Multiattribute Utility Theory,

Intertemporal Utility and Correlation Aversion

by

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ABSTRACT. Convenient assumptions about qualitative properties of the intertemporal utility function have generated counter-intuitive implications for the relationship between atemporal risk aversion and the intertemporal elasticity of substitution. If the intertemporal utility function is additively separable then the latter two concepts are the inverse of each other. We review a simple theoretical specification with a long lineage in the literature on multi-attribute utility, and demonstrate the critical role of a concept known as intertemporal correlation aversion. This concept is the intertemporal analogue of a more general concept applied to two attributes of utility, but where the attributes just happen to be the time-dating of the good. In the context of intertemporal utility functions, the concept provides an intuitive explanation of possible differences between (the inverse of) atemporal risk aversion and the intertemporal elasticity of substitution. We use this theoretical structure to guide the design of a series of experiments that allow us to identify and estimate intertemporal correlation aversion. Our results show that subjects are correlation averse over lotteries with intertemporal income profiles, and that the convenient additive specification of the intertemporal utility function is not an appropriate representation of preferences over time.

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Appendix A: Instructions (WORKING PAPER)

We document the instructions by first listing the "manuscript" that shows what was given to subjects and read to them, and then we document some of the screen displays. The original Danish manuscript is available on request. The originals were in 14-point font, printed on A4 paper for nice page breaks (a horizontal line below indicates a page break), and given to subjects in laminated form. The manuscript below was for the sessions in which the discount rate task was presented first. After these experimental tasks were completed there were additional tasks in the session that are not relevant here.

A. Experimental Manuscript

Welcome announcement

[Give informed consent form to subjects.]

Thank you for agreeing to participate in this survey. The survey is financed by the Social Science Research Council and the Carlsberg Foundation and concerns the economics of decision making.

Before we begin the survey, let me read out the informed consent form that is handed out to you. This form explains your rights as a participant in the survey, what the survey is about and how we make payments to you.

[Read the informed consent form.]

Is everyone able to stay for the full two hours of the meeting? Before we begin, I will ask each of you to pick an envelope from me. The envelope contains a card with an ID number that we will use to keep track of who answered which questions. All records and published results will be linked to anonymous ID numbers only, and not to your name. Please keep your ID numbers private and do not share the information with anyone else.

[Each subject picks an envelope.]

You will be given written instructions during the survey, but make all decisions on the computer in front of you. Please enter your ID number on the computer in front of you, but keep the card for later use.

You will now continue with the first task. The problem is not designed to test you. The only right answer is what you really would choose. That is why the task gives you the chance of winning money. I will now distribute the instructions and then read it out loud.

[Give IDR instructions to subjects.]
[Read the IDR instructions.]

Task D

In this task you will make a number of choices between two options labeled "A" and "B". An example of your task is shown on the right. You will make all decisions on a computer.

All decisions have the same format. In the example on the right Option A pays 100 kroner today and Option B pays 105 kroner twelve months from now. By choosing option B you would get an annual return of 5% on the 100 kroner.

We will present you with 40 of these decisions. The only difference between them is that the amounts and payment dates in Option A and B will differ.

You will have a 1-in-10 chance of being paid for one of these decisions. The selection is made with a 10-sided die. If the roll of the die gives the number 1 you will be paid for one of the 40 decisions, but if the roll gives any other number you will not be paid. If you are paid for one of these 40 decisions, then we will further select one of these decisions by rolling a 4-sided and a 10-sided die. When you make your choices you will not know which decision is selected for payment. You should therefore treat each decision as if it might actually count for payment.

You will receive the money on the date stated in your preferred option. If you receive some money today, then it is paid out at the end of the experiment. If you receive some money to be paid in the future, then it is transferred to your personal bank account on the specified date. In that case you will receive a written confirmation from Copenhagen Business School which guarantees that the money is reserved on an account at Danske Bank. You can send this document to Danske Bank in a prepaid envelope, and the bank will transfer the money to your account on the specified date.

Before making your choices you will have a chance to practice so that you better understand the consequences of your choices. Please proceed on the computer to the practice task. You will be paid in caramels for this practice task, and they are being paid on the time stated in your preferred option.

[Subjects make decisions in the practice IDR task.]

I will now come around and pay you in caramels for your choice of A or B. Please proceed to the actual task after your earnings are recorded. You will have a 1-in-10 chance of being paid for one of the 40 decisions in the actual task.

Password 1:____

[Subjects make decisions in the actual IDR task.]

I will now come around and ask you to roll a 10-sided die to determine if you are being paid for one of the decisions. If the roll of the die gives the number 1 you will be paid for one of the 40 decisions, but if the roll gives any other number you will not be paid. If you are paid for one of the 40 decisions, then I will ask you to roll a 4-sided and a 10-sided die to select one of the decisions for payment.

Password 2:____

[Roll 10-sided die to determine if they are being paid.]
[Roll 4-sided and 10-sided dice to determine the decision for payment.]

You will now continue with the second task. I will distribute the instructions and then read it out loud.

[Give RA instructions to subjects.]
[Read the RA instructions.]

Task L

In this task you will make a number of choices between two options labeled "A" and "B". An example of your task is shown on the right. You will make all decisions on a computer.

All decisions have the same format. In the example on the right Option A pays 60 kroner if the outcome of a roll of a ten-sided die is 1, and it pays 40 kroner if the outcome is 2-10. Option B pays 90 kroner if the outcome of the roll of the die is 1 and 10 kroner if the outcome is 2-10. All payments in this task are made today at the end of the experiment.

We will present you with 40 such decisions. The only difference between them is that the probabilities and amounts in Option A and B will differ.

You have a 1-in-10 chance of being paid for one of these decisions. The selection is made with a 10-sided die. If the roll of the die gives the number 1 you will be paid for one of the 40 decisions, but if the roll gives any other number you will not be paid. If you are paid for one of these 40 decisions, then we will further select one of these decisions by rolling a 4-sided and a 10-sided die. A third die roll with a 10-sided die determines the payment for your choice of Option A or B. When you make your choices you will not know which decision is selected for payment. You should therefore treat each decision as if it might actually count for payment.

If you are being paid for one of the decisions, we will pay you according to your choice in the selected decision. You will then receive the money at the end of the experiment.

Before making your choices you will have a chance to practice so that you better understand the consequences of your choices. Please proceed on the computer to the practice task. You will be paid in caramels for this practice task.

[Subjects make decisions in the practice RA task.]

I will now come around and pay you in caramels for your choice of A or B. I will ask you to roll a 10-sided die to determine the payment for your choice of A or B. Please proceed to the actual task after your earnings are recorded. You will have a 1-in-10 chance of being paid for one of the 40 decisions in the actual task.

Password 3:____

[Subjects make decisions in the actual RA task.]

I will now come around and ask you to roll a 10-sided die to determine if you are being paid for one of the decisions. If the roll of the die gives the number 1 you will be paid for one of the 40 decisions, but if the roll gives any other number you will not be paid. If you are paid for one of the 40 decisions, then I will ask you to roll a 4-sided and a 10-sided die to select one of the decisions for payment. A third die roll with a 10-sided die determines the payment for your choice of Option A or B.

Password 4:____

[Roll 10-sided die to determine if they are being paid.]
[Roll 4-sided and 10-sided dice to determine the decision for payment.]
[Roll 10-sided die to determine payment in Option A and B.]

You will now continue with the third task. I will distribute the instructions and then read it out loud.

[Give RA-IDR instructions to subjects.]
[Read the RA-IDR instructions.]

Task DL

In this task you will make a number of choices between two options labeled "A" and "B". An example of your task is shown on the right. You will make all decisions on a computer.

All decisions have the same format. In the example on the right Option A pays 100 kroner today and 5 kroner in twelve months from now if the outcome of a roll of a ten-sided die is 1, and it pays 5 kroner today and 100 kroner in twelve months if the outcome is 2-10. Option B pays 100 kroner today and 100 kroner in twelve months if the outcome of the roll of the die is 1, and it pays 5 kroner today and 5 kroner in twelve months if the outcome is 2-10.

We will again present you with 40 of these decisions. The only difference between them is that the probabilities, amounts and payment dates in Option A and B will differ.

You have a 1-in-10 chance of being paid for one of these decisions. The selection is made with a 10-sided die. If the roll of the die gives the number 1 you will be paid for one of the 40 decisions, but if the roll gives any other number you will not be paid. If you are paid for one of these 40 decisions, then we will further select one of these decisions by rolling a 4-sided and a 10-sided die. A third die roll with a 10-sided die determines the payment for your choice of Option A or B. When you make your choices you will not know which decision is selected for payment. You should therefore treat each decision as if it might actually count for payment.

You will receive the money on the date stated in your preferred option. If you receive some money today, then it is paid out at the end of the experiment. If you receive some money to be paid in the future, then it is transferred from Copenhagen Business School's account at Danske Bank to your

personal bank account on the specified date. In that case you will receive a written confirmation from Copenhagen Business School which documents the size of your earnings, and when the money is being transferred. You can send this document to Danske Bank in a prepaid envelope, and the bank will transfer the money to your account on the specified date.

Before making your choices you will have a chance to practice so that you better understand the consequences of your choices. Please proceed on the computer to the practice task. You will be paid in caramels for this practice task, and they are being paid on the time stated in your preferred option.

[Subjects make decisions in the practice RA-IDR task.]

I will now come around and pay you in caramels for your choice of A or B. I will ask you to roll a 10-sided die to determine the payment for your choice of A or B. Please proceed to the actual task after your earnings are recorded. You will have a 1-in-10 chance of being paid for one of the 40 decisions in the actual task.

Password 5:____

[Subjects make decisions in the actual RA-IDR task.]

