The Today and Tomorrow of Kids: Time Preferences and Educational Outcomes of Children

Marco Castillo*
ICES, George Mason University

Paul Ferraro
Georgia State University

Jeffrey L. Jordan
University of Georgia

Ragan Petrie
ICES, George Mason University

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Abstract: We experimentally investigate the distribution of children's time preferences along gender and racial lines. We find that boys are more impatient than girls and black children are more impatient than white children. Black boys have the highest discount rates of all groups. Most importantly, we show that impatience has a direct correlation with behavior that is predictive of economic success. An increase of one standard deviation in the discount rate is associated with an increase in the number of disciplinary referrals that a child has the following school year by 14%. Our results suggest that impatience might play an important role in determining the success of performance incentive programs for school children.

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1. Introduction

In the U.S., there are persistent demographic differences in educational outcomes. For example, by all measures, girls graduate high school at higher rates than boys, and whites do so at higher rates than blacks. Recent cohort estimates by Heckman and LaFontaine (2007) show high school graduation rates of 79.9% for girls and 75.2% for boys.[1] Eighty percent of whites graduate compared to 69% for blacks. The rate is even lower for black boys: 63.4%. There are other indicators of racial differences as well. Fryer and Levitt (2006) show a test score gap between blacks and whites that grows as children age. This gap appears at a young age, even though there is no evidence of differences in cognitive ability early in life (Fryer and Levitt, forthcoming).

These observed differences in educational outcomes may depend in part on how much the future is valued. Not all children may solve inter-temporal problems in the same way. If time preferences, or the perceived benefits of patience, vary across demographic groups, different educational paths may occur. Indeed, Heckman et al (2006) show that differences in human capital formation can be attributed in part to differences in non-cognitive abilities. Observed differences in time preferences, however, cannot be taken as innate. The evolution of these preferences may be endogenous (as suggested by Becker and Mulligan, 1997) and thus would imply that children could be taught to be more forward thinking.

Relatively little is known about the nature of children's time preferences, how these preferences relate to the social environment, and what effect they have on outcomes.[2] In this paper, we investigate experimentally if children's time preferences vary across observable

[1] High school graduates are those who receive a traditional high school diploma from an accredited high school program. The percentages of high school graduates cited in this paper come from Table 1, using the NLSY97 data, in Heckman and LaFontaine's (2007).

[2] This paper is not the first to look experimentally at patience in children. For example, Bettinger and Slonim (2007) use economic experiments to examine the patience of children in between the ages of 5-16 years.

characteristics, such as race and sex. Most importantly, we investigate if measured time preferences correlate with a marker of potential educational failure: disciplinary referrals.

There is a large literature in psychology and neuroscience on impulse control and its effects on behavior (see D'Amasio, 1994; Hollander and Evers, 2001; McClure et al, 2004). Most related to our research, Mischel et al (1989) found that the ability of children to refrain from immediate gratification predicted education outcomes later in life. Whereas Mischel et al study impulse control, we focus on eliciting the time preferences of children by incorporating a front-end delay in our experiments.[3] Our design allows us to examine patience, not impulse control, and our sample allows us to detect heterogeneity in preferences. If heterogeneity in time preferences exists, we should expect that any economic policy offering alternative delayed incentives might have different treatment effects across populations.

After testing for heterogeneity in time preferences in our sample, we estimate how time preference affects disciplinary referrals two years after the experimental data were collected. Discipline has been shown to be a predictor of economic outcomes later in life, such as education achievement and lower wages (see Bowles, Gintis and Osborne, 2001; Heckman, Stixrud and Urzua, 2006; Lang and Ruud, 1986; Segal, 2006), as well as high school drop-out rates (Alexander, Entwisle, and Horsey, 1997; Rumberger, 1995). Discipline incidents therefore constitute an ideal test bed for the influence of time preference on behavior.We would expect patient and forward-looking students to refrain from such behavior.

We conduct artefactual field experiments (Harrison and List, 2005) to elicit children's time preferences. The experiments were conducted with a large proportion of the population of 8th grade students in a rural/suburban school district in Georgia. We conducted the experiments

[3] McClure et al, (2004) find that inter-temporal choices with and without front-end delay are governed by separate neural systems, with the prefrontal and parietal cortices more often involved in choices between delayed rewards and these cortices are the brain regions related to general cognitive ability.

with a population of this age because the education literature recognizes that this age is critical to determine future education outcomes, such as the decision to drop out of school (Kaufman, Alt, and Chapman, 2004; Olson, 2006). We also collected data from the students' records. With these records, we can investigate the relationship between our elicited discount rates and discipline.[4]

Our study provides two main findings. First, we observe that boys have higher discount rates than girls and that black children have higher discount rates than white children. A difference in patience between boys and girls was previously found by Bettinger and Slonin (2007). However they did not find a difference by race. Our finding is robust to alternative measures of patience, socio-economic background and measures of cognitive abilities and joint estimation of discount rates and risk preferences. This latter result is important because previous research suggests differences in elicited discount rates might reflect differences in risk preferences (Andersen, Harrison, Lau and Rutstrom, 2008; Andreoni and Sprenger, 2010b) or the existence of field substitutes for lending or borrowing (Cubitt and Read, 2007; Harrison, Lau and Williams, 2002). We find no evidence to support these explanations in our sample.

Our second main finding is that discount rates are correlated with the likelihood that a child has more disciplinary referrals. A one standard deviation increase in a child's discount rate is associated with a 14.3% increase in disciplinary referrals two years after the experiment (the average is 1.7 referrals).

With this second important result, we go beyond establishing that discount rates differ among children. We establish that our experimentally-elicited discount rates help to explain variability in important behaviors, apart from demographic, socioeconomic and cognitive factors. Our results indicate that time preferences are an important component of the economic decisions

[4] Note that we use the term elicited discount rate because this term has been used in the literature to describe these types of estimates. Indeed, our estimates are "naïve" in the sense that a person's discount rate may comprise many things we are not measuring. We use the term discount rate merely to be consistent with previous work.

of children and that experimental methods are a simple and direct way to measure them. Unlike, for example, self-reported personality tests, experimental methods have the advantage of using real stakes and being standardized.

The paper is organized as follows. Section 2 discusses the sample. Section 3 describes the experimental design. Section 4 discusses the distribution of preferences. Section 5 relates time preference measures to future disciplinary referrals. Section 6 concludes.

