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Human Capital and the Lifetime Costs of Impatience[†]

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In this paper, we examine the role of impatience in human capital formation—arguably the most important investment decision individuals make during their lifetimes. We focus on a set of investment behaviors that cannot be explained solely by variation in exponential discounting. Using data from the NLSY and a straightforward measure of impatience, we find that impatient people more frequently invest in dynamically inconsistent ways, such as dropping out of college with one year or less remaining. The cumulative investment differences result in the impatient earning 13 percent less and expressing more regret as this cohort reaches middle age. (*JEL* D91, I26, J24, J31)

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 in life than are other investment choices, and they have permanent consequences. Mincer's (1958) seminal treatment of these choices implies that preferences (i.e., patience) and the investment return jointly determine an individual's optimal education level, a framework that has become the foundation of the human capital investment literature (Heckman, Lochner, and Todd 2006). Yet to our knowledge, this paper represents the first systematic empirical investigation of the importance of impatience in human capital formation.[1]

Given that most models of human capital investment use exponential discount rates, this lack of empirical analysis is perhaps understandable; it would hardly be surprising to find individuals with different preferences making different choices. Yet, in a variety of other investment contexts, evidence increasingly suggests that individual-level variation in time preferences is as much a matter of form as degree. Multiple studies have found patterns of investment implying that a sizable fraction of

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[1] Golsteyn, Grönqvist, and Lindahl (2014) examine the relationship between time preferences and human capital investment in the Swedish context, although their analysis does not focus on time-inconsistency.

the population hold time-inconsistent or quasi-hyperbolic preferences.[2] Importantly, when investors have time-inconsistent preferences, it is possible to improve their welfare by imposing constraints or incentives designed to increase investment.[3]

Several important studies suggest, although they do not show directly, that human capital investments are influenced by these types of preferences. A systematic evaluation of an early childhood intervention designed to improve a variety of children's skills—including delaying gratification—revealed dramatic benefits for later life outcomes including educational attainment (Heckman et al. 2010). Similarly, a seminal paper in the personality psychology literature found that children who were able to wait 20 minutes for a larger reward experienced more success in later life across a number of different metrics (Mischel, Shoda, and Rodriguez 1989). Further, a variety of experiments designed explicitly to affect student investment have found results consistent with hyperbolic discounting (Fryer 2011; Levitt et al. 2012). Additionally, Oreopoulos (2007) finds compelling evidence that a high school completion mandate increased self-reported happiness among affected cohorts, which implies that some dropouts in unaffected cohorts later regretted their choices.

In this paper, we make a distinct contribution to this literature by using nationally representative data to examine directly whether impatient individuals' human capital investment patterns are more likely to exhibit dynamic inconsistency than are their patient counterparts' respondents'. We then track the labor market consequences of these investment differences for roughly 20 years. Our analysis is motivated by introducing quasi-hyperbolic discounting to the standard Mincerian model of human capital investment. This augmented framework reveals the key insight that guides our empirical analysis: A time-inconsistent impatient investor will be more likely to fail to complete educational investments that are personally optimal. Crucially, differences in exponential discount rates cannot explain differential dropout behavior and would instead lead to differences in planned investment and initial enrollment.

We examine this hypothesis empirically using data from the National Longitudinal Survey of Youth (NLSY). We identify individuals as impatient if, during any of the 1980–1985 waves of the survey, their interviewers classify them as "impatient or restless" in their post-interview assessments.[4] The use of this variable to identify individuals with different time preferences was introduced in DellaVigna and Paserman's (2005) analysis of the role of impatience in job search. They find that impatient respondents have longer unemployment spells, which is consistent only with short-run impatience because lower exponential discount rates would lead to lower reservation wages and shorter unemployment durations. We provide additional descriptive analysis that strongly supports this interpretation. We find that those identified as impatient are significantly less likely to have a bank account,

[2] See DellaVigna (2009) for a comprehensive survey and Becker et al. (2012) for a careful exploration of the relationship between economic preferences and psychological measures of personality.

[3] In contrast, if students were free from commitment problems, policymakers may instead want to focus on ensuring that credit constraints do not prevent beneficial investment (Carneiro and Heckman 2002).

[4] The alternatives are "friendly/interested," "cooperative/not interested," and "hostile." The "hostile" response has little predictive power for the outcomes we study, and point estimates suggest that individuals classified as "hostile" using a similar definition actually obtain more human capital than do the nonhostile.

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. The choices the impatient make across this variety of domains suggest that any observed differences in completed schooling may also result from time-inconsistent preferences rather than from differences in individually optimal education levels.

A direct analysis of the educational investment patterns of these two groups supports a similar conclusion. The impatient are over 50 percent more likely to drop out of high school despite expressing a desire and an expectation to finish. Additionally, among those who signal that their personal value of a college degree exceeds the cost, as measured either by directly expressing a desire or expectation to attain a degree or by initially enrolling, the impatient are significantly less likely to achieve their goal. Although each of these results is consistent with the interpretation that individuals identified as impatient hold time-inconsistent preferences, dropout behavior can occur for a number of reasons beyond nonstandard preferences, such as financial difficulties or learning new information about the costs and benefits of degree receipt.

Thus, we spend a substantial portion of the paper investigating whether these alternatives are sufficient to explain the entirety of the observed differences in dropout behavior between patient and impatient individuals. First, we directly examine the reasons that survey respondents provide for leaving school and find that, among dropouts, the impatient are no more likely to report academic or financial difficulties.

We then focus on the college dropout decision and the timing of differential dropout behavior to help distinguish among possible interpretations. The impatient are far more likely than their patient counterparts to drop out immediately upon enrollment, with one year or less of completed college education. Although this result is predicted by a dynamic inconsistency framework, it could also reflect other differences between the patient and impatient, especially the possibility that the impatient may be more likely to learn that completing a college degree will be more difficult than expected.[5]

In contrast, after three years of college, there is little remaining uncertainty about one's ability to complete the required coursework. Importantly, we also find a large gap in dropout behavior at precisely this juncture. Among those who have completed three years of college, the impatient are nearly 70 percent more likely not to finish their degree. This is a key result because this behavior is inconsistent with alternative interpretations wherein the dropout gap results from the impatient experiencing greater information shocks upon enrollment.

Further, when we control for academic readiness for college as proxied by AFQT scores, we find that doing so attenuates the "immediate" dropout gap somewhat but has a relatively small influence on the "late" dropout gap, which remains large and statistically significant.[6] Thus, although some of the dropout

[5] Stinebrickner and Stinebrickner (2012) show that a substantial amount of this type of learning takes place, and it is certainly possible that this learning occurs more frequently among the impatient.

[6] In the empirical section, we are careful to note that it is possible that differences in college readiness are the *result* of impatience-related differences in early investment. In this case, AFQT scores would be part of the mechanism through which impatience affects early dropout and adding them as a control would be inappropriate.

gap may reflect differential ability or differences in new information, the timing of the differential dropout behavior is difficult to explain without time-inconsistency. Finally, we find that the impatient also experience a higher return to degree completion, suggesting that they behave as if they require a larger payoff to overcome their greater short-run costs of investment. If, instead, the higher dropout rate among the impatient reflected better noncollege labor market alternatives, such as entrepreneurship, we would expect to see smaller completion earnings premiums among this group.

