Narrow Framing and Impatience*

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Abstract

We hypothesize that the tendency to frame narrowly is related to an individual's time preference. To test this, we confront a large sample of the Dutch population with a series of incentivized investment decisions and elicit time preferences. We find that the tendency to frame narrowly is not generally related to discount rates. At the same time, we find that it is easier to induce impatient individuals to frame more broadly. This suggests that impatient individuals are more susceptible to 'nudges' than patient individuals, which is important as impatience is typically associated with problematic behaviors such as low savings, little equity holdings, low investments in human capital, and an unhealthy lifestyle.

Keywords: narrow framing, time preferences, field experiment.

JEL classification numbers: C93, D03, D81.

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1 Introduction

A key factor affecting risk attitudes is decision framing, that is, the extent to which an individual aggregates the risk of a particular decision with the risks of past and future decisions.[1] In particular, when facing a series of risky decisions a person can frame these decisions broadly by evaluating the risks in combination or a person can frame the decisions narrowly and evaluate the risk of each decision in isolation.[2] In the present paper, we examine whether there is a relationship between decision framing and time discounting. In principle, decision framing and time preference are independent concepts. Still, there are reasons to expect an association between the two.

Kahneman (2003) argues that the prevalence of narrow framing is related to accessibility, which refers to the ease with which certain attributes of a decision problem come to mind. The particular choice problem at hand and the direct consequences of a choice are far more accessible than an integration of these consequences with those of other choices in the past or future. As a result, when facing a series of risky decisions a person will tend to consider each decision in isolation, rather than evaluating the risks in combination. In a similar vein, accessibility may be relevant for decisions that involve a trade-off between the present and the future. Consequences of a decision set to occur in the near future will come to mind more readily and concretely than consequences in a more distant future (Trope and Liberman, 2003). As a result, the former are likely to attain more weight in the evaluation than the latter. Taking these two lines of argument together, we hypothesize that there is a relationship—mediated by accessibility—between decision framing and time preference.[3] Individuals who care less about the future will also tend to frame more narrowly. Specifically, when confronted with a series of risky decision problems, as compared to a patient person, an impatient person is more likely to consider these problems one by one and fail to aggregate them.

Narrow framing, like any type of framing, relies on the passive acceptance of the way a

[1] Various authors accentuate the role of risk aggregation using more or less synonymous labels. For example, Benartzi and Thaler (1995) refer to the issue as a matter of (myopic) mental accounting, Read, Loewenstein, and Rabin (1999) use the term choice bracketing, while Redelmeier and Tversky (1992) distinguish segregated and aggregated choice modes. In the present paper we employ the terminology "broad" versus "narrow" framing, originally proposed by Kahneman and Lovallo (1993).

[2] Narrow framing is argued to be a key element in explaining important phenomena such as the equity premium puzzle (Benartzi and Thaler, 1995), the stock market participation puzzle (Barberis, Huang, and Thaler, 2006), the high mean/excess volatility of individual stock returns (Barberis and Huang, 2001), the high premium for insurance against small risks (Rabin, 2000), and the disposition effect (Kumar and Lim, 2008).

[3] It is probably no coincidence that the label "myopic" has been used to qualify both decision framing (Benartzi and Thaler, 1995, Haisley, Mostafa, and Loewenstein, 2008) and time preferences (Jehn and Weigelt, 2001, Kirby and Herrnstein, 1995). In both cases, this reflects the fact that myopic individuals see nearby objects very clearly, while distant objects are blurred.

choice is presented (Kahneman, 2003). As the choices that individuals face typically arise one at the time, this is how they will be considered. This means that it is the structure of the environment in which a decision is made that determines which features are more accessible. This suggests that there is yet another way in which time preferences may be related to decision framing. To the extent that impatient individuals are more affected by accessibility than patient individuals, they will also be more affected by the way in which a problem is presented. In other words, impatient persons are more susceptible to framing effects than patient individuals. They are more likely to passively accept the way a decision problem is presented to them and evaluate it as such, and less likely to 'see beyond' its most accessible features.

We use incentivized experiments to examine these two hypotheses regarding the relationship between time preference and decision framing. The experiment consists of two parts. The first part is based on the design of Gneezy and Potters (1997). Two groups of participants are subjected to a sequence of three risky investment decisions. Participants in the first (High frequency) group can change their investment level from one decision to the next and are supplied with feedback about the outcome after each decision. Participants in the second (Low frequency) group are restricted to choose the same investment level for all three rounds before the first lottery is played, and they receive feedback about the outcomes only at the end. Gneezy and Potters (1997) find that participants in the second group invest higher amounts on average than participants in the first group.[4] This may seem remarkable in view of the fact that the former group has more decision frequency than the latter group. However, the result is in line with Kahneman's (2003) view that narrow framing originates from the passive acceptance of the presentation given. When induced to make decisions one-by-one (High frequency), subjects tend to evaluate the different risks in isolation. When induced to decide on a series of risks in combination (Low frequency), individuals tend to pool the risks and to find them more attractive as a result.

The second part of the experiment elicits time preferences and follows the design of Coller and Williams (1999). Participants choose between a smaller amount sooner or a larger amount later. Specifically, they are asked to indicate the minimum amount X for which they prefer a chance to receive $300 + X$ Euro in seven months over a chance to receive 300 Euro in one month.[5]

[4] For similar results see Thaler et al. (1997), Benartzi and Thaler (1995), Read, Loewenstein, and Rabin (1999), Barron and Erev (2003), Gneezy, Kapteyn, and Potters (2003), Langer and Weber (2003), Bellemare et al. (2005), Fellner and Sutter (2009), Haigh and List (2005), Sutter (2007), Hopfensitz and Wranik (2008).

[5] Note that the reward is always received with a delay. Using the CentERpanel (see below) forced us to have a front-end delay since it was impossible to pay the participants immediately or even quickly after the experiment. This probably means that our time preference measure does not pick up present-bias, which arguably weakens our chances to find an association between decision framing and time preference.

The CentERpanel, hosted by Tilburg University, provides the opportunity to run incentivized experiments on a large, broadly representative sample of the adult population. This offers several distinctive advantages. First, for our purpose, it is essential to have a large sample of participants. We want to relate time preferences not only to the investment levels, but also to the size of the treatment effect. Since the latter is a between-subject effect, this requires a large number of observations. Our sample consists of 1102 members of the Dutch population. A second major advantage of the CentERpanel is that it contains a wealth of socioeconomic background variables such as gender, age, occupational status, marital status, education, income, and wealth composition. This is important since, as Tversky and Kahneman (1981) emphasized, the decision frame adopted by a decision-maker is not only determined by the presentation of the decision problem, but also by the personal characteristics of the decision-maker.

Our main result is that there is a significant interaction effect between the time preferences measured in Part 2 and the treatment effect of Part 1 (High versus Low frequency). In line with our hypothesis, the effect of the treatment on investment levels is significantly larger within the group of high discounters than within the group of low discounters. Impatient individuals are affected more by the structure of the decision problem than patient individuals. At the same time, and contrary to our hypothesis, we do not find that impatient individuals generally invest less, or frame more narrowly, than patient individuals. It is only through the interaction with the treatment effect that time preferences affect investment decisions in our experiment.

These results are robust to controlling for economic and sociodemographic background variables. Moreover, almost none of these background variables correlates significantly with either the investment levels or the treatment effect. For example, females do not invest less than males, and participants with a high level of education are affected by the presentation of the decision problem as much as those with a low level of education.

As for the related literature, there are several experimental studies that examine the relationship between risk and time preferences. Most of the evidence suggests that there is a positive correlation: higher risk aversion is associated with higher discount rates (e.g., Anderhub et al., 2001, Burks et al., 2009, Eckel, Johnson, and Montmarquette, 2005; see Booij and van Praag, 2009 for an exception). As more risk-averse individuals should invest less in our experimental investment task, this would suggest that investment levels should be lower for impatient individuals-a result which is not confirmed in our data. At the same time, some recent studies suggest that the correlation between risk and time preference is due to a common driver: cognitive ability (Dohmen

et al., 2010, Benjamin, Brown, and Shapiro, 2006, Frederick, 2005). Our finding that the treatment effect (High versus Low frequency) is stronger for impatient individuals is largely in line with this evidence. After all, framing and presentation effects are associated with intuitive rather than cognitive decision making (Kahneman, 2003).

