Human Capital and the Lifetime Costs of Impatience*

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Abstract

In this paper, we examine the role of impatience in the formation of human capital - arguably the most important investment decision individuals make during their lifetime. Economic agents who are dynamically inconsistent will tend to under-invest in human capital that requires an up-front sacrifice in exchange for greater future consumption. We examine this hypothesis by comparing the investment decisions of impatient people to those of their more patient counterparts, the results of which reveal a substantial divergence. Using data from the NLSY and a straightforward measure of impatience, we find that people with time-inconsistent preferences systematically acquire lower levels of multiple measures of human capital including AFQT scores, educational credentials, and firm tenure. A substantial fraction of these differences arise from dynamically inconsistent behavior, such as starting an educational program but failing to complete it. As this cohort reaches middle age, the cumulative investment differences result in the impatient earning 13 percent less and expressing significantly more regret for their previous decisions.

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1 Introduction

For most individuals, choosing how much human capital to acquire represents the most important investment decision they make during their lifetimes. These decisions are made earlier than other investment choices, and they have permanent and long-lasting consequences. In this paper, we investigate the importance of impatience in human capital acquisition and find that impatient individuals acquire significantly less schooling than do their patient counterparts. This initial result is consistent with either lower exponential discount rates or dynamically inconsistent preferences. We then present several pieces of evidence suggesting that the patience gap in educational attainment results from short-run impatience, which leads to individuals failing to attain their personally optimal level of human capital.

In particular, most of these differences in completed schooling result from a series of failures to complete educational credentials that have already been started. On average, we find that impatient individuals are 50 percent more likely to drop out of high school and 15 percent more likely to drop out of college, conditional on starting. These results are consistent with the central theme of recent work in behavioral economics: time-inconsistency leads to sub-optimal decreases in investment in favor of increases in short-term consumption (DellaVigna 2009). Finally, we present direct evidence that the impatient have higher levels of regret, a result that is inconsistent with fully rational investment behavior.

Our analysis relies on data from the National Longitudinal Survey of Youth (NLSY), a panel of young people aged 14-21 when the survey began in 1979, and a straightforward categorization of impatience. We identify individuals as impatient if, during any of the first five waves of the survey, their interviewer codes them as "impatient/restless."[1] These interviewer ratings have a substantial amount of predictive power for behaviors frequently

[1] The alternatives are "friendly/interested", "cooperative/not interested", and "hostile". The "hostile" response has no predictive power for the outcomes we study.

associated with impatience generally, and with hyperbolic discounting specifically. We find that those identified as impatient are significantly less likely to have a bank account, more likely to smoke, more likely to drink to excess, less likely to complete military commitments, and more likely to leave the survey in which they had previously agreed to participate. These choices are indicative of dynamically inconsistent decision-making, as was also concluded by DellaVigna and Paserman (2005), who rely on the same question from the NLSY and find that impatient individuals are less motivated in their job search.[2] Our supplementary analysis using the National Longitudinal Study of Adolescent Health (Add Health) establishes that these types of interviewer ratings do not simply capture youth with ADHD or other attention difficulties who are known to have higher costs of human capital formation (Currie and Stabile 2006).

We then follow these individuals for the next 25 years, documenting the significant divergence in their human capital investment and resulting earnings. As this cohort reaches middle age, the impatient have obtained substantially less schooling, have experienced a greater number of employment separations, and on average have earned a cumulative total of $64,000 less than their patient counterparts, a difference of approximately 13 percent.

In addition to providing empirical support for the standard theoretical result that discount rates affect human capital investment, our results further substantiate both the existence and importance of time-inconsistent preferences. Previous research has found evidence of dynamic inconsistency across a number of applications, although the costs of many of these suboptimal choices are substantially smaller than the costs identified in this study.[3] Choosing one's level of human capital effectively sets a budget constraint for each remaining period thereafter, and failing to invest optimally early in life thus creates a lifetime of

[2]See also O'Donoghue and Rabin (1999).

[3]For example, DellaVigna and Malmendier (2006) find that gym members paying on a monthly basis frequently pay more per visit than the per-visit cost.

negative consequences.

These results therefore provide potential explanations for important outstanding questions in the economics of education and human capital formation. First, high school dropout rates are difficult to reconcile with the observed size of skill premiums. Students required to remain in school for an additional year experience substantial gains in lifetime earnings and self-reported satisfaction, suggesting that many dropouts make sub-optimal investment decisions (Angrist and Krueger 1991, Acemoglu and Angrist 2000, Oreopoulos 2007). Our results provide direct evidence in favor of interpreting these sub-optimal decisions as resulting from myopic preferences.

Additionally, recent experimental work providing conditional cash transfers to at-risk students has successfully improved school performance and reduced dropout behavior (Fryer 2010).[4] In particular, student outcomes appear much more responsive to incentive payments that target immediate behavior (e.g. studying, reading books) rather than longer-term outcomes (e.g. grades or test scores). Given the relatively small size of the incentive payments compared to the lifetime earnings consequences, these changes in behavior are difficult to understand from a rational investment perspective. If, instead, at-risk students fail to account fully for the long-term consequences of their early choices, providing small conditional payments can create powerful incentives to increase investment in human capital. In fact, taking the level of dynamically inconsistent preferences as given, these types of incentives are likely the most effective policy tool to address the problem of under-investment.

Yet there is additional evidence that impatience is not an immutable personality characteristic and that the ability to delay gratification can in fact be learned. In a seminal paper in the developmental psychology literature, pre-school age children were given a marshmal-

[4]Additional research along similar lines is currently being conducted by Bettinger (Ongoing Research) and Oreopoulos (Ongoing Research).

low and told that they would receive another marshmallow if they could delay eating the first for twenty minutes. Surprisingly, a child's ability to wait for the second marshmallow strongly predicted success in later life across a number of different metrics (Mischel, Shoda and Rodriguez 1989). Importantly, children provided with simple techniques for delaying gratification were able to wait successfully for the additional reward. In addition, Bettinger and Slonim (2007) find that not only do children have high discount rates, but over 25% of children ages 5-16 displayed behavior that was inconsistent with rational inter-temporal choice in a field experiment. Our findings extend this result to show that displays of impatience early in life are correlated with dynamically inconsistent human capital accumulation decisions and significantly lower earnings 25 years later.

Researchers have recently focused on the formative impact of early childhood education and its role in developing both cognitive and non-cognitive skills (Heckman 2000, Almond and Currie 2010). In particular, a systematic evaluation of an early childhood intervention designed to improve a variety of children's skills - including delaying gratification - found dramatic benefits for later life outcomes (Heckman, Moon, Pinto, Savelyev and Yavitz 2010b). Our results suggest that the increase in self-control skills contributes a crucial component of the overall return.

The remainder of the paper is organized as follows: the next section provides a conceptual framework for understanding how impatience generally and dynamic inconsistency specifically alter human capital investment decisions; Section 3 further discusses the data and presents the results; Section 4 concludes.

2 Conceptual Framework

In this section, we present a basic framework for understanding how impatience may affect human capital investment decisions. We discuss the investment decision by introducing the standard hyperbolic discounting representation of dynamically inconsistent preferences to the classic human capital investment model (Mincer 1958, Laibson 1997). The discussion below re-iterates the central finding of the behavioral literature: An economic agent with (β, δ) preferences will under-invest and over-consume relative to his ex ante optimum (DellaVigna 2009).

2.1 Setup

We begin by considering an economic agent deciding whether to obtain a credential, e.g. an academic degree. Given the sequential nature of education decisions, one can consider this decision as recurring repeatedly until an individual decides not to pursue further schooling. The investment is costly, with a net utility of $-C$ in the investment period, while not investing allows the agent to earn the non-credentialed utility level (income) Y_i^0. We assume that credentialed income is $Y_i^C > Y_i^0$ with no uncertainty. For expositional simplicity, we assume no real growth in earnings for either level of education, and we assume that acquiring the degree requires a single discrete time period investment.[5] Agents live for $T + 1$ periods, i.e. investments in the credential pay off for T periods if acquired.[6] We begin by determining the conditions under which an individual would like to obtain the credential, i.e. when ex ante benefits outweigh the ex ante costs.

[5]The central finding that only time-inconsistent impatience can explain dropout behavior is robust to an arbitrary specification of the returns to schooling. The precise formula for required returns for exponential discounters to invest will depend on the full return, including any increased return to experience.

[6]Note that in this setup, an increase in the number of periods required to obtain the credential is equivalent to a proportional decrease in T.

