

Online Appendix

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Premise: information to the reader

This Online Appendix is organized as follows: section 1 provides an extensive description of the alternatives and their parametrization. Section 2 describes the questions and their orders. Section 3 describes the questionnaire. Finally, sections 4 and 5 present the instructions and main screens of the experiment: one screen describing a choice between lotteries, one describing a choice between delayed payment plans, and one describing the direct elicitation of preferences.

1 Alternatives

We start by presenting the rationale behind the parametrization of delayed payment plans and lotteries. A drawback of the experiments of [Manzini et al. \(2010\)](#) and [McCausland et al. \(2020\)](#) was that some alternatives were dominated. This led to a high number of rational participants and a low level of heterogeneity in preferences.

Following [Agranov & Ortoleva \(2017\)](#), we construct the main alternatives with no clear domination. We run a pilot experiment in the game theory classes at Queen Mary University of London to confirm the presence of heterogeneity in preferences.

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1.1 Time

ALTERNATIVES		MONTHS				
		0	3	6	9	12
ONE SHOT (OS)		160	0	0	0	0
	M(OS)	140	0	0	0	0
	Im(OS)	0	160	0	0	0
DECREASING (D)		110	50	25	0	0
	M(D)	100	40	10	0	0
	Im(D)	0	110	50	25	0
CONSTANT (K)		50	50	50	50	0
	M(K)	40	40	40	40	0
	Im(K)	0	50	50	50	50
INCREASING (I)		0	15	40	170	0
	M(I)	0	10	20	160	0
	Im(I)	0	0	15	40	170
NEUTRAL						
	Neu1	15	55	30	20	5
	Neu2	5	20	30	55	15

Notes: The amounts are described in Token with an exchange rate of 20:1 pounds. The alternatives "M" are monotonically dominated; "Im" are impatience-dominated; "Neutral" are confounding alternatives.

Table 1: List of Delayed Payment Plans

Table 1 presents the comprehensive list of delayed payment plans. We use a quasi-hyperbolic discounting model¹: $u(x_0, \dots, x_t) = x_0 + \beta \sum_{t=1,2,\dots} \gamma^t x_t$. This specification displays a present bias for $\beta < 1$. Among many Benhabib et al. (2010) find that in an experimental setting participants display a significant present bias². We set $\beta = 0.9$ such that the following preferences arise for different levels of γ :

Discount rate	Preference – ($>$)
$0.985 < \gamma \leq 1$	I > K > D > OS
$0.982 < \gamma \leq 0.985$	I > D > K > OS
$0.974 < \gamma \leq 0.982$	D > K > I > OS
$0.965 < \gamma \leq 0.974$	D > K > OS > I
$0.926 < \gamma \leq 0.965$	D > OS > K > I
$0 < \gamma \leq 0.926$	OS > D > K > I

¹See Laibson (1997) or Phelps & Pollak (1968) for a review of quasi-hyperbolic discounting. Note the following difference in modelling discount utility:

- Exponential Discounting: $v(x_0, \dots, x_t) = \sum_{t=0,1,2,\dots} \beta^t u(x_t)$;
- Quasi-Hyperbolic Discounting: $v(x_0, \dots, x_t) = u(x_0) + \beta \sum_{t=1,2,\dots} \gamma^t u(x_t)$;
- Hyperbolic Discounting: $v(x_0, \dots, x_t) = \sum_{t=0,1,2,\dots} [\prod_{t=0,1,2,\dots} \gamma(t)] u(x_t)$.

²Benhabib et al. (2010) use a slightly different specification with a fixed cost to represent the present bias.

