loud. The number that I call out will be the question that I use to determine you payment for that part of the study.

ID: _____ Date: _____

Part I

Please do not open until the study coordinator instructs you to do so.

ID: _____ Date: _____

How It Works

In the following four sheets you are asked to make 24 decisions involving payments over time. Each row on the sheets is a decision and is numbered from 1 to 24.

Each row will feature a series of options. Each option consists of a sooner payment AND a later payment. You are asked to pick your favorite option in each row by checking the box below it. You should pick the combination of sooner payment AND later payment that you like the most. For each row, mark only one box.

Here is an example row:

1.	payment in 5 WEEKS…	95	76	57	38	19	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐

In this example, you are asked to choose your favorite combination of payment 5 weeks from now AND payment in 10 weeks. As you can see, the sooner payment varies in value from 95 to 0 and the later payment varies in value from 0 to 100.

Note that there is a trade-off between the sooner payment and the later payment across the options. As the sooner payment goes down, the later payment goes up. For every decrease in your earlier payment, your later payment increases by 20.

At the end of the experiment, you can indicate whether you want your payment through direct bank deposit or for you to pick up through your company.

Next we will walk through some examples of how to indicate your choice.

ID: _____ Date: _____

Part I - Example

Example #1

If someone's favorite option were 95 in 5 weeks AND 0 in 10 weeks, they would mark the box below that option. Make that mark now with the study coordinator:

1.	payment in 5 WEEKS…	95	76	57	38	19	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐

By marking the box, this person is saying that "95 in 5 weeks and 0 in 10 weeks" is their favorite combination of a sooner payment AND later payment.

If this question were drawn for payment, then you will receive a bank deposit or cash from us in 5 weeks for 95.00 and no payment from us in 10 weeks.

Example #2

ID: _____ Date: _____

If someone's favorite option were 38 in 5 weeks AND 60 in 10 weeks, they would mark the box below that option. Make that mark now with the study coordinator:

1.	payment in 5 WEEKS…	95	76	57	38	19	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐

By marking the box, this person is saying that "38 in 5 weeks and 60 in 10 weeks" is their favorite combination of a sooner payment AND later payment.

If this question were drawn for payment, then you will receive a bank deposit or cash for 38 from us in 5 weeks and another payment from us in 10 weeks for 60.

ID: _____ Date: _____

Part I - Start

How to proceed:

There are 4 sheets, each with 6 decisions, making 24 decisions in total. Each decision has a number from 1 to 24.

- NUMBERS 1 THROUGH 6: Each option has one payment issued today AND one payment issued in 5 weeks.
- NUMBERS 7 THROUGH 12: Each option has one payment issued today AND one payment issued in 9 weeks.
- NUMBERS 13 THROUGH 18: Each option has one payment issued in 5 weeks AND one payment issued in 10 weeks.
- NUMBERS 19 THROUGH 24: Each option has one payment issued in 5 weeks AND one payment issued in 14 weeks.

At the end of the study session today, a number between 1 and 24 will be drawn. This number will determine which decision (from 1 to 24) will determine your payoffs.

Remember that each decision could be the decision-that-counts! It is in your interest to treat each decision as if it could be the one that determines your payment.

ID: _____ Date: _____

TODAY *and* 5 WEEKS from today

For each decision number (1 to 6) below, decide the amounts you would like for sure **today AND in 5 weeks** by checking the corresponding box.

Example: In Decision 1, if you wanted 95 today and 0 in five weeks you would check the left-most box. Remember to check only one box per decision!

1.	payment TODAY…	95	76	57	38	19	0
	and payment in 5 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
2.	payment TODAY…	90	72	54	36	18	0
	and payment in 5 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
3.	payment TODAY…	85	68	51	34	17	0
	and payment in 5 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
4.	payment TODAY…	80	64	48	32	16	0
	and payment in 5 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
5.	payment TODAY…	70	56	42	28	14	0
	and payment in 5 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
6.	payment TODAY…	55	44	33	22	11	0
	and payment in 5 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐

ID: _____ Date: _____

TODAY *and* 9 WEEKS from today

For each decision number (7 to 12) below, decide the amounts you would like for sure **today AND in 9 weeks** by checking the corresponding box.

Example: In Decision 7, if you wanted 0 today and 100 in nine weeks you would check the right-most box. Remember to check only one box per decision!