In the end, we find that there are a number of possible interpretations for many of the seemingly suboptimal investment behaviors to which the impatient are more prone. Taken as a whole, however, the evidence supports the view that much of this behavior derives from dynamically inconsistent preferences, as this parsimonious explanation correctly predicts each behavior we examine. This novel interpretation therefore provides an additional explanation for dropout behavior beyond the labor market supply and demand factors examined in previous work (Card and Lemieux 2001).

Throughout our analysis, we are careful to condition on multiple additional family background characteristics in order to isolate the role of impatience. We demonstrate that impatience varies substantially across individuals, even after controlling for other important determinants of human capital accumulation, such as socioeconomic background. Further, we perform supplementary analysis using the National Longitudinal Study of Adolescent Health (Add Health) to establish that these types of interviewer assessments 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).

Having established that the impatient are substantially more likely to exhibit preference reversals in educational investment, we turn to additional hypotheses suggested by the augmented conceptual framework. We find that the impatient express greater levels of regret in middle age—a clear yet understudied empirical prediction of models of dynamic inconsistency. The impatient are also more likely to finish with fewer years of education, and to churn through jobs without corresponding increases in earnings.

Finally, using the NLSY panel, we document the significant divergence between patient and impatient respondents' resulting labor market outcomes. As this cohort reaches middle age, the impatient have experienced a greater number of employment separations and, on average, have earned a cumulative total of $75,000 less than their patient counterparts, a difference of approximately 13 percent.

Our results provide the first direct evidence that impatient individuals are more likely to exhibit preference reversals as they invest in human capital. Thus, for many such investors, low educational attainment is a costly mistake. These empirical results, therefore, can help justify policy interventions designed to increase patience and self-control (see, for example Heckman et al.'s 2010 analysis of the value of the Perry preschool program) as well as policies that provide short-run incentives to keep students enrolled through completion of their degree. 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.[7] Choosing one's level of human capital effectively sets a budget constraint for each remaining period thereafter; failing to invest optimally early in life thus creates a lifetime of negative consequences.

The remainder of the paper is organized as follows. Section I provides a conceptual framework for understanding how impatience generally and dynamic inconsistency specifically interact with human capital investment decisions. Section II further discusses the data and presents the results, and Section III concludes.

I. Conceptual Framework

In this section, we present a basic framework for understanding how impatience affects human capital investment decisions. Although this framework does not explicitly incorporate other factors that may affect the decision to complete a degree, we explore the implications of relaxing this assumption below. We discuss the investment decision by allowing for time-dependent preferences in the classic human capital investment model (Mincer 1958). The discussion below reiterates 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 (Laibson 1997; DellaVigna 2009).[8]

A. *Setup*

We begin by considering an economic agent deciding whether to obtain a credential, for example, an academic degree, in period 0. 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 direct utility of $-C$ in addition to foregone (noncredentialed) earnings in the investment period (period 1). In order to focus on the role of β versus δ impatience, we begin with a simplified model in which credentialed income is $Y^C > Y^0$ with no real growth in earnings for either level of education, and we assume that acquiring the degree requires a single discrete time period investment.[9] In addition, in this framework there is no uncertainty and no learning between periods 0 and 1 about the costs or returns to schooling, a set of assumptions we discuss in detail below. Agents live for $T + 1$ periods, so investment in the credential pays off for T periods if acquired.[10]

[7] 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.

[8] This particular representation of dynamic inconsistency is used for expositional simplicity. One could, of course, consider alternative economic models of self-control beyond quasi-hyperbolic discounting that would also generate the gap in dropout behavior. See, for instance, the dual-self model of Fudenberg and Levine (2006). For the key empirical implications, it is only necessary that the impatient are more likely to reverse their decisions than they would be if commitment were costless.

[9] The central finding that time-inconsistent impatience will predict more frequent 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.

[10] Note that in this setup, when the drop out decision is only made once, an increase in the number of periods required to obtain the credential is equivalent to a proportional decrease in T.

B. *Cutoff Return for Investment*

We begin by describing when an individual would like to obtain the credential, or when ex ante benefits outweigh the ex ante costs. This analysis provides an important first step with an empirical analogue as the NLSY data provide multiple means of measuring an individual's desire for further schooling. Respondents are asked directly about the highest degree they would like to complete, revealing which credentials individuals anticipate will provide sufficient net benefit. Additionally, the enrollment decision frequently occurs prior to actually beginning the investment process. The panel nature of the data allows us to track enrollment decisions, which provides a behavior-based indicator that an individual desires the credential.

In the initial time period, the agent faces the choice between two future streams of utility:

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

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

Using the notation $r^c \equiv \frac{Y^C}{Y^0} - 1$ (the "return to the credential") and $I = 1 + \frac{C}{Y^0}$ (the "cost of investment" as a multiple of base annual earnings), the expressions in (1) and (2) can be rearranged to show that an individual will want to invest when

$$r^c > \frac{(1-\delta)I}{\delta\left(1-\delta^T\right)} \equiv r_0^{min}. \tag{3}$$

The optimal decision, therefore, is based on a cutoff rate of return that depends only on the long-run discount factor (δ) and the cost of investment. Individuals with $r^c > r_0^{min}$ find it optimal to invest, and others do not. Thus, individual differences in δ will result in ex ante differences in desired schooling. Note that the β term has disappeared entirely in this initial period analysis. This is a standard result. The presence of hyperbolic discounting does not affect the discount rate between two future periods.

C. *The Role of Short-Run Impatience*

In the next period, however, 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

$$r^c > \frac{(1-\delta)I}{\beta\delta\left(1-\delta^T\right)} \equiv r_1^{min}. \tag{4}$$

Hyperbolic discounting, therefore, effectively alters the return an individual requires to follow through on his plan to obtain a worthwhile investment ($r_1^{min} \geq r_0^{min}$).

Thus, the optimal investment decision continues to be determined by a cutoff rule, although the cutoff will change from period 0 to period 1 for individuals with $\beta < 1$.

If students have rational expectations about the costs and benefits of investment, then there is effectively no learning between periods 0 and 1, and all exponential discounters ($\beta = 1$) will continue with their investment, as $r_0^{min} = r_1^{min}$. Under this assumption, the only group of students who drop out are hyperbolic discounters with sufficiently low β such that it is no longer worthwhile to attend school.

If, on the other hand, enrollment provides new information about either the costs or the benefits from the investment, then dropout behavior may occur even in the absence of time-inconsistent preferences. Conditional on a given change in relative costs and benefits, individuals with lower β will still experience greater dropout risk. Thus, although exponential discounters may experience a sufficiently large shock to their information set to lead them to drop out, hyperbolic discounters will be even more responsive to a given change in information.

It is also important to recognize that there are several types of students with dynamically inconsistent preferences ($\beta < 1$) who will nevertheless make investment choices that appear time-consistent. First, students with "mild" preferences for immediate utility may manage to complete their investment even though the perceived net benefit falls upon enrollment. Second, students with "severe" preferences for immediate consumption ($\beta << 1$) may fail to enroll if enrollment is costly, even if the perceived net benefit of the credential is large.