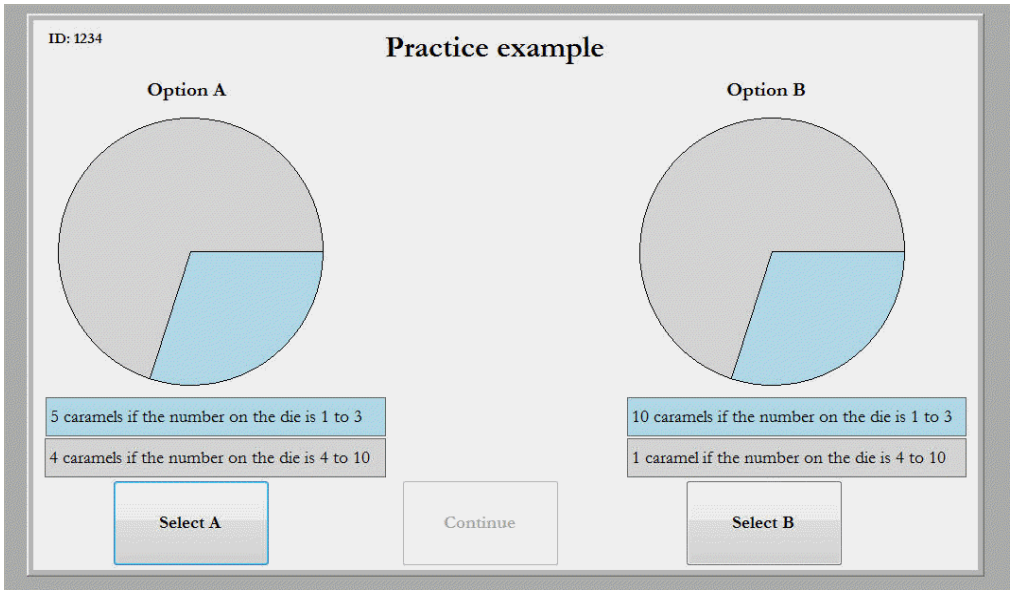
I will now come around and ask you to roll a 10-sided die to determine if you are being paid for one of the decisions. If the roll of the die gives the number 1 you will be paid for one of the 40 decisions, but if the roll gives any other number you will not be paid. If you are paid for one of the 40 decisions, then I will ask you to roll a 4-sided and a 10-sided die to select one of the decisions for payment. A third die roll with a 10-sided die determines the payment for your choice of Option A or B.

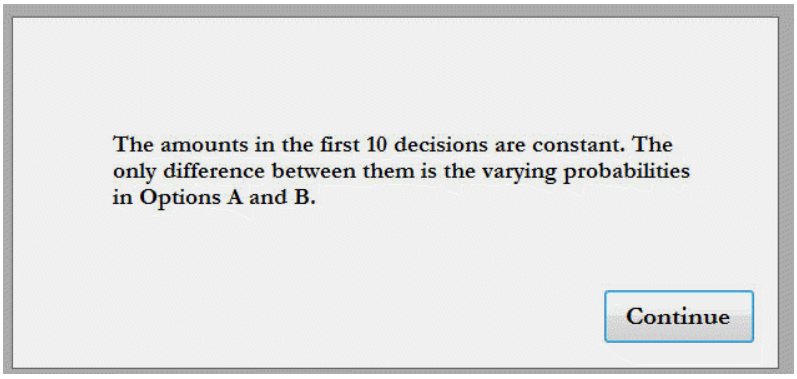
Password 6:____

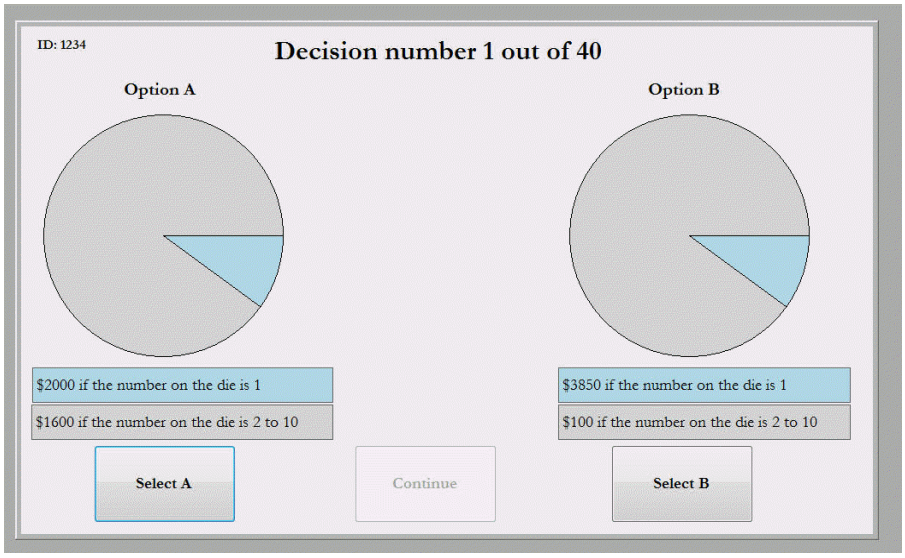
[Roll 10-sided die to determine if they are being paid.]
[Roll 4-sided and 10-sided dice to determine the decision for payment.]
[Roll 10-sided die to determine payment in Option A and B.]

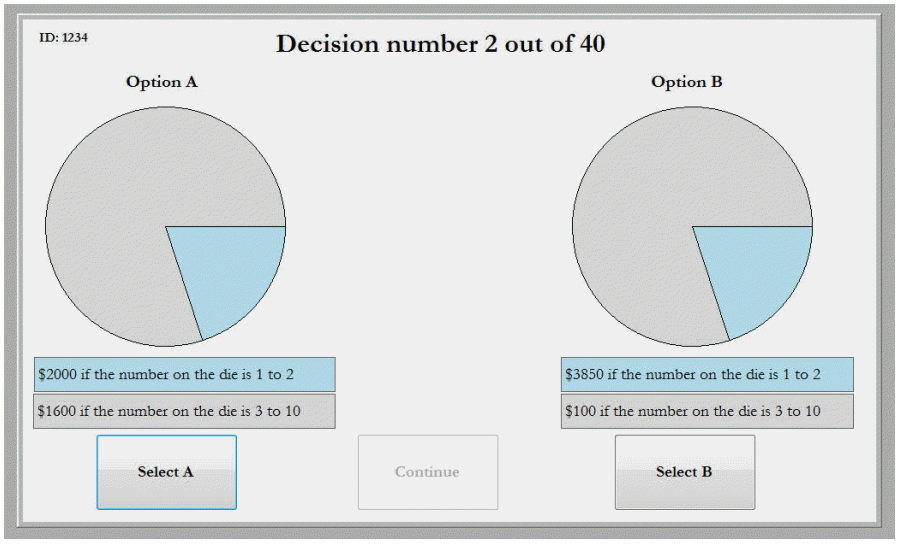
B. Typical Screen Shots for Lottery Choices

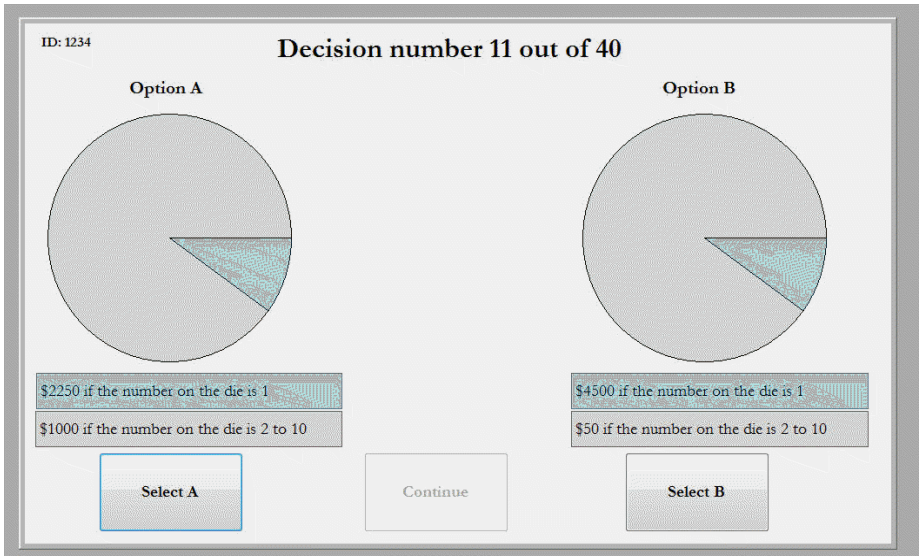
The first screen shot on the next page shows the full screen within which the text box is contained, so that one gets an impression of what the subject encountered in all screen shots. Then we display more detailed screen shots of the practice example and the first few lottery choices. Prior to each block of 10 lottery choices the subject was told that the lottery prizes for the next 10 choices would stay the same and the only thing that would vary would be the probabilities. We then show the sequence of the first two lotteries, and then lottery 11 which uses new prizes.


ID: 1234
Practice example
Option A
Option B
5 caramels if the number on the die is 1 to 3
4 caramels if the number on the die is 4 to 10
10 caramels if the number on the die is 1 to 3
1 caramel if the number on the die is 4 to 10
Select A
Continue
Select B


The amounts in the first 10 decisions are constant. The only difference between them is the varying probabilities in Options A and B.
Continue


ID: 1234
Decision number 1 out of 40
Option A
Option B
$2000 if the number on the die is 1
$1600 if the number on the die is 2 to 10
$3850 if the number on the die is 1
$100 if the number on the die is 2 to 10
Select A
Continue
Select B


ID: 1234
Decision number 2 out of 40
Option A
Option B
$2000 if the number on the die is 1 to 2
$1600 if the number on the die is 3 to 10
$3850 if the number on the die is 1 to 2
$100 if the number on the die is 3 to 10
Select A
Continue
Select B