We are aware of only two studies that try to measure narrow framing and explore its correlates. Guiso (2009) manipulates the accessibility of background risk. Subjects decide whether or not to accept a small stakes lottery and are asked about their future earnings risk; one group of subjects before making the lottery decision and the other group after that decision. Guiso (2009) finds that the former group is significantly more likely to accept the lottery than the latter group. This is in line with the idea that a small favorable lottery will appear more attractive in the face of independent pre-existing risk. Interestingly, this treatment effect is stronger for subjects who say that they base their decisions mostly on thinking (cognition), as compared to subjects who say they mostly rely on intuition.

Rabin and Weizsäcker (2009) use an experimental design inspired by Tversky and Kahneman (1981) and show that most individuals are prone to making stochastically dominated combinations of choices, unless these dominance relations are made very accessible to them. Narrow framing can explain such choice patterns as it suggests that most subjects will evaluate the consequence of each concurrent choice in isolation, rather than evaluating the choices in combination. They find that the tendency to frame narrowly hardly varies with personal characteristics, which is in line with our results.

Since narrow framing can lead to dominated choices (Rabin and Weizsäcker, 2009), and usually leads to worse outcomes than broad framing (Read, Loewenstein, and Rabin, 1999), two relevant policy questions are: who should be encouraged to frame more broadly, and who can be encouraged to frame more broadly. Our results suggest that the answer to both questions is: almost everyone. We complement our reduced-form results by structural estimates which, in line with those of Rabin and Weizsäcker (2009), indicate that as much as 85% of the population tend to frame narrowly. Second, individuals across the board are susceptible to the way in which choice problems are presented to them and can be induced to frame more broadly.

Our finding that impatient individuals are particularly amenable to such presentation effects is important in this respect. Heavy discounting is typically associated with problematic behaviors such as low savings, little equity holdings, low investment in human capital, and an unhealthy life style. Our result that benevolent 'nudges' (Thaler and Sunstein, 2008) may be especially effective

for impatient individuals is in some sense reassuring, as this may be exactly the main target group. At the same time, of course, it also implies that this group may be particularly vulnerable to more malicious nudging. In any case, as far as we know, our finding is one of the first to suggest that the effects of framing and nudging may be related to another important trait, to wit, impatience.

The remainder of this paper is organized as follows. In Section 2, we introduce our experimental design and provide details on the data collection. Then, in Section 3 we report our main results, which consist of estimates of the dependence of the treatment manipulation on investment levels and estimates of the probability to frame narrowly that are obtained using a structural model of investment behavior. Finally, in Section 4, we discuss some implications of our results.

2 Experimental design and data collection

2.1 Experimental design

Our experiment had two parts. The first part was a risky investment decision task and the second part consisted of the elicitation of time preferences.

Part 1: Investment decision. In this part we employed the basic investment task of Gneezy and Potters (1997) involving three independent lotteries. In each of these lotteries, there is a 2/3 chance to lose the invested amount x_t, $t = 1, 2, 3,$, and a 1/3 chance to win $2.5x_t$. Hence, expected earnings in this lottery are equal to $2 - (2/3)x_t + (1/3)2.5x_t = 2 + (1/6)x_t > 2$.

There were two treatments. In the High-frequency treatment (referred to as "HIGH"), subjects made an investment decision round by round. In each round subjects were endowed with €2 and had to decide which amount x_t ($0 \leq x_t \leq 2$) they wanted to invest. That is, at the beginning of round 1 they had to choose the amount x_1 of their endowment of €2 to invest in the lottery. Then they were informed of the result of the lottery in this round. Subjects were then asked to decide on the amount x_2 of their endowment of €2 that they wished to invest in round 2. Again, they were informed of the outcome of the round-2 lottery, and were then asked to make their decision x_3 for round 3, with subsequent feedback about the outcome. In the Low-frequency treatment (referred to as "LOW"), subjects made just one decision for all three rounds, which imposes the constraint $x_1 = x_2 = x_3$. Subjects in this treatment only received feedback about the combined result of rounds 1, 2, and 3. That is, they were only informed whether they had won in no, one, two or all three rounds, but could not assign a gain or loss to any particular round.[6]

[6] There was also a third treatment in which subjects first chose whether they wanted to make their investment

Part 2: Elicitation of time preferences. For this part of the experiment we followed Coller and Williams (1999) and confronted subjects with a set of 20 payoff alternatives, listed in the rows of Table 1. In principle, in each of the 20 rows subjects had to decide between option A and Option B. Option A always paid €300 in one month from the day of the experiment. Option B paid the amount of €300 + €X after seven months from the day of the experiment, where X varied from €3.80 to €79.70 (corresponding to annual interest rates varying from 2.5% to 50% of return on the amount of €300, compounded quarterly).

Instead of asking the subjects to make a choice for each decision listed in the rows of Table 1, a subject's task was to choose the *minimum* X which would make her prefer Option B (performed by moving a slider on a row in Table 1 that represented a "switch point" from preferring Option A to preferring Option B). So, for instance, if a subject's preference was such that it would take an extra payment of at least €25 to wait seven months from the day of the experiment instead of receiving €300 in one month from the day of the experiment, this subject would select the row of decision alternative 7 in Table 1. By asking subjects to indicate the minimum amount of X to make it worth waiting for seven months, we forced subjects to switch from Option A to Option B at only once. In particular, we explicitly stated that there are, in principle, three choices available: a preference for Option A in all decision rows, a preference for Option B in all decision rows, and a preference for Option A for decision rows with a lower number, and Option B for decision rows with a higher number. The instructions explained what a subject needed to do in each of these cases (see the additional document with the instructions for details).[7,8]

As it was prohibitively costly to pay each subject in this part of the experiment, subjects were informed that there was a 1 in 100 chance to be selected and paid in accordance with the stated preference. We told them that for this purpose the computer would randomly select a number between 1 and 100, independently for each subject. If the number was 100, a subject would receive an additional sum of money in this part of the experiment. The computer would then randomly select one of the decision lines in Table 1 and a subject would be paid according to the choice indicated in this decision line. To make sure that subjects received their money exactly

decision(s) under the conditions of treatment LOW or treatment HIGH and only then were confronted with the decision task of the chosen treatment. However, we will not report on this treatment in this paper.

[7] In order for a subject to select Option A in all Decisions, in the experiment, Table 1 contained an additional Decision line 21 with the entry "Always €300" in column 2 labeled "Payment Option A," and no entry in all other columns. Hence, time preference choices ranged from 1 to 21. (Note that the experiment was administered in Dutch and that the additional document with the instructions contains a translation of the screens used in the experiment.)

[8] Note that by eliciting time preferences in this way we only obtain interval-censored instead of precise individual discount rates. For instance, the only information we can infer for a subject who switches from option A to option B at decision row 10 is that he or she has an annual discount rate between 22.5 and 25 percent.

Decision	Payment Option A (pays amount below in 1 month)	Payment Option B (pays amount below in 7 months)	Preferred Payment Option	
1	€300	€303.80	A	B
2	€300	€307.50	A	B
3	€300	€311.40	A	B
4	€300	€315.20	A	B
5	€300	€319.00	A	B
6	€300	€322.90	A	B
7	€300	€326.80	A	B
8	€300	€330.80	A	B
9	€300	€334.70	A	B
10	€300	€338.70	A	B
11	€300	€342.70	A	B
12	€300	€346.70	A	B
13	€300	€350.70	A	B
14	€300	€354.80	A	B
15	€300	€358.90	A	B
16	€300	€363.00	A	B
17	€300	€367.10	A	B
18	€300	€371.30	A	B
19	€300	€375.50	A	B
20	€300	€379.70	A	B

Table 1: Table used for the elicitation of time preferences in part 2 of the experiment

in one or seven months from the day of the experiment, we made use of CentERdata's established and reliable payment system (see also below).

To summarize, our experiment had two parts, with part 1 consisting of two treatments. Treatments only differed in the first part of the experiment. In treatment HIGH, subjects made three investment decisions in part 1 and in treatment LOW they made only one investment decision. In the second part of the experiment we elicited subjects' time preferences.