Finally, this framework has implicitly assumed that impatient individuals are naïve regarding the nature of their preferences. If individuals were "sophisticated" in anticipating the actions of their future impatient selves, they would seek out costly commitment devices to tie their hands in order to complete the investment they desire (Ashraf, Karlan, and Yin 2006). Absent any available commitment device, these individuals may choose not to enroll in order to avoid a costly dropout decision later. In any of these cases, the sophisticates will invest in ways that are indistinguishable from students without a self-control problem. Thus, the existence of differential dropout behavior between the patient and the impatient suggests that many students fail to reach their personally optimal levels of schooling, but the magnitude of the gap likely understates the share of the population for whom dynamically inconsistent preferences affect their investment process.

D. *Empirical Implications*

This augmented framework continues to imply that "impatient" people should begin their working careers with lower levels of education, regardless of the form of their impatience. Yet there are a number of measurable implications that are consistent only with low β, or short-run impatience, rather than with low δ, or a low exponential discount rate. For example, short-run impatience can explain dropping out of high school, despite expressing a desire and intention to receive a diploma. In fact, those with dynamically inconsistent preferences will be more likely to fail to meet their own educational aspirations and expectations more generally. To be clear, the failure to live up to expectations requires either naïveté (as outlined above) 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 (correctly) expect to fail.

In addition, time-inconsistent investors will be more likely to drop out without completing a degree after initially enrolling in a higher education program, although time-inconsistency is not the only explanation for such behavior. Many students who begin an academic program may be misinformed about the costs and benefits (including costs related to their own academic ability) or not adequately risk averse, and they may drop out upon starting the program and updating their beliefs. Further, the impatient may be more likely to experience adverse changes in financial circumstances that necessitate dropout behavior. In the empirical work, we directly address the possibility that these factors may be correlated with an individual's impatience as assessed by the interviewer. To the extent that the data allow, we examine each of these alternatives in detail, with the results continuing to support a role for time-inconsistency.

As additional evidence, we leverage the observation that only time-inconsistency in preferences can explain dropout behavior in the absence of new information. Therefore, most alternative reasons for dropping out will be largely resolved shortly after experiencing the costs of investment firsthand, and information-based dropout behavior should occur shortly after the information is obtained. In contrast, dropping out when very close to completing a degree cannot easily be reconciled with a learning model or a model of risk aversion because there is relatively little remaining uncertainty about one's costs, returns, or ability. We therefore place particular emphasis on differential dropout behavior by the impatient among students who have completed all but one year of a four-year degree.

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 relabeling of the above framework suggests that, conditional on δ, we should find the (naïve) impatient and exponential discounters ($\beta = 1$) equally likely to begin career paths that require an initial investment (long hours, low pay, low status, 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 switch to a position offering greater immediate utility.[11]

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.

Finally, the short-run impatient should express greater levels of regret, as they have underinvested relative to their own optimum level. The presence of regret

[11] Additional empirical work focused more directly on the influence of time-inconsistency on job search and job switching can be found in Drago (2006), Paserman (2008), and van Huizen (2010).

serves as an additional way of distinguishing between exponential and short-run impatience, as the short-run impatient will be more likely to be disappointed in their investment choices, which are more often suboptimal. The next section investigates the novel empirical predictions generated by allowing for dynamic inconsistency in human capital investment decisions.

II. Data and Results

A. *The Impatience Measure*

The data we use to address each of these hypotheses come from multiple waves (1979–2008) 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. In our main analysis, 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 annual surveys from 1980–1985.[12] Roughly 10 percent of NLSY respondents are "impatient" according to this measure.[13] Although this measure was not designed specifically to measure time preferences, their analysis found that these postinterview assessments had strong predictive power for job search duration, another important intertemporal economic outcome.

Our primary empirical strategy compares investment choices between impatient and nonimpatient NLSY respondents, conditional on a number of important controls for family background. We include flexible controls for age (in 1979), gender, race and ethnicity, parents' education (four categories for each parent), family income (categories for quartiles) and poverty status in 1979, whether the respondent lived with both parents at age 14, urbanicity and region in 1979, and the presence of reading materials in the home at age 14.[14] This comprehensive list of covariates represents all available background characteristics in the NLSY and includes several important factors in a child's educational investment decision. Importantly, these additional explanatory variables partially control for parental preferences for investment in education, family financial resources, and the local environment. We treat the remaining variation in impatience as exogenously given in interpreting the behavioral gaps as due to individual heterogeneity in time preferences.

These comparisons are made possible because impatience varies substantially across individuals, even after conditioning on all these background characteristics.

[12] DellaVigna and Paserman (2005) use additional survey questions to classify individuals as impatient, but many of these are reasonably considered outcomes of the types of investment that we study. Thus, they are not appropriate as components of our key explanatory variable.

[13] In the results that follow, the percent who are impatient varies somewhat from specification to specification, but it is consistently close to ten. This percentage is in line with what has been identified in previous work. For example, Fernández-Villaverde and Mukherji (2006) find approximately 13 percent of individuals hold time-inconsistent preferences. In an extension to the main results (Section IIC), we analyze similar interviewer ratings from the Add Health. In this survey, which is also nationally representative but of a more recent cohort, roughly 25 percent of respondents are identified as impatient in one of the first four waves. Notably, the Add Health interviewers were asked whether the respondent *ever* seemed bored or impatient during the interview, whereas the NLSY interviewers were asked to rate the respondent's demeanor during the interview as a whole.

[14] Table A-1 in the online Appendix provides summary statistics for these controls.

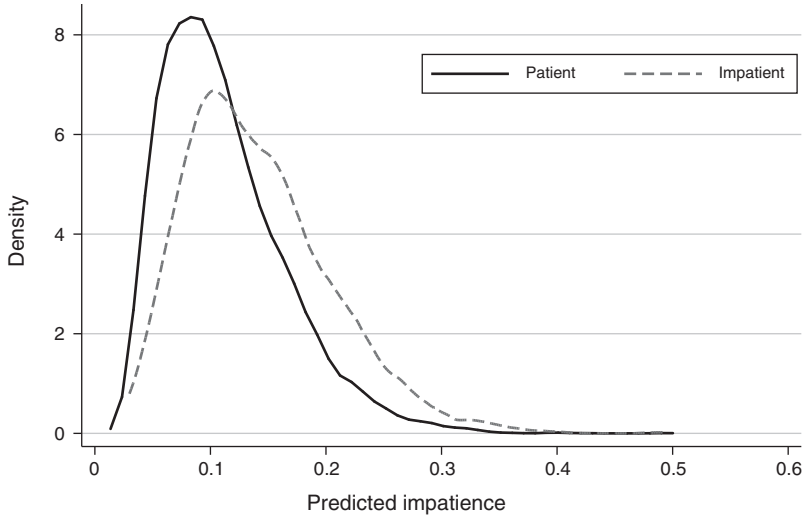

FIGURE 1. COMMON SUPPORT FOR IMPATIENCE—ALL INCLUDED COVARIATES

Notes: Lines represent kernel density estimates of the distribution of predicted impatience based on a probit regression of the impatience indicator variable on all available background characteristics. Impatience indicator definition provided in the text. Complete probit results available in the online Appendix (Table A-2).