2. Study Area and Sample Selection

The setting for our study is a suburban/rural county school district in Georgia. The district is typical of suburban/rural school districts in the U.S. in that income and education levels are lower compared to urban areas. For example, 1999 per capita income in the district was $16,791 ($21,154 in Georgia). Thirty-two percent of the population over 25 had not completed high school in 2000, over 50% higher than for Georgia, and less than half (46%) of the class of 2004 graduated in four years.

Our experiment was conducted at all four public middle schools in the district and our sample represents 82% of the entire student population.[5] The students in our sample come from a broad range of socio-economic backgrounds (sample statistics are presented in Table 2). At the time of the experiment, 97% of our subjects were 13 or 14 years old (mean=13.80, SD=0.20), while the remaining 3% were 15 years old. In Georgia, students can make the decision to drop

[5] Using administrative records of the number of students enrolled on September 1st of the school year in which we conducted the time preference experiments, we can calculate the proportion of the student population who participated in the experiment by demographic group. Using this data, we get the following participation rates: black boys, 74.8%, black girls, 84.5%, white boys, 84.6% and white girls, 82.1%. Overall, the participation rate is 81.5%. Using an equality of proportions test, the only significant differences across populations are that the proportion of black boys who participate is significantly lower than all other groups (p-values are 0.0080 for black boys compared to black girls, 0.0076 for black boys compared to white boys, and 0.0554 for black boys compared to white girls). There are no other significant pair-wise comparisons across groups. Note that the calculated participation rates are most likely a lower bound on the actual participation rate because the experiments were conducted on dates different from September 1st (in two of the three years, earlier, but we can only obtain official enrollment data for Sept 1st) when there is a lot of movement of children in and out of the school district. This is especially true for black boys. Finally, only about twenty children declined to participate in the experiment. Thus attrition bias is very low.

out of school at the age of 16. Thus, we wanted to elicit discount rates in the period prior to when this important decision would be made.

3. Experimental Design

To measure time preferences among adults, both revealed and stated preference methods have been used.[6] Given the potential sources of bias inherent in stated preference methods and the difficulty in observing the consumption and investment decisions of children, we opted to use a controlled experiment to reveal preferences. We also conducted a controlled experiment to reveal risk preferences on a smaller sample of children during the last school year in which we conducted the time preference experiment. We discuss the time preference experiment first.

We measure time preferences by eliciting discount rates with the front-end delay design used by Harrison et al. (2002), instead of allowing an option of payment immediately after the experiment. This design mitigates the potential for confounding trust and patience in the experiment and makes the transaction costs of receiving payment across options the same. In our experiment, subjects are asked, orally and in writing, to make twenty decisions in total. For each decision, subjects are asked if they would prefer $49 one month from now or $49+$X seven months from now. The amount of money, $X, is strictly positive and increases over the twenty decisions. Table 1 shows the decision sheet the subject sees. Subjects did not see the last two

[6] In the economics literature, several revealed preference methods have been used. One estimates discount rates from observations of the use of financial instruments (e.g., Ausubel 1991) or of the purchase of durable consumer goods (e.g., Gately, 1980; Hartman and Doane, 1986; Hausman 1979; Ruderman et al., 1986). Another uses natural experiments in which individuals are forced to choose among alternative payoffs with differential time dimensions (e.g., Warner and Pleeter, 2001). A third uses controlled experiments in which subjects are offered real monetary payoffs that vary in their timing (Holcomb and Nelson, 1992; Pender, 1996; Coller and Williams; 1999; Harrison et al., 2002; Eckel et al., 2005; Meier and Sprenger, 2006; Bettinger and Slonim, 2007; Andreoni and Sprenger, 2010a). Finally, stated preference methods elicit discount rates by asking individuals to make hypothetical choices in the revealed preference settings described above (Thaler, 1981; Loewenstein, 1988; Benzion et al., 1989; Shelley, 1993; Curtis 2002; Bradford et al. 2004).

columns indicating the implied annual interest rate and effective interest rate.[7] For example, in the first decision, a subject is asked if she would prefer $49 one month from now or $50.83 seven months from now. [8] In the ninth decision, a subject is asked if she would prefer $49 one month from now or $67.61 seven months from now. Subjects are asked to make one choice for each of the twenty decisions on the decision sheet. Based on discussions with teachers and students at other schools, we determined that the range of $50 to $99 would be considered by adolescents to be "large" payoffs, but not so large as to potentially cause problems with their parents.

Coller and Williams (1999) and Harrison et al. (2002) argue that one should elicit the market rates of interest that subjects face so that one can control for arbitrage opportunities (field censoring) in the econometric analysis. However, our discussions with teachers at the study site and with similar aged students at other schools led us to believe that students do not price field investments in terms of interest rates. Thus information and questions on rates would simply confuse students. Moreover, our subjects are children, and thus we feel comfortable assuming that they do not incorporate credit market options into their experimental decision task. If subjects were to have access to credit markets, and these interest rates were binding in the experiment, our estimates would be lower bounds on the true discount rates.

Economic theories of discounting predict that an individual faced with the decision sheet in Table 1 would either choose (a) $49 for all decisions, (b) the higher payment for all decisions, or (c) $49 for a number of decisions starting with Decision 1 and then switch to the higher payment for the remaining decisions. In other words, if an individual chose to receive $Y in seven months rather than $49 in one month, then the individual will prefer any amount $Z > $Y

[7] The implied annual interest rate is the fixed interest rate paid out after a year. The implied effective interest rate assumes monthly compounding over the year.

[8] The alternative to $49 is calculated to be the amount that would increase the implied discount rate by 7.35% from the previous alternative on the list. This gives us interval bounds on the elicited discount rate that are identical across the 20 decisions.

in seven months rather than $49 in one month. Following Harrison et al. (2002), we call these individuals "consistent" decision-makers.

However, in experiments using decision sheets like the one in Table 1, some individuals are "inconsistent" decision-makers: they choose $Y in seven months rather than $49 in one month, but then choose $49 in one month rather than $Z > $Y in seven months. Harrison et al. (2002) and Meier and Sprenger (2006) found that 4% and 11%, respectively, of their adult subjects were inconsistent in their choices. Bettinger and Slonim (2007), whose subjects were between 5 and 16 years old, found that 34% of their sample were inconsistent. The proportion of inconsistent decision-makers in our sample (31%) is closer to that of Bettinger and Slonim. We return to this issue in Section 4.