2.2 Data collection

The experiment was conducted by CentERdata, an institute for applied economic and survey research for the social sciences that is affiliated with Tilburg University in the Netherlands. CentERdata carries out its survey research mainly by using its own panel called CentERpanel. This panel is internet-based and consists of some 2000 households in the Netherlands that form a representative

sample of the Dutch population.[9] Panel members use their computers at home to participate in the panel questionnaires. [10] Every weekend, the panel members complete a questionnaire on the Internet from their home. An advantage of the CentERpanel is that researchers have access to background information for each panel member such as demographic and financial data that are regularly collected.

After logging on to our experiment, panel members were randomly assigned to one of the treatments and were informed about the nature of the experiment. Then, subjects decided whether or not to participate – as is common with many modules of the panel. For participating subjects, the next screen then introduced the investment decision task. After making their decision (treatment LOW) or their decisions (treatment HIGH) in the first part of the experiment, the time preference elicitation task was administered. Subjects received their earnings by means of the payment and reimbursement system used by CentERdata. CentERdata reimburses the telephone costs for filling in questionnaires by exchanging "CentERpoints" (1 CentERpoint = €0.01) to panel members' private bank accounts four times a year. Whereas payments for earnings in Part 1 were made at the earliest scheduled normal date of payments, it was absolutely crucial for the payments in Part 2 of the experiment that subjects would receive their money either exactly one month or exactly seven months from the day of the experiment. Hence, subjects were told that they would, conditional on receiving a payment at all, receive it for the second part of the experiment also by means of CentERdata's reimbursement system, in accordance with the their stated preference in the selected line in case they were picked to be paid. Since the reimbursement and other payments are made regularly and reliably, we have no reason to assume that subjects doubted that payments for the time elicitation task would not be paid according to the rules specified.

Prior to the panel experiment, we conducted a pilot experiment in the lab of Tilburg University with 92 student subjects. We conducted this pilot experiment in order to test whether instructions were clear and whether the procedures we designed to use in the main panel study actually worked. The lab experiment was conducted in exactly the same way as later in the CentERpanel. That is, student subjects completed the experiment using a web browser (in the lab) and using the same screens as later the subjects in the panel (at home). As there were no problems with the lab pilot, we used the same procedures and programs later in the main panel study.

[9] For more information about the CentERpanel and the way it is administered see http://www.centerdata.nl/en/.

[10] Panel members without a computer answer questionnaires using a special device connected to their TV sets.

		Participation			**Investment** (in %)		
		YES		NO			
		LOW	HIGH		LOW	HIGH	Difference
Gender	Female	47.2	46.1	50.2	51.7	43.1	8.6***
	Male	52.8	53.9	49.8	52.5	43.7	8.8***
Age	Age 15-24	5.08	3.81	5.11	50.5	44.8	5.7
	Age 25-34	19.4	20.3	7.2	58.1	43.5	14.6***
	Age 35-44	19.8	17.4	16.2	53.2	42.3	10.8***
	Age 45-54	19.8	27.0	18.3	48.6	44.1	4.5
	Age 55-64	18.0	16.9	24.3	47.8	41.1	6.7**
	Age 65+	18.0	14.5	28.9	53.0	45.8	7.2**
Education	Low	30.49	29.95	36.60	52.6	46.0	6.6**
	Middle	35.03	33.58	28.09	52.9	43.2	9.7***
	High	34.48	36.48	35.32	50.8	41.5	9.3***
Location	Rural	57.4	61.9	53.2	53.1	43.9	9.2***
	Urban	42.6	38.1	46.8	50.6	42.6	8.0***
Partner	No	23.1	23.6	26.0	50.3	39.8	10.5***
	Yes	76.9	76.4	74.0	52.6	44.5	8.1***
Position in HH	Head	61.7	63.7	59.2	51.8	41.7	10.1***
	Other	38.3	36.3	40.8	52.6	46.5	6.1**
Children	No	59.5	53.4	66.8	52.2	41.8	10.4***
	Yes	40.5	46.6	33.2	51.9	45.3	6.6**
Occupation	Employed (contract)	50.5	54.1	42.1	51.5	42.7	8.8***
	Retired	18.2	15.3	28.5	55.5	42.5	13.0***
	Works in own household	12.3	14.0	13.2	49.7	45.3	4.4
	Student	5.4	2.9	4.7	53.9	37.6	16.3
	Freelance or self-employed	4.2	3.1	2.1	51.0	50.4	0.6
	Unemployed	2.0	1.8	0.9	39.1	39.7	−0.6
	Other	7.4	8.9	8.5	54.2	47.0	7.2
Household (HH)	HH gr. income ≤ €2,250	25.2	23.1	30.6	54.0	42.5	11.5***
Income	HH gr. income €2,251–€3,130	22.9	26.7	25.5	49.6	41.9	7.7***
	HH gr. income €3,131–€4,350	27.2	27.4	23.8	53.3	46.2	7.1**
	HH gr. income ≥ €4,351	24.7	22.9	20.0	51.1	42.8	8.3**
Equity	No	76.6	74.6	-	52.2	43.7	8.5***
	Yes	23.4	25.4	-	51.8	42.6	8.2***
Plays lottery	Never	32.9	29.6	-	51.4	44.5	6.9**
	At least once a year	67.2	70.4	-	52.4	43.0	9.4***
Has Savings	No	12.9	11.6	-	50.4	50.4	0
account	Yes	87.1	88.4	-	52.3	42.5	9.8***
	Number of observations	551	551	235	551	551	551

Notes: Numbers indicate column percentages within each main category listed in the first column. For treatment HIGH, the table shows the average relative investment over the three rounds. *,**, *** indicate significance at the 10%, 5%, 1% level of Mann-Whitney U tests for differences of the distributions of the percentages invested across treatments for subjects in the category listed in column 1. The last three variables are not available for non-participants as these questions were only presented to participants.

Table 2: Percentages invested by covariates

In total, 1872 members of the CentERpanel logged on to our experiment. Of the subjects logging on, 1637 (87.4%) subjects decided to participate in our experiment, while 235 (12.6%) subjects decided not to participate. Of the 1637 subjects participating, 1102 subjects participated in the two randomly assigned treatments reported in this paper (while the remaining 535 subjects participated in another treatment not reported in this paper).

The column labeled "Participation" in Table 2 shows descriptive statistics for participating subjects in each of the two treatments as well as statistics of subjects who chose not to participate in the experiment. The columns labeled "Investment (in %)" show statistics of investment decisions for participating subjects, which we analyze in Section 3.1.

The table is grouped according to a selection of various sociodemographic and socioeconomic characteristics. Concentrating on descriptive statistics for participating subjects, we note that by and large the distribution of the covariates is balanced across the two treatments when subjects participated. The only exception is that individuals in treatment HIGH are more likely to be of age 45-54. A comparison of the descriptive statistics in the columns for participants with those of non-participants reveals no significant differences except for some of the age and children categories as well as for the occupation category, with retired and older individuals and those with no children being more reluctant to participate.

3 Results

3.1 Descriptive analysis

We first turn to Part 1 of the experiment and compare the average percentage of the endowment invested between the two treatments. Table 3 shows that, on average, subjects invested 43.4% of their endowment in treatment HIGH and 52.1% in treatment LOW—a 8.7 percentage point increase.[11] A Mann-Whitney U test confirms that the means of percentages invested are indeed significantly different across treatments.

To put this result into perspective, let us quickly compare these numbers with those reported in other studies. Although there are some differences in the designs of these studies, all used the basic investment decision of Gneezy and Potters (1997) that we also employ in the current study and, with one exception, all used student subjects. Gneezy and Potters (1997) report an average

[11] For treatment HIGH, the table shows the average investment over three rounds. The average percentages invested are fairly stable over the three individual rounds. They are 42.6%, 42.3%, and 45.4%, respectively. In Appendix A we show and discuss the distribution of (average) percentage investments in the two treatments.

Treatment	Mean	SD	#Obs
LOW	52.1	27.5	551
HIGH	43.4	24.5	551
H_0: Treatment has no effect on investment			
$p < 0.0001$ (two-tailed Mann-Whitney U test)			

Note: For treatment HIGH, the table shows the average investment over three rounds.

