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How to measure time preferences in children – A comparison of two methods

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Abstract

We measure time preferences in a sample of 561 children aged seven to eleven years. Using a within-subject design we compare the behavior of our subjects in two distinct experimental tasks: a standard choice list with multiple decisions and a simpler time-investment-exercise requiring one decision only. We find that both measures yield very similar aggregate results, correlate significantly within subjects and can be explained by basically the same explanatory variables. Advantages and disadvantages of both measures as well as gender differences are discussed. Our findings are relevant for the design of experiments to measure time preferences.

JEL Code: C91, D03, B41.

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1. Introduction

Numerous studies in economics and psychology report a relationship between experimentally elicited time preferences and economically relevant field behavior. For instance, patient adults perform better in their job (Burks et al., 2009), have less credit card debt (Meier and Sprenger, 2010), pursue healthier lifestyles (Bickel et al., 1999; Kirby and Petry, 2004; Chabris et al., 2008; Weller et al., 2008) and exhibit higher cognitive skills (Dohmen et al., 2010). Positive effects of patience on important behavior have not only been documented for adults, but also for children and adolescents. Sutter et al. (2013) show for ten- to eighteen-year-olds that being patient is positively related to their attitudes toward saving, conduct at school and health-related behavior. Bartling et al. (2010) find that patient five- to six-year-old children exhibit higher verbal cognitive abilities and more pronounced pro-social behavior. Most importantly, Golsteyn et al. (2014) find that children's time preferences measured at age 13 predict economically and socially relevant behavior in adulthood. In their study, impatient children attain lower levels of education, show weaker performance in compulsory and secondary school, have lower earnings at middle age, are more days unemployed and have a higher risk of obesity as well as teenage motherhood.

Most economic studies on time preferences employ choice lists in order to elicit time preferences (see Frederick et al., 2002, for a review). In such experiments, subjects are asked to make several choices in a series of binary tasks. In each task, the participant has to choose between a smaller, but earlier, payoff and a larger payoff that is delayed in time. Either the earlier payoff is held constant and the delayed payoff increases across choice tasks, or the delayed payoff is fixed and the earlier payoff is decreasing from roughly the amount of the delayed payoff down to a fairly small amount. Subjects are expected to switch from the immediate to the delayed payment option at some point as the latter becomes more and more attractive. The switching point serves as a proxy for patience: the sooner a subject turns down the earlier payment in favor of the later one, the more patient he or she is. Typically, after choices have been made, one task is randomly selected for payment.

One important advantage of choice lists is that they can identify inconsistent choice patterns which cannot be rationalized with standard theory. A choice pattern is classified as inconsistent if the subject waits for a payoff of x, but not for a payoff of y when $y>x$. Inconsistent choices are not uncommon in such experiments: up to twenty percent of adult subjects choose inconsistently (see, for instance, Coller and Williams, 1999; Bettinger and

Slonim, 2007).[1] While we are not aware of any study which systematically investigates time preferences and how individual characteristics influence the likelihood of inconsistent choices, we provide evidence that (i) inconsistent choice patterns do not arise due to misunderstanding and (ii) standard control variables can explain predictions for consistent but not inconsistent subjects (see Section 3). Since individuals with inconsistent choice patterns systematically differ from consistent ones, identifying inconsistent individuals is an important virtue of choice list tasks. Despite the widespread application of choice lists to elicit time preferences, they bear at least two important disadvantages. First, long lists of choices – of which only one is paid out – may reduce the amount of cognitive effort that decision makers invest into completing each task on the list. Second, choice lists are relatively complex and thus may entail problems of comprehension. It is vital for measuring time preferences reliably that subjects understand (i) the binary choice tasks, (ii) the fact that only one choice problem is payoff relevant and (iii) the procedure with which the relevant decision is determined. Therefore, a significant effort has to be made to explain the task and this becomes more difficult the lower the cognitive development of the participants. Ensuring comprehension is particularly challenging in the growing field of experiments with non-student subject pools such as low-educated persons, indigenous groups or children (see, for instance, Eckel et al., 2013; Angerer et al., 2015).

Given the importance of patience, respectively the ability to delay gratification, already in childhood and adolescence, we are going to examine two different methods to measure intertemporal preferences in children and try to compare them against each other. In particular, we present choice data of 561 children, aged seven to eleven years, from two experimental tasks to elicit time preferences: a standard choice list (CL) and a simpler time-investment-exercise (TIE) which only requires one decision[2]. Employing a within-subject

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1 While several suggestions on how to handle such cases have been made, all of them have their limitations: Some scholars exclude subjects with inconsistent choice patterns from the analysis (see, for instance, Harrison et al., 2002) and others force subjects to make consistent choices (see, for instance, Dohmen et al., 2010). While the former approach neglects potentially important behavioral traits (inconsistent choices don't necessarily coincide with a lack of understanding, see our results section), the latter restricts a subject's choice set by design. Another way to treat multiple switchers is to use their first consistent switching point and ignore subsequent inconsistencies (see, for instance, Meier and Sprenger, 2010), an approach that ignores parts of the data. Yet other solutions are to use the midpoint of the interval over which the subject is indifferent (see, for instance, Lammers and van Wijnbergen, 2007), or to simply use the relative number of patient choices in a choice list as a proxy for patience. Finally, the approach of Burks et al. (2009) assigns inconsistent subjects the level of patience of the "nearest consistent individual" by counting the number of patient choices and translating this number into a consistent choice pattern.

2 It would also be interesting to compare CL and TIE in a standard subject pool of adult participants (e.g., students). Note, however, that the costs for ensuring comprehension are much higher when subjects of lower cognitive development such as children are examined: Working with children usually requires one-on-one explanations and a particularly careful training of the experimenters. Therefore, the relative benefits from using the shorter and simpler TIE-method particularly accrue with such subject pools.

design and eliciting intertemporal preferences at an interval of six months, we show that both measures exhibit quasi identical aggregate patterns and correlate significantly within subjects.

In a recent paper, Burks et al. (2012) compare four measures of time preferences[3] with respect to their capability to predict economically important outcomes (smoking, BMI, credit scores and job related outcomes). They find that all approaches have some predictive power and that the (β, σ)-model (Frederick et al., 2002), a formulation derived from choice list exercises, performs best. In this paper, we extend Burks et al.'s (2012) valuable insights toward an assessment of CL and TIE with respect to their connections to variables which are widely used to explain time preferences in the literature: age, gender, risk-taking propensity and IQ. We find that patience measured with both methods can be explained by virtually the same independent variables and thus argue that CL and TIE yield robust proxies for time preferences in children. The only exception is gender, with females behaving more impatiently in CL but not in TIE. Closer inspection of our data reveals that risk-taking propensity is significantly related to patience as measured by CL and TIE in boys, but not in girls while IQ is significantly correlated with patience across both tasks and gender, except for girls in the CL task.

Our TIE method is closely related to what Andreoni and Sprenger (2012) have introduced as the convex time budget method. In their experiment, subjects had to allocate a fixed amount of money between an earlier and a later date. They let each subject make 45 convex time budget decisions which varied with respect to the interest rate for delaying the money to the later date, the date of the earlier payment and the delay length between the earlier and the later date. From the choice data, the authors estimate discount rates, utility function curvature as well as present bias. We abstained from these parameter variations and let children only make a single decision with the TIE method in order to keep the exposition as simple as possible. Comparing it with the traditional CL method we are then interested in the factors explaining choices in both methods.