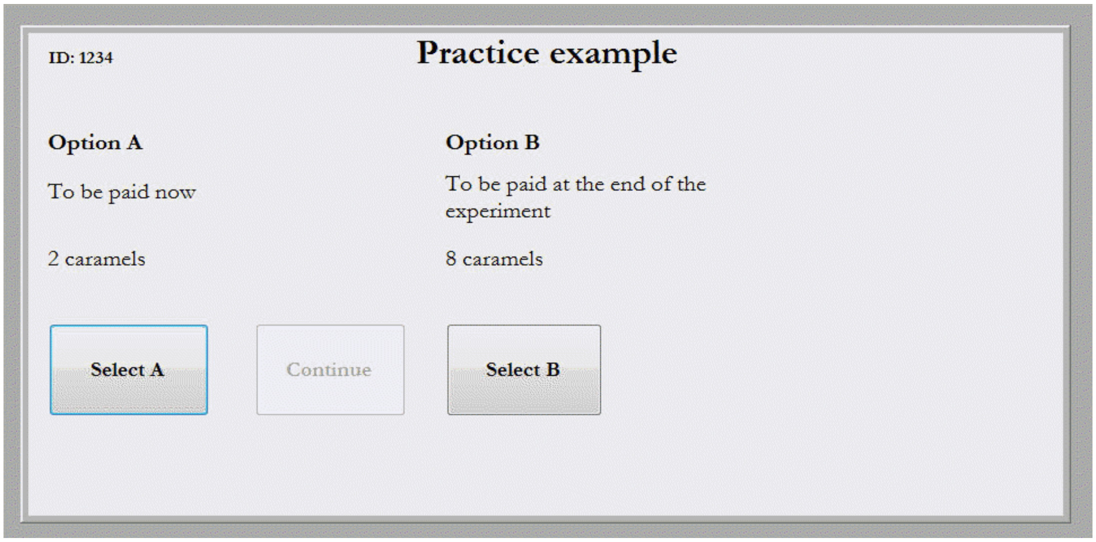


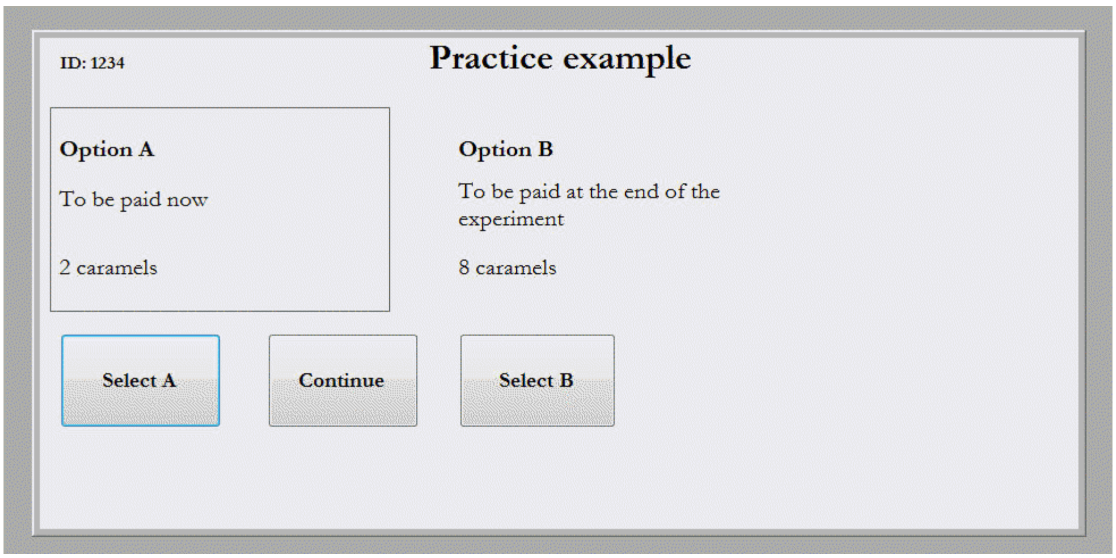
C. Typical Screen Shots for Discounting Choices

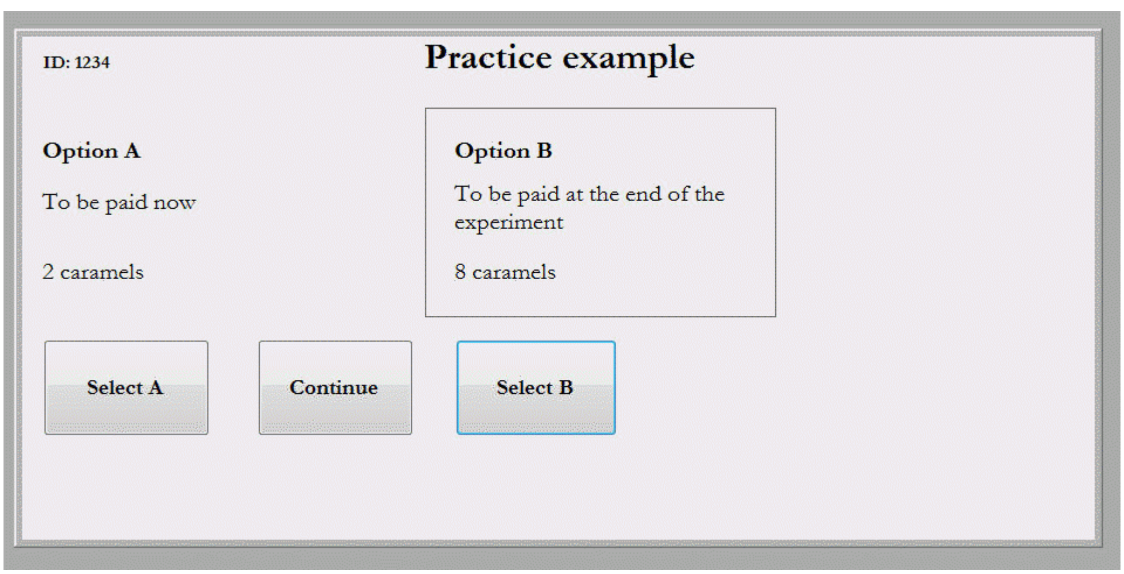
The next page shows the practice example provided at the beginning of these tasks. The top panel shows the initial screen shot, and then the next two panels show how the selected option is highlighted to make it clear to the subject which option is being selected.

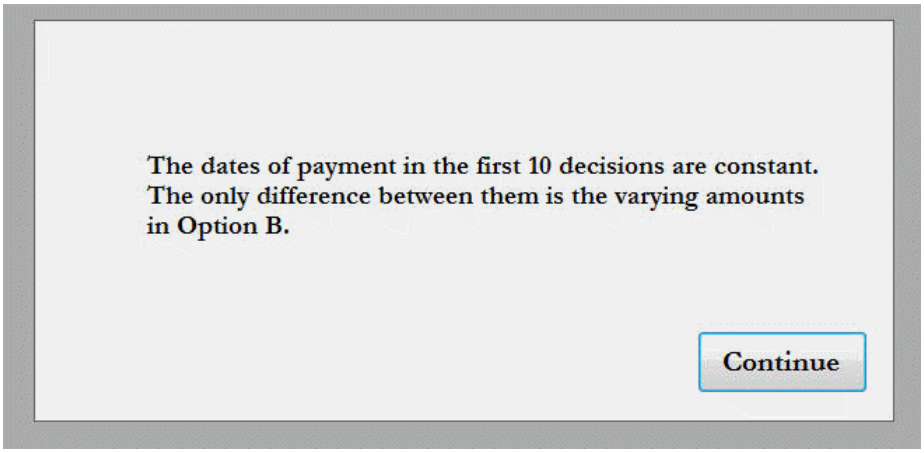
The following page shows the information that was given to each subject prior to each block of 10 choices. This information was that the principal and horizon would remain constant for the next 10 choices, but that the only thing that would change would be the amount in the "later" option. In these displays the implied interest rate is displayed.

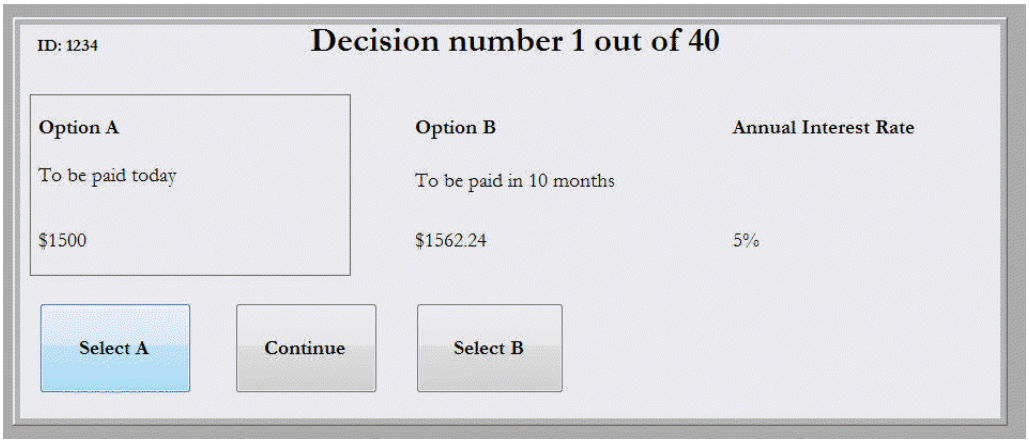
Finally, after the first 10 choices a new horizon was selected for the next 10 choices.

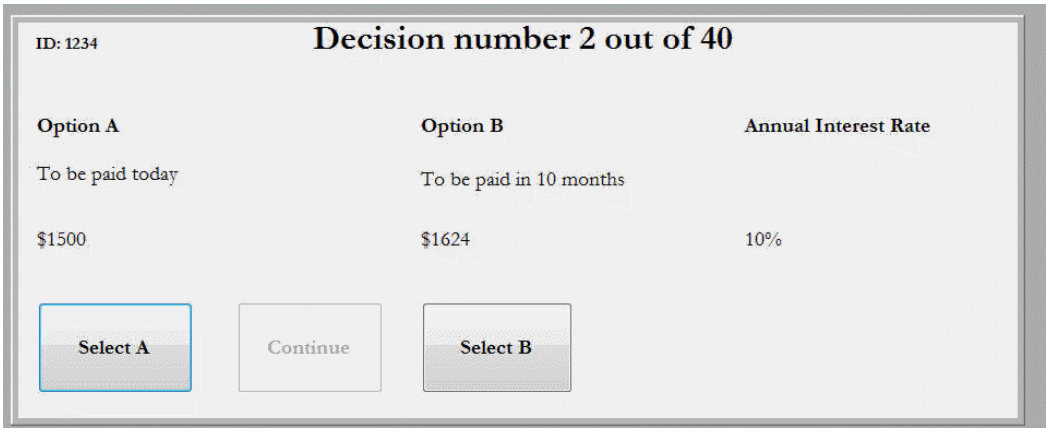

ID: 1234
Practice example
Option A
To be paid now
2 caramels
Option B
To be paid at the end of the experiment
8 caramels
Select A
Continue
Select B

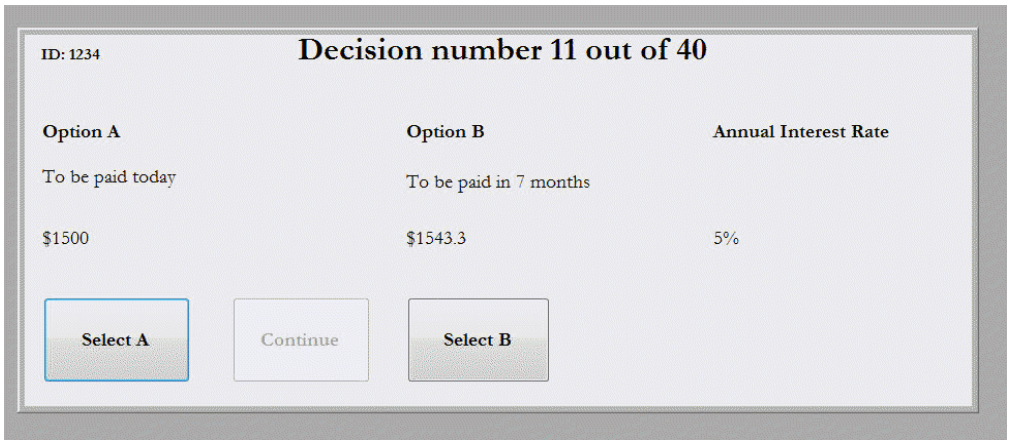

ID: 1234
Practice example
Option A
To be paid now
2 caramels
Option B
To be paid at the end of the experiment
8 caramels
Select A
Continue
Select B