Source: Authors' calculations from NLSY79 1979–2008

Figure 1 presents the distribution of the predicted values from a probit of the impatience measure on this full set of controls. Table A-2 in the online Appendix contains coefficient estimates from the probit regression that generated these predicted values, and it reveals that the impatient are more likely to be male and African-American and to come from families with more disadvantaged backgrounds (lower parental education and income, higher rates of single parenthood).[15] Although the predicted values are somewhat higher among the impatient group, there is considerable overlap in the two distributions, which provides the primary identification we use.

Prior to addressing human capital investment, we first examine whether these assessments are related to behaviors associated with dynamic inconsistency or self-control problems.[16] Table 1 provides the results of linear probability models examining differences in a number of such behaviors. Note that in this table and in those that follow, each specification includes the full set of baseline characteristics described above, although the coefficients on the covariates are suppressed for ease of exposition.[17] The reported regressions are unweighted, although the "patient mean" values are calculated using sampling weights.[18]

[15] Table A-1 in the online Appendix also provides the differences in the means of these covariates between the patient and impatient subsamples. Given these differences, we provide additional robustness checks in the online Appendix that indicate that the results are not driven by any particular gender and racial subgroup.

[16] Additional work identifying these types of links include Chabris et al. (2008); the working paper version of Benjamin, Brown, and Shapiro (2013); and Golsteyn, Grönqvist, and Lindahl (2014).

[17] The online Appendix contains an alternative version of each table with a more complete set of coefficients.

[18] These choices of unweighted regressions and weighted descriptives are as recommended in Solon, Haider, and Wooldridge (2015). There are, however, no substantial differences between weighted and unweighted versions of the regressions. Table A-17 in the online Appendix provides weighted versions of the key results for completeness.

Table 1—Present-Biased Behaviors and Impatience

Outcome	Bank account (1)	Ever smoker (2)	Hangovers (3)	Never attrit from NLSY (4)	Early military exit (5)
Impatient	−0.105***	0.057***	0.068**	−0.063***	0.074
	(0.015)	(0.019)	(0.033)	(0.015)	(0.063)
Patient mean	0.722	0.498	0.239	0.786	0.382
Percent difference	−14.5%	11.3%	28.2%	−8.0%	19.3%
Observations	10,046	7,268	10,038	10,046	621
R^2	0.206	0.026	0.018	0.154	0.158

Notes: Heteroskedasticity-robust standard errors are in parentheses. The sample for this and all subsequent analysis is limited to respondents with a valid impatience measure (described in the text) and a valid value for highest grade completed at age 26. More details on the construction of this education variable are included in the online Data Appendix. Control variables included are gender, race, mother's education (four categories), father's education (four categories), received magazines at age 14, received newspapers at age 14, had library card at age 14, two-headed household at age 14, family income quartile in 1979 (four categories), poverty status in 1979, urban dummy, region of country (four categories), and age (in 1979) dummies. These controls are included in all specifications in all tables, and the coefficients on the controls are provided in the online Appendix. 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. For this and all subsequent tables, patient means are calculated using sampling weights and the regressions are unweighted.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Source: Authors' calculations from NLSY79 1979–2008

The first two columns show that impatient respondents are less likely to have accumulated savings in a bank account and more likely to have been a regular smoker. These respondents are also much more likely to have drunk alcohol to the point of a hangover, a canonical example of over-consumption that later leads to regret. Impatient respondents are also less likely to follow through with the commitments they make. They are more likely to leave the survey in which they had previously agreed to participate, and notably, among those respondents who committed to a term of military service, the impatient are less likely to complete it (although this final gap cannot be statistically distinguished from zero). Together, these regressions suggest that this impatience measure identifies individuals who make a range of behavioral choices linked to time-inconsistent preferences.[19] These results are also consistent with related evidence among Austrian schoolchildren as reported in Sutter et al. (2013). The authors relate children's experiment-based measures of (dynamically inconsistent) impatience elicited from surveys to higher consumption of alcohol and cigarettes and lower levels of saving.

Finally, we note that the NLSY contains an additional survey question in the 2006 wave that provides a potential alternative measure of impatience. Respondents were told to imagine that they had won $1,000 and that they could receive the prize

[19] There is also a positive correlation between this variable and BMI, although the coefficient is no longer statistically significant after including control variables.

either immediately or after a one-month delay. They were then asked how much they would need to be compensated in order to delay the payment. There are multiple reasons why this hypothetical question is an inferior measure of impatience. First, the question is asked in 2006, when effectively all respondents have completed their educational investments. Additionally, these middle-aged adults likely have different levels of earnings and savings, and their stated willingness to wait for $1,000 likely conflates preferences with both liquidity and budget constraints. Further, given that the question asks only about the money immediately or in one month, the responses conflate differences in β and δ.[20] Finally, it is likely that most respondents did not correctly interpret the question, with more than half reporting requiring more than $100 to wait one month for $1,000 and many responses requiring more than twice the initial prize. Despite these concerns, we provide results based on this alternative measure in Section A-2.2 of the online Appendix. These results are broadly consistent with the findings based on our preferred measure of impatience, although there is relatively little correlation between this more noisy measure of impatience and the assessment of the interviewer.

B. *Educational Investment Patterns Differ by Patience*

Figure 2 shows unadjusted distributions of completed education (measured at ages 21 and 26) for the patient and impatient subsamples. The distributions show a substantial divergence in educational attainment between these two groups. Consistent with the impatient underinvesting relative to their desired levels, there are large differences in dropout behavior. Impatient respondents are more likely to fail to finish high school (panel A), and of those who have completed a high school degree and subsequently enrolled in college (panel B), the impatient are less likely to finish a four-year college degree.

Table 2 examines the high school dropout decision in more depth. Portions of this analysis depend on questions about future educational choices asked in the first wave of the survey; therefore, we include only those individuals who are likely still constrained by compulsory schooling laws (under age 17 in 1979). The table reports coefficients from several linear regressions, with the dependent variable listed at the top of the column.[21] Here we consider a respondent to be a dropout if he has not received a regular high school diploma by age 21.[22] Each specification includes the rich set of family background characteristics used to generate Figure 1. Conditional on all of these covariates, impatient respondents are 10.2 percentage points more likely to drop out of high school. Compared to a dropout rate of 18.7 percentage

[20] See Sutter et al. (2013) for a complete discussion of the types of survey questions needed to separately identify these two components.

[21] Many of these regressions have binary variables as outcomes, and these regressions are thus linear probability models. In a model with only the impatience indicator, the functional form would be truly linear. As the majority of our controls are also dummy variables, we continue to report these linear probability models as our preferred specifications. For completeness, we have run each of these models as a logit, and these results are available from the authors upon request. The nonlinear models yield qualitatively similar conclusions, including similar magnitudes for the differences in probabilities between the patient and impatient.

[22] The results are not sensitive to the definition of high school completion, including whether we classify GED recipients as having completed high school. See the data section of the online Appendix for more details on variable construction.