Table 3: Percentage of per-period endowment invested

investment of 67.4% in treatment LOW and 50.5% in treatment HIGH (difference: 16.9 percentage points). Haigh and List (2005) find a difference of 11.6 percentage points for their student sample (62.5% and 50.9%, respectively) and 28.7% points for their professional-trader sample (74.3% and 45.6%, respectively). Bellemare et al. (2005) find an average investment of 71.1% and 59.5% in treatment LOW and HIGH, respectively (difference: 11.6 percentage points), while Fellner and Sutter (2009) report an increase in the average investment of 31.5 percentage points (64.8% and 33.3%, respectively). Finally, in our pilot lab experiment with students as subjects we observed a difference of 14.1 percentage points (51.5% in treatment LOW and 37.4% in treatment HIGH). Hence, the difference we observe in our representative, heterogeneous sample is smaller than the differences found so far in studies that use more homogeneous groups of subjects.

Even though the observed levels of investments are slightly different, the results show that we can replicate the treatment effect that was reported in many other studies for a large sample of the Dutch population. We thus confirm that individuals' attitude towards risk can be effectively manipulated by the employed design and that this is not an artefact of the commonly employed student sample. However, with the sample we study in the current paper, we can go beyond replicating this known effect in a population at large because we can relate invested amounts to a wealth of socioeconomic background variables. This allows us to analyze whether the treatment effect manifests itself also for subpopulations that are usually not represented in lab studies. Table 2 shows the results. The three columns on the right hand side of this table, under the heading "Investment (in %)," show the average percentage invested in the two treatments for subjects with various characteristics listed in the first column of the table. It also indicates the difference between average percentages of investments in treatment LOW and HIGH, respectively, along with the results of Mann-Whitney U tests. Reading Table 2 row-wise, we note that a substantial, and often highly significant, treatment effect is present in the majority of the subsamples displayed in Table 2.[12]

[12] These are effects within subgroups. In Section 3.2.1 below we test for differences across subgroups by means of regressions.

We now turn to Part 2 of the experiment in which we elicited subjects' time preferences. We find a mean choice of 14.31 (standard deviation 6.52) and a median choice of 15. According to Table 1, this corresponds to an annual interest rate of between 32.5 and 35 percent (35 and 37.5 percent), which is similar to the 28 percent that Harrison, Lau, and Williams (2002) find for their Danish sample.[13] Regressing the stated time-preference choice on background variables as listed in Table 2, we find that individuals who have a high education, have invested in equity, or have a savings account are significantly more patient than individuals who have, respectively, low education, no equity, or no savings account.

The main purpose of this study is to use data from both parts of the experiment to relate investment behavior to time preferences. Figure 1 shows local linear regression estimates of mean investment in the two treatments (vertical axis) plotted against the stated time preference (horizontal axis), along with corresponding 95% confidence intervals.[14] As the line indicating investment behavior in treatment LOW is consistently above the line indicating investment behavior in treatment HIGH, this Figure replicates the finding that subjects in treatment LOW invest more than subjects in treatment HIGH. More importantly, however, investment behavior in treatment HIGH hardly varies with subjects' stated time preference. By contrast, investment behavior in treatment LOW increases with the stated time preference choice for values above 10. In other words, the difference between invested shares of the per-period endowment increases as subjects become more impatient. This means that subjects who are more impatient are more likely to be influenced by our treatment manipulation. The econometric analysis in the next section provides formal support for this observation.

3.2 Econometric analysis

3.2.1 Regression analysis

We now characterize the relationship between investment behavior and time preferences by means of regressions of the percentages invested on a treatment dummy "Low", an indicator for a stated time preference choice above 10, "Time01", and the interaction between the two, controlling for sociodemographic characteristics. We use data for the only choice made in treatment LOW and

[13] A substantial fraction of subjects switched from Option A to Option B at 20 or chose Option A throughout (i.e., chose 21) in Table 1. Whereas a choice of 20 means that a subject has a discount rate in the interval from 47.5 to 50 percent, a choice of 21 means that a subject has a discount rate of 50 percent or higher.

[14] We used only the first period's choice of treatment HIGH. Results are not sensitive to the choice of the bandwidth. For the figure, we used a rule-of-thumb bandwidth.

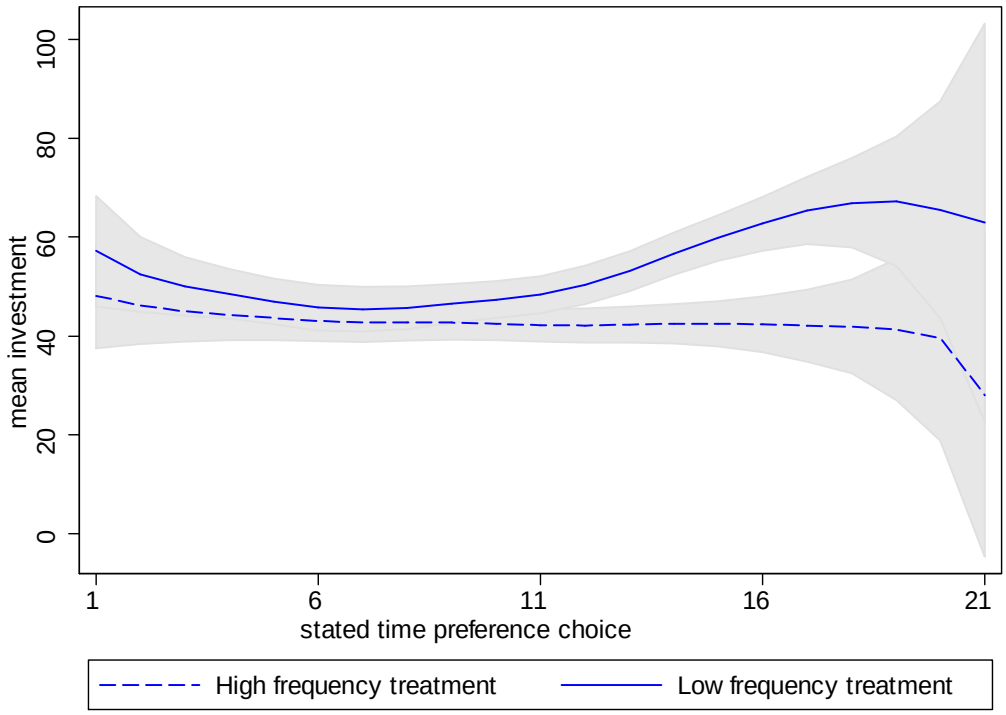

Figure 1: Relationship between investment in each treatment and the stated time preference

the round-1 choice made in treatment HIGH. The coding of "Time01" is based on Figure 1, which suggests that the effect of "Low"is higher for stated time preference choices above 10.[15] All explanatory variables other than "Low" are demeaned when they are not interacted. Hence, the constant term is always the mean investment in the high-frequency treatment. For the interaction terms the mean was calculated for all observations with Low=1 and then subtracted. This demeaned value was then interacted with "Low". Hence, the coefficient on "Low" is always the average effect of "Low" for those in treatment "Low" and across all covariates.[16] The estimation results are presented in Table 4.

The estimated coefficients on the treatment variable "Low", the time preference variable "Time01" and the interaction term between these two variables, "Time01×Low", are remarkably

[15] Defining "Time01" by means of a median split and running the same regressions yielded very similar results. We also carried out a specification check based on regression specification (1). If we additionally include a full set of dummies for stated time-preference choices, and interactions of those with Low, then we cannot reject the null hypothesis that the coefficients on these dummies are jointly zero. Likewise, if we include a second order polynomial in the time preference, interacted with Low, in addition to Low, Time01 and Time01×Low, we cannot reject the null that the additional 4 coefficients are jointly zero. This suggests that our definition of "Time01" is appropriate.

[16] This is the treatment effect on the treated. It differs just very slightly from the average treatment effect, as treatment assignment was random and the distributions of covariates are almost identical in the treatment and the control group.

similar across all 5 specifications. The treatment effect is consistently estimated to be a 9.5 percentage point increase in the percentage of the endowment that was invested, and is always highly significant. This means that the treatment effect (according to which subjects invest more if encouraged to take a broader frame) is still present if we control for socioeconomic variables and the stated time preference. The coefficient of the variable "Time01" is estimated to be negative, but insignificant in all specifications. Hence, subjects' time preferences are not related to their investment behavior in treatment HIGH. However, the coefficient on the interaction term "Time01×Low" is consistently estimated to be around 8.5 and is significantly different from zero in all specifications, suggesting that the treatment effect depends on the time preference. This means that more impatient subjects invest more when placed in an environment that, arguably, encourages them to take a broader perspective. In other words, subjects with a higher discount rate are affected more by our treatment manipulation. This result formally corroborates the visual insights gained from Figure 1.