ID: 1234
Practice example
Option A
To be paid now
2 caramels
Option B
To be paid at the end of the experiment
8 caramels
Select A
Continue
Select B


The dates of payment in the first 10 decisions are constant.
The only difference between them is the varying amounts
in Option B.
Continue


ID: 1234
Decision number 1 out of 40
Option A
To be paid today
$1500
Option B
To be paid in 10 months
$1562.24
Annual Interest Rate
5%
Select A
Continue
Select B

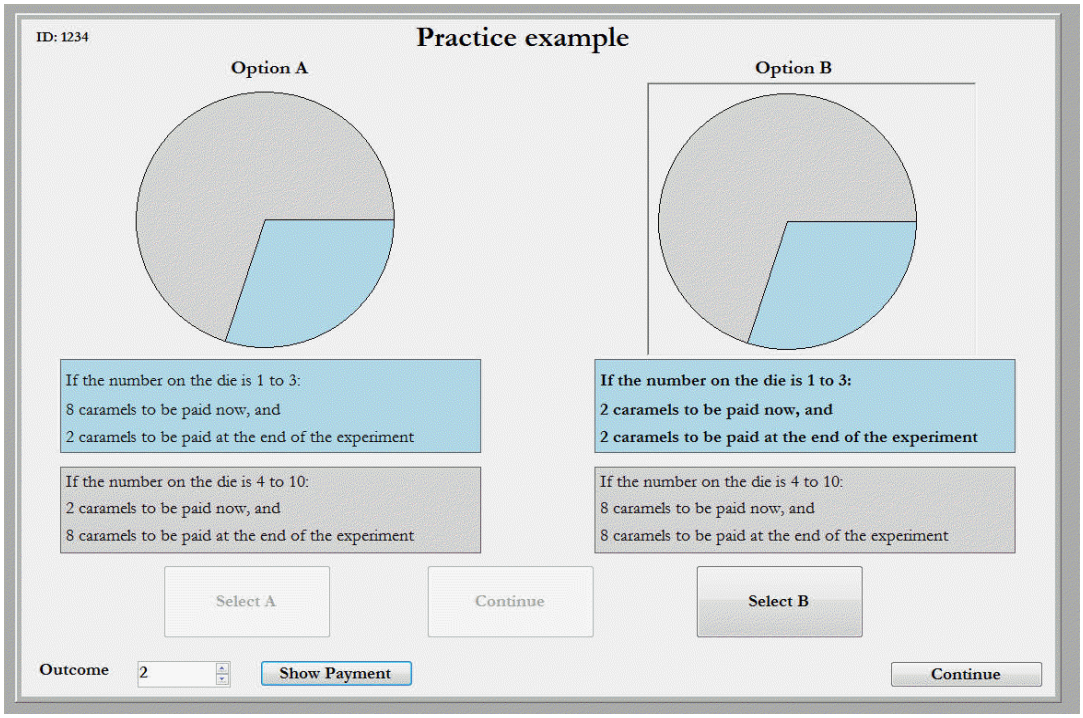

ID: 1234
Decision number 2 out of 40
Option A
To be paid today
$1500
Option B
To be paid in 10 months
$1624
Annual Interest Rate
10%
Select A
Continue
Select B

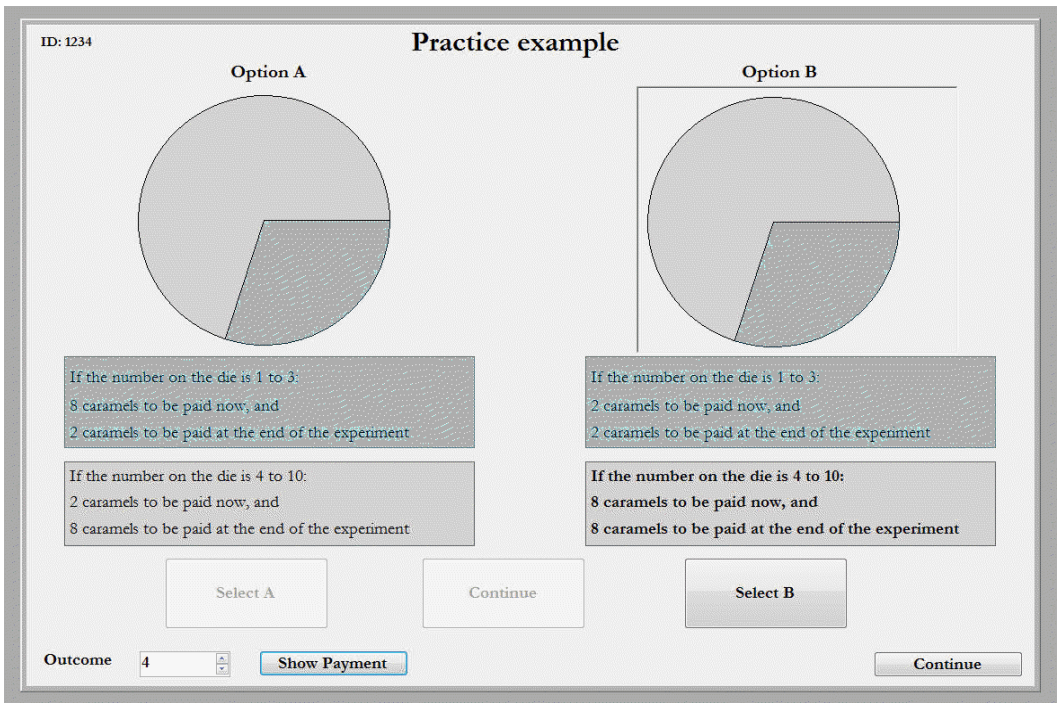


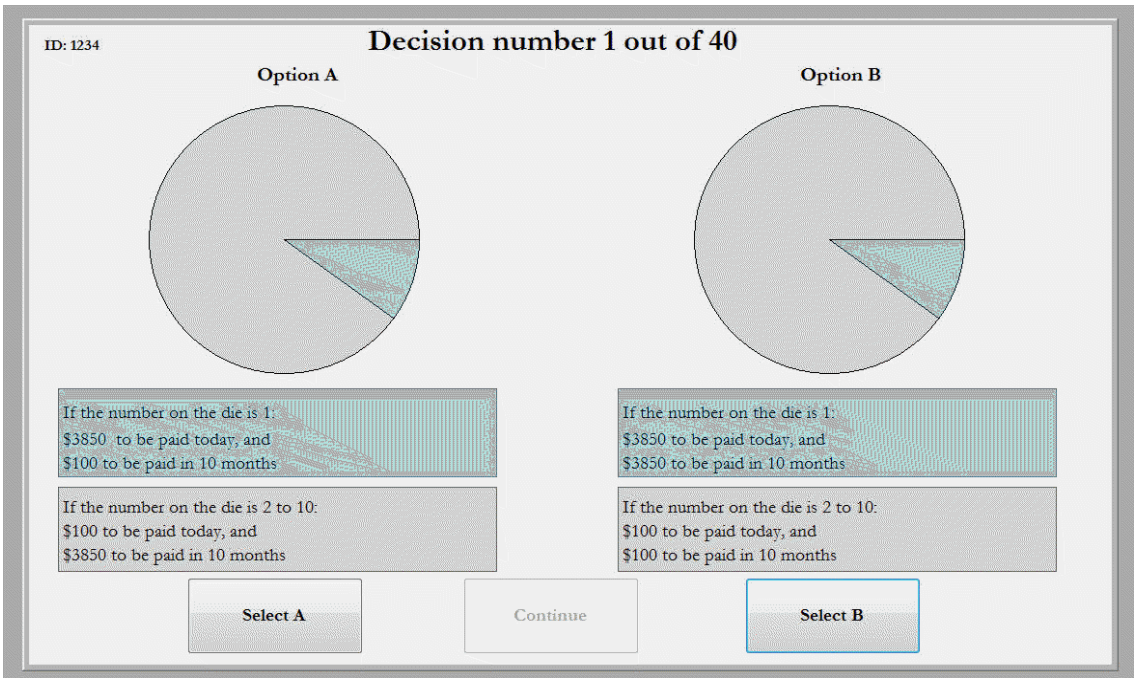
D. Typical Screen Shots for Intertemporal Risk Aversion Choices

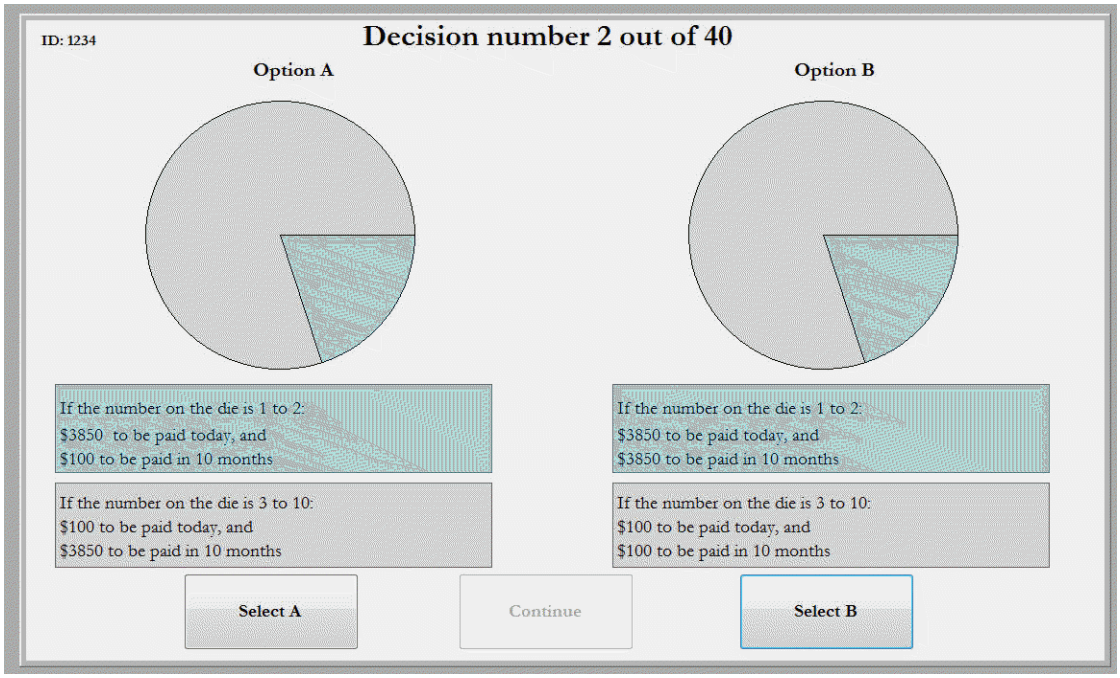
The next page shows the practice example provided at the beginning of these tasks. The top panel shows the initial screen shot, and then the next two panels show how the selected option is highlighted to make it clear to the subject which option is being selected.