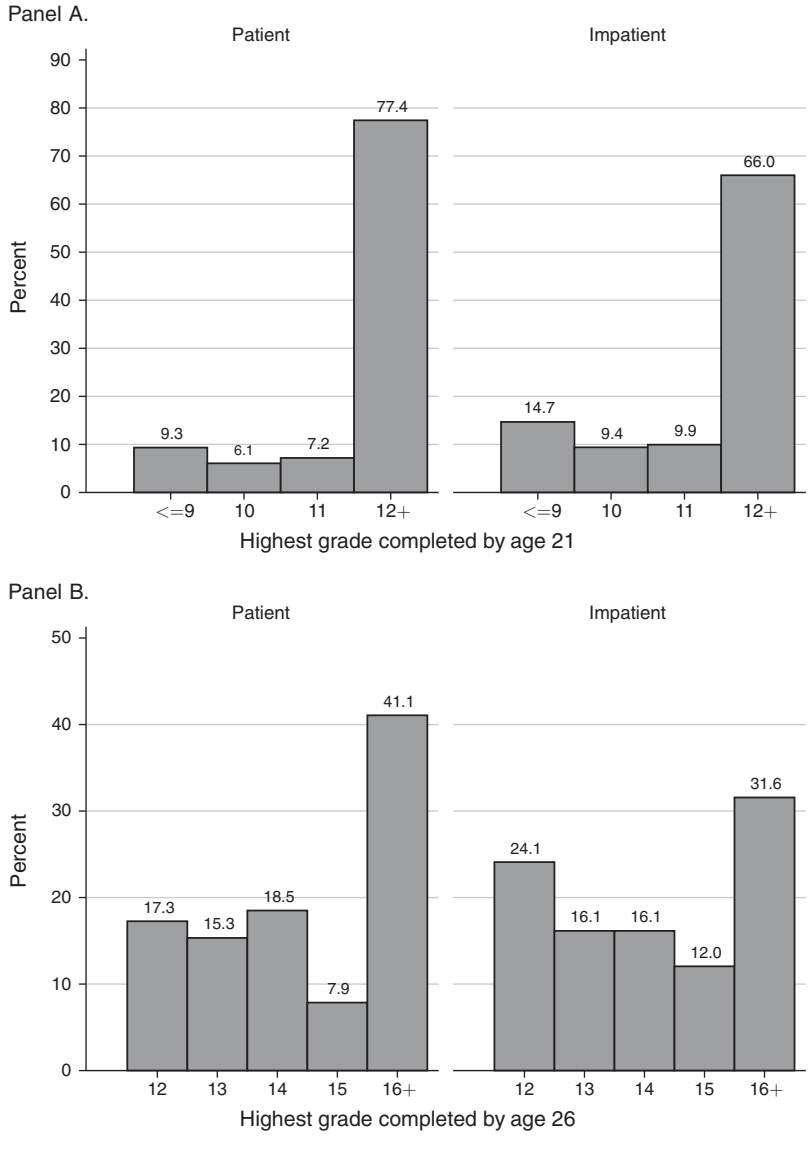

FIGURE 2. UNADJUSTED HIGHEST GRADE COMPLETED DISTRIBUTIONS—PATIENT AND IMPATIENT

Notes: Based on the respondent's highest grade completed by age 26, which is constructed using multiple waves of data. See online Data Appendix for details. Panel A includes all sample respondents. Panel B includes only those respondents who completed a high school degree prior to age 21 (those in the "12+" category in panel A) and who subsequently enrolled in college. Impatience measure described in text.

Source: Authors' calculations from NLSY79 1979–2008

points among the patient, this gap represents a 56 percent larger likelihood of dropping out.[23]

[23] Overall, the impatient fall short of their own educational desires and expectations by roughly 0.1 years more than the patient (adjusted for the standard covariates). Given the strong prediction about dropout behavior from the conceptual framework, our empirical analysis focuses on those outcomes rather than on total educational attainment.

Table 2—Impatience and Time-Inconsistent High School Dropout Behavior

Sample	Under 17 in 1979	Wants to finish HS	Expects to finish HS	Under 17 in 1979
Outcome	No HS diploma by 21 (1)	No HS diploma by 21 (2)	No HS diploma by 21 (3)	No HS diploma by 2008 (4)
Impatient	0.103***	0.098***	0.099***	0.054**
	(0.032)	(0.032)	(0.033)	(0.026)
Patient mean	0.184	0.179	0.162	0.076
Percent difference	56.0%	54.7%	61.1%	71.1%
Observations	2,322	2,292	2,210	2,322
R^2	0.148	0.142	0.126	0.106

Notes: Heteroskedasticity-robust standard errors are in parentheses. All analysis limited to those under 17 at age of first interview and who have nonmissing values for high school completion at age 21 and in the 2008 survey. See the online Data Appendix for additional variable construction details. Includes a full set of demographic, geographic, and family background controls. See notes from Table 1 for a complete list of controls.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Source: NLSY79 1979–2008

Although this difference in completion could represent either short- or long-run impatience, Oreopoulos (2007) presents calculations suggesting that the earnings gains from completing high school are large enough to require seemingly implausible levels of δ. As direct evidence that this dropout gap results from dynamic inconsistency, columns 2 and 3 incorporate information about the respondent's desire for and expectations about completing high school. In the initial survey (1979, ages 14–16), respondents are asked what level of education they desire, and what level of education they actually expect to complete. Notably, nearly every individual in our sample expresses a desire to complete high school (98.7 percent), and a similarly high percentage (95.2 percent) state that they expect to complete high school. Thus, there is little scope for the dropout behavior shown in column 1 to derive from time-consistent investment. It is certainly possible that the answers to these questions are influenced by a social desirability bias and that a smaller percentage of the sample truly intended to complete high school. Nevertheless, given the tight link between these questions and the "initial period" investment problem considered in the conceptual framework, we continue to present results separately for respondents who indicated that dropping out was not their initial intention.

In the second column, the sample is limited to those who express a desire to complete high school (or a higher level of education) during the first survey. Dropouts in this sample have therefore changed their minds and decided not to complete an investment that initially appeared worth the cost. Importantly, if the greater dropout rates among the impatient resulted primarily from differences in δ rather than from differences in short-run impatience, the gap in column 2 should disappear. Individuals with lower exponential discount rates should plan to drop out and follow through on those plans. Instead, we find that essentially none of the dropout gap in column 1 derives from this time-consistent lower investment. Column 3 provides the

results of a similar analysis, which instead limits the sample to students who expect to finish high school. The gap remains statistically significant and large, especially when measured relative to the patient mean (61 percent more likely to drop out among those who expect to finish).

There are two potential ways to interpret the analysis in columns 2 and 3. First, suppose that respondents are reluctant to state that they do not want to complete high school because they are trying to give the socially desirable answer to a question about educational values. Under this interpretation, the expectations question: "As things now stand, what is the highest grade or year you think you will actually complete?" allows the respondent to give a more truthful answer to a question with a more ambiguous "right" answer. If this interpretation is correct, this question provides a better measure of the students' true educational preferences. This seems a particularly reasonable interpretation as nearly the entire sample expresses a desire to complete high school.