Furthermore, our data allows us to investigate the behavioral traits of a relatively large number of subjects who choose inconsistently in the traditional choice list design (N=127). While their decisions in TIE correlate with the relative number of patient choices in CL, we find that the explanatory variables which predict our consistent subjects' behavior very well prove insignificant for participants with inconsistent choice patterns. It is interesting to note that this lack of predictive power persists across tasks, but does not contaminate the results in the whole sample. As TIE picks up roughly the same behavioral traits as CL, TIE seems like a

[3] The four measures are (i) the simple discount factor (σ), (ii) an indicator of present bias (β), (iii) a new proxy for impulsivity and (iv) a measure elicited through a battery of survey questions.

simple and easily comprehensible[4] alternative to traditional choice lists, at least when doing experiments with children.

2. Experimental Design

We present data from 561 children who participated in two experiments that measured their time preferences. These children were attending the Italian-speaking primary schools in the city of Meran in South Tyrol, Italy, and were aged 7 to 11 years.[5] In the first experiment we used the choice list (CL) design. Each child had to make choices in three binary decision tasks. In each task, the child could either get 2 tokens at the end of the experimental session or a larger number of tokens (either 3, 4, or 5) in four weeks' time. Tokens could be exchanged for small presents (e.g., stickers, arm wrists, sweets, pencils). The three tasks were first explained – either in ascending order (starting with 2 tokens now versus 3 tokens in four weeks) or descending order (starting with 2 now versus 5 in four weeks) – and then children had to indicate their choice for each task. One choice was randomly implemented for payment.

In the second experiment, run six months after the first one, we employed the time-investment exercise (TIE). Children were endowed with 5 tokens and had to decide how many tokens to consume immediately (by exchanging them into small presents) and how many tokens to invest into the future. Each invested token was doubled and paid out four weeks after the experiment (as in CL).

In both experiments, the classroom teachers delivered the presents to the children in sealed envelopes exactly four weeks after the experiment in the case a child had chosen a delayed payment. With this approach we avoided transaction costs for our subjects and minimized uncertainty[6] about the delayed payments.

Note that, in contrast to Burks et al. (2012), our experimental design does not allow us to distinguish between simple discounting (σ) and present bias (β) (Laibson, 1997) but rather incorporates both traits in our single measures. While discriminating between σ and β is certainly important in research on time preferences, the combined measure should predict

[4] Among all children participating in the two experiments (see Table 1), only 7 children had problems understanding the CL-task, while only 3 were excluded from the analysis due to comprehension problems in the TIE task. We report only data for the 561 children who understood both tasks.

[5] In Sutter et al. (2015), we examine how the language children speak affects intertemporal choices. There, we also consider the Italian-speaking children that are the basis for this paper, but in total we have a much larger data set, including German-speaking children and many more with an immigrant background, and we focus on how the grammar of a particular language may have an impact on intertemporal choices.

[6] Uncertainty was furthermore reduced by the fact that the choice-list experiment was the third experiment conducted with these children. Therefore children had already experience with economic experiments (on social preferences; see Lergetporer et al., 2014, or Angerer et al., 2015) and receiving delayed payoffs (from previous experiments that were not related to intertemporal choice, though).

behavior similarly as both single measures separately (which is usually sufficient if a researcher wants to use impatience merely as a control variable). In fact, Burks et al. (2012) find that simple exponential discounting (i.e. ignoring present bias) successfully predicts three out of six outcomes (smoking, credit score and going absent without leave) while four outcomes can be predicted when also considering present bias (washing out of job training in addition to the previously mentioned outcomes). Thus we think that omitting this distinction is a reasonable trade-off in experiments with children, especially as our most important endeavor was to simplify and shorten the tasks as much as possible.

For logistical reasons, we ran both experiments always in the same order with all participating children. Therefore, the order might play a role. Since TIE was administered half a year after CL, however, it is reasonable to assume that children could not perfectly recall their decisions in the former while participating in the latter. Thus, we consider it highly unlikely that order effects drive our main results. As a further check for that, we can compare the number of invested tokens of 35 (additional) children who only participated in TIE, but not in CL, with the TIE-decisions of participants of both experiments[7]. We find no statistical difference between the two groups (Mann-Whitney *U* Test; $p > 0.1$; see also the Ordinal Probit Regression in Table A1 in the Appendix). Thus, it seems that prior exposure to CL does not influence behavior in TIE. Note, however, that this is a low powered test: Our power analysis reveals that we can only detect order effects of 0.76 tokens invested in TIE (or 0.48 standard deviations of the outcome variable) or more at the 5-percent significance level with 80% power. Consequently, we cannot exclude the possibility that significant order effects below this cutoff exist.

3. Results

In this section we discuss the results for those 561 subjects who participated in both experiments (see Table 1). The average share of patient choices in CL is 0.99 (out of three), and 1.63 out of five tokens are invested into the future in TIE, on average. Figure 1 shows the average share of patient choices in both experiments for all subjects (N=561). The average numbers in CL (TIE) range from 0.74 to 1.26 (1.14 to 2.15) for 7/8- to 10/11-year olds. We find that, irrespective of the measurement method, patience increases significantly with age ($p < 0.01$ Cuzick's Wilcoxon-type tests for trend). For subjects who decided consistently in CL (N=434) a similar picture occurs. However, when considering only inconsistent choice

[7] These subjects were absent when CL was conducted. While we have no information on the reason for their absenteeism, it is most likely that they were ill.

patterns in CL (N=127) we find no significant age trend for both measures (see Figures A1 and A2 in the Appendix).

Figure 1 and Table 1 about here

The fact that both CL and TIE display a similar age-trend is consistent with the conjecture that both measures pick up the same behavioral trait. To examine this issue in more detail, we now turn to the analysis of within-subject behavior.

We first employ a graphical analysis of a contingency table on both measures in Figure 2. It shows the number of patient choices in CL and the number of tokens that have been saved for the future in TIE. On the horizontal axis, the width of the bars differs across categories because they indicate the relative frequency with which a specific number of tokens was saved for the future. The figure suggests that saving more for the future in TIE is positively related to the number of future-oriented choices in CL ($p < 0.01$ Cuzick's Wilcoxon-type tests for trend).

Figure 2 and Table 2 about here

Furthermore, when running a series of Spearman's rank correlations between both measures of relative patience (see Table 2) we find for both the full sample and the subsample with consistent choices that the two measures of patience are correlated ($\rho > 0.2$ with $p < 0.02$ for each age group; except for 7/8 year olds). Subjects with inconsistent choices exhibit a similar pattern: the Spearman rank correlation coefficient for this subsample is 0.150 ($p < 0.1$)[8]. This finding casts doubt on the conjecture that inconsistencies arise due to misunderstandings and suggests that the relative sum of patient decisions in a CL task could be used for "rescuing" inconsistent choice patterns.[9] These positive and significant correlations underpin the fact that both measures reflect the same underlying behavioral trait, even for subjects with inconsistent choices in CL.

Table 3 about here

[8] While these correlations are not particularly high, sign and significance are consistent with the assumption that both methods measure the same latent variable. Furthermore, low correlations between different measures of patience have also been found for adults: Burks et al. (2012) report rank correlations between their new proxy for impulsivity and β, σ and survey-based measures for patience of ρ=0.066, ρ=0.071 and ρ=0.042, respectively.

[9] However, we find that inconsistent choice patterns are not significantly related to the age of our participants, their IQ or any other of our standard control variables (see Table A2 in the Appendix).