Dependent variable: percentage of the per-period endowment invested						
	(1)	(2)	(3)		(4)	(5)
Constant	42.551***	42.553***	42.544***	Constant	42.576***	42.636***
	(1.12)	(1.12)	(1.12)		(1.12)	(1.12)
Low	9.531***	9.528***	9.546***	Low	9.565***	9.361***
	(1.58)	(1.58)	(1.60)		(1.58)	(1.58)
Time01	−1.648	−1.679	−1.723	Time01	−1.405	−2.218
	(2.44)	(2.45)	(2.47)		(2.47)	(2.46)
Time01×Low	8.554**	8.947**	8.839**	Time01×Low	8.045**	9.351***
	(3.46)	(3.47)	(3.50)		(3.53)	(3.49)
Female		−0.004		Education Low	−0.630	
		(2.26)			(2.81)	
Female×Low		−1.550		Education High	−3.517	
		(3.21)			(2.73)	
Age		1.210		[Education Low]×Low	−0.394	
		(7.69)			(3.96)	
Age×Low		−12.340		[Education high]×Low	2.785	
		(10.46)			(3.91)	
Employed			8.471	HH gross income €2251−€3130	−3.854	
			(6.06)		(4.42)	
Freelance			1.930	HH gross income €3131−€4350	−1.162	
			(8.45)		(4.24)	
Unemployed			−3.591	HH gross income ≥ €4351	3.924	
			(6.74)		(4.26)	
Student			0.666	[HH gross income €2251−€3130]×Low	−3.853	
			(3.37)		(6.44)	
Works in own household			0.378	[HH gross income €3131−€4350]×Low	−5.003	
			(3.26)		(6.22)	
Retired			2.096	[HH gross income ≥ €4351]×Low	−9.224	
			(4.16)		(6.30)	
Employed×Low			−9.601	Lottery01		−2.465
			(8.05)			(2.44)
Freelance×Low			−16.794	Lottery01×Low		3.200
			(11.72)			(3.43)
Unemployed×Low			5.450	Equity01		2.279
			(8.42)			(2.58)
Student×Low			−3.107	Equity01×Low		−1.778
			(4.90)			(3.71)
Works in own household×Low			2.784	Has savings account		−10.721***
			(4.48)			(3.50)
Retired×Low			1.017	[Has savings account]×Low		13.212***
			(6.21)			(4.88)
R^2	0.039	0.042	0.047		0.049	0.049

Note: ** and *** indicate significance at the 5% and 1% level, respectively. Standard errors are in parentheses. Categories left out: "Other" in occupation, "Middle" in education, "≤ €2,250" in HH gr. income.

Table 4: Reduced-form results

In regressions (2) to (5) we include additional covariates to assess whether there is a relationship between investment behavior and observed differences in gender, age, occupation, education, income, and variables that proxy for risk preferences such as whether the individual plays in the lottery, holds equity, or has a savings account. Except for having a savings account, these variables are not significantly (at the 5 percent level) related to investment behavior and the treatment effect.[17]

3.2.2 A structural model

So far we have established that individuals invest significantly more in treatment LOW, and that this effect is bigger for more impatient individuals. This in itself already shows that framing effects are more pronounced for impatient individuals. In this subsection, we complement this reduced form analysis with a structural model that allows us to quantify the probability that individuals frame narrowly, as a function of the treatment and the stated time preference choice, and to characterize the utility function.

We assume there are two types of decision makers: those who frame narrowly and those who frame broadly. Narrow framers evaluate the three lotteries separately, independent of the treatment. Given the two possible outcomes of a single lottery (loss L or gain G), by investing the share b of the per-round endowment $E =$€2, a decision maker with a narrow frame faces a lottery with the probabilities and outcomes as given in the upper part of Table 5. A decision maker who has a broad frame evaluates the three consecutive lotteries as one compound lottery (again, independent of whether she decides in treatment LOW or HIGH) with the four possible outcomes LLL, LLG, LGG, and GGG. Hence, a broad framer who invests the share b faces a lottery with the probabilities and outcomes that are given in the lower part of Table 5. For instance, with probability 8/27 the outcome of the three consecutive lotteries is LLL, implying a payoff of $3E - 3bE$.

This means that a narrow framer ignores the fact that the lottery is played three times in a row and decides as if it was played just once. Broad framers, to the contrary, evaluate the

[17] We also tested for a relationship between the invested amount and the covariates using the following two kinds of tests. For each main category listed in column 1 of Table 2, we tested whether the investment in treatment HIGH is the same across all subcategories listed in column 2 of Table 2 (Test 1), and whether the treatment effect (that is, the effect of LOW) is the same across all subcategories listed in column 2 of Table 2 (Test 2). For example, to conduct these tests for the main category Gender, we first estimated the regression equation $x_p = \alpha_0 + \alpha_1 \times Low + \alpha_2 \times Female + \alpha_3 \times Female \times Low + \varepsilon_i$, where x_p is the percentage of the per-period endowment invested, and "Low" and "Female" are dummy variables coding treatment and gender. Then we tested H_0: $\alpha_2 = 0$ (Test 1) and H_0: $\alpha_3 = 0$ (Test 2). These two hypotheses were not rejected for any of the main categories (at the 5% level). This means that both the average relative investment in treatment HIGH and the difference in average relative investments in treatments HIGH and LOW are statistically the same across the subcategories listed in Table 2.

Frame (f)	Event	Probability $\left(p_i^f\right)$	Monetary outcome $\left(x_i^f\right)$
Narrow (N)	L	$p_1^N = 2/3$	$x_1^N = E - bE$
	G	$p_2^N = 1/3$	$x_2^N = E + \frac{5}{2}bE$
Broad (B)	LLL	$p_1^B = 8/27$	$x_1^B = 3E - 3bE$
	LLG	$p_2^B = 12/27$	$x_2^B = 3E + \frac{1}{2}bE$
	LGG	$p_3^B = 6/27$	$x_3^B = 3E + 4bE$
	GGG	$p_4^B = 1/27$	$x_4^B = 3E + 7\frac{1}{2}bE$

Table 5: Lotteries faced by narrow and broad framers

compound lottery implied by the 3 consecutive repetitions of the basic investment task. Given a utility function u, which in its functional form we assume to be the same for each type of decision maker, a subject then evaluates a lottery according to $E^f u(b) = \sum_i p_i^f u(x_i^f(b))$, depending on his or her type $f \in \{N, B\}$ and the probabilities and monetary outcomes as shown in Table 5.

In the experiment, participants can choose to invest any fraction b of their per-period endowment. For estimation purposes, we discretize choices such that choices b in the interval $[0, 0.125)$, $[0.125, 0.375)$, $[0.375, 0.625)$, $[0.625, 0.875)$, and $[0.875, 1)$ are coded as $0, 0.25, 0.5, 0.75$, and 1, respectively. The set of 5 possible choices is denoted by B.

We assume a logistic choice rule so that a subject of type f chooses b with probability

$$\Pr(b \mid f) = \frac{\exp\left(E^f u(b)/\mu\right)}{\sum_{b' \in B} \exp\left(E^f u(b')/\mu\right)}$$

where μ is a noise parameter such that when $\mu \to 0$ this specification converges to expected utility maximization, whereas when $\mu \to \infty$ choices becomes random.[18]

Individuals are either narrow framers, with probability π^N, or broad framers, with probability $1 - \pi^N$. Hence, the probability of observing choice b is given by the mixture model

$$\Pr(b) = \pi^N \times \Pr(b \mid N) + (1 - \pi^N) \times \Pr(b \mid B). \tag{1}$$

[18] Put differently, we assume that individuals make choice errors because an error term $\mu\varepsilon_{ib}$ specific to the invested amount b is added to each expected utility, where ε_{ib} follows the type 1 extreme value distribution.