The following page shows two of the actual tasks for a subject with no front end delay. The lottery prizes were always the same. Option A always had a mixture of the higher and smaller amount, with the first option having the higher amount sooner and the smaller amount later, and the second option having the lower amount sooner and the higher amount later. Option B always had the all-high or all-lower amounts.


ID: 1234
Practice example
Option A
Option B
If the number on the die is 1 to 3:
8 caramels to be paid now, and
2 caramels to be paid at the end of the experiment
If the number on the die is 1 to 3:
2 caramels to be paid now, and
2 caramels to be paid at the end of the experiment
If the number on the die is 4 to 10:
2 caramels to be paid now, and
8 caramels to be paid at the end of the experiment
If the number on the die is 4 to 10:
8 caramels to be paid now, and
8 caramels to be paid at the end of the experiment
Select A
Continue
Select B
Outcome
2
Show Payment
Continue


ID: 1234
Practice example
Option A
Option B
If the number on the die is 1 to 3:
8 caramels to be paid now, and
2 caramels to be paid at the end of the experiment
If the number on the die is 1 to 3:
2 caramels to be paid now, and
2 caramels to be paid at the end of the experiment
If the number on the die is 4 to 10:
2 caramels to be paid now, and
8 caramels to be paid at the end of the experiment
If the number on the die is 4 to 10:
8 caramels to be paid now, and
8 caramels to be paid at the end of the experiment
Select A
Continue
Select B
Outcome
4
Show Payment
Continue


ID: 1234
Decision number 1 out of 40
Option A
Option B
If the number on the die is 1:
$3850 to be paid today, and
$100 to be paid in 10 months
If the number on the die is 2 to 10:
$100 to be paid today, and
$3850 to be paid in 10 months
If the number on the die is 1:
$3850 to be paid today, and
$3850 to be paid in 10 months
If the number on the die is 2 to 10:
$100 to be paid today, and
$100 to be paid in 10 months
Select A
Continue
Select B


ID: 1234
Decision number 2 out of 40
Option A
Option B
If the number on the die is 1 to 2:
$3850 to be paid today, and
$100 to be paid in 10 months
If the number on the die is 3 to 10:
$100 to be paid today, and
$3850 to be paid in 10 months
If the number on the die is 1 to 2:
$3850 to be paid today, and
$3850 to be paid in 10 months
If the number on the die is 3 to 10:
$100 to be paid today, and
$100 to be paid in 10 months
Select A
Continue
Select B

E. Parameter Values

Table A1 shows the parameters of the lottery choice tasks, Table A2 shows the parameters of the discounting choice tasks, and Table A3 shows the parameters of the intertemporal risk aversion choices.

In Table A1 the parameters are (1) the decision number, (2) the probability of the high prize in each lottery, (3) the high prize of lottery A, in kroner, (4) the low prize of lottery A, in kroner, (5) the high prize of lottery B, in kroner, (6) the low prize of lottery B, in kroner, (7) the expected value of lottery A, and (8) the expected value of lottery B. The information in columns (7) and (8) was not presented to subjects.

Table A1: Parameters for Lottery Choices

Decision	Probability of High Prize	Lottery A High Prize	Lottery A Low Prize	Lottery B High Prize	Lottery B Low Prize	EV of Lottery A	EV of Lottery B
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	0.1	1125	750	2000	250	787.5	425
2	0.2	1125	750	2000	250	825	600
3	0.3	1125	750	2000	250	862.5	775
4	0.4	1125	750	2000	250	900	950
5	0.5	1125	750	2000	250	937.5	1125
6	0.6	1125	750	2000	250	975	1300
7	0.7	1125	750	2000	250	1012.5	1475
8	0.8	1125	750	2000	250	1050	1650
9	0.9	1125	750	2000	250	1087.5	1825
10	1	1125	750	2000	250	1125	2000
11	0.1	1000	875	2000	75	887.5	267.5
12	0.2	1000	875	2000	75	900	460
13	0.3	1000	875	2000	75	912.5	652.5
14	0.4	1000	875	2000	75	925	845
15	0.5	1000	875	2000	75	937.5	1037.5
16	0.6	1000	875	2000	75	950	1230
17	0.7	1000	875	2000	75	962.5	1422.5
18	0.8	1000	875	2000	75	975	1615
19	0.9	1000	875	2000	75	987.5	1807.5
20	1	1000	875	2000	75	1000	2000
21	0.1	2000	1600	3850	100	1640	475
22	0.2	2000	1600	3850	100	1680	850
23	0.3	2000	1600	3850	100	1720	1225
24	0.4	2000	1600	3850	100	1760	1600
25	0.5	2000	1600	3850	100	1800	1975
26	0.6	2000	1600	3850	100	1840	2350
27	0.7	2000	1600	3850	100	1880	2725
28	0.8	2000	1600	3850	100	1920	3100

29	0.9	2000	1600	3850	100	1960	3475
30	1	2000	1600	3850	100	2000	3850
31	0.1	2250	1000	4500	50	1125	495
32	0.2	2250	1000	4500	50	1250	940
33	0.3	2250	1000	4500	50	1375	1385
34	0.4	2250	1000	4500	50	1500	1830
35	0.5	2250	1000	4500	50	1625	2275
36	0.6	2250	1000	4500	50	1750	2720
37	0.7	2250	1000	4500	50	1875	3165
38	0.8	2250	1000	4500	50	2000	3610
39	0.9	2250	1000	4500	50	2125	4055
40	1	2250	1000	4500	50	2250	4500

In Table A2 the parameters are (1) the horizon in months, (2) the task number in sequence if this horizon was selected for the subject to make choices over, (3) the principal of 3000 kroner if the subject had the "higher stakes" condition, (4) the principal of 1500 kroner if the subject had the "lower stakes" condition, (5) the annual interest rate presented to the subject if that treatment was applied (this is also the annual effective rate with annual compounding), (6) the delayed payment if the subject had the "higher stakes" condition, (7) the delayed payment if the subject had the "lower stakes" condition, (8) the implied annual effective rate with quarterly compounding, and (9) the implied annual effective rate with daily compounding. The values in columns (8) and (9) were not presented to subjects.

Table A2: Parameters for Discounting Choices

Horizon in months	Task	Principal in high stakes	Principal if low stakes	Annual Interest Rate	Delayed Payment if low stakes	Delayed Payment if high stakes	AER Quarterly	AER Daily
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0.5	1	3000	1500	5%	3006.10	1503.05	5.1%	5.1%
0.5	2	3000	1500	10%	3011.94	1505.97	10.4%	10.5%
0.5	3	3000	1500	15%	3017.52	1508.76	15.9%	16.2%
0.5	4	3000	1500	20%	3022.88	1511.44	21.6%	22.1%
0.5	5	3000	1500	25%	3028.02	1514.01	27.4%	28.4%
0.5	6	3000	1500	30%	3032.98	1516.49	33.5%	35.0%
0.5	7	3000	1500	35%	3037.75	1518.87	39.9%	41.9%
0.5	8	3000	1500	40%	3042.36	1521.18	46.4%	49.1%
0.5	9	3000	1500	45%	3046.81	1523.40	53.2%	56.8%
0.5	10	3000	1500	50%	3051.11	1525.56	60.2%	64.8%
1	1	3000	1500	5%	3012.22	1506.11	5.1%	5.1%
1	2	3000	1500	10%	3023.92	1511.96	10.4%	10.5%
1	3	3000	1500	15%	3035.14	1517.57	15.9%	16.2%
1	4	3000	1500	20%	3045.93	1522.96	21.6%	22.1%
1	5	3000	1500	25%	3056.31	1528.15	27.4%	28.4%

1	6	3000	1500	30%	3066.31	1533.16	33.5%	35.0%
1	7	3000	1500	35%	3075.97	1537.99	39.9%	41.9%
1	8	3000	1500	40%	3085.31	1542.65	46.4%	49.1%
1	9	3000	1500	45%	3094.34	1547.17	53.2%	56.8%
1	10	3000	1500	50%	3103.10	1551.55	60.2%	64.8%
2	1	3000	1500	5%	3024.49	1512.25	5.1%	5.1%
2	2	3000	1500	10%	3048.04	1524.02	10.4%	10.5%
2	3	3000	1500	15%	3070.70	1535.35	15.9%	16.2%
2	4	3000	1500	20%	3092.56	1546.28	21.6%	22.1%
2	5	3000	1500	25%	3113.67	1556.84	27.4%	28.4%
2	6	3000	1500	30%	3134.09	1567.05	33.5%	35.0%
2	7	3000	1500	35%	3153.87	1576.93	39.9%	41.9%
2	8	3000	1500	40%	3173.04	1586.52	46.4%	49.1%
2	9	3000	1500	45%	3191.65	1595.83	53.2%	56.8%
2	10	3000	1500	50%	3209.74	1604.87	60.2%	64.8%
3	1	3000	1500	5%	3036.82	1518.41	5.1%	5.1%
3	2	3000	1500	10%	3072.34	1536.17	10.4%	10.5%
3	3	3000	1500	15%	3106.67	1553.34	15.9%	16.2%
3	4	3000	1500	20%	3139.91	1569.95	21.6%	22.1%
3	5	3000	1500	25%	3172.11	1586.06	27.4%	28.4%
3	6	3000	1500	30%	3203.37	1601.68	33.5%	35.0%
3	7	3000	1500	35%	3233.74	1616.87	39.9%	41.9%
3	8	3000	1500	40%	3263.27	1631.64	46.4%	49.1%
3	9	3000	1500	45%	3292.03	1646.01	53.2%	56.8%
3	10	3000	1500	50%	3320.05	1660.02	60.2%	64.8%
4	1	3000	1500	5%	3049.19	1524.59	5.1%	5.1%
4	2	3000	1500	10%	3096.84	1548.42	10.4%	10.5%
4	3	3000	1500	15%	3143.07	1571.53	15.9%	16.2%
4	4	3000	1500	20%	3187.98	1593.99	21.6%	22.1%
4	5	3000	1500	25%	3231.65	1615.83	27.4%	28.4%
4	6	3000	1500	30%	3274.18	1637.09	33.5%	35.0%
4	7	3000	1500	35%	3315.63	1657.81	39.9%	41.9%
4	8	3000	1500	40%	3356.07	1678.03	46.4%	49.1%
4	9	3000	1500	45%	3395.55	1697.78	53.2%	56.8%
4	10	3000	1500	50%	3434.14	1717.07	60.2%	64.8%
5	1	3000	1500	5%	3061.61	1530.81	5.1%	5.1%
5	2	3000	1500	10%	3121.53	1560.77	10.4%	10.5%
5	3	3000	1500	15%	3179.89	1589.94	15.9%	16.2%
5	4	3000	1500	20%	3236.78	1618.39	21.6%	22.1%
5	5	3000	1500	25%	3292.31	1646.15	27.4%	28.4%
5	6	3000	1500	30%	3346.55	1673.28	33.5%	35.0%
5	7	3000	1500	35%	3399.59	1699.80	39.9%	41.9%
5	8	3000	1500	40%	3451.50	1725.75	46.4%	49.1%
5	9	3000	1500	45%	3502.34	1751.17	53.2%	56.8%
5	10	3000	1500	50%	3552.16	1776.08	60.2%	64.8%