Inspired by Burks et al. (2012), we ran a series of ordered probit regressions with the number of patient choices in CL, respectively the number of invested tokens in TIE, as the dependent variable in order to investigate whether both measures are mainly explained by the same independent variables. This exercise aims to investigate how important explanatory variables can predict time preferences measured with the two different methods. Table 3 shows that well-established results on the determinants of patience can be reproduced with both of our measures for our whole sample (see specifications [1] and [2]) and the consistent subsample (see specifications [3] and [4]): in accordance with prior findings (Anderhub et al., 2001; Bettinger and Slonim, 2007; Bartling et al., 2010) age, the propensity to take risks and IQ have a significant effect on our subjects' degree of patience. In contrast to that, we find a negative and significant female-effect in CL, but not in TIE. As the evidence on gender differences in time preferences seems inconclusive[10], it might be that gender effects depend upon the measurement method employed and thus should be treated with caution. Apart from that, our analysis reveals that major explanatory variables for time preferences in children perform well for both measurement methods.

In specifications [5] and [6] we only consider subjects with inconsistent choice patterns in CL and find that a rather different picture emerges: None of the before mentioned variables can explain time preferences of these subjects while there is a marginally significant and positive female-effect in TIE, but not in CL. [11] The fact that our control variables perform equally (bad) when predicting the behavior of these subjects in both tasks reveals a remarkable similarity of both measures. It is reassuring, however, that, while we can't establish well known determinants of patience as predictors within our inconsistent sample, including these subjects in the whole sample renders all effects of the consistent subsample identical in sign and significance.

In order to test for differences between the two methods while controlling for further background variables, we ran additional regressions with two observations per subject and with the interactions of method and control variables as independent variables (see Appendix Table A4). Besides replicating the results from Table 3, the post-estimation Wald tests

[10] Some studies report that females are more patient than males (Bettinger and Slonim, 2007) while others do not find any significant difference (Sutter et al., 2013).

[11] In order to detect differences between consistent and inconsistent subjects in the decisions in CL and TIE, Table A3 in the Appendix analyzes differences between the two subsamples by introducing the interactions of controls and inconsistent choice pattern. The results suggest that for CL there exists a significant difference between consistent and inconsistent choices for all but the two oldest age cohorts among male participants. Also for TIE there is a difference between consistent and inconsistent choices among girls in the two youngest age cohorts and among boys in the two oldest age cohorts (see Wald tests for each combination of age group and gender beneath Table A3).

beneath Table A4 show that (i) for the whole sample (specification [1]) there is no difference between the level of patience in TIE and CL for all combinations of age group and gender, (ii) for the consistent subsample (specification [2]) girls in the two youngest age cohorts are more patient in TIE than in CL while for the rest of the subjects no such difference is found and (iii) for the inconsistent subsample (specification [3]) we find a significant difference between the level of patience in TIE and CL for all children except the oldest age cohort among female subjects. While confirming that for the whole sample and for most of the consistent subsample both measures pick up the same behavioral trait, these results show that there exist significant differences between the two methods for subjects exhibiting inconsistent choice patterns in CL. Since gender differences in patience are detected in CL, but not in TIE, we analyzed the predictive power of our control variables for males and females separately (see Appendix Tables A5 and A6, respectively). The age-variable is significantly and positively associated with both measures of patience for both genders. In contrast, we find significant and positive correlations between patience in CL and TIE and risk-taking propensity respectively relative IQ for boys but not for girls.[12] As for girls, risk taking propensity is insignificant in all regressions and thus CL and TIE reveal a consistent picture. In contrast, a positive correlation between relative IQ and patience is only detected in females when TIE is employed. Thus, the consistency of the results delivered by CL and TIE seems to depend on the gender of the subjects under investigation.

4. Conclusion

In this paper, we have compared two methods that can be used to measure time preferences. The methods have been applied to let children make intertemporal choices. One of the methods we used is a standard choice list task where children have to make multiple choices, of which one is randomly selected for payment. The other method requires a much simpler, and single, choice how much of an endowment to invest into the future. We have found that both methods yield very similar results – on the aggregate and on the individual level – and that behavior under both methods is basically explained by the same factors. This is particularly true for male participants.

We see one straightforward extension of this research: Both, the CL and the TIE can be easily augmented to discriminate between discounting (σ) and present bias (β). A "horse race" between the predictive power of σ and β as measured by CL and TIE would therefore be

[12] Note, however, that both measures of patience are correlated for males and females (Males: $\rho = 0.231$ with $p < 0.01$ for the full sample and $\rho = 0.296$ with $p < 0.01$ for the subsample with consistent choices. Females: $\rho = 0.276$ with $p < 0.01$ for the full sample and $\rho = 0.235$ with $p < 0.01$ for the subsample with consistent choices)

very useful in order to investigate whether TIE would also be a convenient device for measuring these dimensions.

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Table1

Number of subjects participating in both experiments, by age and gender

Age (in years)	Female	Male	Total
7/8 years	71	74	145
8/9 years	59	80	139
9/10 years	52	74	126
10/11 years	75	76	151
ALL	**257**	**304**	**561**

Note that 9 additional children participated in the experiments (N=570 in total) but were excluded from the analysis because of comprehension problems. 7 children had problems in the CL task and 3 in the TIE task (among those three children one had problems understanding both the CL and the TIE task).

Table 2

Spearman's rank correlations between both measures (p-values in parentheses)

	SUBJECTS	
Age (in years)	All (N=561)	Consistent (N=434)
7/8 years	0.083 (0.321)	0.048 (0.609)
8/9 years	0.292 (0.001)	0.287 (0.003)
9/10 years	0.254 (0.004)	0.285 (0.005)
10/11 years	0.203 (0.012)	0.227 (0.013)
Overall	0.252 (0.000)	0.282 (0.000)

Table 3
Ordered probit regressions with different measures as dependent variable

Explanatory variables	All Subjects		Consistent		Inconsistent	
	[1] # of patient choices (CL task)	[2] # of tokens invested (TIE)	[3] # of patient choices (CL task)	[4] # of tokens invested (TIE)	[5] # of patient choices (CL task)	[6] # of tokens invested (TIE)
Age (in years)	0.218***	0.253***	0.264***	0.287***	0.060	0.089
	(0.034)	(0.039)	(0.045)	(0.044)	(0.089)	(0.073)
Female (=1)	-0.210**	-0.069	-0.282**	-0.159	0.237	0.365*
	(0.010)	(0.096)	(0.119)	(0.116)	(0.280)	(0.208)
Risk-taking propensity[†]	0.131***	0.095**	0.158***	0.123**	-0.095	-0.054
	(0.045)	(0.046)	(0.053)	(0.055)	(0.092)	(0.093)
Relative IQ[$]	1.032***	1.033***	1.207***	1.066***	-0.131	0.658
	(0.253)	(0.233)	(0.354)	(0.255)	(0.698)	(0.476)
cut1						
Constant	2.729***	3.008***	3.634***	3.378***	0.673	0.963
	(0.432)	(0.444)	(0.561)	(0.504)	(1.005)	(0.772)
cut2						
Constant	3.732***	3.624***	4.434***	4.030***		1.496*
	(0.459)	(0.454)	(0.597)	(0.519)		(0.778)
cut3						
Constant	4.466***	4.189***	4.955***	4.536***		2.284***
	(0.484)	(0.449)	(0.621)	(0.516)		(0.761)
cut4						
Constant		4.634***		4.982***		2.759***
		(0.454)		(0.526)		(0.774)
cut5						
Constant		4.864***		5.169***		3.231***
		(0.448)		(0.521)		(0.819)

Observations[%]	550	550	424	424	126	126
Pseudo R^2	0.0515	0.0373	0.0755	0.0508	0.0161	0.0190

Notes. ***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Clustered on class level.

[†] Number of tokens invested in a risk experiment (min=0; max = 5). The risk taking experiment was run between the two experiments on time preferences. The child had to decide how many of five tokens to invest in a lottery that doubled the number of invested tokens with a 50% probability, while with 50% probability the child lost the invested tokens (*Charness and Gneezy, 2010*). Non-invested tokens were safe earnings for the child.