7.	payment TODAY…	100	80	60	40	20	0
	and payment in 9 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
8.	payment TODAY…	95	76	57	38	19	0
	and payment in 9 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
9.	payment TODAY…	90	72	54	36	18	0
	and payment in 9 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
10.	payment TODAY…	75	60	45	30	15	0
	and payment in 9 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
11.	payment TODAY…	60	48	36	24	12	0
	and payment in 9 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
12.	payment TODAY…	45	36	27	18	9	0
	and payment in 9 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐

ID: _____ Date: _____

5 WEEKS from today *and* 10 WEEKS from today

For each decision number (13 to 18) below, decide the amounts you would like for sure **in 5 weeks AND in 10 weeks** by checking the corresponding box.

Example: In Decision 13, if you wanted 95 in five weeks and 0 in ten weeks you would check the left-most box. Remember to check only one box per decision!

13.	payment in 5 WEEKS…	95	76	57	38	19	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
14.	payment in 5 WEEKS…	90	72	54	36	18	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
15.	payment in 5 WEEKS…	85	68	51	34	17	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
16.	payment in 5 WEEKS…	80	64	48	32	16	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
17.	payment in 5 WEEKS…	70	56	42	28	14	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
18.	payment in 5 WEEKS…	55	44	33	22	11	0
	and payment in 10 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐

ID: _____ Date: _____

5 WEEKS from today *and* 14 WEEKS from today

For each decision number (19 to 24) below, decide the amounts you would like for sure **in 5 weeks AND in 14 weeks** by checking the corresponding box.

Example: In Decision 19, if you wanted 0 in five weeks and 100 in fourteen weeks you would check the right-most box. Remember to check only one box per decision!

19.	payment in 5 WEEKS…	100	80	60	40	20	0
	and payment in 14 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
20.	payment in 5 WEEKS…	95	76	57	38	19	0
	and payment in 14 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
21.	payment in 5 WEEKS…	90	72	54	36	18	0
	and payment in 14 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
22.	payment in 5 WEEKS…	75	60	45	30	15	0
	and payment in 14 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
23.	payment in 5 WEEKS…	60	48	36	24	12	0
	and payment in 14 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐
24.	payment in 5 WEEKS…	45	36	27	18	9	0
	and payment in 14 WEEKS	0	20	40	60	80	100
		☐	☐	☐	☐	☐	☐

Part II

Please do not open until the study coordinator instructs you to do so.

ID: _____ Date: _____

Rules and examples

In this part of the study, you are asked to make a series of choices about how to divide a set of tokens between yourself and one other participant in the room. You and the other participant will be paired randomly and you will not be told each other's identity.

As you divide the tokens, you and the other participant will each earn money but sometimes the money you can earn for each token is different.

Example #1:

Divide 50 tokens: Hold _____ @ 0.5 RMB each, and Pass _____ @ 1 RMB each.

In this choice you must divide 50 tokens. You can keep all the tokens, keep some and pass some, or pass all the tokens. In this example, you will receive 0.5 for every token you hold, and the other participant will receive 1 for every token you pass.

Suppose that you decide to hold 50 and pass 0 tokens. Please take a moment to mark that with the study coordinator.

Divide 50 tokens: Hold ___50__ @ 0.5 RMB each, and Pass __0____ @ 1 RMB each.

By making this choice, you will receive 50 × 0.50 = 25 (RMB), and the other participant will receive 0.

Example #2:

Suppose that you decided to hold 0 tokens and pass 50. Please take a moment to mark that with the study coordinator.

Divide 50 tokens: Hold __0___ @ 0.5 RMB each, and Pass __50___ @ 1 RMB each.

By making this choice, you will receive 0 and the other participant will receive or 50 × 1 = 50.

ID: _____ Date: _____

Example #3:

However, you could choose any number between 0 and 50 to hold. For instance, you could choose to hold 28 tokens and pass 22. Please take a moment to mark that with the study coordinator.

Divide 50 tokens: Hold __28___ @ 0.5 RMB each, and Pass __22___ @ 1 RMB each.

By making this choice, you will receive 28 × 0.5 = 14, and the other participant would receive 22 × 1 = 22.

Example #4:

Divide 40 tokens: Hold _____ @ 1.5 RMB each, and Pass _____ @ 0.5 RMB each.

In this choice you must divide 40 tokens. Every token you hold earns you 1.5, and every token you pass earns the other participant 0.5.

Suppose that you decided to hold 18 tokens and pass 22. Please take a moment to mark that with the study coordinator.

Divide 40 tokens: Hold __18___ @ 1.5 RMB each, and Pass __22___ @ 0.5 RMB each.

