Impatience and Uncertainty: Experimental Decisions Predict Adolescents' Field Behavior

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Abstract: We study risk attitudes, ambiguity attitudes, and time preferences of 661 children and adolescents, aged ten to eighteen years, in an incentivized experiment and relate experimental choices to field behavior. Experimental measures of impatience are found to be significant predictors of health-related field behavior, saving decisions and conduct at school. In particular, more impatient children and adolescents are more likely to spend money on alcohol and cigarettes, have a higher body mass index, are less likely to save money and show worse conduct at school. Experimental measures for risk and ambiguity attitudes are only weak predictors of field behavior.

Keywords: experiments with children and adolescents; risk; ambiguity; time preferences; health status; savings; conduct at school; external validity.

JEL classification: C91; C93; D81; D90.

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Recent research has shown that experimental data on risk and time preferences serve as a good predictor for field behavior concerning, for instance, occupational choices (Holger Bonin et al., 2007; Stephen V. Burks et al., 2009), financial literacy and credit card borrowing (Stephan Meier and Charles Sprenger, 2008, 2010), smoking and alcohol consumption (Ahmed Khwaja, Frank Sloan and Martin Salm, 2006; Christopher F. Chabris et al., 2008), or nutrition intake (Chabris et al., 2008; Rosalyn E. Weller et al., 2008). For example, Chabris et al. (2008) find that experimentally elicited discount rates can explain inter-individual variation in the BMI (body mass index) or the intensity of physical exercise and smoking in a sample of 555 adults. Burks et al. (2009) present data from 1,000 trainee truck drivers and show how experimentally elicited risk and time preferences are related to job attachment and the duration of staying in a job, due to a correlation of these preference parameters with cognitive skills (see also Thomas Dohmen et al., 2010).

So far, research that relates experimental choices to field behavior has only considered adult decision makers. In this paper, we elicit time preferences, risk attitudes, and ambiguity attitudes of 661 children and adolescents, aged ten to eighteen years. We then relate individual experimental choices to behavior in the field, in particular to smoking, drinking, the body mass index (BMI), savings, and conduct at school. We find that experimental measures of time preferences are significant predictors of field behavior *already at an early stage in life*. In particular, more impatient children and adolescents are more likely to spend money on alcohol and cigarettes, have a higher BMI, are less likely to save money, and commit more violations of the school's code of conduct. Taken together, more impatient children and adolescents have a considerably worse health and economic outlook. In contrast to our experimental measures of time preferences, the experimental measures for risk and ambiguity attitudes are at best weak predictors of field behavior for the age groups we study. Risk aversion is only related to the BMI, with more risk averse subjects having a lower BMI. Moreover, subjects who are more ambiguity averse are less likely to smoke.

Measuring children's and adolescents' attitudes towards delay and uncertainty and assessing the external validity of the experimental measurements is relevant because it provides an important input for the optimal design of policy interventions that target children's and adolescents' behavior. In their transition from childhood to adulthood, children and adolescents experience an increasing number of decisions involving uncertainty and long-term consequences. In many circumstances these decisions do not involve *risk* – where probabilities are known – but rather *ambiguity*, where probabilities are unknown or vague (Daniel Ellsberg, 1961; Yoram Halevy, 2007; Mohammed Abdellaoui et al., 2011). Important examples include the uncertainties involved in drug intake, the practicing of unprotected sex, or investments for the future through saving or education. Therefore, we investigate not only risk but also ambiguity attitudes, alongside time preferences.

So far, the evidence on children's risk taking, ambiguity attitudes, and time preferences is still scarce. The existing literature suggests that children are relatively more risk seeking and delay averse, i.e., impatient, than adults (see, for example, Wiliam T. Harbaugh, Kate Krause and Lise Vesterlund, 2002; Irwin P. Levin and Stephanie S. Hart, 2003; Eric Bettinger and Robert Slonim, 2007; Levin et al., 2007). Although many decisions of children and adolescents involve both uncertainty and delay, to the best of our knowledge no empirical study has integrated both aspects in a single, unifying research design. Furthermore, none of the previously mentioned studies has examined the predictive power of experimentally elicited attitudes towards uncertainty or delay for the field behavior of children and adolescents.

The first contribution of this paper is, therefore, to provide a unified experimental framework to measure delay and uncertainty attitudes for a large sample of children and adolescents. If uncertainty and time preferences are correlated, as often conjectured, omitting one of them might lead to a wrong attribution of behavioral effects and consequences to the included one (Halevy, 2008).

The second contribution of this paper is to link elicited attitudes of children and adolescents from the fully incentivized experiment to their field behavior, in particular to health-related behavior, as well as saving decisions and conduct at school. In other words, we assess the external validity of experimental measures for children and adolescents. A recent study by Marco Castillo et al. (2011) is related to this aspect of our approach. They study the link between experimentally elicited time preferences of thirteen- to fifteen-year old children to their disciplinary referrals in school, finding that less patient children have a less favorable outlook for school performance. However, Castillo et al. (2011) do not consider a potentially simultaneous influence of time preferences and attitudes towards uncertainty on behavior. Furthermore, we

consider a larger age spectrum and a broader array of indicators, including also health-related behavior and saving decisions. Putting particular emphasis on health-related behavior (smoking, drinking, and the BMI) of children and adolescents is relevant for the development of policy interventions that are able to avoid negative long-term health consequences, which ultimately also have an impact on labor market success and economic prosperity (Anne Case, Darren Lubotsky and Christina Paxson, 2002).

In our experiment, we elicit risk, ambiguity and delay attitudes using simple versions of standard choice list tasks that are well-established and widely used in the economics literature. All decisions are incentivized, with cash as the reward medium, paid according to the choices made.[1] In addition to eliciting preferences, we use a questionnaire, as well as data obtained directly from the schools, to relate demographic variables and information about subjects' field behavior to attitudes towards delay and uncertainty. Our experiment has another noteworthy feature: in contrast to all previous studies, our experiment was conducted during regular school hours. That is, we had virtually no drop-outs and, thus, no self-selection into the experiment. Recent papers by Gal Zauberman and John G. Lynch Jr. (2005) and Jawwad Noor (2009) provide theoretical arguments and empirical evidence that self-selected participants in experiments may be those most in need of immediate cash, thus potentially biasing experimental results in favor of detecting a present-bias. Avoiding self-selection minimizes the possibility of such a bias.