For the utility function u we use the hybrid CRRA-CARA utility function[19,20]

$$u(x) = \begin{cases} \frac{1-\exp(-r_+ x^{1-\gamma_+})}{r_+} & \text{if } x \geq 0 \\ \frac{1-\exp(-r_-(-x)^{1-\gamma_-})}{r_-} & \text{if } x < 0. \end{cases}$$

The parameters r_+ and γ_+ (r_- and γ_-) determine the shape of the utility function for gains (losses). For $r_+ \to 0$ or $r_- \to 0$ the respective branch of the utility function represents CRRA, whereas for $\gamma_+ \to 0$ or $\gamma_- \to 0$ the respective branch represents CARA.[21]

We estimate the share of narrow framers, π^N, and the parameters of the utility function, r_+, r_-, γ_+, and γ_-, as well as μ by maximizing the log likelihood function constructed using (1) for the observations made in treatment Low and the observations made in the first round of treatment High. Importantly, some of these parameters will be allowed to depend on the treatment, the time preference choice, and observed individual characteristics such as age, education, and occupation. In all estimations reported we set $\gamma_+ = 0$, as it was always estimated to be zero if we constrained it to be nonnegative. The estimation results are presented in Table 6.

In the baseline specification (1), we estimate all parameters of the model and only let the probability of narrow framing, π^N, depend on the treatment dummy Low. We find that the probability of narrow framing is 84.5% in treatment High and that it decreases by 13.9 percentage points in treatment Low. Rabin and Weizsäcker (2009) use a similar estimation procedure in the context of a different experimental design without a treatment such as ours, and report that 89% of the subjects in their sample are estimated to be narrow framers. Figure 2 shows that the estimates of the parameters r_+, r_-, and γ_- imply that the utility function has a kink at 0 and is (slightly) concave above and (slightly) convex below 0.

Specification (2) is similar to specification (1), with the exception that we let the probability of narrow framing also depend on the variable "Time01" (the dummy variable indicating a high time discount rate, which is defined as above) and the interaction term "Time01×Low".[22] We

[19] This function was previously employed by various authors. See, for instance, Holt and Laury (2002), Abdellaoui, Barrios, and Wakker (2007) or Rabin and Weizsäcker (2009).

[20] This utiliy function allows for a kink at zero. We also estimated the model using the utility function $u(x) = \frac{1-\exp(-r_+ x)}{r_+}$ if $x \geq 0$ and $u(x) = \lambda \frac{1-\exp(-r_-(-x))}{r_-}$ if $x < 0$, that explicitly incorporates a loss aversion parameter λ. The estimation results regarding the probability of narrow framing, the treatment effect, and the time-preference choice remained qualitatively unchanged and the shape of the utility function was very similar.

[21] We impose that the parameters r_+, r_-, γ_+ and γ_- lie in the (closed) unit interval by subtracting a penalty from the log likelihood function that is quadratic in the distance to the unit interval if they don't lie in that interval.

[22] As in the reduced form regressions, "Time01" is de-meaned so that the constant term always represents the average probability to frame narrowly in the high frequency treatment. For the interaction term the mean of "Time01" among individuals with "Low"=1 has been subtracted so that, as before, the coefficient on "Low" is the average effect

Parameter		(1)	(2)	(3)	(4)
π^N	Constant	0.845***	0.848***	0.839***	0.825***
		(0.03)	(0.03)	(0.05)	(0.31)
	Low	−0.139***	−0.140***	−0.122***	−0.127
		(0.03)	(0.03)	(0.03)	(0.18)
	Time01		0.045	0.043	0.033
			(0.04)	(0.04)	(0.18)
	Time01×Low		−0.154***	−0.152**	−0.132
			(0.06)	(0.06)	(0.41)
r_+	Constant	0.202***	0.201***	0.209***	0.214
		(0.01)	(0.01)	(0.01)	(0.19)
	Low			−0.018	−0.012
				(0.02)	(0.16)
	Time01				−0.006
					(0.09)
	Time01×Low				0.001
					(0.04)
r_-	Constant	0.112***	0.113***	0.117***	0.110
		(0.01)	(0.01)	(0.03)	(0.12)
	Low			−0.012	−0.008
				(0.02)	(0.11)
	Time01				−0.001
					(0.06)
	Time01×Low				−0.009
					(0.05)
γ_+	Constant	0.000	0.000	0.000	0.000
		.	.	.	.
γ_-	Constant	0.099***	0.096***	0.102**	0.119
		(0.03)	(0.02)	(0.05)	(0.54)
	Low			−0.013	−0.008
				(0.02)	(0.10)
	Time01				−0.019
					(0.25)
	Time01×Low				0.032
					(0.42)
μ	Constant	0.013**	0.014***	0.014	0.010
		(0.01)	(0.00)	(0.01)	(0.12)
LL		−1555.753	−1552.087	−1547.592	−1544.776

Note: *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. Standard errors are in parentheses.

Table 6: Estimates of structural parameters

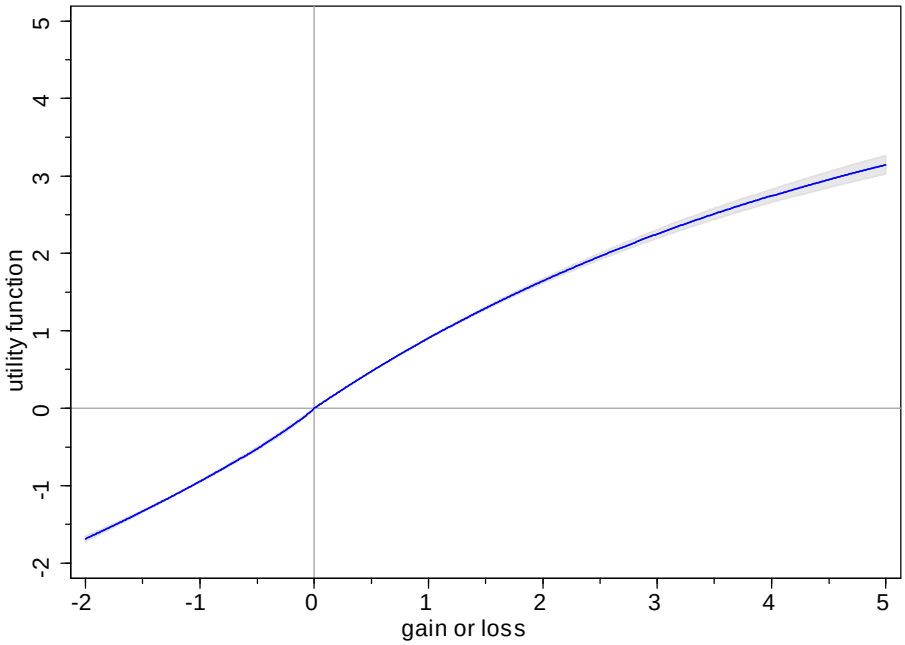

Figure 2: Estimated utility function ($\widehat{r}_+ = 0.202$, $\widehat{r}_- = 0.112$, $\gamma_+ = 0.000$, $\widehat{\gamma}_- = 0.099$).

find that the time preference variable "Time01" is not significantly related to the probability of narrow framing, meaning that in treatment HIGH time preferences do not play a role. However, the coefficient of the interaction term "Time01×Low" is estimated to be -0.154 and is significantly different from zero, meaning that more impatient subjects are more likely to be encouraged to frame more broadly by being exposed to treatment LOW.

To assess whether the parameters of the utility function change with the treatment, we extend specification (2) by also letting the utility function parameters r_+, r_-, and γ_- depend on the treatment. The estimates for specification (3) show that this is not the case as the dependence of these parameters on the treatment variable "Low" is never statistically significant. Moreover, this extension leaves the estimates regarding the probability of narrow framing, π^N, basically unchanged.