If, instead, the respondent answers both questions truthfully, any difference in the two columns would represent respondents' self-awareness of their inability to follow through on their desired investment. A sophisticated hyperbolic discounter may truthfully respond that he would like to complete high school but that he expects to drop out. Under this interpretation, the results would imply that relatively few of those subject to short-run impatient preferences fully recognize their dynamic inconsistency.

The final column of Table 2 completes this set of analyses by exploring the high school completion gap by the 2008 wave of the NLSY. In this specification, we code individuals who earned a high school degree or GED at any age as not having dropped out.[24] Although many individuals have returned to school at some point later in their lives, by age 40 the impatient remain over 70 percent more likely never to have earned a high school degree. This finding implies that these early investment decisions have permanent consequences for total human capital.

Table 3 uses a different sample to analyze college dropout behavior. This sample includes all respondents, regardless of age at the initial survey, who signal an initial interest in completing post-secondary education.[25] We examine three alternative measures of signaling: expressing a desire to complete a college degree, expecting to complete a college degree, or actually enrolling in college. As discussed in the previous section, enrollment is a behavior-based indication that an individual believes that the value to acquiring additional human capital outweighs the costs. All of the analysis continues to control for the same set of individual and family background characteristics.

In the first column, the dependent variable is an indicator for not completing a post-secondary degree of any type (either Associate's or Bachelor's degree) by

[24] The impatient are significantly more likely to hold a GED (not shown). This result is consistent with time-inconsistent human capital investment patterns, as well as the previous finding that GED recipients have worse noncognitive skills and engage in a variety of other present-oriented behaviors (Heckman, Humphries, and Mader 2011).

[25] We relax the age restriction because we have access to a behavior-based version of initial preferences for obtaining a college degree (enrollment). In Table A-5 of the online Appendix, we show that the results are even stronger when limiting the sample to those ages 14–18, i.e., to those who were young enough such that the desires and expectations questions were entirely forward looking.

Table 3—Impatience and Time-Inconsistent College Dropout Behavior

Sample	Desires college degree	Expects college degree	Enrolled in college	Desires Bachelor's degree	Expects Bachelor's degree	Enrolled in 4-year school
Outcome	No degree (1)	No degree (2)	No degree (3)	No Bachelor's degree (4)	No Bachelor's degree (5)	No Bachelor's degree (6)
Impatient	0.072***	0.068***	0.077***	0.072***	0.077***	0.055*
	(0.018)	(0.021)	(0.024)	(0.020)	(0.024)	(0.030)
Patient mean	0.539	0.476	0.425	0.549	0.450	0.359
Percent difference	13.4%	14.3%	18.1%	13.0%	17.1%	15.4%
Observations	6,089	5,143	4,658	4,880	3,739	3,091
R^2	0.186	0.186	0.148	0.227	0.239	0.169

Notes: Heteroskedasticity-robust standard errors are in parentheses. Complete data definitions provided in the online Data Appendix. Enrollment sample restriction based on enrollment status prior to age 22. Completed degree status measured at age 26. Includes a full set of demographic, geographic, and family background controls. See Table 1 for complete list of controls.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Source: NLSY79 1979–2008

age 26.[26] The sample is limited to those who, during the first interview, expressed a desire to complete at least two years of college. The impatient are more than 7 percentage points (roughly 13 percent) more likely to fail to live up to these desires. Conditioning on expecting to complete a college degree, in column 2, yields a similar result: The impatient are 14 percent more likely not to live up to their postsecondary expectations. In column 3, the sample is limited to those who are observed enrolling in postsecondary schooling prior to age 22. Again we find that the impatient are much less likely to complete any degree after enrolling, and are thus significantly more likely to be college dropouts.

Columns 4–6 of Table 3 perform an analogous analysis for those who signal an interest in completing a Bachelor's degree, either through expressing a desire or expectation to complete 16 years or more of education (columns 4 and 5, respectively), or through enrolling at a four-year degree-granting institution (column 6). All three measures yield similar results, with impatient students significantly less likely to complete a Bachelor's degree, even conditional on ex ante indications of interest.

As demonstrated in Table 4 (and as suggested by panel B of Figure 2), the impatient are also especially likely to drop out at points in the investment process that are inconsistent with the standard human capital investment model. First, the impatient are over 20 percent more likely to drop out with no more than a single year of college, conditional on starting (column 1). This type of nearly immediate reversal in

[26] Complete data definitions are provided in the online data Appendix. Note that the NLSY provides two separate sets of questions that can be used to construct degree completion: highest grade completed and highest degree completed. In the main results, we code individuals as having completed a degree if either set of variables shows the respondent having completed the degree. The results are also robust to excluding individuals whose degree status is inconsistent between the two sets of questions.

Table 4—Impatience and College Dropout Dynamics

Sample	Enrolled in college	Ed>=14	Ed>=15	Gave reason for dropping out	Gave reason for dropping out	Enrolled in college
Outcome	<= 1 year credit, no degree (1)	14 years, no degree (2)	No Bachelor's degree (3)	Dropped out due to financial difficulties (4)	Dropped out due to academic difficulties (5)	log hourly wage (2004) (6)
Impatient	0.071***	0.005	0.090***	0.003	0.007	−0.074
	(0.024)	(0.026)	(0.033)	(0.030)	(0.012)	(0.056)
Has Bachelor's degree						0.289***
						(0.027)
Bachelor's × Impatient						0.187**
						(0.089)
Patient mean	0.292	0.129	0.132	0.211	0.028	—
Percent difference	24.3%	3.7%	68.0%	1.2%	24.5%	—
Observations	4,658	3,001	2,218	2,549	2,549	2,589
R^2	0.124	0.060	0.091	0.033	0.016	0.175

Notes: Heteroskedasticity-robust standard errors in parentheses. All analysis limited to sample who enrolled in college prior by age 22. Columns 4 and 5 samples: provided reason for leaving school (did not receive degree). See the online Data Appendix for additional details. Includes a full set of demographic, geographic, and family background controls. See Table 1 for complete list of controls.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Source: NLSY79 1979–2008

investment is certainly predicted by a time-inconsistent investment framework. We note, however, that there are several alternative reasons that individuals drop out of college after completing very few courses. In particular, there are several sources of uncertainty a student faces when enrolling in college, including uncertainty over his own academic ability and other costs of investment (Stinebrickner and Stinebrickner 2012). If those identified as impatient experience larger information shocks, either because they are more likely to have substandard ability levels or because they are more overconfident, these differences, rather than impatience per se may explain their higher dropout rates shortly after enrollment. In fact, in the next section we find that a substantial portion of the impatience gap in nearly immediate dropout behavior can be explained by differences in AFQT scores.

In contrast, by the time students have completed three years of postsecondary schooling there is relatively little new information to be learned about one's ability. Additionally, by completing those three years, students have revealed a sufficiently high level of academic readiness to complete even upper-level college courses. For this reason, the results in column 3 provide strong evidence that the impatient make time-inconsistent dropout decisions. They are nearly 70 percent more likely to complete exactly three years of college, among those who have completed at least three years.[27]

[27] Note that this variable is based on reported individuals' values of "highest degree completed" rather than the number of years of college attendance. See the online data Appendix for further details. These results are also robust to limiting the sample to students who ever enroll in a four-year school prior to age 26, which suggests that the completed years of school accurately reflects coursework that would lead to a bachelor's degree.