2.2 Cutoff Return for Investment

Suppose, as is frequently the case, that the enrollment decision occurs prior to actually beginning the investment process. Thus, in the initial time period, the agent faces the choice between two future streams of utility.

$$\text{Obtain Credential: } \beta\delta(-C_i) + \beta\delta^2 \sum_{t=0}^{T-1} \delta^t Y_i^C \tag{1}$$

$$\text{Do Not Obtain Credential: } \beta\delta Y_i^0 + \beta\delta^2 \sum_{t=0}^{T-1} \delta^t Y_i^0 \tag{2}$$

Note that from an ex ante perspective, the agent applies the hyperbolic discount rate to both the costs and benefits of obtaining the credential. Thus, an individual's optimal choice of whether to obtain the credential can be characterized regardless of his level of dynamic inconsistency. The i subscripts allow for the possibility of heterogenous investment costs and returns to schooling across individuals. We first characterize the set of individuals who *desire* to obtain the credential as a function of the underlying parameters.

Investment is optimal if

$$\beta\delta^2 \sum_{t=0}^{T-1} \delta^t (Y_i^C - Y_i^0) > \beta\delta(Y_i^0 + C) \tag{3}$$

Dividing through by $\beta\delta^2 Y_i^0$ gives

$$\sum_{t=0}^{T-1} \delta^t \left(\frac{Y_i^C}{Y_i^0} - 1 \right) > \frac{1 + \frac{C}{Y_i^0}}{\delta} \tag{4}$$

Using the notation $r_i^c \equiv \frac{Y_i^C}{Y_i^0} - 1$ (i.e. the "return to the credential") and $I = 1 + \frac{C}{Y_i^0}$ (i.e. the "cost of investment" as a fraction of base annual earnings) gives us:

$$r_i^c > \frac{I}{\delta \sum_{t=0}^{T-1} \delta^t} \tag{5}$$

Using the fact that $\sum_{t=0}^{T-1} \delta^t = \frac{(1-\delta^T)}{1-\delta}$, we can write

$$r_i^c > \frac{(1-\delta)I}{\delta(1-\delta^T)} \equiv r_0^{min} \tag{6}$$

The optimal decision, therefore, is based on a cutoff rate of return. Individuals with $r_i^c > r_0^{min}$ find it optimal to invest, and others do not. For completeness, we can group all of the individually varying terms on one side of the inequality:

$$\frac{r_i^c}{I} = \frac{Y_i^C - Y_i^0}{Y_i^0 + C_i} > \frac{(1-\delta)}{\delta(1-\delta^T)} \tag{7}$$

Without loss of generality, we can identify some fraction of individuals $1 - G\left(\frac{(1-\delta)}{\delta(1-\delta^T)}\right)$ for whom enrollment is optimal, with $G(\cdot)$ the CDF of $\frac{r_i^c}{I}$.

2.3 The Role of Impatience

Note that the β term has disappeared entirely in calculating the set of individuals for whom investment is optimal. This is a standard result: The presence of hyperbolic discounting does not affect the discount rate between two future periods. Instead, short-run impatience implies that an economic agent's analysis of whether an investment provides a sufficient return changes when the investment costs must be paid "right now." Continuing with the above example, we find that a subset of the impatient will fail to obtain an ex ante optimal credential, while all of the time-consistent ($\beta = 1$) actors will follow through with their previous plans.

In the next period, agents must decide whether to continue paying the cost of obtaining the credential or instead to drop out. It can easily be shown that people will continue to pay the cost of investment and actually receive the credential when

$$r_i^c > \frac{(1-\delta)I}{\beta\delta(1-\delta^T)} \equiv r_1^{min} \tag{8}$$

The presence of the $\beta \leq 1$ term in the denominator implies that

$$r_1^{min} \geq r_0^{min} \tag{9}$$

The presence of hyperbolic discounting, therefore, effectively alters the return an individual requires to follow through on his plan to obtain a worthwhile investment. The required returns will be equal for exponential discounters; any exponential discounter who decides to enroll in the program will finish his education. For hyperbolic discounters, however, a subset of those who agreed to enroll will end up dropping out when faced with the immediacy of the costs.[7]

2.4 Testable Implications

This basic framework provides a number of empirical implications for how the educational investment decisions of NLSY participants classified as impatient should differ from those of the patient. Further, there are multiple distinct implications that will allow us to determine the extent to which the NLSY impatience measure captures low β, i.e. short-run impatience, rather than low δ, i.e. a low discount rate. As previously discussed, only the dynamically inconsistent version of impatience creates sub-optimal investment decisions when viewed from the individual's perspective.

[7]The fraction of impatient enrollees who drop out will be $\frac{G\left(\frac{(1-\delta)}{\beta\delta(1-\delta^T)}\right)-G\left(\frac{(1-\delta)}{\delta(1-\delta^T)}\right)}{G\left(\frac{(1-\delta)}{\delta(1-\delta^T)}\right)}$.

First, the short-run impatient should be more likely to follow time-inconsistent investment patterns as they acquire human capital. They should be more likely to drop out of high school, only to realize their mistake and return for a GED. Similarly, they should be more likely to fail to complete a college degree, conditional on starting. Additionally, those with dynamically inconsistent preferences should be more likely to fail to meet their own educational expectations.[8] In the empirical section, we present evidence that the impatient engage in precisely this set of behaviors.

As a result of these dynamically inconsistent investment choices, the impatient will begin their working careers with significantly lower levels of human capital. Of course, one would expect "impatient" people to obtain fewer years of schooling, even if their interviewer-perceived impatience merely reflected a lower exponential discount rate (δ). As discussed by Oreopoulos (2007), however, the lifetime labor market returns to schooling are large enough that differences in completed schooling are much more likely to arise from differences in myopia rather than from differences in time-consistent patience. Nevertheless, finding that impatient individuals acquire less schooling does not necessarily imply that they obtain *sub-optimally* lower levels of schooling when viewed from the individual's perspective. Instead, we rely on this finding in combination with the additional evidence of time-inconsistent investment patterns in reaching this conclusion.

Note that low levels of education resulting from long-run impatience (i.e. low δ) may also lead to sub-optimal investment decisions when viewed from a societal perspective. If, for example, impatient (but time-consistent) preferences lead to more reliance on social assistance programs, lower contributions to public goods through the tax system, higher participation in crime, or other externalities, interventions designed to increase long-run

[8] Note that this prediction technically requires either naiveté or overconfidence in addition to dynamically inconsistent preferences. If the impatient can accurately reason that they will fall short of their own goals, they may expect to fail.

patience may also be justified.

2.5 Extension to Experience and Tenure

Determining the predictions for other types of human capital investment, including experience and different forms of tenure, proves more difficult than doing so for education. A simple re-labeling of the above framework suggests that we should find the (naive) impatient and exponential discounters equally likely to begin career paths that require an initial investment (long hours, low pay, low status, reduced freedom, etc.) in exchange for a greater payoff in the future. Exponential discounters should continue along the investment path they have chosen. In contrast, hyperbolic discounters should be more likely to decide to try another position that provides a higher immediate-term utility.

One might therefore expect the impatient to experience more job switches than their patient counterparts. There is, however, a competing force moving this prediction in the opposite direction. The short-run impatient are more susceptible to inertia and less likely to expend effort in the job search process (O'Donoghue and Rabin 1999, DellaVigna and Paserman 2005). Thus, they should be less likely to make upwardly mobile career moves. In the empirical work, therefore, we examine not only the total number of job changes, but also the fraction of those changes that result in an increase in earnings.

3 Data and Results

The data we use to address each of these hypotheses come from multiple waves (1979-2004) of the NLSY. The initial sampling frame provided a nationally representative sample of the cohort aged 14-22 in 1979. The survey was conducted annually until 1994 and biennially thereafter. As previously discussed, we follow DellaVigna and Paserman (2005) and classify a respondent as impatient if he is coded by his interviewer as "impatient/restless" in any of the first five annual surveys (when respondents are between the ages of 14 and 27).

As evidence that these interviewer ratings properly identify respondents likely to have myopic preferences, Table 1 demonstrates that they strongly predict a number of associated behaviors. Respondents classified as impatient are more likely to have been a regular smoker and more likely to drink to excess, classic examples of myopic decisions. Impatient respondents are also less likely to have a bank account and are more likely to leave the survey in which they had previously agreed to participate. Finally, and notably, among those respondents who committed to a term of military service, the impatient are less likely to complete their term. With these supportive findings in mind, we now turn to the relationship between interviewer ratings and educational attainment.