6	1	3000	1500	5%	3074.09	1537.04	5.1%	5.1%
6	2	3000	1500	10%	3146.43	1573.21	10.4%	10.5%
6	3	3000	1500	15%	3217.14	1608.57	15.9%	16.2%
6	4	3000	1500	20%	3286.34	1643.17	21.6%	22.1%
6	5	3000	1500	25%	3354.10	1677.05	27.4%	28.4%
6	6	3000	1500	30%	3420.53	1710.26	33.5%	35.0%
6	7	3000	1500	35%	3485.69	1742.84	39.9%	41.9%
6	8	3000	1500	40%	3549.65	1774.82	46.4%	49.1%
6	9	3000	1500	45%	3612.48	1806.24	53.2%	56.8%
6	10	3000	1500	50%	3674.23	1837.12	60.2%	64.8%
7	1	3000	1500	5%	3086.61	1543.30	5.1%	5.1%
7	2	3000	1500	10%	3171.52	1585.76	10.4%	10.5%
7	3	3000	1500	15%	3254.83	1627.42	15.9%	16.2%
7	4	3000	1500	20%	3336.65	1668.32	21.6%	22.1%
7	5	3000	1500	25%	3417.06	1708.53	27.4%	28.4%
7	6	3000	1500	30%	3496.14	1748.07	33.5%	35.0%
7	7	3000	1500	35%	3573.96	1786.98	39.9%	41.9%
7	8	3000	1500	40%	3650.59	1825.29	46.4%	49.1%
7	9	3000	1500	45%	3726.08	1863.04	53.2%	56.8%
7	10	3000	1500	50%	3800.50	1900.25	60.2%	64.8%
8	1	3000	1500	5%	3099.18	1549.59	5.1%	5.1%
8	2	3000	1500	10%	3196.81	1598.40	10.4%	10.5%
8	3	3000	1500	15%	3292.96	1646.48	15.9%	16.2%
8	4	3000	1500	20%	3387.73	1693.86	21.6%	22.1%
8	5	3000	1500	25%	3481.19	1740.60	27.4%	28.4%
8	6	3000	1500	30%	3573.42	1786.71	33.5%	35.0%
8	7	3000	1500	35%	3664.46	1832.23	39.9%	41.9%
8	8	3000	1500	40%	3754.39	1877.20	46.4%	49.1%
8	9	3000	1500	45%	3843.26	1921.63	53.2%	56.8%
8	10	3000	1500	50%	3931.11	1965.56	60.2%	64.8%
9	1	3000	1500	5%	3111.81	1555.91	5.1%	5.1%
9	2	3000	1500	10%	3222.30	1611.15	10.4%	10.5%
9	3	3000	1500	15%	3331.54	1665.77	15.9%	16.2%
9	4	3000	1500	20%	3439.59	1719.80	21.6%	22.1%
9	5	3000	1500	25%	3546.53	1773.27	27.4%	28.4%
9	6	3000	1500	30%	3652.40	1826.20	33.5%	35.0%
9	7	3000	1500	35%	3757.26	1878.63	39.9%	41.9%
9	8	3000	1500	40%	3861.16	1930.58	46.4%	49.1%
9	9	3000	1500	45%	3964.12	1982.06	53.2%	56.8%
9	10	3000	1500	50%	4066.21	2033.10	60.2%	64.8%
11	1	3000	1500	5%	3137.22	1568.61	5.1%	5.1%
11	2	3000	1500	10%	3273.89	1636.95	10.4%	10.5%
11	3	3000	1500	15%	3410.05	1705.03	15.9%	16.2%
11	4	3000	1500	20%	3545.72	1772.86	21.6%	22.1%
11	5	3000	1500	25%	3680.91	1840.46	27.4%	28.4%

11	6	3000	1500	30%	3815.66	1907.83	33.5%	35.0%
11	7	3000	1500	35%	3949.97	1974.99	39.9%	41.9%
11	8	3000	1500	40%	4083.87	2041.94	46.4%	49.1%
11	9	3000	1500	45%	4217.37	2108.69	53.2%	56.8%
11	10	3000	1500	50%	4350.49	2175.25	60.2%	64.8%
12	1	3000	1500	5%	3150	1575	5.1%	5.1%
12	2	3000	1500	10%	3300	1650	10.4%	10.5%
12	3	3000	1500	15%	3450	1725	15.9%	16.2%
12	4	3000	1500	20%	3600	1800	21.6%	22.1%
12	5	3000	1500	25%	3750	1875	27.4%	28.4%
12	6	3000	1500	30%	3900	1950	33.5%	35.0%
12	7	3000	1500	35%	4050	2025	39.9%	41.9%
12	8	3000	1500	40%	4200	2100	46.4%	49.1%
12	9	3000	1500	45%	4350	2175	53.2%	56.8%
12	10	3000	1500	50%	4500	2250	60.2%	64.8%

In Table A3 we present the parameters for one subject. Recall that we define the lottery α as a 50:50 mixture of {x, Y} and {X, y}, and the lottery β as a 50:50 mixture of {x, y} and {X, Y}. So α is a 50:50 mixture of bad and good outcomes in time t and $t+\tau$, and good and bad outcomes in the two time periods; and β is a 50:50 mixture of all-bad outcomes and all-good outcomes in the two time periods. In the screen image shown above lottery α is Option A, and lottery β is Option B. These parameters in Table A3 are (1) the decision number, (2) the probability for lottery α, (3) the low amount in kroner, (4) the high amount in kroner, (5) the front end delay in months for the sooner option, and (6) the horizon in months for the later option. The sooner option was for delivery in either 1 month, as shown here for this subject, or in the present. The later option was for delivery in the number of months shown in (6) *after* the front end delay. So for this subject decision #1 would have a later delivery time 9 months beyond the present. If this subject had *not* had a front end delay for the sooner option, the later option for decision #1 would have been 8 months from the present.

Table A3: Parameters for Intertemporal Lottery Choices

Decision	Probability for Lottery α	Low Prize (kroner)	High Prize (kroner)	Front End Delay (months)	Horizon (months)
(1)	(2)	(3)	(4)	(5)	(6)
1	0.1	50	4500	1	8
2	0.2	50	4500	1	8
3	0.3	50	4500	1	8
4	0.4	50	4500	1	8
5	0.5	50	4500	1	8
6	0.6	50	4500	1	8
7	0.7	50	4500	1	8
8	0.8	50	4500	1	8

9	0.9	50	4500	1	8
10	1	50	4500	1	8
11	0.1	50	4500	1	7
12	0.2	50	4500	1	7
13	0.3	50	4500	1	7
14	0.4	50	4500	1	7
15	0.5	50	4500	1	7
16	0.6	50	4500	1	7
17	0.7	50	4500	1	7
18	0.8	50	4500	1	7
19	0.9	50	4500	1	7
20	1	50	4500	1	7
21	0.1	50	4500	1	4
22	0.2	50	4500	1	4
23	0.3	50	4500	1	4
24	0.4	50	4500	1	4
25	0.5	50	4500	1	4
26	0.6	50	4500	1	4
27	0.7	50	4500	1	4
28	0.8	50	4500	1	4
29	0.9	50	4500	1	4
30	1	50	4500	1	4
31	0.1	50	4500	1	1
32	0.2	50	4500	1	1
33	0.3	50	4500	1	1
34	0.4	50	4500	1	1
35	0.5	50	4500	1	1
36	0.6	50	4500	1	1
37	0.7	50	4500	1	1
38	0.8	50	4500	1	1
39	0.9	50	4500	1	1
40	1	50	4500	1	1

Appendix B: Experimental Design and Procedures (WORKING PAPER)

A. The Experimental Design

Subjects are presented with three tasks. The first task identifies individual discount rates, the second task identifies atemporal risk attitudes, and the third task identifies intertemporal risk attitudes. We use tasks with real monetary incentives. Observed choices from all three tasks are then used to jointly estimate structural models of the discounting function defined over utility. The first two tasks are variations on designs that have been well documented in Andersen, Harrison, Lau and Rutström [2008a][2013][2014], so we present the elements briefly. The third task is the new one that is needed for present purposes, and is discussed in the main text.

Individual Discount Rates

Individual discount rates are examined by asking subjects to make a series of choices over two certain outcomes that differ in terms of when they will be received. For example, one option can be 3000 kroner in 1 month, and another option can be 3300 kroner in 13 months. If the subject picks the earlier option we can infer that their discount rate is above 10% for 12 months, starting in 1 month, and if the subject picks the later option we can infer that their discount rate is below 10% for that horizon and start date. By varying the amount of the later option we can identify the discount rate of the individual, conditional on knowing the utility of those amounts to this individual. One can also vary the time horizon to identify the discount rate function, and of course one can vary the front end delay.