[$] The IQ was measured relative to the respective grade (values above 1 indicate above average IQ in the respective grade; values below 1 indicate below average IQ)

[%] Eleven children did not take part either in the risk taking experiment or the IQ measurement. Therefore the number of observations drops from 561 to 550.

Our regression results remain largely robust if we run OLS-regressions instead of ordered probit regressions, except that the coefficient female in regression [4] gets significant (p=0.097) and that the same coefficient in regression [6] gets insignificant (p=0.112). The regression results in column [5] and [6] are largely insignificant. Note, that this could in principle also be due to the smaller number of observations compared to the other regressions. In order to check for this possibility, we draw 1000 random samples (for CL and TIE task separately) of size N=126 of all participants who are consistent in the CL task and rerun our regressions. The results for the age effect reveal that in 90% of our random samples the age effect is at least significant on a 10%-level in CL, while in the TIE task this is true for even 97% of the sample. Thus it is very unlikely that the insignificant age effect for the inconsistent sample is due to the lower number of observations. The results for the other coefficients are more mixed. The gender effect is significant at least on a 10%-level in 37% of cases in CL and in 22% of cases in TIE. Risk taking propensity is significantly at least on a 10%-level in 56% of all cases for CL and 46% of all cases for TIE. Finally, the relative IQ is significant at least on a 10%-level in 59% of all cases for CL and 65% of all cases in TIE.

Fig. 1: Frequency of patience in both experiments, all subjects (N = 561 overall)

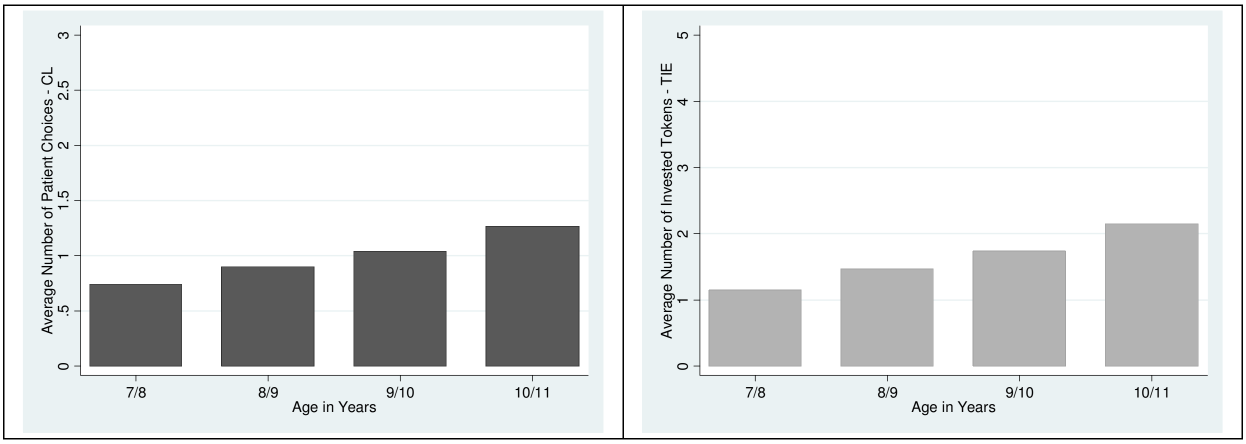
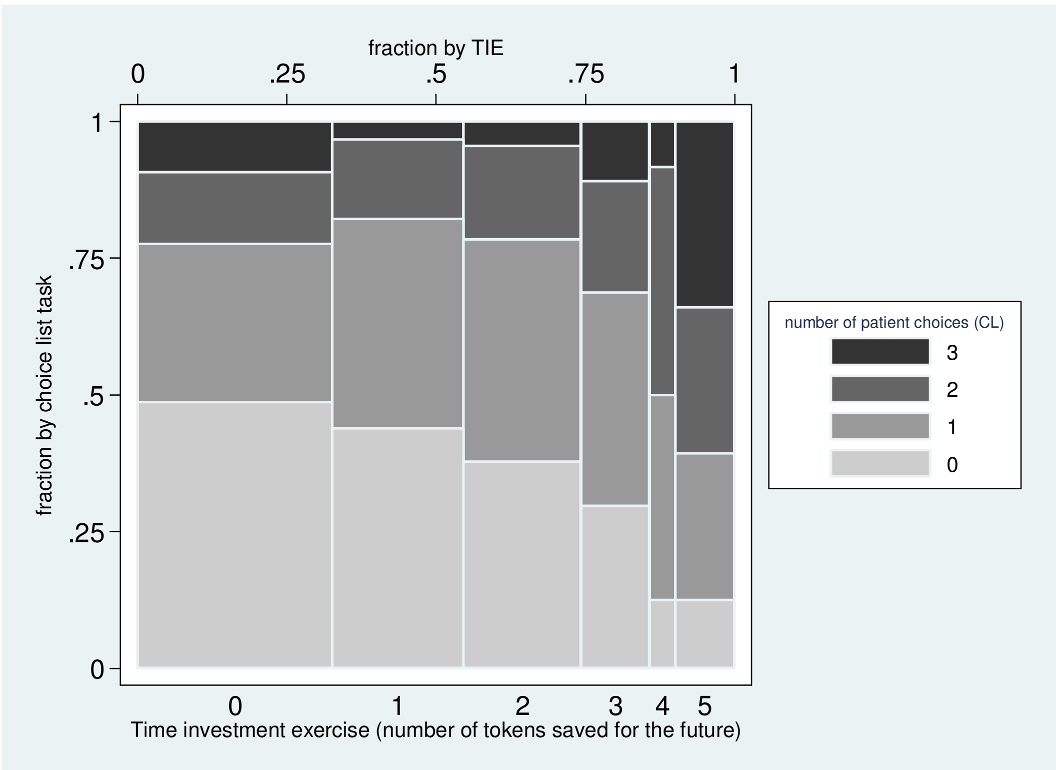


Fig. 2: Relative frequency of patience in the choice list task conditional on the level of patience in the time investment exercise (N = 561)



Online Appendix

Table A1
Ordered probit regression checking for order effects in the TIE task

Explanatory variables	# of tokens invested (TIE)
Age (in years)	0.233***
	(0.039)
Female (=1)	-0.044
	(0.088)
Number of siblings	-0.045
	(0.038)
Both tasks (=1)§	0.078
	(0.205)
cut1	
Constant	1.634***
	(0.426)
cut2	
Constant	2.211***
	(0.436)
cut3	
Constant	2.771***
	(0.434)
cut4	
Constant	3.224***
	(0.431)
cut5	
Constant	3.445***
	(0.430)
Observations	596
Pseudo R^2	0.0223

Notes. ***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Clustered on class level.
§ The variable "Both tasks" indicates whether someone participated in both experiments (=1; N=561) or only in the TIE task (=0; N=35).

Table A2

Probit regression for explaining inconsistent choice patterns in the CL task

Explanatory variables	[1] Inconsistent choice pattern (CL task)	[2] Inconsistent choice pattern (CL task)
Age (in years)	0.028	0.019
	(0.044)	(0.042)
Female (=1)	0.116	0.103
	(0.092)	(0.099)
Risk-taking propensity†		-0.008
		(0.044)
Relative IQ$		0.038
		(0.243)
Constant	-1.039***	-0.969**
	(0.376)	(0.458)
Observations	561	550
Pseudo R^2	0.0022	0.0017

Notes. ***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Clustered on class level.