1.2 Risk

ALTERNATIVES	TOKEN	PROBABILITIES		EV	SD		
DEGENERATE (D)	50	0	1	0	50	0	
	F1(D)	45	0	1	0	45	0
	F2(D)	50	0	0.95	0.05	47.5	10.9
	So(D)	51	0	0.95	0.05	48.45	11.12
SAFE (S)	65	25	0.8	0.2	57	16	
	F1(S)	60	20	0.8	0.2	52	16
	F2(S)	65	25	0.75	0.25	55	17.32
	So(S)	70	15	0.7	0.3	53.5	25.2
FIFTY-FIFTY (50)	95	20	0.5	0.5	57.5	37.5	
	Sim	100	0	0.5	0.5	50	50
	F2(50)	95	20	0.45	0.55	53.75	37.31
	So(50)	110	20	0.4	0.6	56	44.09
RISKY (R)	300	5	0.2	0.8	64	118	
	F1(R)	250	5	0.2	0.8	54	98
	F2(R)	300	5	0.15	0.85	49.25	105.34
	So(R)	500	5	0.1	0.9	54.5	148.5

Notes: The amounts are described in Token with an exchange rate of 10:1 pounds. The alternatives "F1" and "F2" are first-order stochastically dominated; "So" are second-order stochastically dominated; "Sim" is a simple confounding alternative which was created to check for "simplicity seeking" heuristics.

Table 2: List of Lotteries

Table 2 presents the comprehensive list of lotteries. The parametrization has followed a CRRA utility function with parameter γ such that the following preferences arise:

Risk parameter	Preference – ($>$)
$0 \leq \gamma < 0.1$	R > 50/50 > S > D
$0.1 \leq \gamma < 0.2$	S > 50/50 > R > D
$0.2 \leq \gamma < 0.6$	S > 50/50 > D > R
$0.6 \leq \gamma < 1.9$	S > D > 50/50 > R
$\gamma \geq 1.9$	D > S > 50/50 > R

2 Order of Questions

Another drawback of previous experimental designs was the absence of confounding alternatives. This is a crucial feature of our design since it allows us to observe violations of preference axioms such as monotonicity or impatience and to reduce the learning effect. The construction of the questions is based on the literature regarding the order effect. A survey can be found in [Day et al. \(1987\)](#). They identify four factors as different sources of order effects and denote them as:

1. **Discovered preference hypothesis** ([Plott, 1993](#)) and **Institutional learning**. The first refers to respondents that, when faced with new decisions in unfamiliar environments, exhibit significant randomness in initial decisions. The second is related to the fact that respondents may have never experienced a lab experiment and surely they have never experienced the present design;
2. **Fatigue**: respondents may get tired of the choice task, especially if it is repeated many times. Hence they could exhibit higher randomness in later tasks;

3. **Starting point effect:** Respondents may create a reference point in some choice task and base subsequent choices on that.

QUESTIONS		ALTERNATIVES												
1	M A I N	{	OS	D										
2			OS	K										
3			OS	I										
4			D	K										
5			D	I										
6			K	I										
7			OS	D	K									
8			OS	D	I									
9			OS	K	I									
10			D	K	I									
11			OS	D	K	I								
12	A D	{	D	I	M(D)									
13			D	I	M(I)									
14			D	I	Im(D)									
15			D	I	Im(I)									
16			Im(OS)	Im(D)	Im(K)	Im(I)								
17			M(OS)	M(D)	M(K)	M(I)								
18			Neu1	Neu2										
19			M(OS)	M(D)	Neu1	Neu2								
20			Im(K)	Im(I)	Neu1	Neu2								
21	B I G	{	D	I	M(D)	M(I)	Im(D)	Im(I)	Neu1	Neu2				
22			OS	D	K	I	M(OS)	M(D)	M(K)	M(I)	Neu1	Neu2		
23			OS	D	K	I	Im(OS)	Im(D)	Im(K)	Im(I)	Neu1	Neu2		
24			D	I	M(OS)	M(K)	Im(OS)	Im(K)	Neu1	Neu2				
25			OS	D	K	I	M(OS)	M(D)	M(K)	M(I)	Im(OS)	Im(D)	Im(K)	Im(I)