We ask subjects to evaluate choices over several time horizons. We consider time horizons between 2 weeks and 1 year. Each subject is presented with choices over four time horizons, and those horizons are drawn at random, without replacement, from a set of thirteen possible horizons (2 weeks, and 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 months). This design will allow us to obtain a smooth characterization of the discount rate function across the sample for horizons up to one year. We also over-sampled the first three horizons, since this very short-term is clearly of great significance for the alternative specification. Hence each subject was twice as likely to get a horizon of 2 weeks, 1 month or 2 months as any of the later horizons.

Four additional treatments completed the design. First, we varied the time delay to the early payment option on a between-subjects basis: roughly half of the sample had no front end delay, and the other half had a 30-day front end delay. Second, we varied the provision of implied interest rates for each choice on a between-subjects basis, and independently of the front end delay treatment. Third, we varied the order in which the time horizon was presented to the subject: either in ascending order or descending order. Finally, we employ two levels of the principal on a between-subjects basis. These four treatments, the front end delay, information on implied interest rates, the level of the principal, and the order of presentation of the horizon, result in a 2×2×2×2 design. Roughly 1/16 of the sample was assigned at random to any one particular combination.

Risk Attitudes

Risk attitudes were evaluated by asking subjects to make a series of choices over outcomes that involve some uncertainty. Risk attitudes are elicited here simply as a convenient vehicle to estimate the non-linear utility function of the individual. The theoretical requirement, from the definition of the discount factor in (12), is for us to know the utility function over income if we are to correctly infer the

discount rate the individual used. The discount rate choices described above are not defined over lotteries.

Our design poses a series of binary lottery choices. For example, lottery A might give the individual a 50-50 chance of receiving 1600 kroner or 2000 kroner to be paid today, and lottery B might have a 50-50 chance of receiving 3850 kroner or 100 kroner today. The subject picks A or B. One series of 10 choices would offer these prize sets with probabilities on the high prize in each lottery starting at 0.1, then increasing by 0.1 until the last choice is between two certain amounts of money. In fact, these illustrative parameters and design was developed by Holt and Laury [2002] to elicit risk attitudes in the United States, and has been widely employed. Their experimental procedures provided a decision sheet with all 10 choices arrayed in an ordered manner on the same sheet; we used the procedures of Hey and Orme [1994], and presented each choice to the subject as a "pie chart" showing prizes and probabilities. We gave subjects 40 choices, in four sets of 10 with the same prizes. The prize sets employed are as follows: [A1: 2000 and 1600; B1: 3850 and 100], [A2: 1125 and 750; B2: 2000 and 250], [A3: 1000 and 875; B3: 2000 and 75] and [A4: 2250 and 1000; B4: 4500 and 50]. The order of these four sets was random for each subject, but within each set the choices were presented in an ordered manner, with increments of the high prize probability of 0.1.

The typical findings from lottery choice experiments of this kind are that individuals are generally averse to risk, and that there is considerable heterogeneity in risk attitudes across subjects: see Harrison and Rutström [2008] for an extensive review. Much of that heterogeneity is correlated with observable characteristics, such as age and education level.

B. The Experiments

Between September 28 and October 22, 2009, we conducted experiments with 413 Danes. The sample was drawn to be representative of the adult population as of January 1, 2009, using sampling procedures that are virtually identical to those documented at length in Andersen, Harrison, Lau and Rutström [2008a]. We received a random sample of the population aged between 18 and 75, inclusive, from the Civil Registration Office and sent out 1969 invitations.[24]

With a sample of 413, on average 25.8 subjects were assigned to each of the 16 treatments for the discounting tasks. We did not develop this experimental design to estimate models at the level of the individual subject or treatment condition, although obviously we will control for these factors.

Our experiments were all conducted in hotel meeting rooms around Denmark, so that travel logistics for the sample would be minimized. Various times of day were also offered to subjects, to facilitate a broad mix of attendance. The largest session had 15 subjects, but most had fewer. The procedures were standard: Appendix B (available online) documents an English translation of the instructions, and shows typical screen displays. Subjects were given written instructions, which were also read out, and then made choices in a trainer task, which was "played out" so that the full set of consequences of each choice were clear. In fact, subjects were paid *Big Ben* caramels instead of money

[24] That recruiting sample was drawn by us from a random sample of 50,000 adult Danes obtained from the Civil Registration Office, which includes information on sex, age, residential location, marital status, and whether the individual is an immigrant. At a very broad level our sample was representative on average: the sample of 50,000 had an average age of 49.8, 50.1% of them were married, and 50.7% were female; our final sample of 413 had an average age of 48.7, 56.5% of them were married, and 48.2% were female.

for all trainers, and the payments were happily consumed when delivered. All interactions were by computer. The order of the block of discount rate tasks and the block of risk attitudes tasks was randomized for each session. After all choices had been made the subject was asked a series of standard socio-demographic questions.

There were 40 discounting choices, 40 atemporal risk attitude choices and 40 intertemporal risk attitude choices, and each subject had a 10% chance of being paid for one choice in each set of 40 choices. Average payments on the first block were 201.4 kroner (although some were for deferred receipt), on the second block the average was 242.5 kroner, and average payments on the third block were 270.7 kroner for a combined average of 714.6 kroner. The exchange rate at the time was close to 5 kroner per U.S. dollar, so earnings averaged approximately 143 dollars per 2 two-hour session for these tasks. Subjects were also paid a fixed show-up fee of 300 kroner or 500 kroner.[25]

For payments to be made in the future, the following language explained the procedures:

> You will receive the money on the date stated in your preferred option. If you receive some money today, then it is paid out at the end of the experiment. If you receive some money to be paid in the future, then it is transferred to your personal bank account on the specified date. In that case you will receive a written confirmation from Copenhagen Business School which guarantees that the money is reserved on an account at Danske Bank. You can send this document to Danske Bank in a prepaid envelope, and the bank will transfer the money to your account on the specified date.

Payments by way of bank transfer are common in Denmark, Copenhagen Business School is a well-known educational institution in Denmark, and Danske Bank is the largest financial enterprise in Denmark as measured by total assets.

Additional References

Harrison, Glenn W., and Rutström, E. Elisabet, "Risk Aversion in the Laboratory," in J.C. Cox and G.W. Harrison (eds.), *Risk Aversion in Experiments* (Bingley, UK: Emerald, Research in Experimental Economics, Volume 12, 2008).

Hey, John D., and Orme, Chris, "Investigating Generalizations of Expected Utility Theory Using Experimental Data," *Econometrica*, 62(6), November 1994, 1291-1326.

Holt, Charles A., and Laury, Susan K., "Risk Aversion and Incentive Effects," *American Economic Review*, 92(5), December 2002, 1644-1655.

[25] An extra show-up fee of 200 kroner was paid to 35 subjects who had received invitations stating 300 kroner, but then received a final reminder that accidentally stated 500 kroner.

Appendix C: Additional Results (WORKING PAPER)

It is a simple matter to extend the econometric model to allow structural parameters to depend on observed demographics and experimental treatments. Table C1 shows the maximum likelihood estimates by including covariates for each of the core structural parameters to reflect observable heterogeneity in responses. We include covariates for individual demographic characteristics as well as task characteristics. Unless otherwise noted, all variables are binary.

Variable FEMALE indicates a female; YOUNG is someone aged less than 40 (so the omitted age category are those aged 40 and over); SINGLE is someone who lives without a spouse or partner; KIDS is someone who has children; OWNER is someone who owns their apartment or house; RETIRED is someone who is retired; STUDENT is someone who is a student; SKILLED is someone with some post-secondary education[26]; LONGEDU is someone who has substantial higher education[27]; INCLOW is someone with household income in 2009 below 300,000 kroner; and INCHIGH is someone with household income in 2009 of 500,000 kroner or more.

Turning to the task treatments, variable RA_FIRST indicates if the risk aversion task was presented before the discounting task; and FEE_HIGH indicates if the higher show-up fee of 500 kroner was used to recruit the subject (rather than 300 kroner); RAHIGH indicates if the two highest prize sets in the atemporal risk aversion tasks were used; FED indicates if a 30-day front end delay was employed for the "sooner" option; IDRORDER indicates if the subject was presented the horizons in increasing order (rather than decreasing order); IDRHIGH indicates if the higher principal of 3000 kroner was used (rather than 1500 kroner); INFO indicates if information on implied interest rates was provided, and IRAHIGH indicates if the two highest prize sets in the intertemporal risk aversion tasks were used.

The results in Table C1 display considerable heterogeneity in the elicited parameters across the subjects in the sample. Implied values of RRA and IES are also reported in Table C2. We find that several of the demographic characteristics are significantly correlated with variations in the core parameters across subjects. Young subjects appear to have lower estimated atemporal risk attitudes (r) than older subjects, with an estimated marginal effect of -0.58 that is statistically significant with a *p*-value of 0.024. We find similar marginal effects for students and subjects with kids, and cannot reject the hypothesis that subjects with these characteristics have linear atemporal utility functions. The results also point to a negative correlation between relative risk aversion and income: subjects with low income are significantly more risk averse than those with middle or high income, and subjects with high income are significantly less risk averse than those with middle income. It is noteworthy that there is *no significant gender effect on atemporal risk aversion*: women exhibit greater risk aversion (+0.14) than men, but the 95% confidence interval on this estimate spans zero, and the *p*-value is only 0.24.

Despite the considerable variation in atemporal risk attitudes, we find that only one of the

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[26] Specifically, if the individual has completed vocational education and training or "short-cycle" higher education. Danes commonly refer to the cycle of education in this manner: most short-cycle higher education programs last for less than 2 years; medium-cycle higher education lasts for 3 to 4 years, and includes training for occupations such as a journalist, primary or lower secondary school teacher, nursery and kindergarten teacher, and ordinary nurse; long-cycle higher education typically lasts 5 years and is offered at Denmark's five ordinary universities, at the business schools and various other advanced institutions.

[27] Specifically, the completion of medium-cycle or longer-cycle higher education.

demographic characteristics is significantly correlated with individual discount rates (δ). Young subjects have higher discount rates than older subjects, and the marginal effect of 8.8% is significant with a *p*-value of 0.024. None of the other characteristics have significant marginal effects, although individual discount rates tend to be higher for subjects with kids or students than otherwise. One task characteristic, however, is significantly correlated with discount rates: information on interest rates in the discounting choices has a negative effect in discount rates. The estimated effect is -4.3% with a standard error of 2.3% and a *p*-value of 0.064.