Our educational outcome measures are derived from the highest grade completed as measured in the 2004 survey. Figure 1 shows the unadjusted distribution of educational attainment for the patient and impatient subsamples. These distributions provide initial evidence consistent with the hypothesis that the impatient under-invest in human capital. First, the impatient subsample has a significantly lower average level of education. In addition, much of that difference appears to derive from dropout behavior. More impatient respondents fail to finish high school, and of those who have more than a high school degree, the impatient are less likely to finish a four-year college degree.

Although suggestive of a behavioral interpretation, this simple comparison does not account for any alternative explanations for the patient-impatient schooling gap. For example, suppose that racial and ethnic minorities are more likely to be classified as impatient, and that they face discrimination that causes them to under-invest relative to their peers. Similarly, men and women may be differentially likely to exhibit impatience and their educational investment incentives likely differed for this cohort. Additionally, patience may be one of several advantages that children from higher socioeconomic backgrounds are more likely to enjoy along with other resources that allow for higher educational attainment. We therefore examine each of the hypotheses suggested by the conceptual framework in a multivariate regression that includes the following controls: gender, race and ethnicity dummies, mother's and father's level of education, access to reading materials, and year of birth dummies. Table 2 provides summary statistics for each of the dependent and independent variables.

Empirically, however, whether a survey respondent is characterized as impatient is only weakly correlated with these control variables. Figure 2 presents the distribution of the predicted values from a probit of impatience on this full set of controls.[9] Although the predicted values are somewhat higher among the impatient group, there is considerable overlap in the two distributions, suggesting that our patience measure varies substantially within each demographic category.

3.1 Educational Attainment Results

A large gap in educational attainment between impatient and patient respondents is documented in Table 3. The earliest available measure of educational attainment is the Armed Forces Qualifying Test (AFQT), administered as part of the 1980 survey. Although this measure is sometimes equated with "innate ability" or IQ, previous research instead suggests that a respondent's performance on this test measures his cumulative level of investment in cognitive human capital prior to the exam (Neal and Johnson 1996, Hansen, Heckman and Mullen 2004, Neal 2006, Cascio and Lewis 2006).[10] Compulsory attendance laws prevent meaningful variation in the level of early investment as measured by years of schooling. Consequently, the AFQT provides an especially useful measure of the extent to which impatient

[9]In Appendix Table A-1 we present the results from the probit regression that generated these predicted values.

[10]We follow Neal and Johnson (1996) in using age-adjusted AFQT scores.

individuals failed to invest in their own human capital early in their educational careers.

The regression results reveal a substantial gap: the impatient enter the survey with AFQT scores approximately one quarter of a standard deviation lower than those of their patient counterparts. The patient-impatient gap is about one third the size of the black-white gap and roughly equal in magnitude to the college graduate-high school graduate gap in one parent's education. Because AFQT scores are reasonably considered an outcome measure of cumulative human capital investment at the time of the test, we do not include AFQT scores as an independent variable in the analysis that follows.

The disparity in total schooling attained, suggested by Figure 1, is confirmed in the second column of Table 3. On average, the impatient complete about one half year less than similar patient respondents after controlling for observable pre-survey differences. Importantly, they are also nearly fifty percent more likely to drop out of high school (column 3). Given the returns to a high school education, it is difficult to reconcile this decision with a rational model of a optimizing investor with standard time-consistent preferences. This result is consistent with the findings of Oreopoulos (2007), who estimates that students compelled to take an extra year of school through minimum schooling laws experience an increase in annual earnings of 12 percent on average. Oreopoulos presents basic calculations of the exponential discount rates that could reconcile this finding and argues that the standard human capital model cannot explain the decision to drop out of high school. Much of the difference in total schooling attained can be attributed to the heightened rate at which the impatient drop out of high school.

The remainder of the specifications reported in Table 3 examine hypotheses unique to the short-run impatience interpretation. For each outcome, we find evidence that the impatient are significantly more likely to engage in dynamically inconsistent investment patterns. The impatient are fifteen percent more likely to fail to obtain a four-year degree, conditional on starting college. To the extent that enrolling in college reveals a desire for a bachelor's degree, these results are consistent with the impatient failing to obtain their desired level of education at a greater rate.

Alternatively, the lower rate of bachelor's degrees among the impatient could instead represent a time-consistent desire for lower levels of schooling, e.g. associate's degrees. In additional results not reported in the table, we find that the impatient are eight percent less likely to finish an associate's degree, conditional on ever enrolling at a two-year college and nine percent less likely to complete a bachelor's degree, conditional on ever enrolling at a four-year college.[11] Due to the smaller samples of enrollees, we cannot reject the null hypothesis that patient and impatient individuals complete these individual degrees at equal rates (t=0.96 and t=1.50 for two-year and four-year, respectively), but the point estimates are nevertheless consistent with a time-inconsistent interpretation of the impatience measure.

Furthermore, these differential completion rates are not simply the result of differences in financial resources. The impatient are more likely to provide a non-financial reason for leaving school (column 7). Non-financial reasons include getting married, pregnancy, "other reasons/didn't like school", poor grades, home responsibilities, choosing to work, entering the military, and being expelled or suspended.

Respondents classified as impatient also hold a disproportionate number of GEDs, conditional on having exactly a high school education (column 5, column 6). Thus, the impatient are more likely to drop out of high school only later to regret that decision and earn their missing credential. This result is consistent with the previous finding that GED recipients have worse non-cognitive skills and engage in a variety of other present-oriented behaviors (Heckman, Humphries and Mader 2010a). Again, neither dropping out of college nor return-

[11]The patient completion rate for two-year degrees is 46 percent, and the regression adjusted difference is 3.7 percentage points. The patient four-year degree completion rate is 56 percent, and the regression adjusted difference is 5.1 percentage points.

ing for a GED are consistent with simply having a low exponential discount rate. Finding a person altering his own desired level of education during the investment process is instead consistent with time-inconsistent preferences.[12]

As further evidence that these individuals are failing to obtain their personally optimal level of education, consider the final two columns of Table 3. In column (8), we define the educational expectations gap as the difference between the number of years of education the respondent expected to obtain when surveyed in 1979 and the number he actually obtained by 2004. On average, the impatient fall short of their expectations by an additional sixth of a year relative to comparable patient observations. Measured in percentage terms, the average impatient individual's gap is about 30 percent larger than their patient peers'.

To complement the results in column (8), we present respondents' expectations for a single credential - obtaining a high school diploma - in the final column. An individual is defined as "over-optimistic" about finishing high school when he states in 1979 that he expects to finish high school but fails to do so by 2004. The impatient are nearly 50 percent more likely to fail to live up to their own expectations regarding high school completion. Taken as a whole, the results in this table strongly support the hypothesis that individuals suffering from short-run impatience fail to reach their personal optimum level of education.

3.2 Experience and Tenure

As discussed in the conceptual framework, the linear and cumulative nature of the educational investment process allows for clean predictions about how an impatient individual should behave. It proves much more difficult to form clean predictions for how investments in work experience and firm tenure should differ for the impatient. Nevertheless, we examine

[12] Note that this statement assumes both rational expectations and that exogenous shocks are uncorrelated with preferences.

job switching, overall experience, and firm tenure outcomes as these combine to create the second canonical type of human capital (Mincer 1958).

In Table 4, we find significant divergence in the career paths of the patient and the impatient. In the first two columns, we examine the number of job switches individuals make in their careers. Here, a job switch is defined as switching from one employer to another; an internal transfer or promotion will not be counted as a job switch. Thus, this measure counts the number of times in an individual's working career that his firm-specific tenure gets set back to zero. The impatient are substantially more prone to job churn: they average an extra half job switch after completing their education. As a result, their longest career job match lasts about forty weeks less than similar patient individuals (column 4). These estimates are consistent with the impatient failing to account for the future benefits of firm tenure and instead responding to differences in near-term utility.

Recall, however, that the impatient should also be subject to inertia and thus less likely to seek out and find new employment opportunities that advance their careers. In column (5), we find that, in fact, the job switches among the impatient are less likely to come with a substantial (greater than ten percent) increase in wages. Topel and Ward (1992) estimate that the first ten years of young males' careers determines two-thirds of lifetime wage growth, with wage gains through job changes accounting for at least a third of early-career wage growth. That the impatient make job changes that do not lead to wage improvements is particularly damaging to their lifetime wage profile.