Our experimental results confirm the typical patterns of preferences regarding risk, ambiguity, and impatience, that are also observed with adult experimental participants (Shane Frederick, George Loewenstein and Ted O'Donoghue, 2002; Dohmen et al., 2011). On average, children and adolescents are risk averse, ambiguity averse and impatient. Interestingly, we find hardly any age effect within each dimension (of risk, ambiguity and patience), indicating that these preferences are stable in the age group of ten- to eighteen-year olds. As is standard in the literature on adults' risk aversion (Rachel Croson and Gneezy, 2009), we also find a strong gender difference such that girls are more risk averse than boys. High ability students measured by their math grades are more patient. Importantly, there is a significant relation between risk aversion and time preferences, with more risk averse subjects being more patient. Looking at the

[1] Note that Harbaugh et al. (2002), Bettinger and Slonim (2007) and Castillo et al. (2011) use vouchers or small gifts as rewards. However, gift certificates may carry more uncertainty than cash, thus causing an interaction of both time and risk preferences in the delay task (see Uri Gneezy, John A. List and George Wu, 2006). For this reason, and given the permission of all involved parties, including parents and school principals, we have decided to use cash in our experiment.

predictive power of experimental decisions for behavior in the field, we observe that for children and adolescents time preferences are a strong predictor of health-related field behavior, saving decisions, and conduct at school, as already indicated above. However, the link between laboratory decisions and supposedly related behavior in the field is only weak for risk and ambiguity attitudes.

The rest of the paper is organized as follows. In section I we describe the data set and the general features of the experimental study. Sections II and III present the specific designs and results of the uncertainty and delay attitude elicitation as well as the effects of individual background variables on these measures. We also discuss aspects of our results that replicate existing findings in the literature and those that deviate from them. Following previous papers (Gideon Keren and Peter Roelofsma, 1995; Bettinger and Slonim, 2007; Halevy, 2008), we assume that delay often implies uncertainty, and we use uncertainty attitudes elicited in section II as explanatory variables in the analysis of time preferences in section III. In section IV, we study how our experimental measures relate to field behavior with respect to smoking, drinking, the BMI, saving, and conduct at school. Section V discusses our main findings and concludes the paper.

I. Subject Pool and General Experimental Setup

A. Subject Pool

We conducted experiments with a total of 661 children and adolescents, aged ten to eighteen years. The experiments were run in three Austrian schools, comparable to US high schools, in Innsbruck and Schwaz, two cities in the Federal State of Tyrol, between November 2007 and May 2008. We randomly selected 28 classes in 5th, 7th, 9th, and 11th grade. The youngest participants were ten years old, the oldest ones eighteen years. The distribution of students across grades and gender is shown in Table 1. The study was approved by the central school administration board of Tyrol, and the principals and teachers of the participating schools gave permission to conduct the experiments in class during regular school hours. Parents were informed about the experiment and the collection of survey data. All children got their parent’s permission to participate. Besides asking parents for consent, we also asked all students whether they would be willing to participate in the experiments. No student opted out.

Table 1 about here

B. General Experimental Setup

The experiments involved real monetary payoffs, and each subject got paid according to his or her choices. Payoffs used were between €4 and €14 (see sections II and III as well as the experimental procedure documented in online Appendix A1). All students faced exactly the same decision tasks, instructions and payoffs (except for a variation in reward levels in a subset of students to test for payoff effects, see section II). Students were aware that they could earn money in the experiments and that their payoffs would depend on their choices. Payoffs were determined and paid in cash immediately, except for future payoffs in the time preference experiment, which were paid (during school hours at the same school) on a predetermined date in the future (see section III).

All experimental sessions were run jointly by the first author (male) and the third author (female) of this study in the students' classrooms during regular school hours. At the end of the experimental sessions, demographic background variables and additional survey data were collected through self-reports (see Appendix A2 for the questionnaire). Additional data on students' grades and conduct at school were obtained directly from the schools.

We elicited risk and ambiguity attitudes as well as time preferences through choice lists. Each subject faced a number of ordered choices where a gamble (or an immediate payoff) was compared to an increasingly attractive sure (or future) payoff. Choice lists have been widely used in the economics literature (see, for example, Charles A. Holt and Susan K. Laury, 2002; Dohmen et al., 2010). They allow conditioning real payoffs on actual choices in an incentive compatible way.

Despite their simplicity, choice list elicitations sometimes yield inconsistent choice patterns when subjects switch repeatedly between early and delayed payments (or the sure payoffs and the gamble) and sometimes choose the gamble over a sure payoff that is identical to the gamble's largest prize (Holt and Laury, 2002; Bettinger and Slonim, 2007). Although some authors have tried to recover consistent preferences from inconsistent choice lists (e.g., Bettinger and Slonim, 2007; Judith Lammers and Sweder van Wijnbergen, 2008), we believe that most of the inconsistencies we observe are actually due to mistakes or misunderstandings and that no consistent preferences can be recovered from the lists involving inconsistent choices. We have therefore eliminated all subjects with inconsistent choices (either in the uncertainty or the time

preference experiment; see right-hand side of Table 1) from the analysis.[2] This leaves us with 639 (out of 661) subjects with complete and consistent data. The relatively high proportion of consistent choices is probably a consequence of putting a lot of effort in explaining the choice lists to our participants, going through many examples and answering any remaining questions after carefully explaining the experiment. Note that the instructions carefully avoided any suggestions that choosing either safe (or risky), respectively earlier (or later) payment, is normative or rational. It is also important to note that our choice lists for eliciting uncertainty attitudes were significantly easier than the choice lists based on Holt and Laury (2002), which are often used in the literature. In contrast to Holt and Laury (2002), our subjects did not compare two different gambles with changing probability distributions along the list. Rather, they had to compare one (fixed) gamble to a sure amount that increased monotonically. Violations of monotonicity through multiple switching as, e.g., in the preference €4 $\succ$ gamble $\succ$ €5 are more likely to become obvious.

In principle, utility models for risk and ambiguity can be calibrated from the observed switching points (as in Holt and Laury, 2002, for instance). Similarly, discounting models for time preferences can be estimated from the choice lists for delay (Han Bleichrodt, Kirsten Rohde and Peter P. Wakker, 2009; Arthur E. Attema et al., 2010). However, we decided to study preferences and their effects on field behavior in terms of the raw switching points to avoid any confounding effects due to (arbitrary) parametric assumptions. That is, we will define certainty equivalents for uncertainty tasks, and future equivalents for delay tasks, and relate them to demographics and field behavior directly, i.e., in a model-free way.