The last panel in Table C1 shows that there is a significant age effect on intertemporal risk attitudes as measured by η. Young subjects are significantly more intertemporal risk averse than those above 40 years of age; the marginal effect is 0.25 with a standard error of 0.09 and a *p*-value of 0.006. We also find a gender effect, with women being more risk averse over lotteries with intertemporal payment profiles than men. The estimated η is 0.25 larger for women, and this estimate has a *p*-value of only 0.006.[28]

The results show that only one task characteristic is significantly correlated with one of the estimated core parameters in the model, which is the treatment on information of interest rates in the discounting choices. The absence of all other treatment effects on the curvature of the atemporal utility function and individual discount rates are noteworthy, since several of these treatments have been found to have significant effects on behavior in similar types of studies. In particular, we do not find a significant effect from varying the stakes in the atemporal risk aversion task or in the discount rate task, and individual discount rates do not vary significantly with the delay to the sooner payment option.

Table C2 shows the implied ML estimates of relative risk aversion and the intertemporal elasticity of substitution. Younger subjects, students, and those with kids have linear atemporal utility functions and the IES coefficient is effectively infinite for these subjects. We also infer significantly negative marginal effects on the RRA coefficient for these three types of subjects. The marginal effect on RRA for young subjects is -0.46 with a *p*-value of 0.079, it is -0.52 for subjects with kids (*p*-value of 0.066), and is -0.58 for students (*p*-value of 0.063). Finally, the results point to a significant positive marginal effect on RRA for subjects with low income and a significant negative marginal effect for subjects with high income. Hence, there is evidence that RRA declines with income, but we find no significant effect of income on the IES coefficient.

We can also evaluate the total effects of several of the demographic characteristics on the estimated RRA and IES, by estimating marginal effects without controls for other characteristics. We calculate total effects since many demographic characteristics co-vary in the population and therefore also in our sample. For example, the men in our sample have a number of characteristics that differ from the women apart from sex. By not controlling for these other characteristics of men, we can estimate the difference in RRA and IES between men and women that jointly reflects all of these differences. To consider the total effects, we simply repeat the statistical analysis shown in Table C1 and C2 but with only one demographic characteristic included at a time. In this manner our estimates include all of the demographic characteristics correlated with the characteristic of interest.

[28] We find a significant effect of sex on relative risk aversion and discount rates when the intertemporal utility function is additively separable: women appear to be significantly more risk averse and patient in monetary terms than men.

The maximum likelihood estimates of RRA and IES for a selection of demographic characteristics are displayed in Table C3. We find that women are more risk averse than men with an estimated RRA of 0.45 for women and 0.33 for men. This difference in RRA between men and women is statistically significant with a *p*-value of 0.026. However, we can not reject the hypothesis that men and women have identical IES coefficients; the difference of 0.37 has a *p*-value of 0.740. There is an age effect on the two RRA and IES coefficients. The older age group has a higher RRA and lower IES than younger subjects, where the difference in RRA is significant with a *p*-value of 0.064 and the difference in IES has a *p*-value of 0.102. We do not find any significant variation in the estimated RRA and IES coefficients for the other individual characteristics that are included in Table C3. Hence we can not reject the hypothesis that the coefficients of RRA and IES are similar across income groups and education levels.

Table C1: Maximum Likelihood Estimates with Covariates

N=49,560 observations, based on 413 subjects

Parameter	Point Estimate	Standard Error	*p*-value	95% Confidence Interval	
		Atemporal Utility Function (r)			
Constant	0.58	0.257	0.024	0.08	1.08
RAfirst	-0.09	0.151	0.537	-0.39	0.20
FEEhigh	0.04	0.094	0.694	-0.15	0.22
RAhigh	-0.03	0.087	0.762	-0.20	0.14
Female	0.14	0.120	0.241	-0.09	0.38
Young	-0.58	0.257	0.024	-1.08	-0.08
Single	-0.21	0.250	0.409	-0.70	0.28
Kids	-0.58	0.257	0.024	-1.08	-0.08
Owner	0.04	0.162	0.791	-0.27	0.36
Retired	-0.17	0.184	0.362	-0.53	0.19
Student	-0.56	0.264	0.034	-1.08	-0.04
Skilled	-0.18	0.134	0.171	-0.45	0.08
Longedu	0.07	0.131	0.572	-0.18	0.33
IncLow	0.29	0.152	0.052	0.00	0.59
IncHigh	-0.37	0.191	0.050	-0.75	0.00
μ^{RA}	0.18	0.011	<0.001	0.15	0.20
		Discounting Function (δ)			
Constant	0.113	0.055	0.039	0.006	0.221
RAfirst	0.032	0.033	0.332	-0.033	0.097
FEEhigh	0.001	0.025	0.968	-0.048	0.050
FED	0.020	0.025	0.429	-0.030	0.070
IDRorder	-0.038	0.025	0.137	-0.087	0.012
IDRhigh	0.024	0.029	0.398	-0.032	0.081
INFO	-0.043	0.023	0.064	-0.088	0.003
Female	-0.016	0.025	0.512	-0.065	0.032
Young	0.088	0.039	0.023	0.012	0.164
Single	0.014	0.063	0.826	-0.108	0.137
Kids	0.080	0.054	0.140	-0.026	0.186
Owner	-0.039	0.034	0.249	-0.104	0.027
Retired	0.015	0.064	0.812	-0.111	0.141
Student	0.136	0.084	0.106	-0.029	0.301
Skilled	0.019	0.036	0.597	-0.052	0.090
Longedu	-0.014	0.033	0.657	-0.078	0.049
IncLow	-0.043	0.040	0.279	-0.120	0.035
IncHigh	0.045	0.038	0.238	-0.030	0.119
μ^{DR}	0.16	0.012	<0.001	0.14	0.18

Intertemporal Utility Function (η)

Constant	0.09	0.208	0.652	-0.31	0.50
RAfirst	0.06	0.090	0.527	-0.12	0.23
FEEhigh	0.07	0.091	0.475	-0.11	0.24
FED	-0.04	0.085	0.664	-0.20	0.13
IDRorder	-0.10	0.083	0.238	-0.26	0.06
IRAhigh	0.05	0.095	0.606	-0.14	0.23
Female	0.25	0.090	0.006	0.07	0.42
Young	0.19	0.102	0.068	-0.01	0.39
Single	-0.08	0.157	0.632	-0.38	0.23
Kids	0.07	0.101	0.517	-0.13	0.26
Owner	-0.01	0.121	0.966	-0.24	0.23
Retired	-0.28	0.200	0.160	-0.67	0.11
Student	-0.10	0.197	0.605	-0.49	0.28
Skilled	0.05	0.132	0.685	-0.21	0.31
Longedu	0.04	0.135	0.776	-0.23	0.30
IncLow	0.09	0.221	0.676	-0.34	0.53
IncHigh	0.09	0.104	0.382	-0.11	0.30
μ^{SDR}	0.18	0.010	<0.001	0.16	0.20

Table C2: Implied Maximum Likelihood Estimates

N=49,560 observations, based on 413 subjects

Parameter	Point Estimate	Standard Error	*p*-value	95% Confidence Interval	
		Relative Risk Aversion			
Constant	0.60	0.232	0.010	0.15	1.06
RAfirst	-0.07	0.138	0.591	-0.35	0.20
FEEhigh	0.05	0.085	0.576	-0.12	0.22
RAhigh	-0.03	0.083	0.761	-0.19	0.14
FED	-0.01	0.019	0.678	-0.04	0.03
IDRorder	-0.02	0.020	0.307	-0.06	0.02
IRAhigh	0.01	0.020	0.602	-0.03	0.05
Female	0.17	0.112	0.130	-0.05	0.39
Young	-0.46	0.262	0.079	-0.97	0.05
Single	-0.22	0.227	0.333	-0.67	0.23
Kids	-0.52	0.284	0.066	-1.08	0.03
Owner	0.04	0.147	0.787	-0.25	0.33
Retired	-0.24	0.163	0.138	-0.56	0.08
Student	-0.58	0.314	0.063	-1.20	0.03
Skilled	-0.16	0.125	0.202	-0.40	0.09
Longedu	0.08	0.118	0.515	-0.15	0.31
IncLow	0.29	0.138	0.037	0.02	0.56
IncHigh	-0.32	0.188	0.089	-0.69	0.05
		Intertemporal Elasticity of Substitution			
Constant	1.72	0.760	0.024	-0.23	3.21
RAfirst	0.33	0.568	0.563	-0.78	1.44
FEEhigh	-0.10	0.283	0.715	-0.66	0.45
RAhigh	0.08	0.266	0.759	-0.44	0.60
Female	-0.34	0.428	0.432	-1.17	0.50
Young	.	.	.	.	.
Single	0.95	1.787	0.596	-2.56	4.45
Kids	.	.	.	.	.
Owner	-0.12	0.491	0.810	-1.08	0.84
Retired	0.70	0.956	0.466	-1.18	2.57
Student	.	.	.	.	.
Skilled	0.79	0.979	0.417	-1.12	2.71
Longedu	-0.19	0.426	0.649	-1.03	0.64
IncLow	-0.58	0.599	0.333	-1.75	0.59
IncHigh	3.10	2.675	0.247	-2.15	8.34

Table C3: Maximum Likelihood Estimates of Total Effects

N=49,560 observations, based on 413 subjects

Variable	Estimate	Standard Error	*p*-value	95% Confidence Interval	
		Relative Risk Aversion			
Female	0.45	0.062	<0.001	0.32	0.57
Male	0.33	0.060	<0.001	0.21	0.45
Young	0.33	0.048	<0.001	0.24	0.43
Old	0.42	0.066	<0.001	0.29	0.55
Unskilled	0.38	0.065	<0.001	0.25	0.51
Skilled	0.35	0.072	<0.001	0.21	0.50
Longedu	0.41	0.064	<0.001	0.28	0.53
IncLow	0.42	0.076	<0.001	0.27	0.57
IncMiddle	0.45	0.077	<0.001	0.30	0.60
IncHigh	0.36	0.055	<0.001	0.24	0.45
		Intertemporal Elasticity of Substitution			
Female	3.86	1.193	<0.001	1.53	6.20
Male	4.23	0.903	<0.001	2.46	6.00
Young	7.98	3.200	0.013	1.71	14.25
Old	3.30	0.699	<0.001	1.93	4.67
Unskilled	4.16	1.026	<0.001	2.15	6.17
Skilled	4.80	2.018	0.017	0.84	8.75
Longedu	3.69	1.009	<0.001	1.71	5.67
IncLow	3.54	1.152	0.002	1.28	5.80
IncMiddle	2.80	0.747	<0.001	1.33	7.26
IncHigh	5.21	1.388	<0.001	2.49	7.93