By making this choice, you will receive 18 × 1.5 = 24, and the other participant will receive 22 × 0.5 = 11

ID: _____ Date: _____

How to proceed:

You will be asked to make 8 allocation decisions like the examples we discussed previously. We will calculate your payments as follows:

After all your decisions have been submitted, we will randomly match you with another participant in this study session today. At the end of the study session today, a number between 1 and 8 will be drawn from the bag. This number will determine which decision (from 1 to 8) will determine your payoffs.

We will then randomly determine whether your decision or your match's decision will count for determining payment. ½ of the time your decision will be the one that determines the payment and ½ of the time your payment is determined by the decision of your match.

If your decision counts, you will then get the money you allocated in the 'hold' portion of your decision, and your match will get the money you allocated on the 'pass' portion of your decision.

If your match's decision counts, you will then get the money your match allocated in the 'pass' portion of their decision, and they will get the money they allocated on the 'hold' portion of their decision.

At the end of the study session today, we will tell you how much you have earned in this part of the study. This amount will be paid to you in cash and in private at the end of the study session today.

On the following sheet are the choices we would like you to make. Please fill out the choices, taking the time you need to be accurate.

Remember that each decision could be the decision-that-counts! It is in your interest to treat each decision as if it could be the one that determines your payment.

ID: _____ Date: _____

Directions: Please fill in all the blanks below. Make sure the number of tokens listed under Hold plus the number listed under Pass equals the total number of tokens available.

1	Divide 75 tokens: Hold	_____	@ 0.5 RMB each, and Pass	_____	@ 1 RMB each.
2	Divide 40 tokens: Hold	_____	@ 0.5 RMB each, and Pass	_____	@ 1.5 RMB each.
3	Divide 75 tokens: Hold	_____	@ 1 RMB each, and Pass	_____	@ 0.5 RMB each.
4	Divide 60 tokens: Hold	_____	@ 0.5 RMB each, and Pass	_____	@ 1 RMB each.
5	Divide 40 tokens: Hold	_____	@ 1.5 RMB each, and Pass	_____	@ 0.5 RMB each.
6	Divide 60 tokens: Hold	_____	@ 0.5 RMB each, and Pass	_____	@ 0.5 RMB each.
7	Divide 100 tokens: Hold	_____	@ 0.5 RMB each, and Pass	_____	@ 0.5 RMB each.
8	Divide 60 tokens: Hold	_____	@ 1 RMB each, and Pass	_____	@ 0.5 RMB each.

ID: _____ Date: _____

Part III

Please do not open until the study coordinator instructs you to do so.

ID: _____ Date: _____

Part III

On the next page, you will see a table with 10 decisions in 10 separate rows. In each decision you will see an option A and an option B. Option A and B will offer you the chance to earn different amounts of money depending on the role of a die.

At the end of the study session today, a number between 1 and 10 will be drawn from the bag to determine which question is selected for payment. This number will determine which decision (from 1 to 10) will be used to calculate your payoffs.

Then we will determine your payment. The payments are determined by throwing a ten-sided die. Each outcome, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, is equally likely.

To indicate your choice you will circle A or B in the last column of each row, for each of the 10 rows.

ID: _____ Date: _____

Part III - Examples

Example #1:

For example, decision #1 asks you to consider two options. If you choose Option A in the row shown below, you will have a 1 in 10 chance of earning 30 and a 9 in 10 chance of earning 17. Similarly, if you chose Option B you will have a 1 in 10 chance of earning 40.00 and a 9 in 10 chance of earning 1.

Suppose you chose option A. Then you would circle the letter A. Please take a moment to mark that with the study coordinator.

Decision	Option A	Option B	Your Choice
1	You receive 30 if the die is 1; You receive 17 if the die is: 2-10	You receive 40 if the die is 1; You receive 1 if the die is: 2-10	A / B

If, at the end of the study session today, the number 1 is drawn from the bag then your answer to question #1 will count for payment. We will see that you choose Option A for this question. We will then roll a 10 sided die. If the number 1 comes up, then we will pay you 30. If either the number 2, 3, 4, 5, 6, 7, 8, 9, or 10 comes up, then we will pay you 17.

Example #2:

For example, decision #3 asks you to consider two different options. If you choose Option A in the row shown below, you will have a 3 in 10 chance of earning 30 and a 6 in 10 chance of earning 17. Similarly, if you chose Option B you will have a 3 in 10 chance of earning 40.00 and a 6 in 10 chance of earning 1.