II. Risk and Ambiguity Attitudes

A. Method

We elicited risk and ambiguity attitudes within the framework of the Ellsberg two-color choice task (Ellsberg, 1961). Subjects were presented with two bags with twenty balls each. The balls were either white or orange. Subjects could win a fixed amount of money (see below) by betting on the color of their choice to be blindly drawn from a bag by themselves. One of the bags, the

[2] If we recover switching points from inconsistent subjects by assuming that repeatedly switching between the two options indicates near indifference (Lammers and van Wijnbergen, 2008), all our results remain qualitatively unchanged.

risky prospect, contained exactly ten white and ten orange balls, the distribution being known (and shown) to the subjects. The other bag, the *ambiguous prospect*, contained twenty balls that were either white or orange. The exact numbers of either color were unknown to the subjects. Note that no reference was given to probabilities for either bag. Rather, both prospects were described and actually played in terms of balls drawn from bags.

For each prospect we presented subjects with a series of choices between playing the aforementioned bet or taking a sure payoff instead. The choices for each prospect were arranged in a list that offered the choice between increasing sure amounts and the gamble. An excerpt from the list that has been used in the experiment is shown in Figure 1.

Figure 1 and Figure 2 about here

Subjects made twenty ordered choices for the risky prospect and twenty choices for the ambiguous prospect, with changing orders between subjects. All choices were numbered, and one of the choices was randomly determined by lot to be played for real payoffs. Depending on the subject's decision in the selected choice problem she would either play the gamble by betting on a color and drawing one ball from the bag, or receive the sure payoff instead.

From the two choice lists we calculated the subject's *certainty equivalents* for the prospects as the midpoint between the two sure payoffs where the subject switched from the gamble to the sure payoff. In the example in Figure 2, the certainty equivalent is calculated as €3.75.[3]

B. Payoffs

If subjects chose to play the gamble, they chose a color first and then blindly drew a ball from the bag. If the color drawn matched the color chosen before, they received a prize. Otherwise they received nothing. The prize was fixed at €10 for 471 out of 639 subjects, irrespective of their age. Keeping the prize constant allowed us to have exactly the same design for all age groups. Of course, the €10 prize might have been perceived differently by the younger cohorts than by the older cohorts in our experiment. To control for stake size effects we introduced a prize variation in part of the sample (for 168 out of the 639 subjects with consistent choices),

[3] One subject always chose the gamble and was thus excluded from the analysis. Subjects who always chose the sure amount were classified as having a certainty equivalent that is halfway in between zero and the sure amount in the first row. Thirty eight subjects choose always the sure amount both in the risky and ambiguous prospect, five subjects only for the risky prospect, and thirty six subjects only for the ambiguous prospect.

increasing the prize from €6 for 5th graders in steps of €2 up to €12 for 11th graders. In addition to the payoffs from the experiment, each participant received a show-up fee of €2.

Denote the prize in the gamble with π. The sure payoffs in the choice lists always varied from $\pi/20$ to π in twenty evenly spaced steps. For instance, in the €10-prize group the smallest sure amount was €0.50, and each step added €0.50 to the sure amount. As a consequence, we kept the number of items in the choice list constant across payoff variation groups, eliminating possibly confounding list structure effects.

C. Attitude Measures

We define measures of risk and ambiguity attitudes based on certainty equivalents (Wakker 2010, chapter 11). As a measure of individual risk attitude r we use

$$r = 1 - CE_R / \pi \,, \tag{1}$$

where CE_R denotes the certainty equivalent of the risky prospect, and individual subscripts are omitted. Values of r larger (smaller) than 0.5 indicate risk aversion (risk loving), with risk neutrality for $r = 0.5$. As a measure of ambiguity attitude we employ the value a,

$$a = (CE_R - CE_A)/(CE_R + CE_A) \,, \tag{2}$$

with CE_A being the certainty equivalent of the ambiguous prospect. This measure ranges from –1 (extreme ambiguity loving) over 0 (ambiguity neutrality) to 1 (extreme ambiguity aversion). The larger the difference between the two certainty equivalents, the stronger is the ambiguity attitude, controlling for the absolute level of risk and ambiguity attitude. The normalization controls for the fact that, for example, a €2-difference weighs more heavily for a relatively risk averse subject than for a relatively risk neutral subject.

D. Results

Risk aversion. In the aggregate, we find significant risk aversion in our sample, with a mean (median) measure of risk aversion of $r = 0.57$ (0.53) ($p < 0.001$, Wilcoxon signed-ranks test,[4] testing whether r is different from 0.5). A regression including demographic background variables is shown in Table 2. It reveals first and foremost a clear gender effect: girls are significantly more risk averse than boys. Age does not have a significant effect. All other independent variables are not significant, either. Among them are the grades for math and

[4] All tests reported in this paper are two-sided.

German, which were obtained directly from the teachers. They are coded as relative grades in comparison to a class's average grade, and larger values indicate better performance.

Table 2 about here

Ambiguity aversion. A clear majority of our sample is ambiguity averse. The mean (median) ambiguity aversion for the whole sample yields $a = 0.13$ (0.07) ($p < 0.001$, Wilcoxon signed-ranks test, testing whether a is different from 0). The regression in Table 2 shows that there are neither gender effects nor age effects for ambiguity preferences. The number of siblings as well as better German grades increase the level of ambiguity aversion weakly significantly. Other background variables are not significant.

E. Discussion

Overall, we find a considerable degree of risk and ambiguity aversion in our sample of children and adolescents. Interestingly, there are no age effects on risk and ambiguity aversion, contrary to an earlier study by Harbaugh et al. (2002), for instance. The practical absence of self-selection of participants into our experiments might be responsible for the disparity. The stronger risk aversion of girls found here mirrors a standard result for adults (Croson and Gneezy, 2009).

In our study, ambiguity aversion does not change with age, but it is prevalent in all age groups, and ambiguity attitudes seem to be influenced by different factors than risk attitudes. There is no overlap between the factors affecting risk and ambiguity preferences. Most strikingly, while gender has a strong influence on risk attitudes, no effect is found for ambiguity attitudes. These results are in line with findings in Lex Borghans et al. (2009) for a sample of fifteen and sixteen year old high school students. Ambiguity is influenced by social factors, though, such as the number of siblings. This result is consistent with social explanations of ambiguity attitudes proposed, e.g., by Shawn P. Curley, Frank Yates and Richard A. Abrams (1986), Stephen Morris (1997), or Stefan Trautmann, Ferdinand Vieider and Wakker (2008).

III. Attitudes Toward Delayed Payoffs – Measuring Impatience

A. Method, Payoffs, and Attitude Measures

Attitudes toward delay – or a subject's impatience – were elicited by letting subjects choose between sure payoffs at two different points in time. We used choice lists where the early payoff remained fixed, and the later payoff was increased monotonically along the list, starting with the payoff at the earlier time point (see Figure 3 for an example and Appendix A1).