Dependent variable: dummy coded 1 if choice pattern in the CL-task was inconsistent, 0 else.

† Number of tokens invested in a risk experiment (min=0; max = 5). The risk taking experiment was run between the two experiments on time preferences. The child had to decide how many of five tokens to invest in a lottery that doubled the number of invested tokens with a 50% probability, while with 50% probability the child lost the invested tokens (*Charness and Gneezy, 2010*). Non-invested tokens were safe earnings for the child.

$ The IQ was measured relative to the respective grade (values above 1 indicate above average IQ in the respective grade; values below 1 indicate below average IQ)

Table A3

OLS# Regressions of patience with different measures as dependent variable

Explanatory variables	[1] Patience (CL-Task)	[2] Patience (TIE)
Age (in years)	0.1932***	0.2306***
	(0.0342)	(0.0421)
Female (=1)	-0.2563**	-0.1756*
	(0.1005)	(0.1038)
Risk-taking propensity†	0.1394***	0.1265***
	(0.0442)	(0.0454)
Relative IQ$	0.8877***	0.7688***
	(0.2597)	(0.1997)
Incons (=1)§	3.0783***	1.7223**
	(0.5196)	(0.6790)
Age*Incons	-0.1724***	-0.1511**
	(0.0482)	(0.0642)
Female*Incons	0.3426**	0.4615**
	(0.1436)	(0.2122)
Risk*Incons	-0.1736***	-0.1605*
	(0.0472)	(0.0871)
IQ*Incons	-0.9255**	-0.2354
	(0.4262)	(0.4440)
Constant	-1.8149***	-2.050***
	(0.3776)	(0.4186)
Observations	550	550
R^2	0.1707	0.127
Wald Tests		
H0: no age effect for inconsistent subjects		
$(\beta_{age}+\beta_{age*Incons}=0)$	0.537	0.165
H0: no gender effect for inconsistent subjects		
$(\beta_{female}+\beta_{female*Incons}=0)$	0.403	0.108
H0: no effect of risk tolerance for inconsistent subjects		
$(\beta_{risk}+\beta_{risk*Incons}=0)$	0.309	0.629
H0: no effect of IQ for inconsistent subjects		
$(\beta_{IQ}+\beta_{IQ*Incons}=0)$	0.883	0.168
H0: no difference between consistent and inconsistent girls with average risk tolerance and average IQ in each age group …		
$(\beta_{Incons}+\beta_{age*Incons}*7.5+\beta_{female*Incons}+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.000	0.002
$(\beta_{Incons}+\beta_{age*Incons}*8.5+\beta_{female*Incons}+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.000	0.038
$(\beta_{Incons}+\beta_{age*Incons}*9.5+\beta_{female*Incons}+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.000	0.479
$(\beta_{Incons}+\beta_{age*Incons}*10.5+\beta_{female*Incons}+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.021	0.996
H0: no difference between consistent and inconsistent boys with average risk tolerance and average IQ in each age group …		
$(\beta_{Incons}+\beta_{age*Incons}*7.5+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.000	0.676
$(\beta_{Incons}+\beta_{age*Incons}*8.5+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.020	0.112
$(\beta_{Incons}+\beta_{age*Incons}*9.5+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.189	0.042
$(\beta_{Incons}+\beta_{age*Incons}*10.5+\beta_{risk*Incons}*\overline{risk}+\beta_{IQ*Incons}*\overline{IQ}=0)$	0.524	0.003

Notes.

***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Clustered on the level of individual subjects.

We employ OLS rather than Ordered Probit because of the problems associated with Logit and Probit models when incorporating interaction terms (Ai and Norton, 2003).

Dependent variables: patience in CL and TIE normalized by dividing the number of patient choices in CL, respectively the number of invested tokens in TIE through the average patience level of CL and TIE, respectively. Through the normalization the values of the two measures are adjusted to a common scale and range between 0 and 3.04 for TIE, respectively 3.07 for CL.

† Number of tokens invested in a risk experiment (min=0; max = 5). The risk taking experiment was run between the two experiments on time preferences. The child had to decide how many of five tokens to invest in a lottery that doubled the number of invested tokens with a 50% probability, while with 50% probability the child lost the invested tokens (*Charness and Gneezy, 2010*). Non-invested tokens were safe earnings for the child.

$ The IQ was measured relative to the respective grade (values above 1 indicate above average IQ in the respective grade; values below 1 indicate below average IQ).

§ Indicates if a subject chose inconsistently in the CL-task (=1) or not (=0).

Table A4

OLS[#] Regressions of patience in each of the two methods

Explanatory variables	[1] Patience (All subjects)	[2] Patience (Consistent)	[3] Patience (Inconsistent)
Age (in years)	0.1664***	0.1932***	0.0207
	(0.0304)	(0.0368)	(0.0341)
Female (=1)	-0.1813**	-0.2563***	0.0864
	(0.0788)	(0.0957)	(0.0877)
Risk-taking propensity[†]	0.1091***	0.1394***	-0.0342
	(0.0345)	(0.0412)	(0.0374)
Relative IQ[$]	0.7808***	0.8877***	-0.0377
	(0.2171)	(0.2522)	(0.2379)
TIE (=1)	-0.1066	0.1816	-1.4625**
	(0.4405)	(0.5161)	(0.7282)
Age*TIE	0.0153	0.0100	0.0516
	(0.0398)	(0.0472)	(0.0670)
Female*TIE	0.0963	0.0774	0.2053
	(0.0991)	(0.1181)	(0.1647)
Risk*TIE	-0.0108	-0.0098	-0.0016
	(0.0459)	(0.0543)	(0.0691)
IQ*TIE	-0.0404	-0.1647	0.5528
	(0.2655)	(0.3080)	(0.4592)
Constant	-1.3403***	-1.8149***	1.2634***
	(0.3593)	(0.4260)	(0.4141)
Observations	1,100	848	252
R^2	0.1063	0.1443	0.1169
Wald Tests			
H0: no age effect for TIE $(\beta_{age}+\beta_{age*TIE}=0)$	0.000	0.000	0.248
H0: no gender effect for TIE $(\beta_{female}+\beta_{female*TIE}=0)$	0.281	0.050	0.064
H0: no effect of risk tolerance for TIE $(\beta_{risk}+\beta_{risk*TIE}=0)$	0.008	0.003	0.575
H0: no effect of IQ for TIE $(\beta_{IQ}+\beta_{IQ*TIE}=0)$	0.000	0.001	0.218
H0: no difference between CL and TIE for girls with average risk tolerance and average IQ in each age group …			
$(\beta_{TIE}+\beta_{age*TIE}*7.5+\beta_{female*TIE}+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.580	0.069	0.009
$(\beta_{TIE}+\beta_{age*TIE}*8.5+\beta_{female*TIE}+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.440	0.053	0.017
$(\beta_{TIE}+\beta_{age*TIE}*9.5+\beta_{female*TIE}+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.426	0.111	0.075
$(\beta_{TIE}+\beta_{age*TIE}*10.5+\beta_{female*TIE}+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.440	0.189	0.329
H0: no difference between CL and TIE for boys with average risk tolerance and average IQ in each age group …			

$(\beta_{TIE}+\beta_{age*TIE}*7.5+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.476	0.513	0.000
$(\beta_{TIE}+\beta_{age*TIE}*8.5+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.541	0.379	0.000
$(\beta_{TIE}+\beta_{age*TIE}*9.5+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.764	0.298	0.004
$(\beta_{TIE}+\beta_{age*TIE}*10.5+\beta_{risk*TIE}*\overline{risk}+\beta_{IQ*TIE}*\overline{IQ}=0)$	0.896	0.414	0.057

Notes.