Suppose you chose option B. Then you would circle the letter B. Please take a moment to mark that with the study coordinator.

Decision	Option A	Option B	Your Choice
3	You receive 30 if the die is 1-3; You receive 17 if the die is: 4-10	You receive 40 if the die is 1-3; You receive 1 if the die is: 4-10	A / B

If, at the end of the study session today, the number 3 is drawn from the bag then we will see that you choose Option B for this question. We will then roll a 10 sided die. If the either the number 1,2 or 3 comes up, then we will pay you 40. If either the number 4, 5, 6, 7, 8, 9, or 10 comes up, then we will pay you 1.

Please think about each decision carefully, since each row is equally likely to end up being the one that is used to determine payoffs.

ID: _____ Date: _____

In each decision you see an option A and an option B. Option A and B offer you the chance to earn different amounts of money depending on the role of a die.

To indicate your choice you will circle A or B in the last column of each row, for each of the 10 rows.

Decision	Option A	Option B	Your Choice
1	You receive 30 if the die is 1; You receive 17 if the die is: 2-10	You receive 40 if the die is 1; You receive 1 if the die is: 2-10	A / B
2	You receive 30 if the die is 1-2; You receive 17 if the die is: 3-10	You receive 40 if the die is 1-2; You receive 1 if the die is: 3-10	A / B
3	You receive 30 if the die is 1-3; You receive 17 if the die is: 4-10	You receive 40 if the die is 1-3; You receive 1 if the die is: 4-10	A / B
4	You receive 30 if the die is 1-4; You receive 17 if the die is: 5-10	You receive 40 if the die is 1-4; You receive 1 if the die is: 5-10	A / B
5	You receive 30 if the die is 1-5; You receive 17 if the die is: 6-10	You receive 40 if the die is 1-5; You receive 1 if the die is: 6-10	A / B
6	You receive 30 if the die is 1-6; You receive 17 if the die is: 7-10	You receive 40 if the die is 1-6; You receive 1 if the die is: 7-10	A / B
7	You receive 30 if the die is 1-7; You receive 17 if the die is: 8-10	You receive 40 if the die is 1-7; You receive 1 if the die is: 8-10	A / B
8	You receive 30 if the die is 1-8; You receive 17 if the die is: 9-10	You receive 40 if the die is 1-8; You receive 1 if the die is: 9-10	A / B
9	You receive 30 if the die is 1-9; You receive 17 if the die is: 10	You receive 40 if the die is 1-9; You receive 1 if the die is: 10	A / B
10	You receive 30 if the die is 1-10	You receive 40 if the die is 1-10	A / B

Part IV

ID: _____ Date: _____

[QUESTIONS FOR EVEN SUBJECT ID'S]

End of the study

Please take a moment to answer these questions. When you are done, close your booklets up and then we will know to come and collect your booklet.

1) A bat and a ball cost 1.10 in total. The bat costs 1.00 more than the ball. How much does the ball cost?

2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

Do you think you are patient or impatient? Please indicate your answer by tick one of the following boxes: 0 means least patient; 10 means most patient.

0	1	2	3	4	5	6	7	8	9	10

Do you think you are someone who is willing to take risks, or someone who is trying to minimize risks? Please indicate your answer by tick one of the following boxes: 0 means least willing to take risks; 10 means most willing to take risks.

0	1	2	3	4	5	6	7	8	9	10

Thank you! That concludes our study. Please indicate to me whether you give me permission to show your data to other researchers. Only data that has no identifying information on it will be shared. Indicate your preference by checking a box below.

_____yes, you may share my data with other researchers.

_____No, you may not share my data with other researchers.

ID: _____ Date: _____

[QUESTIONS FOR ODD SUBJECT ID'S]

End of the study

Please take a moment to answer these questions. When you are done, close your booklets up and then we will know to come and collect your booklet.

1) A piece of flatbread and a piece of fried flourstick cost 1.10 in total. The flatbread costs 1.00 more than the flourstick.
   How much does the flourstick cost?

2) If it takes 5 cooks 5 minutes to make 5 buns, how long would it take 100 cooks to make 100 buns?

3) There are many eggs in a chicken farm. Every day, the eggs double in number. If it takes 48 days for the eggs to fill the warehouse, how long would it take for them to fill half of the warehouse?

Do you think you are patient or impatient? Please indicate your answer by tick one of the following boxes: 0 means least patient; 10 means most patient.