Figure 3 and Figure 4 about here

From the lists we calculated the *future equivalent* of the fixed payoff at the earlier point in time as the midpoint between the two later payoffs where a subject switches from the earlier to the later payment. In Figure 4, for example, the future equivalent equals €11.40. A larger future equivalent indicates stronger delay aversion, i.e., impatience.

We presented to each subject eight different choice lists. The lists differed in the stake size of the early payoff (either €4.05 or €10.10) and in the timing of the early and/or late payoffs. The amounts in the lists increased in steps of €0.10 (€0.20) from €4.05 (€10.10) to €5.95 (€13.90). For each stake size we elicited preferences for four different timing combinations of payoffs, summarized in Figure 5. In the first list subjects made choices between receiving a payoff today (*upfront-delay* of zero) versus receiving a payoff in three weeks (*delay* of three weeks). The second list maintained the three weeks delay, but shifted it into the future by having the early payment only in three weeks (i.e., the upfront-delay was three weeks). List 3 required choices between a payoff today and a payoff in one year, and list 4 shifted the latter list into the future by an upfront-delay of three weeks again.

Figure 5 about here

Note that choice lists 1 and 2, respectively 3 and 4, measure the attitude toward an identical delay (of three weeks, respectively on year) with and without an upfront-delay. A comparison of future equivalents between pairwise lists allows us to test for constant versus hyperbolic discounting/present bias (David Laibson, 1997; Drazen Prelec, 2004; Bleichrodt et al., 2009). If future equivalents are higher for list 1 (3) than for list 2 (4), the immediate payment receives more weight than the early payment in three weeks time, indicating present-biased discounting.

Recall that the four timing combinations were used both with high and low stakes to control for stake-size effects.

Subjects filled out the eight choice lists in a random order. One list and one item on the chosen list were randomly selected after all choices had been made. Payoffs were paid out at the date chosen by the subject in the selected choice problem.

B. Payment Procedures for Delayed Payoffs

A potential problem in time preference experiments with real payoffs concerns transaction costs and uncertainty regarding the delivery of the payment. Both might be different at different points in time. As a remedy, some researchers have argued in favor of using hypothetical payoffs in such tasks (Daniel Read, 2005), others have used dated checks or vouchers (e.g., Vital Anderhub et al., 2001; Samuel McClure et al., 2004) or delivered the money in person to each single participant on the relevant day (Konstanze Albrecht et al., 2011). In general, researchers acknowledge the empirical problems and try to minimize confounds through uncertainty and transaction costs, an approach also taken here.

Transaction costs. The experiment was part of a larger series of experiments conducted at all participating schools, with researchers coming to the schools on a regular basis over a period of two years. The time frame involved in the delay task (with payments up to one year and three weeks in the future) was completely covered by the two-year period, implying practically no additional transaction costs of future payments. For those who changed to another school, it was announced and guaranteed through the principal's office that they would receive their payment by mail. In fact, no students left school for the three-week and six-week periods. During the one year and three weeks period, seven students (1%) left their school and received their payments by mail.[5]

Uncertainty of future payment. The time preference experiment was preceded at earlier dates by other experiments in which the students earned money exactly as described in the provided instructions, building up students' trust in our experimental procedure and credibility.[6] Furthermore, parents, principals and teachers had consented to this long-term project, adding to

[5] Mobility is very low in Austria – compared to the U.S., for instance – and is most probably not a factor in children's decisions.

[6] For instance, in Peter Martinsson et al. (2011) we studied social preferences.

the trustworthiness of the researchers and reducing the possible uncertainty surrounding future payments.

C. Results

In Table 3 we analyze the determinants of subjects' impatience. We run separate regressions for the three-weeks and the one-year delay.[7] We define the *normalized future equivalent* as a subject's future equivalent divided by the size of the early payoff, and take it as the dependent variable in the regressions that are based on the eight choice lists (clustering on single subjects). As independent variables, we include dummies to account for the presence of an upfront-delay (=1), for high stakes (=1), and the interaction of these two dummies. Gender is also interacted with these dummies because gender differences in impatience might be related to the details of intertemporal choice. Finally we add our measures for risk attitude and ambiguity attitude as explanatory variables, and include all background variables used earlier.

Table 3 about here

We observe a negative effect of the high stakes conditions, that is, subjects become more patient if stakes are higher, in both the three-weeks and the one-year delay condition. However, we do not observe an effect of the upfront-delay in the three weeks condition. Only in the cases where an upfront delay is combined with high stakes and a one-year delay period, there is evidence of hyperbolic discounting such that both girls and boys become more patient if payments are shifted into the future (see the Wald tests below Table 3 for details).

More risk averse subjects are more patient, i.e., have smaller normalized future equivalents, in both delay conditions. The same holds true for subjects with better math skills (relative to the class average). Ambiguity aversion has no effect, nor has age. Gender is not clearly correlated with patience, except for women being weakly significantly more patient in the condition with high stakes, no upfront-delay, and a three-weeks delay period. Students who receive more

[7] Note that because of the fixed choice list design, the step size (e.g., €0.20 in the high stakes conditions) implies – by design – a larger discount rate if calculated with respect to a three-week delay compared to a one-year delay. Therefore, a subject may have a higher future equivalent in a one-year delay choice list compared to the equivalent 3 week-list, but a lower discount rate in the one year-list. We therefore run separate regressions for the three-weeks and one-year delay and mostly avoid interpretation of comparisons across delay conditions, noting that they should be treated with care.

weekly pocket money are less patient for both delay periods. This might seem surprising at first sight because one could presume that children receiving small amounts of pocket money are more liquidity constrained and therefore less patient. A conceivable explanation for our finding could be that children receiving more pocket money are less used to exert financial self-constraint and are therefore less able to do so in the experiment.

Table 4 about here

The future equivalents observed in the eight choice lists can be used to calculate implicit annual discount rates.[8] Table 4 presents the median annual discount rates. Not surprisingly, they are considerably larger for the short delay (of three weeks) than the long delay (of one year) and also higher for low stakes than for high stakes.[9] Interestingly, the median annual discount rates are practically identical for choice lists with and without an upfront delay of three weeks.

D. Discussion

In contrast to other studies (see Frederick et al., 2002) we find no strong evidence for hyperbolic or present-biased discounting. Testing whether an upfront delay reduces impatience, we find evidence of a present bias only with the long delay period (of one year) and high stakes, indicating that hyperbolic discounting does not play a strong role in the current data set.