In each session, subjects are assigned a unique identification code. This code is private, and subjects do not know the identification codes of other subjects. Subjects make their decisions by circling one amount, either $49 or $49+$X, on their decision sheet for each of the twenty decisions. After subjects make their decisions, each subject puts her decision sheet in an envelope and the envelopes are collected.

One decision out of the twenty decisions is randomly chosen for payment by taking 20 index cards with the numbers 1-20 written on them, shuffling them in front of the subjects, presenting them "face down," and asking a subject to choose one card. The number on the card is the decision number to be paid for each of the three subjects in each session who are chosen to receive payment. So, for example, if decision 15 is chosen for payment and one of the winning subjects circled $83.03, the subject would receive $83.03 in seven months. If another winning subject circled $49, that subject would receive $49 in one month.

After determining the decision to be paid, all the envelopes are shuffled in front of the subjects, and three envelopes per session are chosen for payment. The identification codes of those chosen to receive payment are written on the blackboard. Because identification codes are kept private by each subject, no other subject knows which subjects have been chosen to receive payment. Subjects who are chosen to receive payment are paid with a Wal-Mart gift card by the school principal on the specific date for the decision chosen. We chose to pay with a Wal-Mart gift card for two reasons. It minimizes potential problems associated with giving children cash and it can be transformed into many goods that children desire, so it very similar to cash. We chose to have the school administration store and distribute the cards to assure the children that they would be paid in the future. In all schools, the principal is regarded as a permanent fixture and interacts regularly with the children. Within a week of the experiment, the winning subjects stop by the principal's office to verify the gift card. On or within a week of the payment date, the subjects go privately to the principal's office to pick up their gift cards.[9] Their names and payment are kept private. Subjects know all of these procedures before making their decisions.

For the risk experiment, the procedures are similar to the time preference experiment. The main differences are as follows. Subjects are given a simple risk task. They have to choose one of five options involving a lottery that pays one payoff with 50% probability and another with 50% probability. The five options differ in expected value and variance. The first option pays $25 for sure, and each subsequent option increases one payment by $15 and decreases the other by $5, so that the last option, if chosen, pays $85 with 50% probability and $5 with 50% probability.[10] Subjects choose one option from the five, and three subjects per session are

[9] Before subjects made decisions, they were informed that, should they move before the payment date, their Wal-Mart card would be forwarded to their new address. One winning subject transferred to another school district prior to the date of payment. The principal found the student and sent him/her the Wal-Mart gift card.

[10] This task is sometimes referred to as an Ordered Lottery Sequence. To our knowledge, it was first used by Binswanger (1980) in India and more recently by Eckel and Grossman (2002) and Castillo, Petrie and Torero (2010).

randomly chosen to be paid for their decisions. The lottery is resolved by drawing a ball from a bingo cage with 20 balls. If a ball numbered between 1 and 10 comes out, the higher payoff is paid. Subjects are paid privately with a Wal-Mart gift card within a week of the experiment by the principal. Some subjects (241) who had participated in the time preference experiment also participated in the risk experiment, which was run six weeks later.

All experiments were conducted by the authors. For the time preference experiment, 878 8th grade students participated (ages 13 to 15).[11] One hundred and twenty students were paid an average of $62.88 (std dev = $18.04), with a total payout of $7,546.17. One month after the experiment, 66 students received gift cards of $49. Seven months after the experiment, 54 students received gift cards ranging from $52.71 to $98.02. The experiments were conducted in three sets and encompass all four middle schools in the school district. The first set was on September 19, 2006. The second was on August 31, 2007, and the third was on August 26, 2008.

For the risk experiment, 608 subjects participated (241 of these also participated in the time preference experiment in August 2008). Eighty students were randomly chosen to be paid, and the average payment was $31. The risk experiment was conducted in October 2008. Subject characteristics are presented in more detail in the next section.

4. Time Preference Results

4.1 Descriptive Statistics

Table 2 shows descriptive statistics from school records for subjects in the time preference experiment.[12] Forty-eight percent are male, and 46.6% are Black. Over 63% of the

[11] Some of the 901 participants did not make all 20 decisions. We include in our sample the 834 subjects that made all 20 decisions and the 44 subjects that made 19 decisions. The results in Tables 6 & 7 hold if these 44 subjects are dropped (some results become more or less precise). The discount rate implied from the decision sheet for subjects who missed one decision are smoothed over, so the implied discount rate is more coarsely measured than for subjects who made all decisions.

[12] Descriptive statistics for subjects in the risk experiment are similar because they are drawn from the same population.

children receive free or reduced price lunch and one-quarter are part of a special education program.[13] The proportion of children that make consistent decisions in the experiment is 69%.[14] The distribution of inconsistent behavior is not distributed randomly. Black subjects are significantly more likely to behave inconsistently than white subjects, and girls make more inconsistent choices than boys.[15] Gifted children are the least likely to make inconsistent decisions, and children that do not meet reading requirements for grade level on the standardized exam are the most likely to make inconsistent choices.[16]

4.2 Distribution of Time Preferences

Our first research question is whether implied time preferences relate to the demographic, socio-economic and cognitive characteristics of children. Tables 3a & 3b shows the distribution of elicited discount rates. Table 4 summarizes the main results on the distribution of time preference measures across socio-economic characteristics.

Table 3a presents the distribution of discount rates for all subjects and for only subjects that chose consistently. Discount rates are put in ranges to make the presentation clearer. We do not have a unique switch point for inconsistent subjects that would indicate their discount rate. Instead of throwing the data out, discount rates are estimated. We do this with a simple

[13]The range of test scores (min and max) changed in 2006, so to make test scores comparable prior to and after 2006, we standardized scores to between zero and one. We did this by subtracting out the lowest possible score for that year and dividing by the range of scores. We are missing test scores for some subjects because either they were absent for the test or came from another school district and the test scores did not transfer. If we replace the missing test scores with the median test score and include a dummy variable for missing a test score, all qualitative results in Tables 6 & 7 hold.