Again, each of these results is consistent with time-inconsistent preferences leading to suboptimal investment in college, and the higher dropout rates after three years are difficult to reconcile with any alternative rational model of human capital investment. Given that the costs of the third year of college are quite similar to the fourth year and that the returns are substantially higher (sheepskin effects), it seems unlikely that *any* exponential discount rate can rationalize completing three years but failing to complete a fourth.[28] For completeness, we include column 2, which shows no difference in "dropout" behavior at exactly two years of postsecondary schooling, although interpreting this difference is complicated by the possibility that some of these students were seeking associate's degrees.

These results, however, leave open the possibility that the impatient are more likely to drop out because they face more financial difficulties in completing their education. Although all of the dropout results are conditional on parents' educational attainment, parental income quartiles, and poverty status (in 1979), it is possible that time-varying family income shocks are coincidentally more likely to affect the impatient. Column 4 of Table 4 therefore investigates the role of financial resources directly and finds that, in fact, the impatient are not more likely to drop out for financial reasons. The sample in column 4 is limited to those who have left school without completing a degree and who provided a reason for leaving.[29] The dependent variable is an indicator for whether the respondent reports leaving school due to financial difficulties. Although financial difficulties are a frequent source of dropout behavior (roughly 20 percent of both the patient and the impatient cite financial reasons for dropping out), the hypothesis that the patient and impatient are equally likely to leave for financial reasons cannot be rejected. Further, the point estimate suggests that there is effectively no difference in financial difficulty between patient and impatient dropouts. Similarly, in column 5, we test whether academic difficulties can explain the reasons for dropping out. The impatient appear to be slightly more likely to drop out for academic reasons, although we cannot reject that the dropout rates are the same, and very few students cite academic factors in the dropout decision.

Finally, recall that the conceptual framework suggested that the impatient should be more likely to reverse their preferences as they re-evaluate the relative costs and benefits of investing. This mechanism implies that the observed wage gap for any given educational credential should be larger among the impatient than among the patient because the impatient invest *as if* they require a greater return. To address this hypothesis, we estimated the college–no college log wage gap in 2004 in an interaction model that allows for differential returns for the patient and impatient subsamples (column 6). Conditional on the standard set of covariates, the return to a 4-year degree among those who expect at least a 4-year degree is 18.7 log points higher for the impatient than it is for the patient, and the difference is statistically

[28] For example, given standard estimates of annual returns to school (on the order of 10 percent per year) and a postschooling working career of roughly 40 years, even minimal sheepskin effects, such that the return to the final year is approximately 0.2 percentage points higher than the return to the junior year, will compel all those who completed their junior year to also complete their senior year.

[29] A complete cross-tab of the reasons for dropping out by impatient status is provided in Table A-16 in the online Appendix.

significant at conventional levels. Importantly, this difference is at odds with alternative interpretations that would lead to lower returns to completion among the impatient. For example, the short-run impatient could be more entrepreneurial or risk-taking, which would increase their noncredentialed earnings relative to their patient counterparts. Alternatively, the gap would also be smaller if impatience were a proxy for ability and ability were complementary with schooling.

C. *Potential Alternative Interpretations*

In this subsection, we consider potential alternative interpretations of the differences in human capital investment presented thus far. First, the main results include controls for multiple background characteristics, but they do not include a fully interacted set of covariates. We provide additional analysis in the online Appendix (Table A-3) demonstrating that the estimated impatience gap in investment outcomes is fairly consistent among all race $\times$ gender groups.

One remaining potential concern with the interviewer assessments is that they are measured subsequent to some human capital decisions, especially among respondents who begin the survey at older ages. There is good evidence, however, that key aspects of an individual's personality and preferences crystallize early and are roughly fixed through adulthood (Cobb-Clark and Schurer 2012). Despite this finding, the main results are limited to only younger respondents for high school outcomes, and we have conducted sensitivity analysis that allows the impatience gap in investment behavior to differ by birth cohort. These results reveal that, if anything, the impatience gap is largest among younger cohorts for whom the measures are taken earlier in life.[30]

An additional concern is that these measures may reflect the value of a respondent's time, with the result that those who are already working are more likely to be perceived as impatient. Further, this measure may be influenced by interviewer bias based on the respondent's race or gender. We present a detailed sensitivity analysis of the key results in Section A-2.2 of the online Appendix in which we adjust the impatience measure to account for each of these possibilities. None of these potential confounding influences has any qualitative impact on the estimated investment gaps between the patient and the impatient, however, and we have presented the main results using the simpler measure for ease of interpretation.

Next, we consider the role of cognitive skills by taking advantage of the NLSY's inclusion of scores on the Armed Forces Qualifying Test (AFQT), which was administered as part of the 1980 survey wave.[31] Although this measure is sometimes equated with "innate ability" or IQ, a substantial literature 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).[32] Compulsory

[30] The results by age are available in Table A-4 of the online Appendix.

[31] The link between time inconsistency and cognitive ability has been established in multiple papers, including Benjamin, Brown, and Shapiro (2013).

[32] We follow Neal and Johnson (1996) in using age-adjusted AFQT scores, which are further adjusted to be mean zero and standard deviation one.

Table 5—Impatience and AFQT

Sample	Full sample	Under 17 in 1979	Enrolled in college	Enrolled in college	Ed>=15	Enrolled in college
Outcome	AFQT	No HS diploma by 21	No degree	<= 1 year credit, no degree	No Bachelor's degree	log hourly wage (2004)
	(1)	(2)	(3)	(4)	(5)	(6)
Impatient	−0.217***	0.071**	0.045*	0.040*	0.073**	−0.042
	(0.026)	(0.030)	(0.023)	(0.023)	(0.033)	(0.055)
Has Bachelor's						0.208***
						(0.027)
Bachelor's × Impatient						0.173*
						(0.088)
AFQT	—	−0.168***	−0.202***	−0.190***	−0.115***	0.192***
	—	(0.011)	(0.010)	(0.010)	(0.016)	(0.020)
Patient mean	0.324	0.184	0.425	0.292	0.132	—
Percent difference	—	38.6%	10.5%	13.6%	55.2%	—
p-value from H_0: AFQT control irrelevant	N/A	0.001	0.000	0.000	0.005	0.434
Observations	9,827	2,322	4,658	4,658	2,218	2,589
R^2	0.426	0.228	0.211	0.187	0.116	0.205

Notes: Heteroskedasticity-robust standard errors in parentheses. AFQT is age-adjusted and standardized to have a mean of zero and a standard deviation of one. See text for details. Includes a full set of demographic, geographic, and family background controls. See Table 1 for complete list of controls. The p-value listed comes from a seemingly unrelated regression test of the null hypothesis that the key coefficient (impatient in columns 2–5 and the interaction in column 6) is the same whether or not AFQT is included as a control variable.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Source: NLSY79 1979–2008

attendance laws prevent meaningful variation in the level of early investment as measured by years of schooling. Consequently, the AFQT provides a potentially useful measure of early human capital attainment. As shown in the first column of Table 5, the impatient score roughly one-quarter of a standard deviation lower than do similar patient respondents, confirming that the impatient have indeed invested less by the second wave of the survey.