In specification (4) we let the parameters of the utility function also depend on the time-preference variable "Time01" and the interaction term "Time01×Low." We find that none of the utility function parameters are significantly related to any of these two variables (but the coefficient of the interaction term "Time01×Low" in the parameter π^N ceases to be significant). This shows that our estimates are robust to letting the utility function depend on the treatment and the stated

(across stated time preference choices) of the low-frequency treatment on the probability to frame narrowly for the individuals in the low frequency treatment.

time preference choice.[23]

4 Summary and conclusions

In this paper, we show that impatient individuals are particularly amenable to presentation effects. Heavy discounting is typically associated with problematic behaviors such as low savings, little equity holdings, low investment in human capital, and an unhealthy life style. Our result that benevolent "nudges" may be especially effective for impatient individuals is in some sense reassuring, as this may be exactly the main target group. At the same time, of course, it also implies that this group may be particularly vulnerable to more malicious nudging. In any case, as far as we know, our finding is one of the first to suggest that the effects of framing and nudging may be related to another important trait, to wit, impatience.

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[23] We also estimated a specification similar to specification (4), in which the probability of narrow framing, π^n, only depends on the treatment variable "Low" but not on the time preference choice. Again, we find that the parameters of the utility function, r_+, r_-, and γ_-, are not correlated with the variables "Low," "Time01," and "Time01×Low." Moreover, we estimated specifications with covariates and found that they are generally not related to any of the parameters, a finding that is not surprising in light of the reduced form results reported in Table 4.

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A Distribution of investments

Figure 3 shows the distribution of average percentage investments in the two treatments. (Again, for the ease of comparison, we use average percentage investments over the three individual rounds of treatment High.) Inspecting these two histograms, we make two observations that confirm that more mass of the observations is distributed to higher values in treatment Low as compared to treatment High. First, whereas the mode of the distribution in treatment Low is 50%, it is only 25% in treatment High. Second, there is a higher percentage of choices that fall into the bin 100% in treatment Low (about 17%) than in treatment High (about 7%).

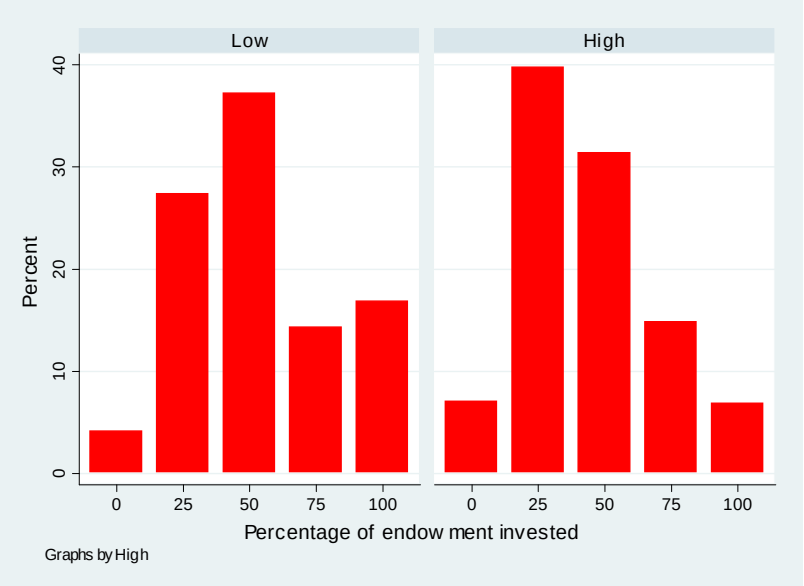

Figure 3: Distribution of investments

Instructions (translations of the screens used in the experiment)

Screen 1

This study is about individual decision making, and it is conducted by researchers from Tilburg University.

In the questionnaire you will be presented a number of decision problems. The questions are not meant to test you. We are only interested in the choices you make. The only correct choice is the choice that you prefer.

The questionnaire consists of two parts. First you will see the explanation of the first part. After completing the first part, the explanation of the second part will follow. Some general questions will follow at the end of the questionnaire.

In this experiment, you stand to win a sum of money. Your earnings also depend on the decisions that you take in the experiment, and they will be paid in the form of CentERpoints. If you do not want to participate as a matter of principle, you can indicate this below. You will then go directly to the end of the questionnaire.

- o I wish to continue with this questionnaire
- o No, I don't want to participate in this questionnaire.

Continue

Previous

Treatment HIGH

Screen 2

Instructions, part 1

The first part of the study consists of three successive rounds. In each round you start with an amount of 2 euros (200 eurocents). You have to decide which part of this amount (between 0 and 200 eurocents) you want to invest in the following choice situation:

You have a 1 in 3 chance (33%) to win 2.5 times the invested amount and a 2 in 3 chance (67%) to lose the invested amount.

Whether you win or lose depends on the color of the ball that is drawn by the computer. Below you see one white ball and two black balls. The computer randomly draws one of these three balls. Each ball has equal probability to be drawn. If the computer draws the white ball (which happens with a 1 in 3 chance), then you win 2.5 times the amount invested extra in the choice situation; if the computer draws one of the black balls (which happens with a 2 in 3 chance), then you lose the amount invested in the choice situation.

Continue

Screen 3

Your earnings in a round are determined as follows. In each round you start with an amount of 200 eurocents and your earnings in the choice situation are added to that. Thus, if you decide to invest an amount of Y eurocents in the choice situation, then your earnings in a round are equal to 200 + 2.5 times Y if a white ball is drawn and 200 - Y if a black ball is drawn.
After you have decided how much you want to invest in the first round, you are informed of the color of the ball the computer has drawn, what your earnings are in the choice situation, and what your total earnings are for the round.

After that you have to decide how much you want to invest in the choice situation of the second round. You start again with an amount of 200 eurocents, part of which you can invest. Your earnings in this round are determined in the same way as in the previous round. The computer again draws a ball, and the color determines whether you win or lose. Also the third and last round proceeds in the same way.

Please note: the computer draws a new ball for each round and these draws do not influence each other; they are independent. Therefore there is always a 1 in 3 chance to win in the choice situation (a white ball) and a 2 in 3 chance to lose (a black ball). Once you are ready to start, click on the CONTINUE button below.

Continue Previous

Screen 4a

First round
You start with an amount of 200 eurocents. How many cents do you want to invest in the choice situation in round 1?

You have a 1 in 3 chance (33%) to win 2.5 times the invested amount extra and a 2 in 3 chance (67%) to lose the invested amount.

Below, please enter an amount between 0 and 200 eurocents.

[ ] cents

Continue Previous

Screen 5a

You have chosen to invest [X1] eurocents in round 1. The computer has drawn the following ball:

[ball 1:

 or ]

This means that you win 2.5 times the invested amount X1 / This means that you lose the invested amount X1. Your earnings for this round are: 200 + 2.5 times X1 = [total1] eurocents./ Your earnings for this round are: 200 – X1 = [total1] eurocents. Click the CONTINUE button when you are ready to choose your investment for the second round.

Continue

Screen 4b

Second round
You start with an amount of 200 eurocents. How many cents do you want to invest in the choice situation in round 2?

You have a 1 in 3 chance (33%) to win 2.5 times the invested amount extra and a 2 in 3 chance (67%) to lose the invested amount.

Below, please enter an amount between 0 and 200 eurocents.

[ ] cents

Continue Previous

Screen 5b

You have chosen to invest [X2] eurocents in round 2. The computer has drawn the following ball:

[ball 2:

 or ]

This means that you win 2.5 times the invested amount X2 / This means that you lose the invested amount X2. Your earnings for this round are: 200 + 2.5 times X2 = [total2] eurocents./ Your earnings for this round are: 200 - X2 = [total2] eurocents. Click the CONTINUE button when you are ready to choose your investment for the third round.

Continue

Screen 4c

Third round
You start with an amount of 200 eurocents. How many cents do you want to invest in the choice situation in round 3?

You have a 1 in 3 chance (33%) to win 2.5 times the invested amount extra and a 2 in 3 chance (67%) to lose the invested amount.

Below, please enter an amount between 0 and 200 eurocents.

[ ] cents

Continue Previous

Screen 5c

You have chosen to invest [X3] eurocents in round 3. The computer has drawn the following ball:

[ball 3:

 or ]

This means that you win 2.5 times the invested amount X3 / This means that you lose the invested amount X3. Your earnings for this round are: 200 + 2.5 times X3 = [total3] eurocents./ Your earnings for this round are: 200 - X3 = [total3] eurocents.

This is the end of the first part of the study. In total you have earned [total1] + [total2] + [total3] = [total4] cents in this part. [This amount will be added to your number of CentERpoints in a few weeks.]

Click the CONTINUE button for the instructions to the second part.