3.3 Lifetime Earnings

The results presented to this point have shown that the human capital investment decisions of the impatient deviate in significant ways at each point in their careers. The remainder of the results provide a measure of how costly these deviations are for the lifetime earnings of the impatient. In most investment decisions, sub-optimal choices result in relatively small initial differences with the full cost only later materializing. The earnings consequences of under-investing in human capital are no different. As shown in Figure 3, the early-career differences in earnings are relatively small. By the time this cohort has reached middle age, however, the impatient consistently earn ten to fifteen percent less annually than do the patient.

Figures 4 and 5 decompose the differences in earnings into hours worked and the hourly wage. The figures show that by 2004, the impatient both worked fewer hours and were paid less for each hour worked. Although the impatient have worked fewer hours since very early in the survey, their hourly wages generally kept pace with their patient counterparts until the mid-1990s. Since that point, the hourly wages of the impatient have diverged from those of the patient respondents, who now benefit from the investments made earlier in their careers.

Further, the impatient appear to recognize and regret their earlier life choices as they reach middle age. The final column of Table 4 provides results using an index of regret constructed from selected questions used to gauge self-esteem in 2006. Respondents were asked whether they agreed with a number of statements, including: “I am inclined to feel that I am a failure”; “I feel I do not have much to be proud of”; and “I am satisfied with myself.” We coded affirmative responses to the first two questions and negative responses to the third question as indicating regret. We then standardized these responses into an index with mean zero and a unitary variance. The impatient express significantly more regret, scoring about fourteen percent of a standard deviation higher on the regret index. These results again support the interpretation that the impatient are making personally sub-optimal investments.

3.4 Alternative Definitions of Impatience

For robustness, we replicate several of our main results using alternative measures of impatience. Each entry in Table 5 displays the coefficient from a separate regression. The rows represent four different definitions of impatience, with the first row our preferred measure used through the results section. Expanding the definition in the second row to include individuals ever coded as impatient in the 21 waves of the NLSY reduces the magnitude of each of the coefficients, but the statistical significance is preserved. These results are consistent with the interpretation that the most impatient are more likely to be coded as impatient in any given year. Thus, those who are flagged in a shorter time window are, on average, more impatient than those ever flagged at any point in the survey.

The third row provides a rescaled version of the fraction of times a respondent is coded as impatient. This measure moves beyond the binary coding and leverages the fact that some respondents are coded as impatient during multiple interviews. The impatience measure is scaled such that a unit change represents a standard deviation increase in the number of times coded as impatient. The results are quite consistent with the first two definitions.

The final row of Table 5 adjusts the impatience measure for a number of controls related to the interview and interviewer. In these regressions, the impatience measure is a normalized version of the residuals from a probit model that fits "respondent coded as impatient" using interview length, interviewer gender, interviewer race, and whether the interviewer and respondent are of the same race and/or gender. These coefficients are essentially identical to the third row, reflecting the fact that interviewer characteristics do not have much explanatory power in determining who is coded as impatient.

3.5 Time-Inconsistent Preferences vs. ADHD

One remaining question is whether the survey interviewers are simply coding individuals as impatient when they suffer from Attention Deficit Hyperactivity Disorder (ADHD). Although one might reasonably consider young adults with ADHD to have biologically-based impulsive or time-inconsistent preferences, they have not been the focus of the economic literature focused on failures of self-discipline. In fact, if these results merely represented a finding that those with ADHD fail to reach the same educational milestones as those without, they would simply confirm existing findings on the effects of ADHD on educational progress (Currie and Stabile 2006). Unfortunately, the NLSY has not collected any information on whether an individual has been diagnosed with ADHD; so we cannot control directly for these diagnoses in our principal results.

We do, however, augment our main results with parallel findings from the Add Health study. Add Health is also a nationally representative longitudinal study of youth (grades 7-12), begun in the 1994-1995 school year. The data contain a question asked of the interviewer similar to the rating we use for our impatience measure. Importantly, the most recent wave of the data (Wave IV) contains a question on whether the respondent has ever been diagnosed with ADHD.[13]

We use this additional data source to replicate some of the main findings from the NLSY results and to determine whether adding a control for an ADHD diagnosis substantially affects our findings. The results of this replication and extension are found in Table 6, with regression specifications similar to those found in Table 3, column (3). The dependent variable is a dummy indicating whether the respondent is a high school dropout, and the key explanatory variable is a dummy indicating whether the respondent was rated by the

[13] The exact wording of these questions are "Did the respondent ever seem bored or impatient during the interview?" and "Has a doctor, nurse, or other health care provider ever told you that you have or had: attention problems or ADD or ADHD?"

interviewer as impatient during any of the first four waves of the survey.[14]

The first column presents results that confirm the essential finding from the NLSY: individuals coded as impatient are more likely to drop out of high school. Dropout rates are 11.7 percent for the impatient and 8.6 percent for the patient. In the second column, we include a control for whether a respondent has ever been diagnosed with ADHD or related attention problems. Although the coefficient on the diagnosis (+0.040) suggests that individuals with ADHD are more likely to drop out of high school, the coefficient on the interviewer's rating of impatience hardly changes (from +0.031 to +0.030). A similar pattern emerges in the final two columns, which add controls comparable to those in our main analysis. Taken together, the results in these pairs of columns therefore imply that the interviewers' ratings are roughly uncorrelated with the respondents' ADHD status. While identifying underlying mental health conditions can explain some variation in educational attainment, our results suggest that the interviewer ratings provide an independent measure of impatience that is strongly reflective of dynamically inconsistent preferences.

3.6 Heterogeneity across Race, Gender, and Age

Our main results include controls for several demographic characteristics, but they do not include a fully interacted set of covariates. Thus, it is possible that some distinct demographic group drives those results. As an example, suppose that black men are more likely to be perceived as impatient by their interviewers (even if they are, in fact, no less patient) and that these men also face discrimination in schooling and/or employment that is not captured by additive controls for race and gender separately. These two results could combine to produce results similar to our findings. Tables 7 and 8 examine this alternative in detail, in

[14] We use the version of the high school dropout variable that is coded directly from the respondents' transcripts.

addition to exploring the heterogeneous role of impatience across demographic groups more generally. In Table 7, we interact the impatience measure with dummy variables for race $\times$ gender categories: black male, black female, non-black male, and non-black female. This interaction model sets patient non-black females as the omitted category, and the within-group differences are tested using a linear combination of coefficients F-test. The results across race and gender suggest that the effect of impatience is actually quite consistent across demographic groups.

In the top panel of Table 7, the impatient accumulate between 0.4 and 0.6 fewer years of education within each of the race $\times$ gender categories, with non-black females having the largest effect and black females having the smallest effect. Furthermore, all of the adjusted race-gender differences between patient and impatient respondents are highly statistically significant. In the second panel, the impatient are between 3.5 and 6.9 percentage points more likely to drop out of high school, again with the effects being largest for non-black females and smallest for black females. Although two of the adjusted within-group differences are no longer significant, the magnitudes of the coefficients are very similar and suggest that no single demographic group is driving our full sample results.

In a similar vein, Table 8 presents results from regressions that interact respondents' ages in 1979 with the impatience measure. Given the sampling frame, some of the respondents had already made their high school completion decisions by the time they were first interviewed. If further schooling teaches students self-control techniques, our main results could be driven by an older, more educated subgroup that is less likely to be categorized as impatient. To address this concern, we interact patience with dummy variables for age categories, with patient 21-22 year-olds as the omitted category. In the top panel, the youngest respondents in 1979 have the largest impatience differential of total years of education, with 0.6 fewer years of schooling than their patient counterparts. The impatient in the other age categories have 0.45 fewer years of school on average. In the lower panel, we see that three of the four age groups exhibit large and significant differences in dropout behavior between patient and impatient respondents. These results confirm the main findings within each age group, and, in particular, they show that the results are not solely due to respondents who had already dropped out at the time of the first survey.

4 Conclusion

In this paper we have shown that individuals identified as impatient by an interviewer earn significantly less, even 25 years later. By their mid-40s, the impatient have accumulated less human capital, through both schooling and on-the-job experience. Our result that the impatient earn 13 percent less annually is comparable to estimates for the returns to an additional year of school in the compulsory schooling literature.[15] That we only observe an average difference of one half year of schooling suggests that some of the difference can be attributed to the differences in the post-educational experience acquired by the impatient.