Table 3: List of questions in Time

QUESTIONS		ALTERNATIVES											
1	M A I N	{	D	S									
2			D	50									
3			D	R									
4			S	50									
5			S	R									
6			50	R									
7			D	S	50								
8			D	S	R								
9			D	50	R								
10			S	50	R								
11			D	S	50	R							
12	A D	{	S	R	F1(S)								
13			S	R	So(S)								
14			S	R	F1(R)								
15			S	R	So(R)								
16			F2(D)	F2(S)	So(50)								
17			F2(D)	F2(R)	So(50)								
18			F2(S)	F2(50)	F2(R)								
19			F2(50)	Sim									
20	B I G	{	D	S	50	R	So(D)	So(S)	So(50)	So(R)	F1(D)	F1(50)	
21			D	S	50	R	So(D)	So(S)	So(50)	So(R)			
22			D	S	50	R	F2(D)	F2(S)	F2(50)	F2(R)			
23			Sim	S	50	R	So(D)	So(S)	So(50)	So(R)			
24			Sim	R	S	50	D	So(D)	So(S)	So(R)			
25			D	S	50	R	F1(D)	F1(S)	F1(50)	F1(R)	Sim	F2(R)	

Table 4: List of questions in Risk

In order to reduce the magnitude of the first two effects we construct confounding alternatives,

as described in Section 1. We also avoid participants having immediate knowledge of the MAIN alternatives by designing a heterogeneous list of questions. This design feature has been previously exploited by [Badescu & Weiss \(1987\)](#), and suggested by [Charness et al. \(2012\)](#). As described in Tables 3 and 4, the questions are divided into three main domains: MAIN, AD and BIG; the remaining questions are neutral questions.

As suggested by [Ladenburg & Olsen \(2008\)](#) and [Carlsson et al. \(2012\)](#), we include three example questions before each part of the experiment in order to reduce institutional learning. These questions have irrelevant alternatives and are mixed in the number of alternatives so as to not affect the preferences or create reference points.

Fatigue is not a major issue. Numerous studies find no or small differences in preferences due to fatigue in a sequence of identical choice problems ([Carlsson et al., 2012](#)) (note that our choice problems are not identical). We set the number of questions to 50, more or less in line with the literature: [Agranov & Ortoleva \(2017\)](#) asked 70 questions, [Cavagnaro & Davis-Stober \(2014\)](#) 120 questions, [Manzini et al. \(2010\)](#) 22 questions, [Barberá & Neme \(2016\)](#) 16 questions. However, the first two experiments involved pairs of lotteries and so they have a simpler design compared to our experiment; while the second two experiments lasted only 15 to 30 minutes.

TIME		RISK	
ORDER 1	ORDER 2	ORDER 1	ORDER 2
21	24	23	21
14	14	13	13
1	4	1	4
23	16	20	24
10	3	10	3
13	13	14	14
3	1	3	1
19	17	16	18
7	8	7	8
22	22	22	22
2	10	2	10
18	18	19	19
11	11	11	11
20	19	17	16
15	15	15	15
9	9	9	9
25	25	25	25
8	6	8	6
17	23	18	20
4	2	4	2
12	12	12	12
16	7	24	7
6	20	6	17
5	5	5	5
24	21	21	23

Table 5: The four orders of questions

Table 5 presents the four orders used. The construction, both in Time and Risk, followed a structural randomization. Namely, we divided the alternatives into the four similarity groups shown in Table 3 and 4. Then, we randomized the positions to avoid, as much as possible, similar questions appearing consecutively.

3 Questionnaire

To have more insights into students' understanding of the experiment, we conducted a non-incentivized questionnaire. In the first part, summarized in Table 6, participants were asked to agree or disagree with some statements (1 to 5). We find that overall participants show both a good understanding of the experimental design and of the instructions. They also report signals of learning effect expressed both in terms of preference learning and quicker response times. The reward has been considered a significant contribution to their daily budget.