[14] The distribution of the number of inconsistent switches back to the $49 earlier payment after switching over to a higher payment is skewed to the left. Specifically, 55% made four or fewer switches, out of the 31% that made inconsistent choices. One way to avoid appearing inconsistent in decisions is to always wait for the later payment or always take the earlier payment. So, we would not be able to distinguish this type of inconsistent behavior from extreme behavior. We thank a referee for pointing this out to us. However, because males are more consistent than females, but blacks are less consistent than whites, it is not obvious that the factors that are causing inconsistency are also generating our racial and gender differences in our patience measure.

[15] A test of difference in the proportion of inconsistent subject across black and white subjects yields a p-value of 0.0008 and comparing girls and boys is 0.0675. The differences are also significant in a linear regression where a dummy variable of being inconsistent is regressed on male, black and math and reading scores.

[16] Roughly 8% of children in our sample do not meet grade level requirements for both math and reading.

nonparametric procedure. We find the distribution of choices over the twenty decisions that is consistent and minimizes the total amount of money that would have to be spent to adjust the subject's behavior to make the choice pattern appear consistent.[17]

As Table 3a makes clear, our procedure does not alter the basic features of the distribution of elicited discount rates. The distributions across the full sample and the consistent subjects are similar. The table also suggests that, in comparison with Harrison et al.'s (2002) experiment, children are more impatient than adults.[18]

Table 4 shows that, on average, boys have larger discount rates than girls. Overall, the rates of boys are 12.5 percentage points larger among children that answered consistently (9.5 percentage points in the full sample), and this difference is significantly different. The same is true if preferences are measured by the number of impatient decisions. The sex difference result is consistent with what Bettinger and Slonim (2007) found in their sample of kids aged 5-16. Table 4 suggests, however, that the result that boys are more impatient than girls is partially race dependent. While the discount rates of white boys are larger than those of white girls, these differences are imprecisely measured (p-value= 0.151 for a t-test of difference in means). We look at these results more closely in subsequent regressions.[19]

Black boys have discount rates between 12 and 16 percentage points larger than those of black girls, and they make between 1.8 and 2.2 more impatient decisions than black girls. Table 4 shows that the differences in time preferences are not due to the choices of the inconsistent children or the way in which we model these choices. The differences tend to be larger when the analysis is restricted to children making consistent choices.

[17] Let x_{ij} be the amount of money child i chooses from menu j and let X be the set of all possible consistent patterns of behavior. Our estimates for inconsistent children are based on the x such that $x=\text{argmin}_{x \in X} \sum_j | x_{ij}-x_j|$.

[18] We know from Andersen et al (2008) and others that without accounting for risk aversion, discount rates are overestimated. We show estimates of time preferences controlling for risk in the next subsection.

[19] The results for boys versus girls and black children versus white children are main effects. Interval regression analysis using an interaction term of sex and race does not yield a significant coefficient on the interaction term.

The results also show that there are statistically significant differences between races. Black children have higher discount rates than white children, and black boys possess larger rates than any other group. For example, the discount rates of black boys are between 13.2 and 14.7 percentage points larger than that of white boys. Bettinger and Slonim find no differences by race.

Looking at the distribution of discount rates across race and sex, Table 3b shows that impatience is not distributed uniformly. In particular, 32.8% of black boys and 27.8% of black girls have elicited discount rates above 140%. In comparison, only 16.1% of white girls, and 19.1% of white boys have rates above 140%. There is a more equal distribution across sex and race at the other end of the distribution, where discount rates are less than 20%. The patterns are similar among consistent subjects. These results suggest that while there is a sizable group of black children that behave extremely impatiently and drive up the average rates, not all do.

4.3 Robustness Checks on Discount Rates

The raw averages and distribution of elicited discount rates may be affected by a variety of factors, including availability of field alternatives, risk aversion, cognitive ability and socio-economic background. We address each of these in turn and show that the main sex and race differences still hold.

First, black children and boys may seem to have higher discount rates because they have investment alternatives that are more profitable than what is offered in the experiment. For black children, given that the differences in discount rates are largely explained by the over representation above 140%, this explanation would suggest exceedingly large potential gains in the field that are available to black children but not white children. For boys, this explanation

would suggest that boys have greater access to field alternatives than girls. Based on conversations with school administrators and teachers, such alternatives do not appear to exist in the school district.

Second, Andersen et al (2008) argue that differences in elicited discount rates can instead reflect differences in risk preferences. In particular, relatively more risk averse subjects will appear more impatient.[20] Risk preferences thus could affect the ordering of our results across sex and across race if those who have higher discount rates are also more risk averse or those who have lower discount rates are less risk averse. This would mean that black children would have to be more risk averse or girls less risk averse.[21]

The data collected from the risk preference experiment help us address this issue. Table 5 shows maximum likelihood estimates of discount rates controlling for risk. As has been used previously in the literature, we use a constant relative risk aversion (CRRA) utility function.[22]

The first column shows estimates on discount rates by sex and race for the entire sample, without controlling for risk. Confirming the results from the previous section, the estimates show that boys and black children have significantly higher discount rates. Column 2 replicates the estimates in column 1 for the subsample that participated in both the time and risk preference experiments. The differences across sex and race are also found in this subsample. The final column shows joint estimates of discount rates and risk with this smaller subsample. There are no significant differences by sex or race for risk in the subsample, however, the estimated constant is 0.46 and significantly different from zero. This value implies a coefficient of constant

[20] Andreoni and Sprenger (2010a) would suggest that any "de-biased" estimate of discount rates (by controlling for risk) would over correct discount rates because risk preferences are more concave than time preferences. Also, note that Bettinger and Slonim (2007) collected independent data on risk preferences of their subjects and find that they have no effect on time preferences.
[21] We find the opposite pattern in our raw data. Using all the risk data (608 obs) and an Ordered Logit regression, with the number of the chosen lottery in the risk experiment (higher numbers indicating riskier options) as the dependent variable, we find that both boys and black children are more risk seeking, not more risk averse.
[22] The specific utility function is $u(x)=x^r$.

relative risk aversion of 0.56, similar to estimates among adults (Harrison et al, 2005; Cox and Oaxaca, 1996).

Most importantly, even controlling for risk, boys and black children have significantly higher discount rates. Note that, as suggested by Anderson et al. (2008), controlling for risk preferences reduces the estimates of elicited discount rates. The coefficient estimates in column 3 are roughly a third of the size of the estimates in column 2. Nevertheless, controlling for risk does not alter the relative differences across sex and race: boys and black children have significantly higher discount rates.