0	1	2	3	4	5	6	7	8	9	10

Do you think you are someone who is willing to take risks, or someone who is trying to minimize risks? Please indicate your answer by tick one of the following boxes: 0 means least willing to take risks; 10 means most willing to take risks.

0	1	2	3	4	5	6	7	8	9	10

Thank you! That concludes our study. Please indicate to me whether you give me permission to show your data with to other researchers. Only data that has no identifying information on it will be shared. Indicate your preference by checking a box below.

_____yes, you may share my data with other researchers.

_____No, you may not share my data with other researchers.

Appendix B. Time preference analysis

To test the impact of our treatment on time preference consistency, we define inconsistent choices as those where a subject chooses an option that implies that he will save *less* when the interest rate is *higher*. Such choices would be equivalent to having an upward-sloping demand curve. In our sample, we find that 47.2% of our subjects exhibit time preference inconsistency. [12]

In Table 9, we report the results for our four probit specifications. The dependent variable is a dummy variable that takes the value of 1 if a subject has one or more inconsistent responses. The independent variables (omitted) include hungry (sated), female (male), an interaction term, the same set of biological variables (3) as in Table 7, and lastly, the number of wrong answers in the CRT (4).

Our results show no significant treatment effect on the likelihood of exhibiting inconsistent time preferences (0.027, $p > 0.10$, specification 1). While females are 20 percentage points more likely than males to exhibit inconsistent time preferences ($p < 0.05$, specification 2), we find that this result becomes marginally significant after controlling for biological factors (0.207, $p < 0.10$, specification 3), and insignificant after further controlling for the number of wrong CRTs (0.104, $p > 0.10$, specification 4).

Next, we simultaneously estimate subjects' time and risk preferences using the same functional form with quasi-hyperbolic discounting as used by Andreoni et al. (2015):

$$U(x_t, x_{t+k}) = \begin{cases} x_t^\alpha + \beta\delta^k x_{t+k}^\alpha & \text{if } t = 0, \\ x_t^\alpha + \delta^k x_{t+k}^\alpha & \text{if } t > 0, \end{cases}$$

where x_t is the sooner choice, x_{t+k} is the later choice, α is the curvature of the utility function, β captures the present bias, and δ is the long-run discount rate. This utility function, subject to budget constraints, gives us the following intertemporal Euler equation:

$$P = MRS = \frac{x_t^{\alpha-1}}{\beta^{t_0}\delta^k x_{t+k}^{\alpha-1}}.$$

From here, we can generate a non-linear regression equation based on:

$$x_t = \frac{20(\beta^{t_0}\delta^k P)^{\frac{1}{\alpha-1}}}{1 + P(\beta^{t_0}\delta^k P)^{\frac{1}{\alpha-1}}}.$$

[12] Researchers using the CTB methodology typically find very few subjects who choose an option that implies an upward-sloping demand curve. For example, Andreoni and Sprenger (2012) find that only 8/97 subjects did so. However, they caution that this relatively small percentage should be understood within the context of the fact that a high fraction of subjects (37% in the 2012 study) have no interior choices. Cheung (2015), Ashton (2014) and Andreoni et al. (2015) have similar findings.

Table 9: Inconsistency in time preference: Probit

Dependent Variable	Having at least one inconsistent choice			
	(1)	(2)	(3)	(4)
Hungry	0.027	0.105	0.135	0.125
	(0.070)	(0.098)	(0.108)	(0.107)
Female		0.200**	0.207*	0.104
		(0.099)	(0.111)	(0.113)
Female × Hungry		-0.168	-0.219	-0.182
		(0.139)	(0.154)	(0.150)
Age			0.004	0.005
			(0.006)	(0.006)
BMI			-0.006	-0.011
			(0.013)	(0.013)
Blood glucose			-0.053	-0.071
			(0.042)	(0.048)
BP, systolic			0.004	0.003
			(0.005)	(0.005)
BP, diastolic			-0.002	-0.001
			(0.006)	(0.006)
Blood lipid			-0.005	0.005
			(0.037)	(0.035)
# of wrong CRTs				0.117***
				(0.033)
Observations	201	201	171	171
Female + Female × Hungry		0.033	-0.012	-0.077
		(0.099)	(0.115)	(0.112)
Hungry + Female × Hungry		-0.062	-0.084	-0.056
		(0.099)	(0.107)	(0.103)

Notes: Subjects without blood test results are dropped in (3) and (4). Standard errors in parentheses are clustered at the individual level; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. Average marginal effects are reported; the marginal effects for interaction terms are the difference between the average marginal effect (AME) of the dummy Hungry for female and male; the standard errors are calculated using the Delta method (Ai and Norton, 2003); and hypotheses are tested using the Wald test; Female + Female × Hungry stands for the marginal effect of Female at Hungry = 1; Hungry + Female × Hungry stands for the marginal effect of Hungry at Female = 1.