The human capital decisions of the impatient are suggestive of not simply lower discount rates but in fact time-inconsistent preferences. First, the choices to drop out of high school but then return to obtain a GED, begin college but not complete a 4-year degree, and churn through jobs without corresponding salary increases are all indicative of forgoing long-term investments in favor of short-term consumption. In particular, (Oreopoulos 2007) finds that the returns to completing high school are too large to be reconciled with plausible values of dynamically consistent discount rates. Second, previous research by (DellaVigna and Paserman 2005) found this same measure of impatience to be more consistent with dynamically inconsistent preferences in their analysis of job search. Third, our ancillary calculations

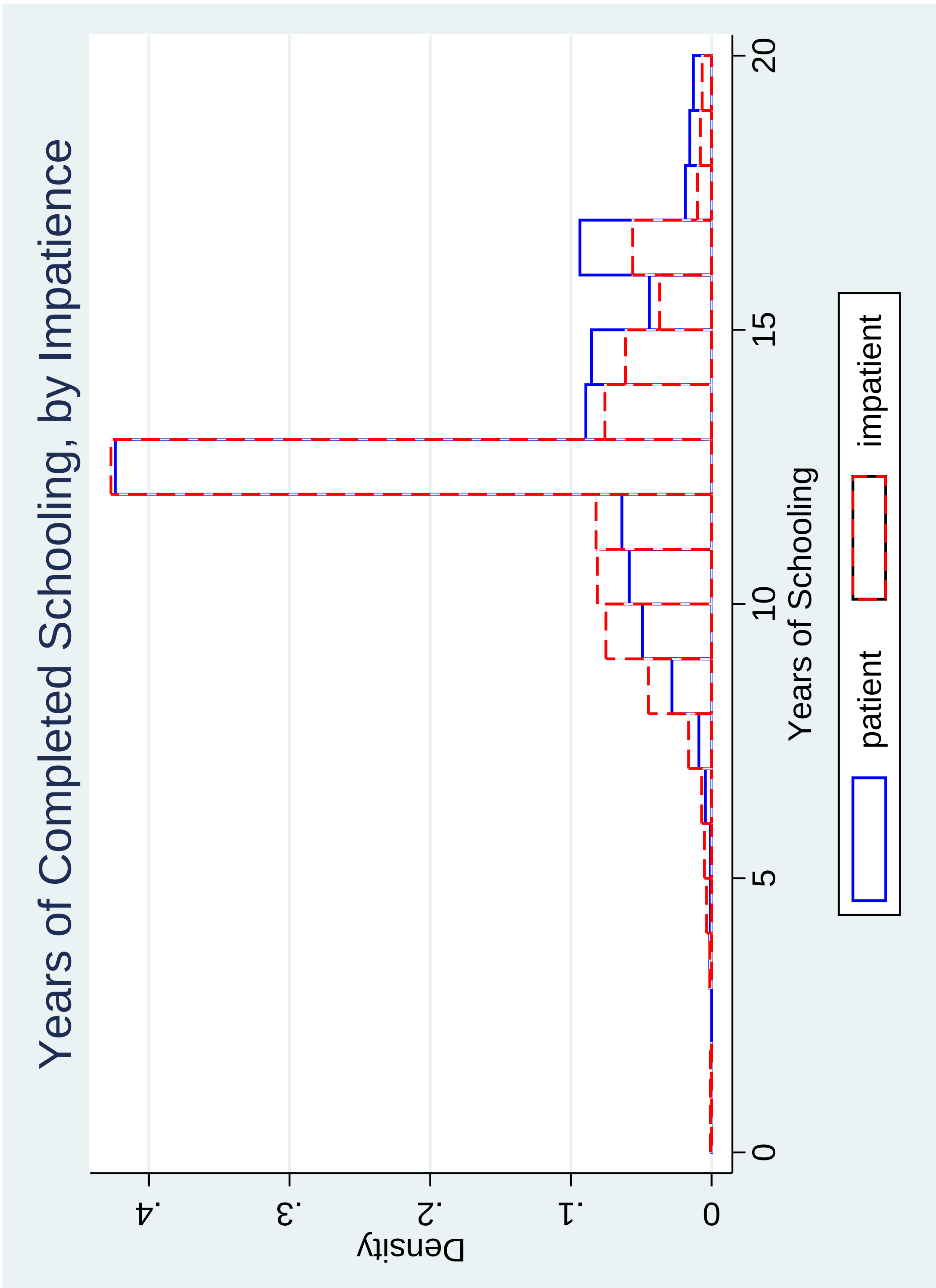
[15] See, for example Angrist and Krueger (1991), Acemoglu and Angrist (2000), Oreopoulos (2007).

show that this measure is correlated with additional time-inconsistent behaviors, especially drinking resulting in hangovers and early exits from military commitments. Finally, although it is difficult to test directly for differences between ex ante and ex post preferences, we find that impatient respondents are less likely to meet their educational expectations and more likely to regret their decisions than their patient counterparts.

Our findings are consistent with the experimental psychology literature on the value of self-regulation and the role of "soft skills" in young people's development. Studies by developmental psychologists have yielded compelling results that, for some tasks, self-regulation can be learned. Our results suggest that finding techniques to improve one's ability to postpone gratification can have potentially large and long-lasting payoffs.

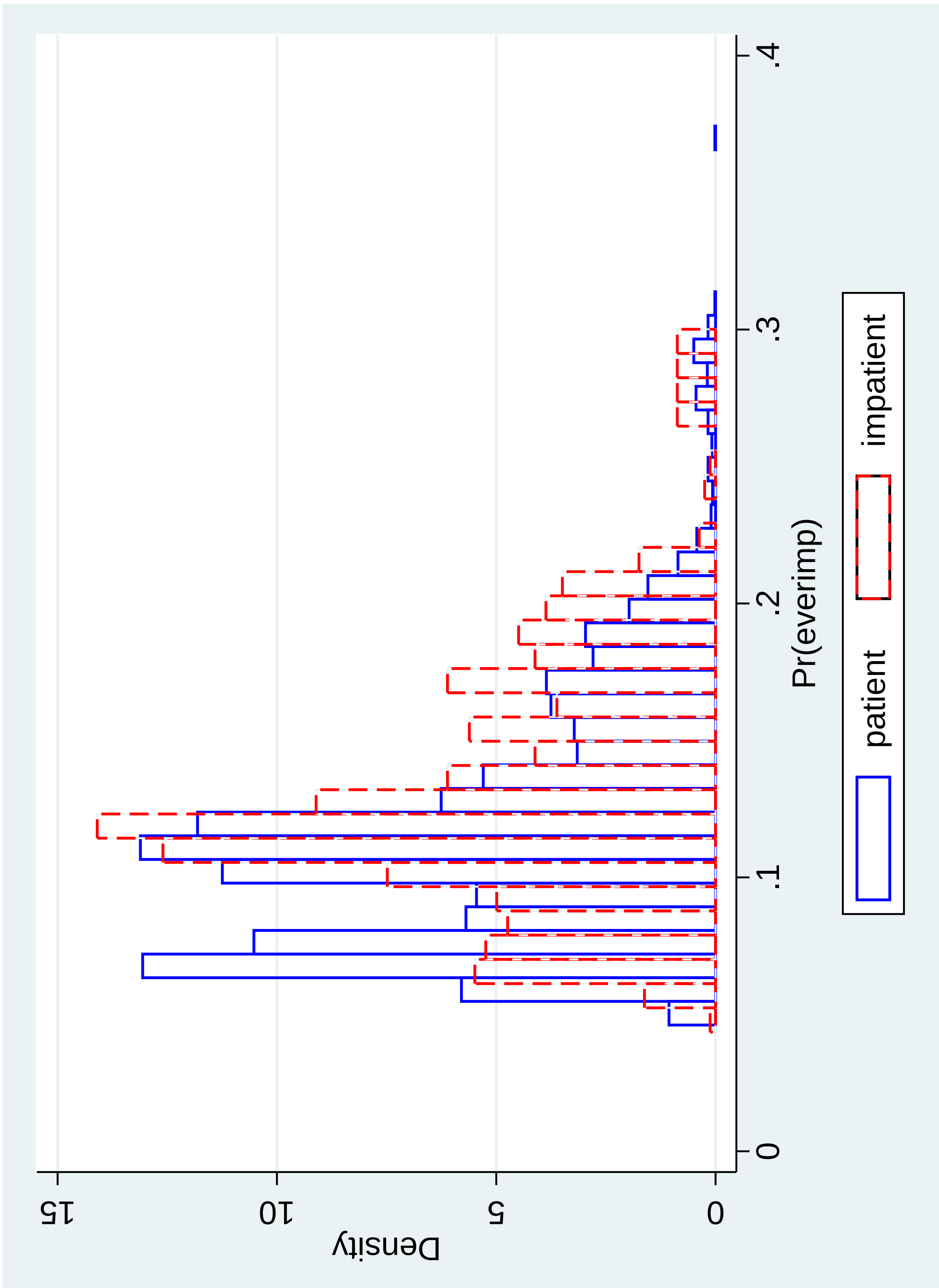
Importantly, these results have different policy implications for different cohorts of students. Interventions in early childhood can be especially effective at increasing self-control skills. For pre-school age children, a direct investment in programs that teach children to delay gratification is likely to pay large dividends (Heckman et al. 2010b). For older students, such programs may not be able to overcome years of ingrained instant gratification habits. Policies designed to influence older children should therefore provide immediate payoffs to encourage investment in human capital (Fryer 2010). Such programs will likely pay large dividends relative to the cost of funding the incentives, as they need only function as a commitment device to help students attain the level of human capital they truly desire.