	QUESTIONS	MEAN	SD
1	"I got a good understanding of overall experiment (incentives, how to choose, nature of the alternatives)".	1.552	0.600
2	"The instructions and explanations provided have been enough to understand experiment's duties".	1.366	0.622
3	"The clarity of my preferences on the alternatives improved during the course of the experiment".	1.993	0.961
4	"The time required for choosing has reduced during the course of the experiment".	1.931	1.045
5	"The money I earn through participating in this experiment is a substantial contribution to my daily budget"	2.462	1.167

Table 6: Questionnaire 1

	QUESTIONS	YES	NO
1	"Did you find that some questions were more difficult than others?"	123	22
2	"If yes, what features did play a main role in making these questions more difficult?" [YES - High number of alternatives] - [NO - Complexity of some alternatives]	92	53
3	"Do you think some questions were asked multiple times?"	133	12
4	"Did you always read all the alternatives carefully before choosing?"	118	27
5	"Did you base some decisions on previous choices?"	123	22
6	"In case of lotteries, in general, did you calculate the expected value and choose according to the "highest expected value" criterion?"	75	70
7	In case of delayed payment plans, in general, did you calculate the summation of the plan and choose according to the "highest summation" criterion?	97	48

Table 7: Questionnaire 2

In the second part of the questionnaire (Table 7), participants were asked to reply with a "Yes" or "No" to a series of questions about the structure of the experiment and their behaviour. Overall they accept the idea that some questions were more difficult than others and they indicate the high number of alternatives as the main source of complexity (this is confirmed by their response times).

Strangely most of the participants had the impression that some questions were repeated even though this was not the case. They overall confirm to have read all alternatives before choosing. Finally, they confirm the presence of reference point effects.

Questions 6 and 7 focus on the reasoning of participants. About half of the participants report risk neutrality using the "highest expected value" criterion, while about two-thirds report patience using the "highest summation" criterion.

4 Instructions

General Instructions

This is an experiment in the economics of decision-making and in particular risk and time attitudes of individuals.

Notice there is no RIGHT or WRONG answer for any of these questions. We are interested in studying your preferences.

The tasks are extremely simple and if you make good decisions you may earn a **considerable amount of money** that will be **paid to you by direct debit** at the end of the experiment and at particular times in the future.

The currency in this experiment is called **tokens**.

The experiment should last at maximum 1:30 hour even though more probably around 1 hour. It is divided in four parts:

1. **Part 1:** 25 Questions;
2. **Part 2:** 25 Questions;
3. **Questionnaire**
4. **Test**

At the end of experiment, the computer will randomly choose on question for each part of the experiment and pay your choice. In case of Lottery the computer will also play out the Lottery according to the respective probabilities.

Your total earning from the experiment will consist of the sum of three components:

1. One Choice from Part 1;
2. One Choice from Part 2;
3. A participation fee of £ 5.

Notice:

- There is no time constraint for any question;
- Before each part of the experiment you will complete a three questions trial in order to make you fully understand which kind of questions you are going to answer. The alternatives in the trial questions do not have sense and will not be considered in the calculation of your reward.
- After you click the "OK" button, there might be a short delay before the next question appears, due to the software. Please be patient.
- At the end of **PART 1** the screen "**BREAK**" will appear. Please remain sit and wait. During the break you are not allowed to speak with anyone. You will receive the instructions for **PART 2** and the experiment will restart.

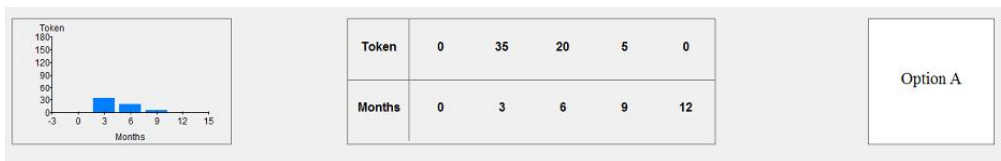
Specific Instructions

Instructions are visualized on the screen before each Part of the Experiment. This is the paper version. You can keep it and revise it in case you have doubts about the experiment.