Here, subject sensitivity to changing interest rates delivers identification of α and the variation in timing (across sheets) of the sooner and later payments identifies δ and β. Table 10 presents our aggregate parameter estimates for our sated and hungry treatment groups. In the last row, we also display the findings from Andreoni et al. (2015) for comparison purposes.

Table 10: Aggregate parameter estimates

Experimental Condition	Sample size N	Risk α	Present bias β	Discount rate δ
All	201	0.814	0.968	0.998
Sated	98	0.820	0.958	0.998
Hungry	103	0.808	0.958	0.998
Andreoni et al. (2015)	58	0.928	0.988	0.999

Our aggregate estimates indicate that our subjects are risk averse (a result consistent with our earlier findings presented in Table 5) with a small present bias. Compared to those in Andreoni et al. (2015), our subjects exhibit similar aggregate time preferences but slightly greater risk aversion.

As a robustness check, we report the results of four quantile regressions (median) in Table 11. The dependent variable is the curvature parameter of the utility function, α. The independent variables (omitted) again include hungry (sated), female (male), an interaction term, the same set of biological variables (3), and lastly, the number of wrong answers in the CRT (4). Consistent with our analysis of risk preferences using the lottery choice task, we find that women are more risk averse (specifications 2 and 3), although this result becomes insignificant when we control for CRT correctness (4). Thus, we conclude that our findings support the idea that hunger reduces the gender gap in risk preferences. Of the biomarkers, we again find that a higher blood lipid level is associated with greater risk aversion (-0.045, $p < 0.05$, specifications 3 and 4). Lastly, we note that people with lower cognitive abilities (as measured by a higher number of wrong CRT responses) are significantly more risk averse (-0.046, $p < 0.05$), a finding consistent with that of Dohmen et al. (2010) using a German subject pool. By contrast, we do not find any treatment or heterogeneous treatment effects on our time preference parameters, β and δ, using similar quantile regressions. We summarize our results on time and risk preferences using the convex time budget (CTB) below.

Result 5 (Time and risk preferences using CTB)**.** *An additional mistake in the CRT increases the likelihood of time preference inconsistency by 12 percentage points. Furthermore, subjects with a higher number of wrong CRT responses or a higher blood lipid level are significantly more risk averse.*

Table 11: Risk parameter α

Dependent Variable	Risk parameter, α			
	(1)	(2)	(3)	(4)
Hungry	-0.003	-0.038	-0.038	-0.055
	(0.048)	(0.062)	(0.064)	(0.066)
Female		-0.185***	-0.169**	-0.075
		(0.063)	(0.066)	(0.070)
Female × Hungry		0.118	0.153*	0.088
		(0.087)	(0.090)	(0.092)
Age			0.004	0.003
			(0.003)	(0.003)
BMI			-0.002	0.000
			(0.008)	(0.008)
Blood glucose			-0.002	-0.007
			(0.018)	(0.019)
BP, systolic			0.001	-0.001
			(0.003)	(0.003)
BP, diastolic			0.002	0.005
			(0.004)	(0.004)
Blood lipid			-0.045**	-0.045**
			(0.022)	(0.023)
# of wrong CRTs				-0.046**
				(0.021)
Constant	0.908***	0.973***	0.679**	0.837***
	(0.035)	(0.043)	(0.274)	(0.282)
Observations	198	198	168	168
Female + Female × Hungry		-0.067	-0.016	0.013
		(0.061)	(0.066)	(0.069)
Hungry + Female × Hungry		0.080	0.116*	0.033
		(0.202)	(0.062)	(0.064)

Notes: All subjects whose parameters can be estimated are included. Those without blood tests are dropped in (3) and (4). Standard errors in parenthesis are clustered at the individual level; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; hypotheses for combinations of coefficients are tested using t-tests.

Support. *Specification (4) in Table 9 shows that the coefficient for the number of wrong CRTs is 0.117 ($p < 0.01$). Likewise, specification (4) in Table 11 shows that the coefficient for the number of wrong CRTs (blood lipid) is -0.046 (-0.045, $p < 0.05$ in both cases).*