As we have argued, uncertainty and transaction costs involved in the future payoffs were comparatively low in our study. Since other studies have also controlled for these factors, they are unlikely to fully account for the weak evidence of a present bias. Perhaps more relevant as an explanation for our results is the fact that all students of the recruited classes did actually participate in the experiments. That is, in contrast to other studies, there was no self-selection of participants into the experiment. Recent papers by Zauberman and Lynch (2005) and Noor (2009) present theoretical arguments and empirical evidence that self-selected participants in experiments may be those most in need for immediate cash, i.e., those with present-biased preferences. Hence, self-selection into an experiment could have biased estimation results

[8] Using continuous discounting we calculate the discount rates with i=*ln*(future equivalent/early payoff) in case of a one year delay and with i=*ln*(future equivalent/early payoff)*52/3 in case of a three weeks delay.

[9] Because of the list design, the discount rates calculated from the future equivalents cannot easily be compared across long and short delay periods (see footnote 7). However, comparisons across upfront-delay and stake-size conditions can readily be made in Table 4.

towards finding present-biased discounting in other studies. The absence of self-selection in our experiment is therefore a promising potential explanation for the weak evidence for hyperbolic discounting in our study. In general, however, the annual discount rates and the variation in these rates across time ranges and stake sizes that we report are similar to those described in other studies (see Frederick et al., 2002). We also find that subjects are more patient for the larger stake size, replicating the widely discussed magnitude effect (e.g., Noor, 2010) with real payoffs, and extending the evidence to a subject pool of children and adolescents.

Interestingly, higher individual levels of risk aversion as measured in the first experiment predict more patience. There are no robust age effects and we find no relationship between ambiguity attitudes andn patience, however. Concerning the relation of risk attitudes and patience, we note that impatience has been related to low self-control and impulsivity (Walter Mischel, Yuichi Shoda and Monica L. Rodriguez, 1989; Brady Reynolds et al., 2006). Risk tolerance has similarly been related to impulsivity (Rudy E. Vuchinich and Maria L. Calamas, 1997; Tomasz Zaleskiewicz, 2001; Levin and Hart, 2003; Borghans et al., 2009). While these studies show a relationship between impatience and risk tolerance for adults, our results extend these findings to decision making of children and adolescents. A lower level of risk tolerance is associated with less delay aversion, or put the other way, more risk averse students are more patient.

High ability students (with respect to math grades) are also more patient. This effect is consistent with findings in Laurence Steinberg et al. (2009) and Castillo et al. (2011), and it shows an important association between intellectual capacity and the self-control necessary to overcome the temptations of immediate gratification. Finally, while Bettinger and Slonim (2007) and Castillo et al. (2011) have found girls to be more patient in intertemporal choice, we have found no unambiguous evidence for gender effects.

IV. Experimental Measures and Field Behavior

All previous studies relating field behavior to experimental measures of impatience or uncertainty attitudes consider only either time preferences or uncertainty attitudes as explanatory variables. In the present study we use experimental measures of risk, ambiguity, and delay attitudes to explain field behavior of children and adolescents. We put particular emphasis on the relation of experimental measures to health-related behavior, a relation that has, so far, only been studied for adults (Chabris et al., 2008; Weller et al., 2008).

We have collected data on five dependent variables. Information on saving, smoking, drinking and the BMI was collected through self-reports (see Appendix A2). We obtained data on these variables for all 661 subjects. Data on pupils' conduct at school were obtained directly from the principals' offices, but only for a subsample of 389 students, because we were not able to obtain approval from all school boards for using this information.

The variable "*body mass index*" (BMI) is a continuous variable, allowing us to use least squares regressions.[10] Conduct at school is measured as an ordered grade ranging from 1 (no misbehavior) to 4 (serious misbehavior), and we employ ordered probit regressions for this variable. The other three variables are constructed as binary variables, indicating the use of probit regressions. The variables "*smoking*" and "*alcohol consumption*" are coded as one if subjects indicated in the questionnaire that they spend money on cigarettes and alcohol respectively.[11] Likewise, "*saving*" is coded one if subjects indicated to save money. A look at the raw data shows that these questions elicited reasonable answers. For instance, according to our data the proportion of students that spend pocket money on alcohol rises monotonically from 2.4% at an age of twelve years to 55.3% at an age of seventeen years.[12]

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[10] We computed a specific measure by dividing the child's body mass index by the median body mass index for each age cohort, controlling for gender. The median body mass index for girls and boys in each age group was taken from a dataset of the World Health Organization in 2007 (at http://www.who.int/growthref/bmifa_girls_5_19years_z.pdf, and http://www.who.int/growthref/bmifa_boys_5_19years_z.pdf). We were able to validate the BMI that relied on self-reports of weight and height for a subset of 87 subjects (7th and 11th grade of one school) who underwent a medical check-up in school in the very same month of running the time preference experiment. In this check-up, a subject's height and weight was recorded by a medical doctor, and we got data on the resulting BMI. The correlation of the BMI based on self-reports and the one based on medical reports is 0.92 ($p < 0.001$). A t-test shows that both measures are not significantly different (actual BMI = 20.28; self-reported BMI = 20.26; $p = 0.85$). Testing separately for boys and girls does not yield any significant differences between actual and self-reported BMI either.

[11] About 6 months after the time preference experiment, for control reasons, we administered a questionnaire concerning the frequency of smoking ("never", "sometimes", or "regularly") and drinking ("never", "rarely", "sometimes", or "regularly"). If we use the answers to these questions instead of the binary questions (that we chose because we considered them less intrusive and more likely to elicit honest answers than a finer-grained question), the results for both smoking and drinking remain qualitatively unchanged. The only difference concerns the effect of ambiguity attitude on smoking shown below, which becomes insignificant. Note that the binary variables used in Table 5 capture whether or not children and teenagers have actively consumed alcohol and tobacco. Christine Jackson et al. (1997) show that early age usage, irrespective of its extent, decreases children's competence in academic and social skills and in self-confidence.

[12] Note that the legal drinking age in Austria for beer and wine is sixteen years and enforcement is much less strict than in the US, for instance.

Table 5 presents the regression results in a condensed form (while the single regressions underlying Table 5 are presented separately in Table A in Appendix A3). With each of the eight measures of impatience (i.e., for the normalized future equivalent in each single choice list) we have run one regression for each of our five dependent variables. This is a conservative approach that allows for different choice lists for time preferences to yield a different relationship between future equivalents and the dependent variables. Only if the data from all eight choice lists support basically the same conclusion, we can confidently know that impatience has a robust influence on a certain dependent variable. Table 5 also reports for each of the dependent variables results of an F-test over all eight measures of time preference, thus testing for joint significance to control for the effect of multiple testing.