The exchange rate for this part of the experiment is:

20 Token = £ 1

In this part, you will choose among Delayed Payment Plans. The following screen shows a delayed payment plan:

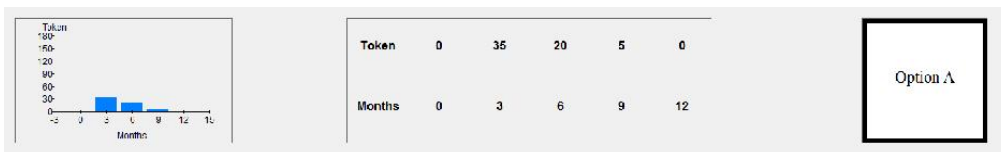


A delayed payment plan is described in two ways:

- A histogram, on the left, allows to visualize the number of tokens paid at different months;
- A table in which Token and Months are written.

This delayed payment plan allows you to win 35 Tokens in 3 months, 20 Tokens in 6 months and 5 Tokens in 9 months.

On the right you can see a Button to select. If you click on “Option A” you select this Delayed Payment Plan and a black frame will appear.



You can change your choice even after you have selected one. When you are sure of your choice you can click the Button “OK” in the Right-Bottom part of the screen (see below). Once you clicked “OK” your decision is recorded and you cannot change it.



Notice:

- Questions may have a different number of alternatives to choose from;
- Delayed Payment Plans may differ both in Token and in Time of Payments.

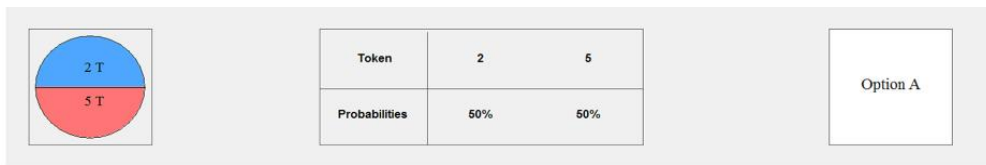
Specific Instructions

Instructions are visualized on the screen before each Part of the Experiment. This is the paper version. You can keep it and revise it in case you have doubts about the experiment.

The exchange rate for this part of the experiment is:

10 Token = £ 1

In this part, you will choose among Lotteries. The following screen shows a lottery:



A lottery is described in two ways:

- A pie, on the left, allows to visualize the probabilities to win;
- A table in which Token and Probabilities are written.

This lottery allows you to win 2 Token with 50% probability and 5 Token with 50% probability.

On the right you can see a Button to select. If you click on “Option A” you select this Lottery and a black frame will appear.



You can change your choice even after you have selected one. When you are sure of your choice you can click the Button “OK” in the Right-Bottom part of the screen (see below). Once you clicked “OK” your decision is recorded and you cannot change it.



Notice:

- Questions may have a different number of alternatives to choose from;
- Lotteries may differ both in Token and in Probabilities.