A final robustness check controls for socio-economic background and measures of cognitive ability in math and reading (Table 6). Cognitive ability may play a role in determining discount rates, as well as in our ability to measure them accurately through an experimental procedure (Benjamin et al., 2006; Burks et al, 2009; Dohmen et al., 2011). Indeed, if cognitive ability makes people more patience, then including cognitive ability on the right-hand side would bias our results on sex and race towards no effect.

The regressions in Table 6 proceed in two stages. We show interval regressions for the experimental discount rates and count regressions for the number of impatient decisions. The first set of regressions controls for the exogenous variables of sex and race and school fixed effects (school fixed effects are also a proxy for neighborhood effects). The results are even stronger if we just regress discount rates on sex and race and do not include school fixed effects. The table shows that our main results hold.

The next set of regressions includes controls for cognitive ability, income and neighborhood characteristics (which we use because we do not have additional controls for household characteristics). The first set of controls includes instructional setting (gifted, special

education), a measure of cognitive ability (math and reading scores from 7th grade standardized tests), income (free and reduced lunch status) and school fixed effects.[23] The second set of controls is from the 2000 census at the block group level: the proportion of college educated and the proportion of vacant housing. Education is used as a proxy for neighborhood income, since median neighborhood income is likely more imprecisely measured than education.[24] We also use vacant housing as a proxy for the economic vibrancy of the neighborhood.

Only the covariates for male, black and math ability are statistically different from zero (children with higher math scores have smaller discount rates).[25] The coefficients on male and black are smaller than in the first set of regressions, consistent with cognitive ability biasing estimates downwards. The census variables are insignificant.

In sum, our main results that boys are more impatient than girls and black children are more impatient than white children are robust to controls for risk aversion, cognitive ability and socio-economic characteristics.

5. Economic Consequences of Time Preferences

We now turn to our second research question, whether there is a relationship between time preferences and an educational outcome that has been shown to have economic consequences.

[23] We use the full sample for these regressions, but we obtain qualitatively similar results if we include a dummy variable for being inconsistent.
[24] Proportion of college educated is highly correlated with median income (correlation=0.78). All regression results in Tables 6 & 7 hold (some less precisely, but all still significant) if we include median income.
[25] The qualitative results also hold if we control for age of the subject. That is, we can eliminate the hypothesis that higher discount rates may be due to older students choosing impatiently because they believe they will drop out of school before payment of the patient option. We also run a stacked regression (as did Bettinger and Slonim, 2007), where the dependent variable is the decision to wait for the larger amount of money, controlling for the alternative, the other covariates in the Table 6 regression, and clustering the errors on the subject. We draw the same qualitative conclusions: the covariates for male, black and math ability affect impatience in the same directions as in Table 6 (some coefficients are less precisely estimated).

As argued by Bowles, Gintis and Osborne (2001) and Heckman, Stixrud and Urzua (2006), non-cognitive abilities influence educational and labor market outcomes. In this section, we investigate whether elicited discount rates affect the likelihood that a child receives a disciplinary referral after our experiment. The number of discipline acts incurred by a child in secondary school has been found to be a good predictor of a child's decision to drop out of school and of lower average lifetime earnings (Neild, Balfanz and Herzog, 2007; Segal, 2006; Viadero, 2006).

Our measures of discipline are based on the number of disciplinary referrals the child received during 8th grade and during 9th grade. We include 9th grade referrals because, in this grade, they are typically given for more serious infractions. A disciplinary referral happens when a student is sent to the administrative office (by a teacher, administrator or bus driver) and the behavior is entered into the student's data file (i.e. reprimand, detention, suspension, etc.). This measure does not include referrals to the office that do not result in a recorded entry in the student's data file.

On average, the children in our sample receive 2.2 referrals during eighth grade and 1.7 during ninth grade. However, the distributions are highly concentrated. Forty-four percent of the children have no disciplinary referrals at all in 8th grade and 57% have none in 9th grade. Also, the distribution of disciplinary referrals depends on the sex and race of the child. A black boy is disciplined an average of 3.5 (3.0) times in 8th grade (9th grade) while a white boy is disciplined 2.0 (1.5) times on average. A black girl is disciplined 2.4 (1.8) times while a white girl is disciplined only 0.8 (0.9) times.

We would like to see if our experimental measure of discount rate has additional explanatory power beyond what is currently known to correlate with disciplinary referrals. As

was noted above, boys get more referrals than girls, and black children get more referrals than white children. This pattern is not atypical of school districts in the U.S. (McCarthy and Hoge, 1987; Skiba, Michael, Nardo and Peterson, 2002). The following analysis examines whether discount rates are related to disciplinary referrals, even after controlling for factors that are known to explain discipline, such as sex and race.

Tables 7a - 7c present the estimates of a negative binomial regression model of disciplinary acts in 8^{th} or 9^{th} grade on a measure of impatience, controlling for demographics, measures of cognitive ability, instructional setting, inconsistency, income, and school and session fixed effects. Estimates are presented for the full sample and the sample of consistent subjects. We show results using the elicited discount rate as the measure of impatience. If we use the number of impatient decisions instead, we get the same qualitative results.[26]

Table 7a shows estimates for the relationship between discipline and the elicited discount rates. The estimates of the effect of impatience on discipline in the 9^{th} grade are larger than in 8^{th} grade, and the estimates for consistent subjects are the largest and most precisely estimated. For example, the estimates for 9^{th} grade discipline, using the full sample, imply that an increase in one standard deviation in the elicited discount rate increases the number of disciplinary referrals by 0.243 referrals (49.6×0.0049=0.243), implying an 14.3% increase from the average number of referrals.[27]

[26] We could use the maximum likelihood estimates of the discount rate (from Table 5) in these regressions. We do not for two reasons. First, because the maximum likelihood estimates do not yield a significant difference across sex and race for risk aversion, the estimated discount rates are just a linear deflation of our elicited discount rates (because we use the annual interest rate, not the effective interest rate). Therefore, using the ML estimates would not change the results in the discipline regressions. Second, the ML estimates are from the subsample of children who participated in both the risk and time preference experiments. Using this smaller sample will give us less precise estimates of the effect of impatience on discipline.