Table 5 about here

To simplify the presentation of the results in Table 5 we, first, show the significant signs of the coefficients that capture the effects on behavior. In fact, the signs of significant coefficients are always identical for all eight regressions for each of the five dependent variables, providing a first indication that the eight different regressions produce a consistent pattern. In columns [A1] to [A5] of Table 5, we report the number of times (x y z) an independent variable is significant at the 1 (= x), 5 (= y), and 10 (= z) percent level. For instance, "– (8 0 0)" means that a certain independent variable is significantly negative in all eight regressions on the 1-percent level. The stars next to (x y z) indicate the results from F-tests that control for multiple testing. In columns [B1] to [B5] of Table 5, we provide, first, the average marginal effects/coefficients in the eight regressions, provided an independent variable is significant. For binary independent variables we report the effect of switching from zero to one. In squared brackets we report the effect of a one-standard-deviation increase in an independent variable. These latter effects can thus directly be compared across variables, e.g., by comparing the effects of the experimental preference measures to those of ability measures.

Our measure for impatience predicts most field behavior strongly and significantly. More impatient students are persistently more likely to spend money for smoking and alcohol consumption, less likely to save, and show worse conduct at school. For the body mass index our measure of impatience yields significant results only for two out of eight regressions, such that in these cases more impatient students have a higher BMI, but the F-test fails to support a joint significance of the impatience measure on the BMI (p = 0.16). The BMI is strongly associated with risk aversion, however. More risk averse students have a lower BMI. For the other four

dependent variables risk aversion has no significant impact. Ambiguity is only significant for smoking habits. Students who are more ambiguity averse are less likely to spend money for smoking.

In general, we find that adding impatience, risk averion, and ambiguity aversion as explanatory variables explains a significant amount of variation. The inclusion of these variables improves the explained variance by 0.03 for saving and smoking, 0.02 for the body mass index as well as the grade for behavior at school, and 0.01 for drinking. The lower panel of Table 5 presents results for regressions that include each experimental measure (risk, ambiguity, patience) separately. The results show that the effects remain very robust.

We find a few interesting effects of demographic background variables. Smoking and drinking increase significantly with age, while saving goes down. Girls have a lower BMI and show better conduct across all regressions. Intellectual capacity as measured by math grades is important. Students with better math grades are more likely to save money, less likely to smoke, and show better behavior at school. Having more pocket money increases the likelihood of alcohol consumption, and it is also associated with a higher BMI.

The general picture emerging from Table 5 suggests that impatience is more important than uncertainty attitudes in shaping the field behavior that we were interested in here and that especially time preferences are a more consistent predictor than any of the background variables. We find evidence that only for the BMI and smoking both impatience and uncertainty attitudes have a joint influence. This provides evidence for the presumption that especially delay aversion and, to a lesser extent, low levels of risk aversion and ambiguity aversion are related to low inhabitation levels of impulse-driven behavior. The size of the observed effects for preference measures is similar to those of cognitive ability: the effect of a one-standard-deviation increase in the preference measures is about the same size as a one-standard-deviation increase in the math grade, when both are significant predictors.

Overall, our results on field behavior involving delay and uncertainty are broadly consistent with the findings for adults. In particular, our study of school children replicates the effects of impatience on health and financial behaviors shown for adults. The magnitudes of the effects are similar to those reported in Chabris et al. (2008), for instance. They point out that the relatively small effects of delay aversion on single activities may accumulate to substantial effects in total. The same holds true for our study. We find that more impatient children are more likely to smoke, drink alcohol and have a higher BMI, leading to an overall far less favorable health outlook compared to more patient children.

V. Conclusion

In this paper, we have analyzed how experimentally elicited risk and ambiguity attitudes as well as time preferences of children and adolescents relate to field behavior concerning decisions with delayed and uncertain outcomes such as health-related behavior, saving, or conduct at school. Our experiment has been run in three different schools by randomly selecting 28 classes from 5th, 7th, 9th, and 11th grade, including in total 661 students, aged ten to eighteen years. A particularly noteworthy feature of our experiment is the absence of selection effects of students. Since the experiments were run during regular school hours there were no drop outs. Hence, our results cannot be biased from self-selection into experimental participation.

In the experiment, we have found clear evidence for delay, risk and ambiguity aversion in the aggregate. Our findings for children and adolescents are largely in line with adult populations (Frederick et al., 2002; Croson and Gneezy, 2009; Dohmen et al., 2010; Wakker, 2010). Considering the effects of demographics on attitudes, it seems interesting to note that for our sample of ten- to eighteen-year olds we have found no significant age effects in any dimension (risk, ambiguity, impatience). The results in Harbaugh et al. (2002) suggest that noteworthy age effects might occur before the age of ten, which could explain our findings. We have been able to replicate the standard result that women are more risk averse than men (Croson and Gneezy, 2009). Similarly, women have been found to be somewhat more patient, like in Bettinger and Slonim (2007) and Castillo et al. (2011). However, the latter finding is restricted to the time preference tasks with high stakes and a waiting period of three weeks only. Concerning cognitive abilities, better math grades are associated with more patience.

Turning to the relation of risk and ambiguity attitudes with time preferences, we have found that more risk averse subjects are more patient. Ambiguity attitudes, however, are not systematically related to time preferences. Interestingly, in our subject pool we have seen little evidence for present-biased preferences. Only with high stakes and a one-year delay we find some evidence for decreasing impatience, both for boys and girls. If present-biasedness is affected by the self-selection of subjects into experiments (Zauberman and Lynch, 2005; Noor, 2009), our findings might be explained by the lack of self-selection into the experiment.

The key finding of this paper, however, concerns the relationship of experimental measures and field behavior. Most importantly, we have found that students who are more impatient in the time preference experiment are less likely to save money, more likely to smoke, more likely to consume alcohol, have a higher body mass index, and misbehave more often at school. Taken together, these effects lead in particular to an overall far less favorable health and economic outlook for impatient students than for more patient ones. In contrast to our experimental

measures of impatience, the elicited risk and ambiguity attitudes are worse predictors of field behavior. Risk aversion is only related to the for body mass index, indicating that more risk averse students have a lower BMI. A higher level of ambiguity aversion is associated with a lower likelihood of spending money for smoking.