***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Clustered on the level of individual subjects.

[#] We employ OLS rather than Ordered Probit because of the varying number of categories between the two methods (4 categories in CL and 6 in TIE) and because of the problems associated with Logit and Probit models when incorporating interaction terms (Ai and Norton, 2003).

Dependent variable: patience in CL and TIE (two observations per subject) normalized by dividing the number of patient choices in CL, respectively the number of invested tokens in TIE through the average patience level of CL and TIE, respectively. Through the normalization the values of the two measures are adjusted to a common scale and range between 0 and 3.04 for TIE, respectively 3.07 for CL.

[†] Number of tokens invested in a risk experiment (min=0; max = 5). The risk taking experiment was run between the two experiments on time preferences. The child had to decide how many of five tokens to invest in a lottery that doubled the number of invested tokens with a 50% probability, while with 50% probability the child lost the invested tokens (*Charness and Gneezy, 2010*). Non-invested tokens were safe earnings for the child.

[$] The IQ was measured relative to the respective grade (values above 1 indicate above average IQ in the respective grade; values below 1 indicate below average IQ)

Table A5

Ordered probit regressions with different measures as dependent variable: Male

Explanatory variables	All Subjects		Consistent		Inconsistent	
	[1] # of patient choices (CL task)	[2] # of tokens invested (TIE)	[3] # of patient choices (CL task)	[4] # of tokens invested (TIE)	[5] # of patient choices (CL task)	[6] # of tokens invested (TIE)
Age (in years)	0.177***	0.233***	0.199***	0.272***	0.264*	-0.008
	(0.043)	(0.053)	(0.051)	(0.061)	(0.147)	(0.112)
Risk-taking propensity†	0.197***	0.147**	0.240***	0.188***	-0.040	-0.073
	(0.062)	(0.060)	(0.069)	(0.070)	(0.124)	(0.129)
Relative IQ$	1.399***	0.959***	1.766***	1.149***	-1.395	-0.242
	(0.354)	(0.296)	(0.435)	(0.316)	(0.950)	(0.795)
cut1						
Constant	2.923***	2.960***	3.872***	3.573***	1.317	-0.809
	(0.558)	(0.597)	(0.672)	(0.673)	(1.540)	(1.108)
cut2						
Constant	3.953***	3.493***	4.674***	4.152***		-0.369
	(0.587)	(0.588)	(0.718)	(0.665)		(1.114)
cut3						
Constant	4.576***	4.012***	5.144***	4.589***		0.526
	(0.597)	(0.587)	(0.729)	(0.661)		(1.077)
cut4						
Constant		4.430***		5.023***		0.934
		(0.581)		(0.667)		(1.096)
cut5						
Constant		4.688***		5.248***		1.664
		(0.567)		(0.655)		(1.176)
Observations	298	298	234	234	64	64
Pseudo R^2	0.0585	0.0357	0.0835	0.0527	0.0759	0.0028

Notes. ***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Clustered on class level.

† Number of tokens invested in a risk experiment (min=0; max = 5). The risk taking experiment was run between the two experiments on time preferences. The child had to decide how many of five tokens to invest in a lottery that doubled the number of invested tokens with a 50% probability, while with 50% probability the child lost the invested tokens (*Charness and Gneezy, 2010*). Non-invested tokens were safe earnings for the child.

$ The IQ was measured relative to the respective grade (values above 1 indicate above average IQ in the respective grade; values below 1 indicate below average IQ)

Table A6

Ordered probit regressions with different measures as dependent variable: Female

Explanatory variables	All Subjects		Consistent		Inconsistent	
	[1] # of patient choices (CL task)	[2] # of tokens invested (TIE)	[3] # of patient choices (CL task)	[4] # of tokens invested (TIE)	[5] # of patient choices (CL task)	[6] # of tokens invested (TIE)
Age (in years)	0.284***	0.285***	0.404***	0.325***	-0.089	0.174
	(0.059)	(0.059)	(0.079)	(0.066)	(0.120)	(0.111)
Risk-taking propensity†	0.004	0.007	-0.008	-0.003	-0.130	0.027
	(0.062)	(0.069)	(0.075)	(0.081)	(0.152)	(0.138)
Relative IQ$	0.438	1.078***	0.273	0.909**	0.951	1.684**
	(0.445)	(0.404)	(0.600)	(0.436)	(1.112)	(0.745)
cut1						
Constant	2.578***	3.109***	3.737***	3.329***	0.148	2.527**
	(0.774)	(0.695)	(0.939)	(0.749)	(1.699)	(1.136)
cut2						
Constant	3.575***	3.828***	4.591***	4.076***		3.195***
	(0.805)	(0.720)	(0.989)	(0.777)		(1.129)
cut3						
Constant	4.524***	4.460***	5.242***	4.692***		3.908***
	(0.855)	(0.743)	(1.057)	(0.810)		(1.140)
cut4						
Constant		4.958***		5.181***		4.447***
		(0.767)		(0.842)		(1.115)
cut5						
Constant		5.153***		5.314***		4.817***
		(0.764)		(0.846)		(1.177)
Observations	252	252	190	190	62	62
Pseudo R^2	0.0505	0.0438	0.0851	0.0503	0.0345	0.0322

Notes. ***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Clustered on class level.

† Number of tokens invested in a risk experiment (min=0; max = 5). The risk taking experiment was run between the two experiments on time preferences. The child had to decide how many of five tokens to invest in a lottery that doubled the number of invested tokens with a 50% probability, while with 50% probability the child lost the invested tokens (*Charness and Gneezy, 2010*). Non-invested tokens were safe earnings for the child.

$ The IQ was measured relative to the respective grade (values above 1 indicate above average IQ in the respective grade; values below 1 indicate below average IQ)

Fig. A1: Frequency of patience in both experiments, subjects with consistent choice patterns (N = 434 overall)

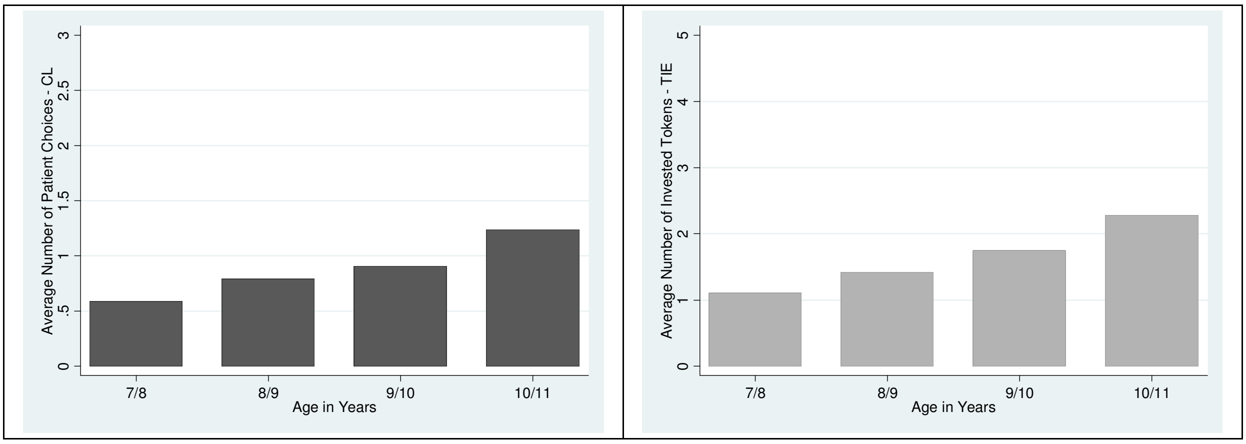
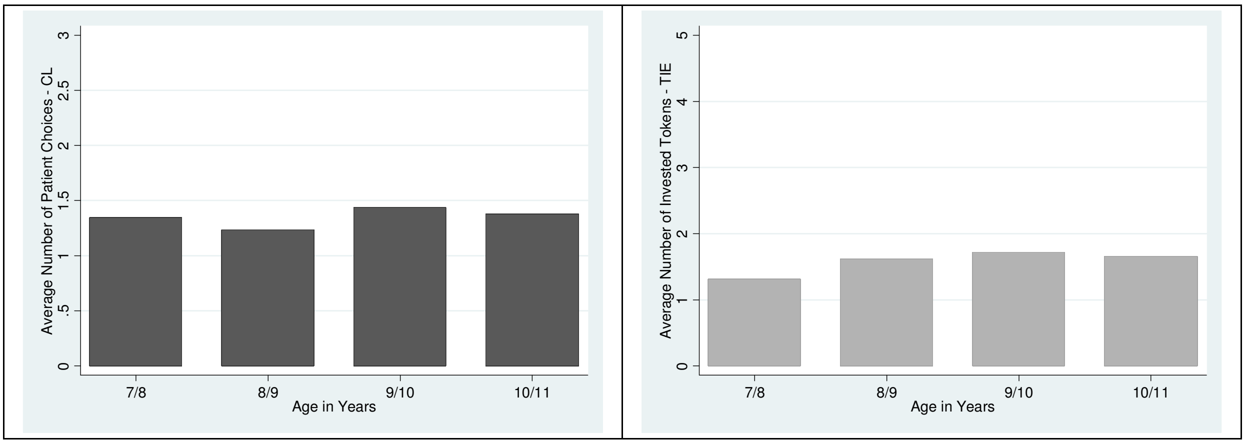