[27] The estimated standard deviations are underestimated because of censoring at the top of the distribution of elicited discount rates from the experiment. Thus our estimate of the effect of discount rate on referrals is also underestimated. The mean elicited discount rate for all subjects in Table 4 is 85.8 (standard deviation 49.6). The marginal effect of discount rate on referrals is 0.0049, and the average number of disciplinary referrals in 9^{th} grade 1.7.

Of course, these estimations do not control for other factors that might affect discipline, such as demographics, cognitive ability and socio-economic factors. It is important to note that including controls that are correlated with the discount rate, such as male, black or math scores, makes it more difficult to get a precise estimate of the relationship between patience and discipline. Thus, including these additional controls, which we do in the next set of regressions, makes generating statistically significant estimates less likely.

As shown in Tables 7b & 7c, patience is still significantly correlated with discipline even after including these potential confounders in the regressions. Table 7b shows estimates for the full sample. Table 7c does the same for the sample of consistent subjects. In Table 7b, the estimates of the effect of patience on 8^{th} grade discipline become insignificantly different from zero and the ones for 9^{th} grade are the same in magnitude and significance. If we narrow the sample to only that of consistent subjects (Table 7c), the estimates are more precise. The estimates for impatience are now significant for both 8^{th} and 9^{th} grades. The coefficient estimates for 8^{th} grade are similar to those in Table 7a, but the estimates for 9^{th} grade are larger.

The estimation indicates that, for the sample of only consistent subjects and controlling for other factors, an increase of one standard deviation in the elicited discount rate increases the number of disciplinary referrals in 9^{th} grade by 0.268 (49.6×0.0056=0.268), implying an increase in 15.8% above the mean number of referrals. This effect is slightly smaller than a one standard deviation increase in qualifying for free and reduced lunch (an increase in 0.32 referrals) or in standardized math scores (in the opposite direction however: a decrease in referrals by 0.53).

These results show that experimentally-elicited measures of impatience are correlated with an economic outcome of interest: disciplinary referrals. The correlation holds even when controlling for other factors that are predictive of discipline. Experimental measures of patience

thus seem to be another variable to consider when trying to understand school outcomes that have consequences later in life.

6. Conclusions

We investigated the distribution of time preferences of children and its effects on educational outcomes. We collected data from 878 eighth graders in a suburban/rural school district in Georgia. These students represent a large proportion of the entire population of 8th graders in the county. We find that boys are more impatient than girls and black children are more impatient than white children. Black boys have the largest discount rates compared to any other demographic group. Measures of risk aversion, socio-economic background and cognitive ability are unable to explain the difference in time preferences across sex and race. We find a high degree of heterogeneity in children's preferences, but more so among black children who are overrepresented among children with extremely high discount rates.

Most importantly, our research shows that experimentally-elicited measures of time preferences are correlated with disciplinary referrals, even controlling for other covariates such as demographics, measures of cognitive ability and school effects. Disciplinary referrals have been show to predict economic outcomes, such as dropping out of school and lower wages later in life. A one standard deviation increase in the discount rate increases disciplinary referrals in 9^{th} grade by 14.3%. To our knowledge, this is the first experimental work on time preferences among children that provides evidence of a relationship between preferences and outcomes.

Our design using a front-end delay allows us to measure patience, not impulsivity (as Mischel et al (1989) did in their marshmallow experiment), as it relates to educational outcomes.

To improve our understanding about educational outcomes, future research should measure both patience and impulsivity and elucidate which explains more of the variance in outcomes.

Our data do not fully reveal from where time preferences and their heterogeneity across children come, nor the full range of behaviors that are affected by them. However, they do show that experimental methods are important not only in detecting differences in a population, but perhaps also as a starting point in improving our understanding of divergent life paths. More specifically, they suggest testable predictions about how students will respond to educational interventions, particularly those that use economic incentives, and how interventions could be redesigned to be more effective.

For example, based on our results, we would predict that girls would likely be more responsive to student performance incentives because they have lower discount rates. Angrist and Lavy (forthcoming) found that an incentive program in Israel that paid students conditional on their performance on university entrance exams had a greater effect on girls. Similarly, Angrist, Lang and Oreopoulus (2009) found that girls were more responsive in a study of the effect of financial incentives on college achievement. Among elementary school students in Ohio, however, Bettinger (2010) found no significant gender effects of financial incentives on standardized test scores.

Our results also lead to a prediction that any disparities created by a performance reward system would decrease as the period between investments and rewards is shortened; a hypothesis that can be tested experimentally. At the very least, our results suggest that future performance incentive experiments might benefit from experimentally soliciting time preferences at baseline in order to better understand heterogeneous treatment effects.

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Table 1: Subject Decision Sheet

Decision	Paid One Month From Now		Paid Seven Months From Now	Implied Annual Interest Rate	Implied Annual Effective Interest Rate
1	$49.00	or	$50.83	7.35%	7.60%
2	$49.00	or	$52.71	14.7%	15.73%
3	$49.00	or	$54.66	22.05%	24.42%
4	$49.00	or	$56.66	29.40%	33.70%
5	$49.00	or	$58.72	36.75%	43.62%
6	$49.00	or	$60.85	44.10%	54.20%
7	$49.00	or	$63.04	51.45%	65.50%
8	$49.00	or	$65.29	58.80%	77.54%
9	$49.00	or	$67.61	66.15%	90.39%
10	$49.00	or	$70.00	73.50%	104.09%
11	$49.00	or	$72.46	80.25%	118.68%
12	$49.00	or	$74.99	88.20%	134.22%
13	$49.00	or	$77.59	95.55%	150.77%
14	$49.00	or	$80.27	102.90%	168.38%
15	$49.00	or	$83.03	110.25%	187.13%
16	$49.00	or	$85.86	117.60%	207.06%
17	$49.00	or	$88.78	124.95%	228.26%
18	$49.00	or	$91.77	132.30%	250.79%
19	$49.00	or	$94.85	139.65%	274.73%
20	$49.00	or	$98.02	147.00%	300.16%

Note that subjects did not see the last two columns in this table. These columns are included to show the implied annual interest rate and effective interest rate associated with each choice.