5 Screens

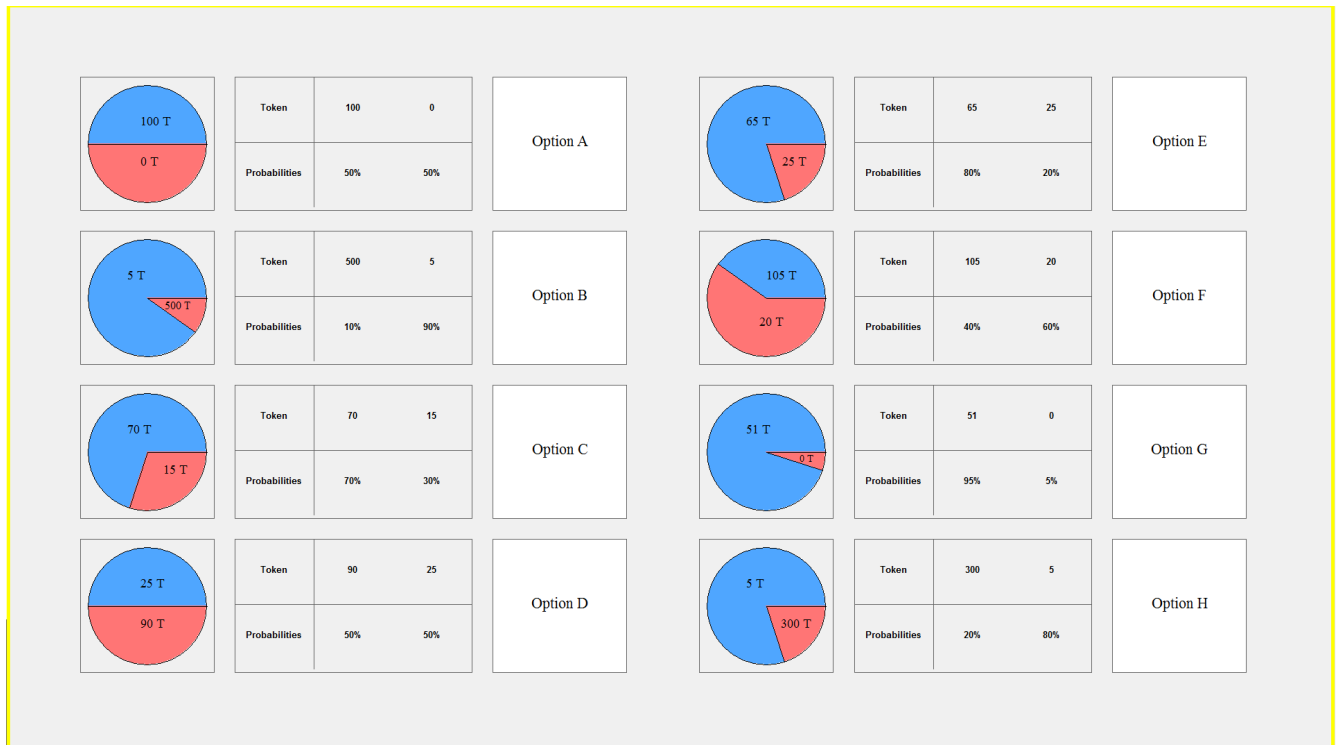


Figure 1: Screenshot of a question in Risk



Figure 2: Screenshot of a question in Time

4) Here you are presented with four options. Can you please rank them from the best to the worst? (Note that you cannot assign the same position to two different alternatives)

Token	50	0
Probabilities	100%	0%

Token	65	25
Probabilities	80%	20%

Token	90	25
Probabilities	50%	50%

Token	300	5
Probabilities	20%	80%

1st 2nd 3rd 4th

1st 2nd 3rd 4th

1st 2nd 3rd 4th

1st 2nd 3rd 4th

5) Here you are presented with four options. Can you please rank them from the best to the worst? (Note that you cannot assign the same position to two different alternatives)

Token	160	0	0	0	0
Months	0	3	6	9	12

Token	110	50	25	0	0
Months	0	3	6	9	12

Token	50	50	50	50	0
Months	0	3	6	9	12

Token	0	15	40	170	0
Months	0	3	6	9	12

1st 2nd 3rd 4th

1st 2nd 3rd 4th

1st 2nd 3rd 4th

1st 2nd 3rd 4th

Figure 3: Screenshot of the elicitation of reported preferences

Notes: the participants were forced to rank the alternatives without indifference. For instance, if they had already selected an alternative as 1st, then a selection of another alternative as 1st implied a substitution.

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