Fig. A2: Frequency of patience in both experiments, subjects with inconsistent choice patterns (N = 127 overall)



Experimental instructions (translated from Italian)

Note: Italic font is used for the instructions to the experimenter.

Experimental instructions "Time preferences – choice list task"

Register the order of explanation (blue first or green first) in the computer.

Good morning. My name is … Today I have prepared a game for you. In this game you can earn tokens. With these tokens you can buy some presents in our shop. Each present costs 1 token. You can choose your favorite present in our shop and you will get equally many pieces of this present as many tokens as you have earned in this game. The game consists of 3 parts. The blue part, the yellow part and the green part *(when mentioning the parts please point at the respective decision sheets).*

The game works as follows:

In the blue part you have to decide whether you prefer receiving 2 tokens (*please point at the tokens on the decision sheet*) immediately, in this case please tick THIS box (*point at the respective box*), or whether you prefer receiving 3 tokens in 4 weeks, in that case please tick THAT box (*point at the respective box*). If you want to receive 2 pieces of your favorite present, you will get the presents immediately after the game. If you rather want to wait, you will get three pieces of your favorite presents in 4 weeks. This is the blue part. Could you please repeat the rules of the game? (*If the child is unable to repeat, please explain the game again; the child has to be able to repeat the correct meaning of the game autonomously.*)

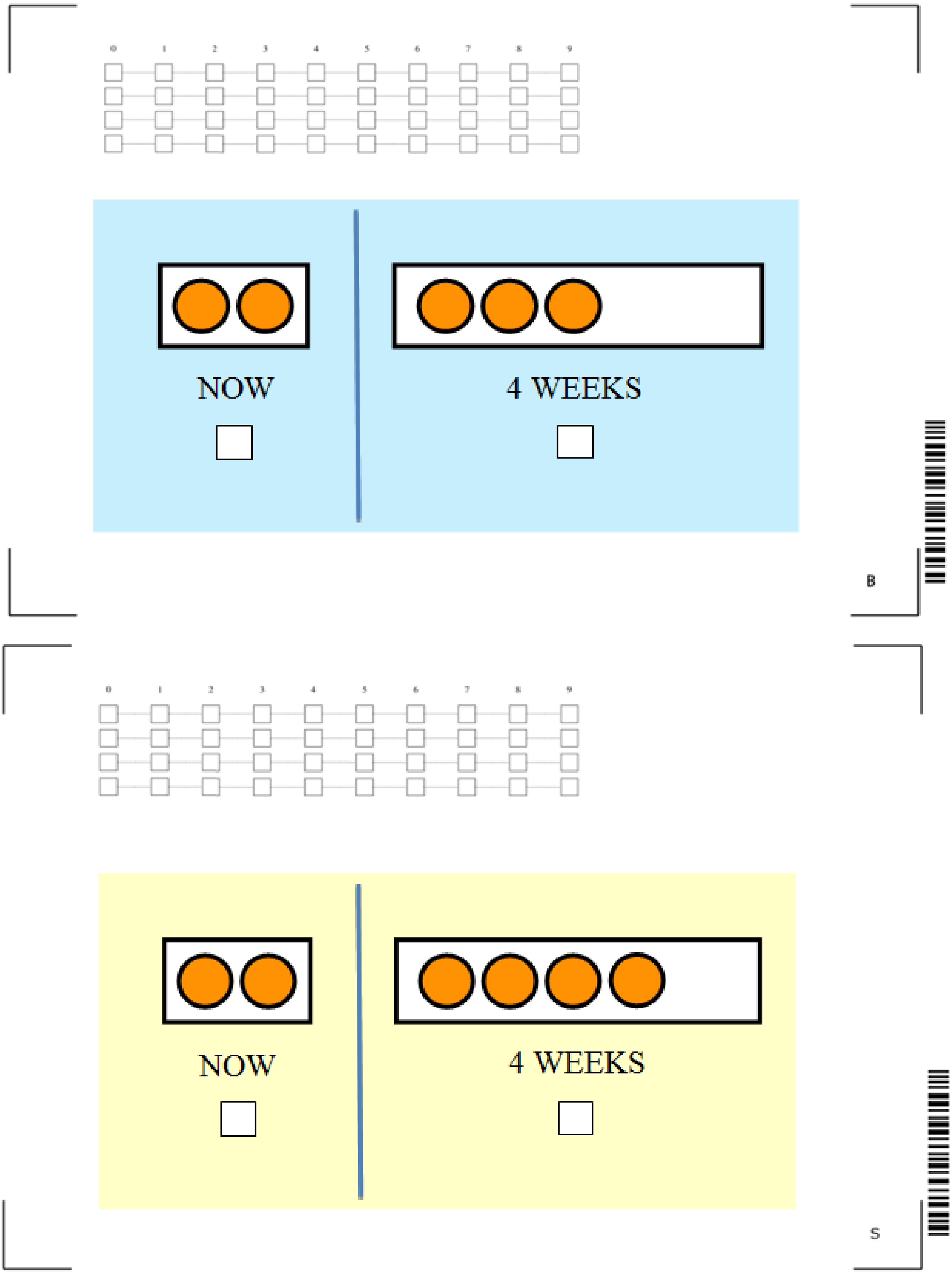
The yellow part is very similar to the blue part. Here you see the decision sheet for the yellow part. Again, there are 2 tokens on the left-hand side, but on the right-hand side there are 4 tokens now. What do you think will happen if you tick THIS box? (*please point at the box with the immediate reward*) What do you think will happen if you tick THAT box? (*please point at the box with the delayed reward of four tokens*; *the child has to answer the questions correctly, otherwise the experimenter has to repeat the explanation*).

The green part is very similar to the blue and yellow part. Here you see the decision sheet for the yellow part. Again, there are 2 tokens on the left-hand side, but on the right-hand side there are 5 tokens now. What do you think will happen if you tick THIS box? (*please point at the box with the immediate reward*) What do you think will happen if you tick THAT box? (*please point at the box with the delayed reward of five tokens*; *the child has to answer the questions correctly, otherwise the experimenter has to repeat the explanation*).