Table 2: Descriptive Statistics

Variable	Mean (s.e.)	% Inconsistent Choices (s.e.)	Number
Age (years)	13.8 (0.2)		866
Male	48.4%	28.1 (2.3)	410
Female	51.6%	33.9 (2.3)	437
Black	46.6%	37.5 (2.4)	395
White	47.5%	26.4 (2.2)	402
Black Males	21.6%	33.3 (3.5)	183
Black Females	25.0%	41.0 (3.4)	212
White Males	24.7%	24.9 (3.0)	209
White Females	22.8%	28.0 (3.3)	193
Free & Reduced Lunch	63.5%	33.7 (2.0)	537
Special Education	24.8%	35.8 (3.2)	218
Gifted	8.8%	15.6 (4.2)	77
Math score 7^{th} grade (standardized)	0.56 (0.003)		791
Reading score 7^{th} grade (standardized)	0.56 (0.002)		792
7^{th} Grade Discipline (number)	1.9 (0.1)		814
8^{th} Grade Discipline (number)	2.2 (0.1)		862
9^{th} Grade Discipline (number)	1.7 (0.1)		819
Total		30.8 (46.2)	878

Note: some subjects are missing demographic data (sex, race and age) and discipline data, and some are missing data on test scores (because they were not in the school system between testing and the experiment).

Table 3a. Distribution of Preferences

Discount Rate	Frequency (Percent)	
(*d.r.*)	Full Sample	Consistent
d.r.≤20	122 (13.9)	93 (15.3)
20<*d.r.*≤40	44 (5.0)	33 (5.4)
40<*d.r.*≤60	129 (14.7)	106 (17.4)
60<*d.r.*≤80	120 (13.7)	101 (16.6)
80<*d.r.*≤100	103 (11.7)	68 (11.2)
100<*d.r.*≤120	50 (5.7)	30 (4.9)
120<*d.r.*≤140	102 (11.6)	50 (8.2)
d.r.>140	208 (23.7)	127 (20.9)
Total	878	608

Table 3b. Distribution of Preferences by Sex and Race

Discount Rate	Girls (Percent)		Boys (Percent)	
(*d.r.*)	White	Black	White	Black
d.r.≤20	29 (15.0)	37 (17.5)	23 (11.0)	22 (12.0)
20<*d.r.*≤40	12 (6.2)	8 (3.8)	11 (5.3)	4 (2.2)
40<*d.r.*≤60	34 (17.6)	33 (15.6)	33 (15.8)	17 (9.3)
60<*d.r.*≤80	32 (16.6)	17 (8.0)	36 (17.2)	21 (11.5)
80<*d.r.*≤100	22 (11.4)	24 (11.3)	30 (14.4)	21 (11.5)
100<*d.r.*≤120	13 (6.7)	9 (4.2)	11 (5.3)	13 (7.1)
120<*d.r.*≤140	20 (10.4)	25 (11.8)	25 (12.0)	25 (13.7)
d.r.>140	31 (16.1)	59 (27.8)	40 (19.1)	60 (32.8)
Total	193	212	209	183

Table 4: Unconditional Means of Discount Rates and Impatient Decisions and t-tests for Difference in Means

	Discount Rate								Number of Impatient Decisions							
	Full sample				Consistent				Full sample				Consistent			
	Male	Female	t-test	p-value	Male	Female	t-test	p-value	Male	Female	t-test	p-value	Male	Female	t-test	p-value
All	90.7	81.2	-2.83	(0.005)	85.4	72.9	-3.09	(0.002)	11.0	9.6	-3.36	(0.000)	11.1	9.4	-3.08	(0.002)
Black	97.9	86.0	-2.33	(0.020)	93.3	77.4	-2.42	(0.016)	11.8	10.0	-2.89	(0.004)	12.2	10.0	-2.42	(0.016)
White	84.7	77.9	-1.44	(0.151)	78.6	71.2	-1.37	(0.173)	10.3	9.4	-1.54	(0.124)	10.2	9.2	-1.36	(0.176)
	Black	White	t-test	p-value	Black	White	t-test	p-value	Black	White	t-test	p-value	Black	White	t-test	p-value
All	91.5	81.4	-2.88	(0.004)	85.2	75.1	-2.36	(0.019)	10.8	9.8	-2.26	(0.024)	11.1	9.7	-2.36	(0.019)
	Yes	No	t-test	p-value	Yes	No	t-test	p-value	Yes	No	t-test	p-value	Yes	No	t-test	p-value
Gifted	71.1	87.2	3.16	(0.002)	65.0	81.0	2.89	(0.005)	9.0	10.4	2.16	(0.033)	8.3	10.5	2.89	(0.005)
Special Education?	90.8	84.1	-1.66	(0.098)	83.5	78.0	-1.08	(0.283)	10.6	10.2	-0.894	(0.372)	10.8	10.1	-1.070	(0.286)
Math - below median?	93.4	77.3	-4.59	(0.000)	87.0	71.9	-3.50	(0.001)	11.0	9.4	-3.50	(0.001)	11.3	9.3	-3.50	(0.001)
Reading - below median?	88.9	81.7	-2.05	(0.041)	84.0	73.9	-2.36	(0.018)	10.5	9.9	-1.56	(0.120)	10.9	9.6	-2.36	(0.018)
Free/Reduced lunch?	88.8	80.7	-2.40	(0.017)	81.6	75.7	-1.45	(0.147)	10.5	9.9	-1.53	(0.127)	10.6	9.8	-1.44	(0.150)

Table 5: Maximum Likelihood Estimates: Discount Rates Controlling for Risk Aversion

VARIABLES	(1) All Data On time preferences	(2) Subsample On time and risk preferences	(3) Subsample On time and risk preferences
Discount rates			
Male	0.29***	0.21***	0.08**
	(0.03)	(0.08)	(0.03)
Black	0.27***	0.44***	0.11***
	(0.03)	(0.08)	(0.04)
Constant	0.99***	1.21***	0.44***
	(0.02)	(0.06)	(0.07)
Risk			
Male			0.02
			(0.01)
Black			-0.01
			(0.01)
Constant			0.46***
			(0.06)
Observations	804	225	225
Log likelihood	-9646.97	-2720.51	-3098.18

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 6: Regression Analysis: Discount Rates and Number of Impatient Decisions (ALL DATA)