Continue

Treatment LOW

Screen 2

Instructions, part 1

The first part of the study consists of three successive rounds. In each round you start with an amount of 2 euros (200 eurocents). You have to decide which part of this amount (between 0 and 200 eurocents) you want to invest in the following choice situation:

You have a 1 in 3 chance (33%) to win 2.5 times the invested amount and a 2 in 3 chance (67%) to lose the invested amount.

The amount that you invest will stay the same for all three rounds. Therefore, if you invest a certain amount for round 1, then you will invest the same amount for round 2 and round 3.

Whether you win or lose depends on the color of three balls that are drawn by the computer. Below you see one white ball and two black balls. For each round separately, the computer randomly draws one of these three balls. Each ball has an equal probability to be drawn. If the computer draws the white ball (which happens with a 1 in 3 chance), then you win 2.5 times the amount invested extra in the choice situation of that round; if the computer draws one of the black balls (which happens with a 2 in 3 chance), then you lose the amount invested in the choice situation for that round.

Continue

Screen 3

Your total earnings are determined as follows. In each round you start with an amount of 200 eurocents and your earnings in the three choice situations are added to that. Thus, if you decide to invest an amount of Y eurocents in the choice situation, then your total earnings are equal to 600 (three times the starting amount of 200) + 2.5 times Y for each white ball that is drawn - Y for each black ball that is drawn.

After you have decided how much you want to invest in the three rounds, you are informed of the colors of the three balls the computer has drawn, about your combined earnings in the three choice situations, and about your total earnings for the three rounds.

Once you are ready to start, click on the CONTINUE button below.

Continue

Previous

Screen 4

You start with an amount of 200 eurocents. How many cents do you want to invest in the choice situation?

You have a 1 in 3 chance (33%) to win 2.5 times the invested amount extra and a 2 in 3 chance (67%) to lose the invested amount.

Please note: the amount you invest stays the same in all three rounds. Therefore, when you invest a certain amount in round 1, then you invest the same amount in round 2 and in round 3.

Below, please enter an amount between 0 and 200 eurocents.

[ ] cents

Continue Previous

Screen 5

You have chosen to invest [Z] eurocents in each round. The computer has drawn the following three balls:

FIRST ROUND: [ball1:

 or ]

SECOND ROUND: [ball2:

 or ]

THIRD ROUND: [ball3:

 or ]

This means that in [count number of white balls] round(s) you win 2.5 times the invested amount and that in [count number of black balls] round(s) you lose the invested amount.

Your total earnings are therefore: 600 + ([count number of white balls] times 2.5 times [Z] eurocents) - ([count number of black balls] times [Z] eurocents) = [total4] eurocents.
[This amount will be added to your number of CentERpoints in a few weeks.]

Click the CONTINUE button for the instructions to the second part.

Continue

Screen 6

Instructions, part 2 (after Treatment HIGH as well as after Treatment LOW)

Each participant in this part of the study has a chance to earn an additional sum of money. You have a 1 in 100 chance to be selected for this. Whether you actually receive an additional amount of money depends on a number between 1 and 100 that is drawn by the computer. If the number is equal to 100 you are selected for payment.

Continue Previous

Screen 7

Instructions, part 2
In this part you have to choose between two payment options: option A and option B. Option A will pay 300 euros in 1 month and option B will pay 300 + X euros in 7 months, where X is different in each situation. In the table below you see 20 different amounts for option B. You will be asked later as of which amount you would start choosing option B.

If you are selected for payment (i.e. if the computer has drawn the number 100 for you out of the numbers 1 to 100), then the computer will draw another random number between 1 and 20 which corresponds to one of the 20 choice options you see below. The payment you receive is then in accordance with the preference you have indicated for the choice situation concerned. If for example number 10 is drawn, then you will receive 300 euros in 1 month if you chose option A, and 338.70 euros in 7 months if you chose option B.

	option A in 1 month		**option B in 7 months**		**option A in 1 month**		**option B in 7 months**
1:	300 euros	or	303.80 euros	11:	300 euros	or	342.70 euros
2:	300 euros	or	307.50 euros	12:	300 euros	or	346.70 euros
3:	300 euros	or	311.40 euros	13:	300 euros	or	350.70 euros
4:	300 euros	or	315.20 euros	14:	300 euros	or	354.80 euros
5:	300 euros	or	319.00 euros	15:	300 euros	or	358.90 euros
6:	300 euros	or	322.90 euros	16:	300 euros	or	363.70 euros
7:	300 euros	or	326.80 euros	17:	300 euros	or	367.10 euros
8:	300 euros	or	330.80 euros	18:	300 euros	or	371.30 euros
9:	300 euros	or	334.70 euros	19:	300 euros	or	375.50 euros
10:	300 euros	or	338.70 euros	20:	300 euros	or	379.70 euros

Continue Previous

Screen 8

In the table below the amounts for option B are indicated once again. In option A you can receive 300 euros in 1 month. In option B you can receive a higher amount in 7 months. We would like to ask you to choose option A or option B for all 20 situations. This you can do by clicking on a box in the table below. The chosen box indicates that you prefer option B (payment in 7 months) as of that amount, and that you prefer option A (payment in 1 month) until that amount.

O 303.80 euros	O 342.70 euros
O 307.50 euros	O 346.70 euros
O 311.40 euros	O 350.70 euros
O 315.20 euros	O 354.80 euros
O 319.00 euros	O 358.90 euros
O 322.90 euros	O 363.00 euros
O 326.80 euros	O 367.10 euros
O 330.80 euros	O 371.30 euros
O 334.70 euros	O 375.50 euros
O 338.70 euros	O 379.70 euros

O I would always choose for 300 euros in 1 month

Continue Previous

Screen 9

[You have chosen [choice]. This means that you would rather receive 300 + [choice-300] = [choice] in 7 months than 300 euros in 1 month. If the amount you can receive in 7 months is smaller than [choice], then you would rather receive 300 euros in 1 month. /
You have chosen for “always 300 euros". This means that you would rather receive 300 euros in 1 month than a higher amount in 7 months (if this higher amount is not higher than 379.70 euros).]
Below you see the 20 choice situations in which your preferences are underlined. If you want to change your answer, you can click PREVIOUS and fill in the answer again on the previous screen. If the preferences below are correct, click CONTINUE to see whether you will be selected to win one of the amounts chosen.

If you are selected for payment, the computer will draw a random number between 1 and 20 which corresponds to one of the 20 choice situations that you see below. The payment you receive then corresponds to the preference you have indicated for the choice situation concerned. This payment will be paid to you in CentERpoints in exactly one month if you choose for option A and exactly in 7 months if you choose for option B.

[example:]

	option A in 1 month		**option B in 7 months**		**option A in 1 month**		**option B in 7 months**
1:	300 euros	or	303.80 euros	11:	300 euros	or	342.70 euros
2:	300 euros	or	307.50 euros	12:	300 euros	or	346.70 euros
3:	300 euros	or	311.40 euros	13:	300 euros	or	350.70 euros
4:	300 euros	or	315.20 euros	14:	300 euros	or	354.80 euros
5:	300 euros	or	319.00 euros	15:	300 euros	or	358.90 euros
6:	300 euros	or	322.90 euros	16:	300 euros	or	363.70 euros

7:	300 euros	or	326.80 euros	17:	300 euros	or	367.10 euros
8:	300 euros	or	330.80 euros	18:	300 euros	or	371.30 euros
9:	300 euros	or	334.70 euros	19:	300 euros	or	375.50 euros
10:	300 euros	or	338.70 euros	20:	300 euros	or	379.70 euros

Continue

Previous

Screen 10a ***(screen if selected)***

The computer has drawn the number 100 out of the numbers 1 to 100. This means that you have been selected to receive money for this part of the study.

The computer has drawn the number [ERandom] out of the numbers 1 to 20. This means that the next choice situations will be paid:

Option A	**Option B**
in 1 month	**In 7 month**

[choice situation 1..20 drawn based on ERandom]

Here you had chosen for option [A/B]. This option will pay [Q] euros in 1 month/7months. This amount will be added to your number of CentERpoints in 1 month/7months.

Continue

Screen 10b ***(screen if not selected)***

The computer has drawn the number [draw20] out of the numbers 1 to 100. This means that you have not been selected to receive money for this part of the study.

Continue