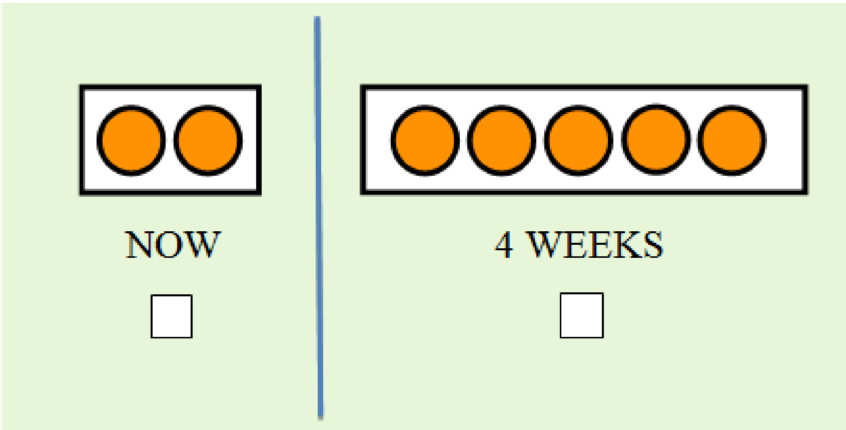
It is important to note that at the end only one of the three parts counts. That means that you will receive the tokens for one of the three parts only. After your decisions I will mingle the three decision sheets under the table (*please demonstrate*; *Attention: you have to handle the sheets such that the child is not able to see the color of the respective sheet! You need to cover the three parts with an additional large-format sheet when placing the sheets on the table for drawing*) and then you can draw one of the three parts. (*In what follows, adapt the explanation to the order in which you draw the sheets:*) If you draw the blue part (*demonstrate the drawing of the first sheet*), only the blue part counts and you will receive the tokens for this part only. The other two parts do not count in this case. If you, for example, ticked THIS box (*please point at the box with the immediate reward*), what happens? If you, for example, ticked THAT box (*please point at the box with the delayed reward*), what happens (*child must answer both questions correctly; IMPORTANT: give both examples*!)? If you however draw the yellow part (*demonstrate the drawing of the second sheet*), only the yellow part counts and you will receive the tokens for the yellow part only. The other two parts do not count in this case. If you draw the green part (*demonstrate the drawing of the third sheet*), only the green part counts and you will receive the tokens for the green part only. The other two parts do not count in this case. However, you need to make a decision for each of the three parts because you don't know yet which part will be drawn at the end of the game. Could you please repeat the last part? Will you receive the tokens for all three parts? Do you need to make a decision for each of the three parts? (*If the child answers incorrectly the experimenter has to repeat the explanation of this part.*)

Please take your decision for each of the three parts now (*place the decision sheets side by side on the table; the child should fill out the decision sheets from left to right).* Start with this part (*point at the first decision sheet (blue or green, depending on the order of explanation)*) and continue with this part (*point at the second decision sheet*) and finally make your decision in this part (*point at the third decision sheet*). Take as much time as you need. In the meantime I will turn around so that I don't disturb you. Just call me when you are done.

Fig. A3: Decision sheets for the choice list tasks (translated from Italian)



0 1 2 3 4 5 6 7 8 9



Experimental Instructions for the time-investment-exercise (TIE)

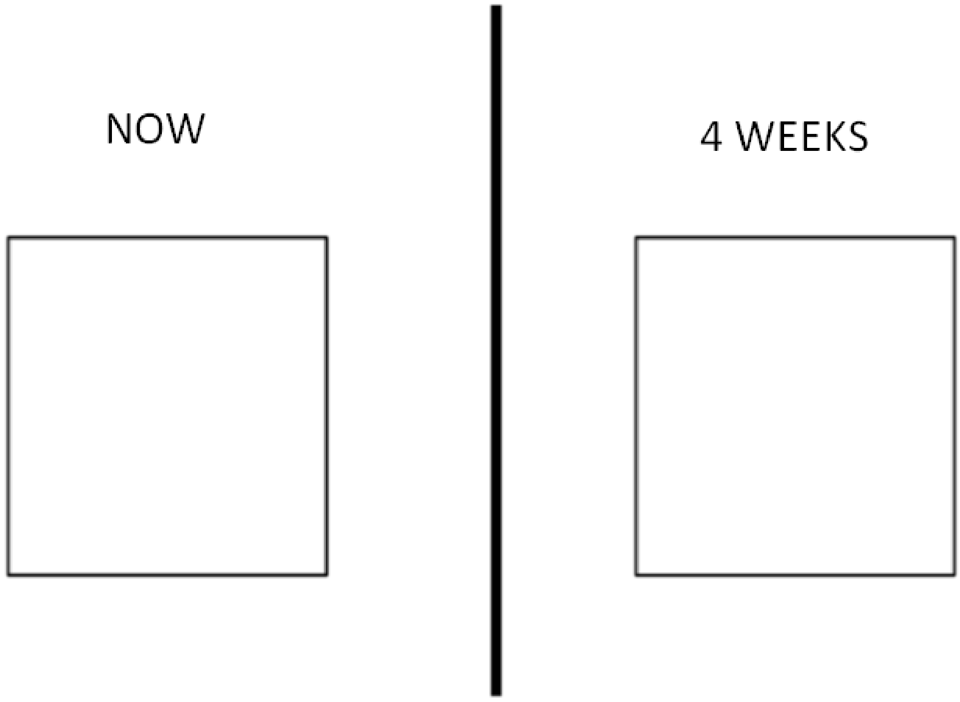
Good morning. My name is … Today's game works as follows:

At the beginning you will receive 5 tokens *(please place the 5 tokens in front of the child).* You have to decide how many of these 5 tokens you want to put in the box labeled NOW (*point at the left box*) and how many tokens you want to put in the box labeled "4 WEEKS" (*point at the right box*). You will receive the tokens that you put in the box "NOW" immediately after the game and you can use these tokens for buying presents in our present shop. You can take these presents home today. Each token that you put in the box "4 WEEKS" will be doubled and you will receive the presents that you choose with these tokens in 4 weeks only.

Let's consider an example: If you, for instance, want to receive two tokens today, what do you have to do? (*Answer of the child: "I have to put 2 tokens in the left box)* And what happens with the other 3 tokens? (*Answer: I have to put these tokens in the right box"; please let the child demonstrate this*) How many tokens will be added to this box? (*point at the right box*; *answer of the child: "3"; please demonstrate!*) How many tokens are in the box in total? *(Answer: 6).* When will you receive the presents which you can choose with these 6 tokens? *(Answer: in 4 weeks).* And what happens if you put 5 tokens in that box? (*point at the left box; Answer: then I will receive 5 tokens immediately after the game and I can choose presents with these 5 tokens which I can take home today).* And what happens if you put all 5 tokens in that box? (*point at the right box; Answer: then these tokens will be doubled and I can choose presents with the 10 tokens which I will receive only in 4 weeks.)* Could you please repeat the rules of the game? (*If the child is unable to repeat, please explain the game again; the child has to be able to repeat the correct meaning of the game autonomously.*)

Please take your decision now. You have to put the tokens which you want to receive today in this box (*point at the left box*) and the tokens with which you can buy presents which you will receive in 4 weeks in that box (*point at the right box*). Take as much time as you need for your decision. In the meantime I will turn around so I don't disturb you. Just call me when you are done.

Fig. A4: Decision sheet for the time-investment-exercise (TIE, translated form Italian)



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