VARIABLES	(1) Discount Rate Interval Regression	(2) Discount Rate Interval Regression	(3) Impatient Decisions Count Regression	(4) Impatient Decisions Count Regression
Male	10.68**	9.34**	0.14***	0.12**
	(4.28)	(4.53)	(0.05)	(0.05)
Black	9.17**	6.27*	0.08*	0.08*
	(3.87)	(3.61)	(0.04)	(0.04)
Hispanic/Multi-Racial	-0.33	1.89	0.03	0.07
	(7.98)	(8.02)	(0.11)	(0.11)
Gifted		-3.02		-0.02
		(7.75)		(0.10)
Special Education		-6.06		-0.09
		(5.83)		(0.06)
7^{th} grade math score		-74.04**		-0.56
(standardized)		(30.64)		(0.38)
7^{th} grade reading score		-6.35		-0.28
(standardized)		(50.81)		(0.53)
Free and reduced lunch		0.54		-0.01
		(4.71)		(0.07)
Proportion College Ed		-13.58		-0.20
(Block-group census)		(19.67)		(0.24)
Proportion vacant housing		57.25		0.36
(Block-group census)		(91.39)		(1.01)
Constant	78.81***	129.84***	2.26***	2.82***
	(4.78)	(24.40)	(0.06)	(0.25)
School Fixed Effects	*Yes*	*Yes*	*yes*	*yes*
Observations	847	780	847	780
Log likelihood	-2641.56	-2433.60	-2739.98	-2523.31

Robust standard errors clustered by school and room in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 7a: Disciplinary Referrals – Negative Binomial Regressions

VARIABLES	(1) All Data 8th Grade	(2) Consistent Only 8th Grade	(3) All Data 9th Grade	(4) Consistent Only 9th Grade
Discount Rate	0.002	0.002*	0.003**	0.005***
	(0.001)	(0.001)	(0.002)	(0.002)
Constant	1.121***	1.169***	-0.097	-0.116
	(0.200)	(0.223)	(0.239)	(0.279)
School and Room Fixed Effects	*Yes*	*Yes*	*Yes*	*Yes*
Observations	862	596	819	570
Log likelihood	-1606.16	-1078.16	-1312.19	-909.11

Robust standard errors clustered by school and room in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 7b: Disciplinary Referrals (ALL DATA) – Negative Binomial Regressions

VARIABLES	(1) All Data 8th Grade	(2) All Data 8th Grade	(3) All Data 9th Grade	(4) All Data 9th Grade
Discount Rate	0.001	0.001	0.003**	0.003**
	(0.001)	(0.001)	(0.001)	(0.002)
Male	0.617***	0.608***	0.468***	0.470***
	(0.081)	(0.081)	(0.157)	(0.150)
Black	0.359***	0.342***	0.240	0.275*
	(0.131)	(0.126)	(0.163)	(0.163)
Hispanic/Multi-Racial	0.186	0.168	-0.183	-0.131
	(0.219)	(0.223)	(0.262)	(0.259)
Gifted	-0.466	-0.424	-0.163	-0.187
	(0.340)	(0.343)	(0.310)	(0.328)
Special Education	-0.018	-0.012	0.115	0.073
	(0.131)	(0.132)	(0.153)	(0.152)
7th grade math score	-4.267***	-4.221***	-5.749***	-5.742***
(standardized)	(0.953)	(0.957)	(1.283)	(1.323)
7th grade reading score	-1.536	-1.523	-3.453**	-3.468**
(standardized)	(1.191)	(1.190)	(1.483)	(1.443)
Free and reduced lunch	0.521***	0.503***	0.810***	0.851***
	(0.125)	(0.123)	(0.205)	(0.219)
Inconsistent	-0.141	-0.129	-0.317*	-0.331*
	(0.144)	(0.145)	(0.173)	(0.178)
Proportion College Ed		-0.321		0.980
(Block-group census)		(0.550)		(0.624)
Proportion vacant housing		1.059		-0.856
(Block-group census)		(1.815)		(2.197)
Constant	3.335***	3.277***	3.625***	3.575***
	(0.550)	(0.527)	(0.672)	(0.577)
School and Room Fixed Effects	*yes*	*Yes*	*Yes*	*Yes*
Observations	790	779	748	738
Log likelihood	-1388.27	-1373.68	-1138.99	-1125.23

Robust standard errors clustered by school and room in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7c: Disciplinary Referrals (CONSISTENT ONLY) – Negative Binomial Regression

VARIABLES	(1) Consistent Only 8th Grade	(2) Consistent Only 8th Grade	(3) Consistent Only 9th Grade	(4) Consistent Only 9th Grade
Discount Rate	0.002*	0.002*	0.005***	0.005***
	(0.001)	(0.001)	(0.002)	(0.002)
Male	0.586***	0.591***	0.473**	0.466**
	(0.123)	(0.125)	(0.200)	(0.198)
Black	0.258**	0.243*	0.346**	0.354**
	(0.130)	(0.130)	(0.168)	(0.175)
Hispanic/Multi-Racial	0.318	0.301	-0.037	-0.006
	(0.271)	(0.277)	(0.268)	(0.263)
Gifted	-0.275	-0.226	-0.079	-0.088
	(0.356)	(0.361)	(0.392)	(0.405)
Special Education	-0.106	-0.108	0.178	0.147
	(0.192)	(0.200)	(0.209)	(0.204)
7th grade math score	-4.409***	-4.318***	-5.977***	-5.960***
(standardized)	(0.933)	(0.941)	(1.286)	(1.288)
7th grade reading score	-2.325*	-2.407**	-4.108**	-4.478**
(standardized)	(1.224)	(1.224)	(1.818)	(1.810)
Free and reduced lunch	0.402**	0.398**	0.658***	0.719***
	(0.160)	(0.168)	(0.246)	(0.271)
Proportion College Ed		-0.345		0.851
(Block-group census)		(0.530)		(0.775)
Proportion vacant housing		0.750		-0.991
(Block-group census)		(2.071)		(2.871)
Constant	3.979***	3.966***	3.969***	4.115***
	(0.840)	(0.857)	(0.985)	(0.939)
School and Room Fixed Effects	*yes*	*Yes*	*Yes*	*Yes*
Observations	547	540	520	514
Log likelihood	-931.13	-920.03	-784.98	-777.33

Robust standard errors clustered by school and room in parentheses. *** p<0.01, ** p<0.05, * p<0.10