Figure 1: Unadjusted Education Distributions - Patient and Impatient



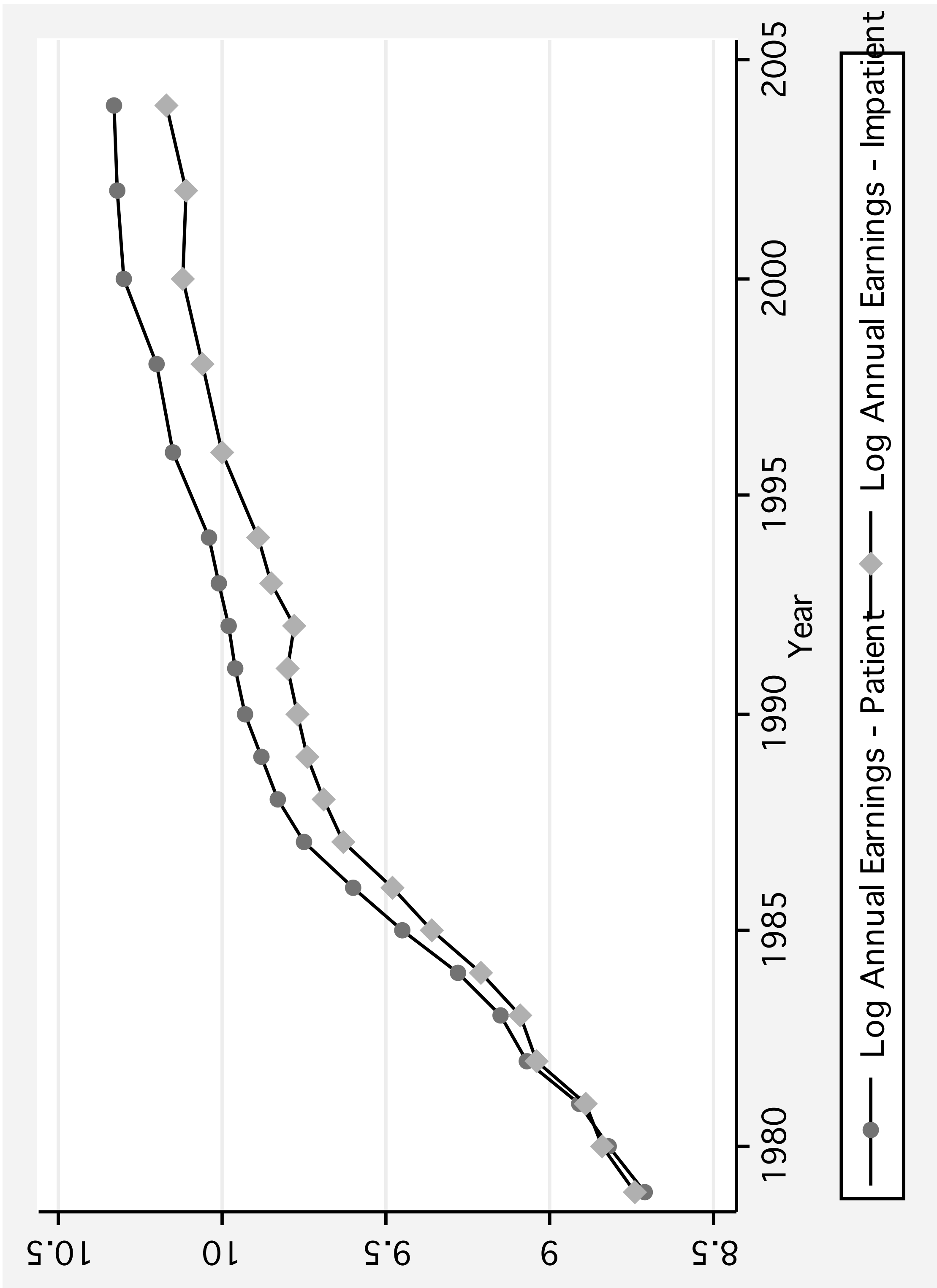
Source: Authors' calculations from 2004 wave of NLSY79. Impatience measure described in text.

Figure 2: Common Support for Impatience - All Included Covariates



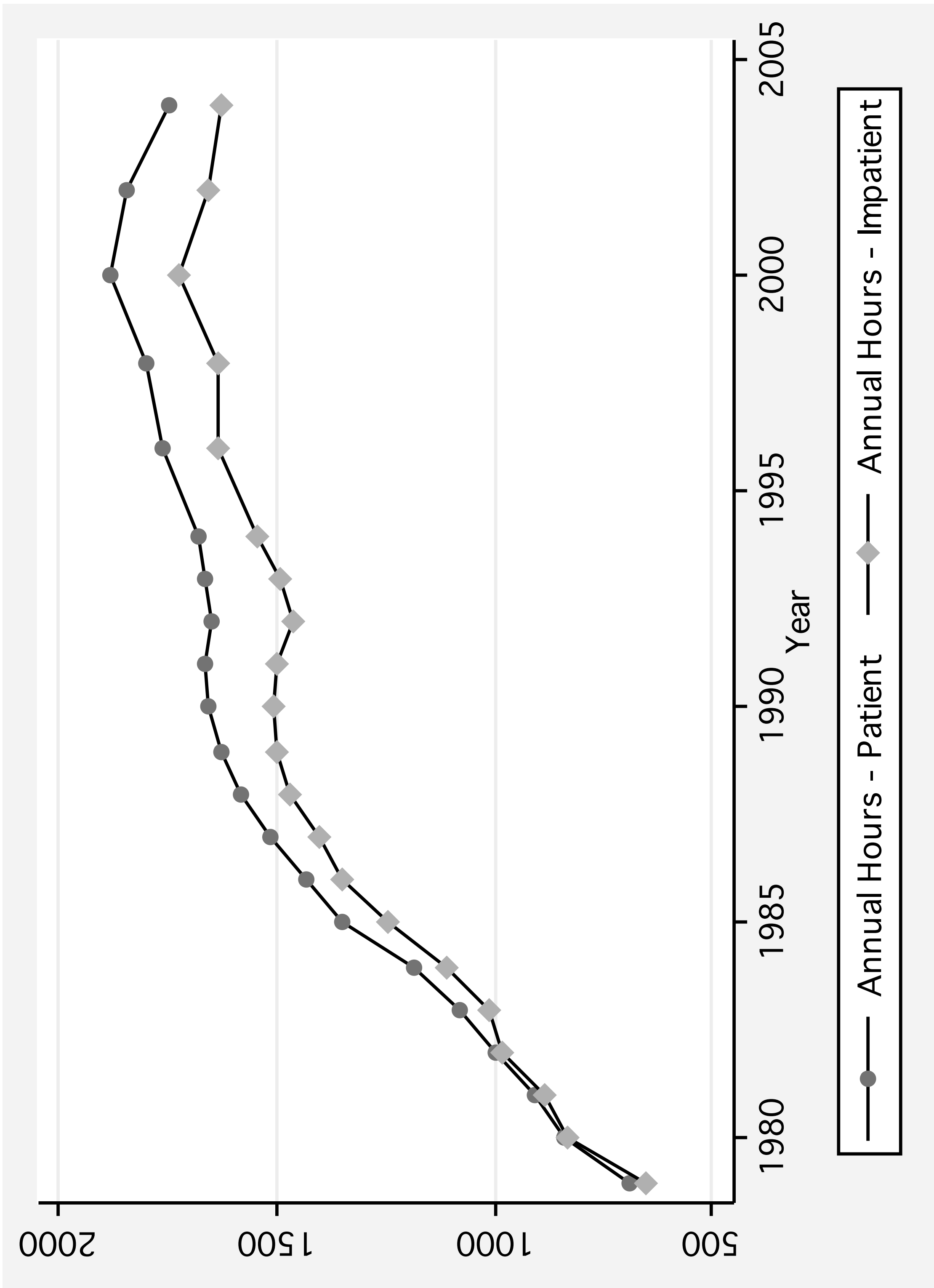
Source: Authors' calculations from NLSY79 1979-2004. Impatience measure described in text. Complete probit results available in appendix.