Low predictive power of experimentally elicited risk attitudes for field behavior has been found for adults before (e.g., Dohmen et al., 2011). Risk attitudes have been shown to have a strong domain-specific component and to depend on risk perceptions, thus making the link to field behavior rather weak (Elke U. Weber, Ann-Renee Blais and Nancy Betz, 2002; Khwaja et al., 2006; Katherine G. Carman and Peter Kooreman, 2010). Our study corroborates these findings for a large sample of children and adolescents. Experimental time preference measures, however, seem more directly related to self-control problems, for instance with respect to health-related behavior or procrastination. Children may perceive some activities that require self-control to abstain from, for instance smoking, as unhealthy or unproductive, but not necessarily as *risky*. If this is the case, then experimentally measured risk attitudes will not identify such behavior in the field. However, time preferences that are clearly related to self-control may still successfully predict such activities, although they are typically interpreted as "risky behavior" by researchers. In general, we consider the fact that field behavior of children and adolescents is predictable by some meaningful experimental preference measures an important result, because our results concern a period in life where, following the "diagnosis", policy interventions might most easily be implemented.

Given our findings on the negative effects of impatience on saving decisions, good conduct at school, and health-related behavior already for children and adolescents, it seems an important avenue for future research to address possible policy interventions. Early identification of at-risk children is an obvious first step. Moreover, as the work by Walter Mischel and collaborators has shown, children need to develop and train strategies to successfully exert self-control (e.g., Mischel et al., 1989). Our observation that the effects of time preferences and cognitive skills on behavior are comparable in size, suggests emphasizing these self-control skills at preschool and elementary school. The research on active decision making and optimal defaults to help overcome working professionals' myopia in saving for retirement (see, e.g., Gabriel D. Carroll et al., 2009) has not yet been extended to children's and adolescents' decisions. It seems plausible that active decision making (for choosing healthier food or exercising more frequently, for instance) and defaults (regular weight controls in schools, for example) might similarly contribute to overcome the negative effects of impatience in children and adolescents. Finally, because our study suggests that preferences concerning the timing and the uncertainty of payoffs

form early in childhood, with no clear age effects between the age of ten and eighteen, early identification and targeted intervention in children that are at risk is important in order to be able to maximize the potential benefits of such interventions.

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Tables

Table 1: Distribution of participants by age and gender

Age (years)	Grade	Total	# girls	# boys	# inconsistent choice list Uncertainty	Delay
10-11	5th	208	118	90	3 (1%)	7 (3%)
12-13	7th	184	94	90	4 (2%)	5 (3%)[A]
14-15	9th	135	75	60	3 (2%)	2 (1%)
16-18	11th	134	71	63	0 (0%)	0 (0%)
SUM		661	358	303	10 (2%)	14 (2%)

[A] *Two subjects were inconsistent both in the risk preference task and the time preference task, implying that 639 subjects made consistent choices in both tasks.*

Table 2: OLS-regression analysis for risk and ambiguity attitude

Explanatory variables \ Dependent variable	Risk aversion		Ambiguity Aversion	
Female	0.067***	(0.019)	0.025	(0.019)
Age (in years)	-0.004	(0.005)	0.006	(0.005)
No. of siblings	-0.005	(0.009)	0.017*	(0.009)
Pocket money per week	-0.000	(0.001)	-0.001	(0.000)
Size prize urns	-0.003	(0.009)	-0.013	(0.009)
German grade[#]	0.016	(0.011)	0.022*	(0.012)
Math grade[#]	-0.005	(0.010)	-0.003	(0.011)
No. of observations	639		639	
R squared	0.038		0.038	

Notes. ***, **, * denote significance at the 1%, 5%, 10% level, robust standard errors in parentheses. Positive coefficients imply increasing risk/ambiguity aversion.

[#] Grades are relative to the average in class. Positive variables indicate better than average performance.

Controls for counterbalancing the two choice lists included.

Table 3: OLS-regression analysis for impatience (future equivalents)

Explanatory variables \ Dependent variable	Normalized future equivalent			
	Three weeks delay		One year delay	
Upfront-delay	0.004	(0.005)	0.001	(0.004)
High stakes	-0.053***	(0.005)	-0.076***	(0.005)
Upfront-delay*high stakes	-0.004	(0.004)	-0.009***	(0.003)
Female	-0.010	(0.011)	-0.006	(0.013)
Female*upfront-delay	0.003	(0.006)	0.003	(0.004)
Female*high stakes	-0.007	(0.007)	-0.010	(0.006)
Age (in years)	0.002	(0.002)	0.003	(0.003)
Risk aversion	-0.069***	(0.023)	-0.043*	(0.025)
Ambiguity aversion	0.017	(0.019)	0.004	(0.021)
No. of siblings	0.010*	(0.005)	0.010	(0.006)
Pocket money per week	0.001*	(0.000)	0.001**	(0.000)
German-grade[#]	0.004	(0.006)	0.011	(0.007)
Math-grade[#]	-0.028***	(0.005)	-0.026***	(0.007)
No. of observations	639		639	
R squared	0.124		0.128	

Wald tests for joint effects (p-values)	Three weeks delay	One year delay
H_0: no delay effect in low stake size condition for males ($\beta_{delayed} = 0$)	0.412	0.767
H_0: no delay effect in low stake size condition for females ($\beta_{delayed} + \beta_{delayed*female} = 0$)	0.117	0.267
H_0: no delay effect in high stake size condition for males ($\beta_{delayed} + \beta_{delayed*high} = 0$)	0.962	0.014
H_0: no delay effect in high stake size condition for females ($\beta_{delayed} + \beta_{delayed*high} + \beta_{delayed*female} = 0$)	0.391	0.094
H_0: no female effect in low stake size and non-delayed condition ($\beta_{female} = 0$)	0.385	0.639
H_0: no female effect in low stake size and delayed condition ($\beta_{female} + \beta_{delayed*female} = 0$)	0.572	0.819
H_0: no female effect in high stake size and non-delayed condition ($\beta_{female} + \beta_{female*high} = 0$)	0.066	0.147
H_0: no female effect in high stake size and delayed condition ($\beta_{female} + \beta_{female*high} + \beta_{delayed*female} = 0$)	0.131	0.232
H_0: no high stake size effect in non-delayed condition for males ($\beta_{high} = 0$)	0.000	0.000
H_0: no high stake size effect in non-delayed condition for females ($\beta_{high} + \beta_{female*high} = 0$)	0.000	0.000
H_0: no high stake size effect in delayed condition for males ($\beta_{high} + \beta_{delayed*high} = 0$)	0.000	0.000
H_0: no high stake size effect in delayed condition for females ($\beta_{high} + \beta_{delayed*high} + \beta_{female*high} = 0$)	0.000	0.000

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

Positive coefficients imply higher normalized future equivalents, i.e., more impatience.

[#] Grades are relative to the average in class. Positive variables indicate better than average performance.