Figure 3: Unadjusted Annual Age-Earnings Profiles - Patient and Impatient



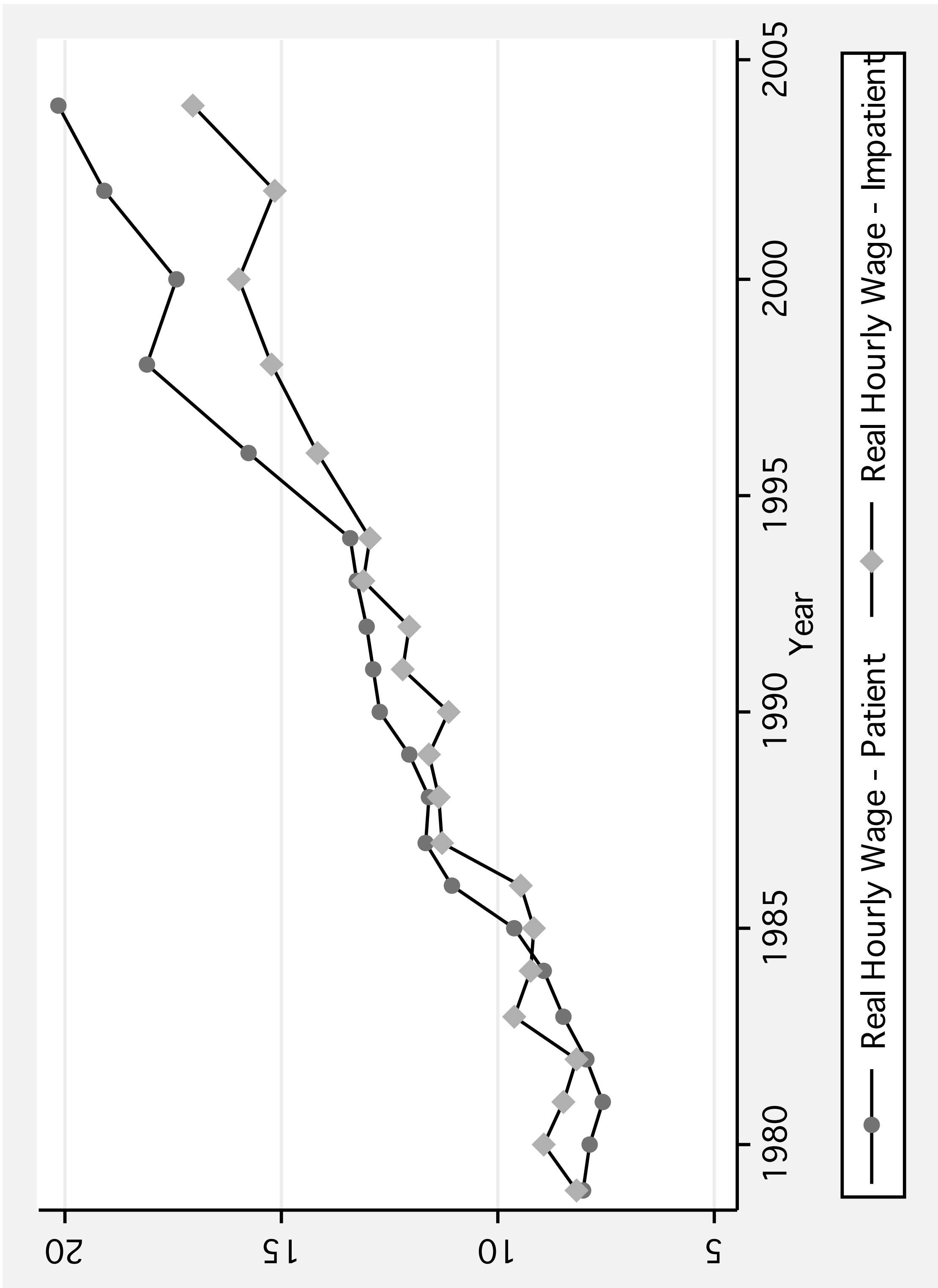
Source: Authors' calculations from NLSY79 1979-2004. Impatience measure described in text.

Figure 4: Unadjusted Annual Age-Hours Profiles - Patient and Impatient



Source: Authors' calculations from NLSY79 1979-2004. Impatience measure described in text.

Figure 5: Unadjusted Age-Hourly Wage Profiles - Patient and Impatient



Source: Authors' calculations from NLSY79 1979-2004. Impatience measure described in text.

Table 1: Present-Biased Behaviors and Impatience

	(1) Bank Account	(2) Ever Smoker	(3) Hangovers	(4) Never Attrit from NLSY	(5) Early Military Exit
Impatient	-0.127***	0.0638***	0.122**	-0.0611***	0.112**
	(0.0164)	(0.0186)	(0.0542)	(0.0130)	(0.0544)
Male	-0.0141	0.0419***	0.149***	-0.0579***	-0.152***
	(0.0103)	(0.0118)	(0.0226)	(0.00846)	(0.0343)
African-American	-0.205***	-0.0372***	-0.155***	0.180***	-0.0238
	(0.0127)	(0.0138)	(0.0250)	(0.00994)	(0.0399)
Other Race	-0.101***	-0.0633**	0.0394	0.0577***	-0.107*
	(0.0245)	(0.0262)	(0.0538)	(0.0192)	(0.0649)
Mother's Ed	0.0184***	-0.00208	0.00940*	-0.00507***	-0.000266
	(0.00221)	(0.00250)	(0.00544)	(0.00179)	(0.00774)
Father's Ed	0.0113***	0.00278	-0.00328	0.00187	0.00448
	(0.00181)	(0.00208)	(0.00397)	(0.00149)	(0.00596)
Library Card	0.0170	-0.0110	0.0159	0.00353	-0.0247
	(0.0125)	(0.0139)	(0.0281)	(0.0100)	(0.0397)
Magazines	0.107***	-0.0449***	-0.0208	0.0412***	-0.0197
	(0.0125)	(0.0137)	(0.0256)	(0.00976)	(0.0354)
Newspapers	0.0754***	0.0237	0.0420	-0.0112	-0.0342
	(0.0144)	(0.0156)	(0.0326)	(0.0113)	(0.0528)
Age Fixed Effects	Y	Y	Y	Y	Y
Patient Mean	0.62	0.48	0.21	0.61	0.28
Percent Diff	20.5%	13.3%	57.1%	10.0%	39.7%
Observations	7661	7247	7530	12686	882
R-squared	0.177	0.011	0.016	0.063	0.090

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Data: NLSY 1979-2004.
Bank Account is measured in 1985; Ever a Smoker is measured in 1998
Number of hangovers in past 30 days is measured in 1983
Military Exit sample includes those who ended service between 1980-1985

Table 2: Summary Statistics - Key Variables

Variable	Obs	Mean	Std. Dev.
Less than High School	7661	0.082	0.27
High School	7661	0.420	0.49
Some College	7661	0.232	0.42
College and Up	7661	0.266	0.44
GED	7661	0.108	0.31
Age	7661	43.3	2.32
Mother's highest grade completed	7188	11.6	2.78
Father's highest grade completed	6534	11.8	3.60
Male	7661	0.509	0.50
African-American	7661	0.142	0.35
Access to magazines at age 14	7614	0.666	0.47
Access to newspapers at age 14	7633	0.832	0.37
Had a library card at age 14	7629	0.754	0.43
Ever impatient 1980-1985	7661	0.105	0.31

Source: NLSY79, 1979-2004. Observations weighted using sample weights.

Table 3: Educational Outcomes and Impatience

	(1) AFQT	(2) Completed Years of Education	(3) HS Dropout	(4) Some College, No 4-year Degree	(5) GED	(6) GED, HS grad	(7) Non-Financial Reason for Leaving School	(8) Educational Expectations Gap	(9) Overoptimistic about finishing HS
Impatient	-0.265***	-0.545***	0.0546***	0.0769***	0.0398***	0.0495**	0.0356**	-0.153**	0.0271***
	(0.0311)	(0.0792)	(0.0126)	(0.0274)	(0.0132)	(0.0229)	(0.0172)	(0.0723)	(0.0104)
Male	-0.00320	-0.269***	0.0299***	-0.0204	0.0131*	0.0182	-0.00841	-0.238***	0.0225***
	(0.0186)	(0.0511)	(0.00681)	(0.0162)	(0.00752)	(0.0143)	(0.0109)	(0.0462)	(0.00557)
African-American	-0.794***	-0.141**	-0.0140*	0.122***	0.00990	0.0278*	0.0382***	-0.478***	0.0116*
	(0.0219)	(0.0554)	(0.00799)	(0.0191)	(0.00900)	(0.0165)	(0.0127)	(0.0536)	(0.00667)
Other Race	-0.285***	0.0234	0.0295	0.0538	0.0330*	0.131***	0.0173	-0.301**	0.0311*
	(0.0462)	(0.138)	(0.0195)	(0.0392)	(0.0196)	(0.0381)	(0.0248)	(0.117)	(0.0162)
Mother's Ed	0.0870***	0.197***	-0.0152***	-0.0263***	-0.00618***	-0.00765**	-0.00975***	0.0244**	-0.00619***
	(0.00402)	(0.0119)	(0.00158)	(0.00338)	(0.00166)	(0.00334)	(0.00226)	(0.0101)	(0.00121)
Father's Ed	0.0578***	0.156***	-0.0103***	-0.0177***	-0.00481***	-0.00572**	-0.00146	0.00812	-0.00543***
	(0.00327)	(0.00968)	(0.00125)	(0.00274)	(0.00135)	(0.00291)	(0.00190)	(0.00832)	(0.000984)
Age fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Patient Mean	0.009	13.3	0.097	0.519	0.119	0.215	0.345	-0.483	0.059
Percent Diff	--	4.1%	56.3%	14.8%	33.4%	23.0%	10.3%	31.7%	45.9%
Observations	7309	7661	7661	3512	7661	3334	7661	7595	7661
R-squared	0.406	0.220	0.089	0.109	0.023	0.028	0.017	0.022	0.040

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Data: NLSY 1979-2004.
AFQT is standardized to be mean 0, variance 1.

Table 4: Employer Tenure and Impatience

	(1) Number of Job Switches	(2) Post-Education Job Switches	(3) Total Weeks Worked	(4) Longest Tenure (weeks)	(5) Fraction Switches with > Wages	(6) Regret Index in 2006
Impatient	0.336***	0.507***	-72.46***	-41.36***	-0.0301***	0.109***
	(0.128)	(0.138)	(9.524)	(10.73)	(0.00978)	(0.0318)
Male	-0.163**	0.274***	111.8***	74.29***	0.0397***	-0.0579***
	(0.0793)	(0.0845)	(5.602)	(6.885)	(0.00662)	(0.0169)
African-American	0.409***	0.517***	-100.9***	-66.26***	-0.0460***	-0.00447
	(0.0913)	(0.0990)	(6.836)	(7.945)	(0.00727)	(0.0200)
Other Race	0.114	-0.285	-64.34***	-38.97***	-0.0121	0.0301
	(0.171)	(0.185)	(14.23)	(14.93)	(0.0154)	(0.0448)
Mother's Ed	-0.00390	-0.0877***	9.484***	4.362***	0.00462***	-0.0153***
	(0.0160)	(0.0175)	(1.206)	(1.409)	(0.00134)	(0.00406)
Father's Ed	0.0241*	-0.0720***	3.441***	0.123	0.00345***	-0.00540*
	(0.0136)	(0.0144)	(1.000)	(1.194)	(0.00119)	(0.00322)
Age Fixed Effects	Y	Y	Y	Y	Y	Y
Patient Mean	7.15	5.13	723.3	501.5	0.198	-0.011
Percent Diff	4.7%	9.9%	10.0%	8.2%	15.2%	--
Observations	7661	7661	7661	7619	6321	7217
R-squared	0.051	0.037	0.166	0.061	0.028	0.016

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Data: NLSY 1979-2004, except for regret measure in 2006.

Table 5: Robustness of Impatience Measure

Impatience Measure	Completed Years of Education	HS Dropout	Started College, No 4-year Degree	Regret Index in 2006	Mean	SD
Ever impatient in first 5 years	-0.55***	0.055***	0.077***	0.11***	0.12	0.32
Ever impatient at any point	-0.36***	0.034***	0.064***	0.082***	0.32	0.47
Mean impatience at any point rescaled	-0.24***	0.023***	0.048***	0.049***	0	1
Mean impatience adjusted rescaled	-0.24***	0.023***	0.049***	0.049***	0	1

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Data: NLSY 1979-2004.
Adjustments include: interview length, interviewer race, interviewer gender, interviewer same race, interviewer same gender.

Table 6: Impatience, ADHD, and HS Dropout Behavior - Add Health Data

	(1)	(2)	(3)	(4)
Ever Impatient	0.031**	0.030**	0.028**	0.027**
	(0.006)	(0.006)	(0.006)	(0.006)
Ever Diagnosed ADHD		0.040**		0.050**
		(0.015)		(0.015)
Male			0.021**	0.019**
			(0.006)	(0.005)
Hispanic			0.065**	0.068**
			(0.009)	(0.009)
Black			0.052**	0.054**
			(0.008)	(0.008)
Native American			0.116*	0.119*
			(0.053)	(0.053)
Asian			0.016	0.019
			(0.011)	(0.011)
Other Race			0.036	0.035
			(0.033)	(0.033)
Multiple Races			0.056**	0.057**
			(0.016)	(0.016)
Month of Birth Dummies	NO	NO	YES	YES
Constant	0.086**	0.084**	0.053**	0.051**
	(0.003)	(0.003)	(0.004)	(0.004)
Observations	11637	11637	11637	11637
R-squared	0.00	0.00	0.02	0.02

Robust standard errors in parentheses
* significant at 5%; ** significant at 1%
Source: Authors' calculations from Waves I-IV of the National Longitudinal Study of Adolescent Health.

Table 7: Education Results by Race and Gender

	(1) Black Male	(2) Black Female	(3) Non-Black Male	(4) Non-Black Female
Years of Education				
Patient	-0.34***	0.17***	-0.16**	--
Impatient	-0.84***	-0.23**	-0.65***	-0.62***
Adjusted Difference	-0.50***	-0.40***	-0.49***	-0.62***
HS Dropout				
Patient	0.001	-0.033***	0.029***	--
Impatient	0.048*	0.0002	0.078***	0.069***
Adjusted Difference	0.047	0.035	0.049**	0.069***

Coefficients are all relative to patient non-black females.
*** p<0.01, ** p<0.05, * p<0.1
Data: NLSY 1979-2004.
Includes controls for parents' education, presence of newspapers, magazines, library card at age 14.

Table 8: Education Results by Age

	(1)	(2)	(3)	(4)
Age in 1979	14-16	17-18	19-20	21-22
Years of Education				
Patient	-0.08	-0.11	-0.30***	--
Impatient	-0.71***	-0.55***	-0.76***	-0.46**
Adjusted Difference	-0.63***	-0.44***	-0.46***	-0.46**
HS Dropout				
Patient	-0.0004	0.006	0.018*	--
Impatient	0.055**	0.019	0.099***	0.059**
Adjusted Difference	0.055**	0.013	0.081***	0.059**

Coefficients are relative to patient 21-22 year olds.

*** p<0.01, ** p<0.05, * p<0.1

Data: NLSY 1979-2004.

Includes controls for race, gender, parents' education, presence of newspapers, magazines, library card at age 14.

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Table A-1: Determinants of Impatience - Probit Coefficients

Variable	(1) Impatience
Male	0.266***
	(0.0380)
African-American	0.201***
	(0.0432)
Other Race	0.194**
	(0.0789)
Mother's Ed	-0.00908
	(0.00799)
Father's Ed	-0.00510
	(0.00675)
Library Card	-0.00825
	(0.0439)
Magazines	-0.127***
	(0.0441)
Newspapers	-0.0347
	(0.0488)
Age Fixed Effects	Y
Observations	7661
Pseudo R-squared	0.03

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1