Table 4: Median annual discount rates (%)

Delay Stake size	3 weeks	3 weeks with upfront delay	1 year	1 year with upfront delay
Low	330	365	29	31
High	179	179	21	19

Table 5: Determinants of field behavior (OLS- and Marginal-Probit-Regression) – Overview[§]

	Saving		Smoking		Alcohol consumption	
	[A1]	[B1]	[A2]	[B2]	[A3]	[B3]
Impatience (future equivalent)	– (7 1 0)**	-0.175 [-0.025]	+ (2 4 1)**	0.034 [0.005]	+ (4 2 1)***	0.175 [0.025]
Risk aversion						
Ambiguity aversion			– (0 3 5)**	-0.016 [-0.004]	– *	
Age	– (8 0 0)***	-0.012 [-0.028]	+ (8 0 0)***	0.007 [0.017]	+ (8 0 0)***	0.056 [0.130]
Female			+ (0 0 1)*	0.006 [0.006]		
German grade[#]						
Math grade[#]	+ (8 0 0)***	0.032 [0.032]	– (8 0 0)***	-0.008 [-0.008]		
No. of siblings						
Pocket money per week					+ (0 0 5)**	0.001 [0.018]
No. of observations	639		639		639	
Mean (pseudo) R^2	0.168		0.361		0.397	
Impatience (future equivalent)[a]	– (7 1 0)*	-0.174 [-0.025]	+ (2 4 1)**	0.039 [0.006]	+ (3 4 0)***	0.172 [0.024]
Risk aversion [one regression][a]						
Ambiguity aversion [one regression][a]			+ (_ _ 1)	-0.019 [-0.004]		

Notes:

[§] The table shows in columns [A1], [A2], [A3], [A4], and [A5] significant effects (by sign) of independent variables on the five dependent variables. We have run eight regressions per dependent variable, using each of the eight choice lists in the intertemporal choice task once. The entries in the table read as follows:

+: increases dependent variable, – : decreases dependent variable; (x y z) denotes the number of times the variable is significant at the 1% (= x), 5% (= y), 10% (= z) level.

The full set of regressions behind this table is reproduced in Table A in online Appendix A3, where Panel A concerns saving, Panel B smoking, Panel C alcohol consumption, Panel D the body mass index, and Panel E conduct at school

Columns [B1], [B2], [B3], [B4], and [B5] show the mean marginal effects/coefficients of the independent variables over the eight choice lists. [ ] gives the marginal effects/coefficients multiplied by one standard deviation of the independent variable.

[#] Grades are relative to the average in class. Positive variables indicate better than average performance.

***, **, * denote significance at the 1%, 5%, 10% level in a regression with all eight impatience measures included; for impatience, it refers to joint F-test over all eight measures.

[a] Significant effects from analogous regressions including each impatience/risk/ambiguity measure alone and excluding the two other measures.

Table 5: Determinants of field behavior (OLS- and Marginal-Probit-Regression) – Overview, continued[†]

	Body mass index (BMI)		Grade for conduct at school (higher grade is worse)	
	[A4]	[B4]	[A5]	[B5]
Impatience (future equivalent)	+ (0 0 2)	0.040 [0.006]	+ (7 1 0)***	1.595 [0.227]
Risk aversion	– (7 1 0)***	-0.062 [-0.014]		
Ambiguity aversion			– *	
Age				
Female	– (0 8 0)**	-0.024 [-0.024]	– (8 0 0)***	-0.552 [-0.552]
German grade[#]			– (8 0 0)***	-0.264 [-0.245]
Math grade[#]			– (0 7 1)*	-0.195 [-0.198]
No. of siblings				
Pocket money per week	+ (0 8 0)**	0.001 [0.009]		
No. of observations	611		389	
Mean (pseudo) R²	0.043		0.134	
Impatience (future equivalent)[a]	+ (0 2 0)	0.049 [0.007]	+ (7 1 0)***	1.654 [0.235]
Risk aversion [one regression][a]	– (1 _ _)	-0.062 [-0.014]		
Ambiguity aversion [one regression][a]				

[†] refer to first page of Table 5 for notes.

Figures

Figure 1: Choice list for uncertainty task

[1] draw from bag A	O	or	O	€0.50 for sure
[2] draw from bag A	O	or	O	€1.00 for sure
[3] draw from bag A	O	or	O	€1.50 for sure
	.... etc.			

Figure 2: Choice list for uncertainty task

[6] draw from bag A	⊗	or	O	€3.00 for sure
[7] draw from bag A	⊗	or	O	€3.50 for sure
[8] draw from bag A	O	or	⊗	€4.00 for sure
	...etc.			

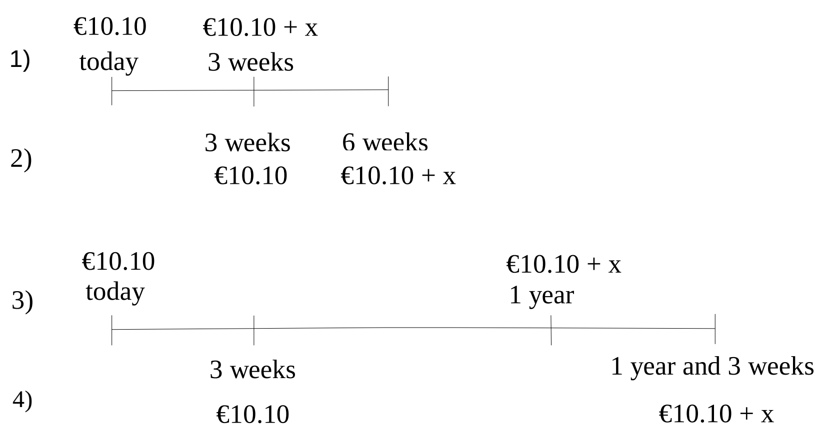
Figure 3: Choice list for time preference task

[1] receive €10.10 now	O	or	O	receive €10.10 in three weeks
[2] receive €10.10 now	O	or	O	receive €10.30 in three weeks
[3] receive €10.10 now	O	or	O	receive €10.50 in three weeks
		....etc.		

Figure 4: Choice list for time preference task

[6] receive €10.10 now	⊗	or	O	receive €11.10 in three weeks
[7] receive €10.10 now	⊗	or	O	receive €11.30 in three weeks
[8] receive €10.10 now	O	or	⊗	receive €11.50 in three weeks
		...etc.		

Figure 5: Combinations of early and late payoffs†



† Illustrated in this figure for the four choice lists with an early payoff of €10.10. Analogously, we had four choice lists with an early payoff of €4.05.