For completeness, we present versions of some of the key earlier results that include the score as a control variable. In order to justify the use of this variable as a valid control, one must believe that the AFQT measures some attribute that is predetermined at the time that a respondent's degree of patience is crystallized. This assumption is incompatible with several findings from the literature demonstrating that additional schooling and other forms of investment affect an individual's score.[33] Nevertheless, the variation in the measured score likely derives both from innate ability and from investment (Dohmen et al. 2010).

[33] No measure in the NLSY is likely to capture this ideal control variable. In fact, several components of the ASVAB (e.g., General Science, Word Knowledge, Mathematics Knowledge) explicitly measure accumulated knowledge. All but one of the remaining components measure aspects of human capital that are produced through both investment and raw ability, e.g., Paragraph Comprehension and Arithmetic Reasoning. The final component,

In general, the AFQT-adjusted impatience gaps are smaller in magnitude, although the gaps remain statistically significant at the 5 percent level for the results related to dropping out of high school (column 2, comparable to column 3 of Table 2) and at the 10 percent level for the result of enrolling in college but failing to complete a degree (column 3, which mirrors column 3 from Table 3). Each of the gaps continues to have the predicted sign and large magnitudes when measured in percentage terms.

Columns 4–6 of Table 5 present specifications comparable to columns 1, 3, and 6 of Table 4.[34] Notably, the impatience gap in dropout after one year or less is substantially smaller when controlling for AFQT. Again, this decrease in coefficients could reflect the fact that the impatient are more likely to learn that their costs to completing college are higher than they had previously anticipated. Given the discussion above, however, it is likely that part of this difference in coefficients reflects the fact that initial investments (prior to the start of the survey) continue to affect future dropout risk. When those with time-inconsistent preferences suboptimally downweight the future value of cognitive skills in completing college, they will choose to acquire lower skill levels early on and find themselves underprepared for their desired levels of human capital. In any case, we note that, even controlling for AFQT, the impatient are 13.6 percent more likely to drop out after a year or less and that this difference is statistically significant at the 10 percent level.

In contrast, adding a control for AFQT has relatively little effect on the impatience gap in dropping out after three or more years of college (column 5). This stability in coefficients is consistent with the idea that much of the learning about one's ability has already taken place prior to the point where students have completed all but their final year of the degree. Additionally, the larger wage return to completing a bachelor's degree experienced by the impatient is quite robust to controlling for AFQT score. We therefore conclude that the impatience gaps are not solely the result of differences in innate cognitive ability, although the "immediate" dropout gap likely derives in part from lower investment earlier in the educational process.

One remaining question is whether the "impatience and/or restlessness" noted by the interviewer captures ADHD, which has a significant detrimental effect on the production of human capital (Currie and Stabile 2006). Although young adults with ADHD may be considered to have biologically based impulsive or time-inconsistent preferences, they have not been the focus of the economic literature concerned with failures of self-discipline. It is therefore worth determining whether the interviewer assessments represent a form of impatience other than ADHD. 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.

Coding Speed, although potentially unrelated to completed investment, has been associated with intrinsic motivation, and is therefore also far from an ideal control (Segal 2012).

[34] In the online Appendix, Tables A-18 and A-19, we provide full versions of Tables 3 and 4 with and without AFQT as a control to facilitate comparison of all of the college dropout results. A seemingly unrelated regression test of the null hypothesis that the key coefficients are the same with and without the AFQT control is rejected in all but the final column. The individual p-values are listed in the table.

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

Outcome	HS dropout (1)	HS dropout (2)	HS dropout (3)	HS dropout (4)
Ever impatient	0.031***	0.030***	0.022***	0.020***
	(0.006)	(0.006)	(0.006)	(0.006)
Ever ADHD (Wave IV)		0.040***		0.054***
		(0.015)		(0.015)
Controls	No	No	Yes	Yes
Patient mean	0.086	0.086	0.086	0.086
Percent difference	35.8%	34.7%	25.2%	23.8%
Observations	11,631	11,631	11,631	11,631
R^2	0.002	0.003	0.051	0.052

Notes: Coefficients listed are from linear probability models with a dependent variable coded as one if the respondent dropped out of high school based on transcript graduation data from Wave III (dropouts and "other nongraduates" are coded as having dropped out). The sample includes individuals with valid transcript graduation data, valid responses to the ADHD questions, and valid interviewer ratings for at least three waves. Ever ADHD based on a survey question from Wave IV. Columns 3 and 4 add controls for gender, race and ethnicity, mother's and father's education level, an indicator for living with both parents at Wave I, parental income in 1995, and a full set of month of birth dummies. Complete results available in the online Appendix (Table A-14). Heteroskedasticity-robust standard errors in parentheses.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Source: Authors' calculations from Waves I-IV of the National Longitudinal Study of Adolescent Health

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 although it samples later birth cohorts than does the NLSY (grades 7–12 in the 1994–1995 school year). The data contain a question asked of the interviewer similar to the assessment 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.[35] 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 alters the central findings. The results of this replication and extension are found in Table 6, with regression specifications similar to those found in Table 2, column 1.[36] 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 interviewer as impatient during any of the first four waves of the survey.[37]

[35] 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?"

[36] Unfortunately, Add Health does not ask educational expectations questions in the early waves. Given that nearly all students desire and expect to complete high school in the NLSY sample, this specification provides a close approximation.

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

Table 7—Additional Results Consistent with β-Impatience

Outcome	Regret index (1)	Number of job switches (2)	Fraction job switches with > wages (3)
Impatient	0.090**	0.346**	−0.024**
	(0.035)	(0.149)	(0.011)
Patient mean	−0.043	4.85	0.215
Percent difference	—	7.1%	−11.1%
Observations	6,714	6,771	5,607
R^2	0.030	0.126	0.050

Notes: Heteroskedasticity-robust standard errors in parentheses. The regret index is calculated based on questions asked in 2006; thus the sample is limited to those who remained in the NLSY79 until that wave and provided valid answers. It is standardized to have a mean of zero and a standard deviation of one. See text for details. The job switching regressions are run using individuals who remained in the sample until 2004. Each of these specifications control for three completed education threshold dummies in addition to the standard controls. See text for details regarding construction of regret index. Includes a full set of demographic, geographic, and family background controls. See Table 1 for complete list of controls.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Source: NLSY79 1979–2008

The first column confirms an 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.[38] 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 implies that individuals with ADHD are more likely to drop out of high school, the coefficient on the interviewer's assessment of impatience hardly changes. A similar pattern emerges in the final two columns, which add controls comparable to those in our main analysis. While underlying mental health conditions can explain some variation in educational attainment, our results suggest that the interviewer assessments provide an independent measure of impatience that predicts dynamically inconsistent choices.

D. *Additional Results Consistent with β Impatience*

In each of the previous specifications, the preference-reversing dropout results have supported a dynamic inconsistency interpretation of the type of impatience captured by the interviewer's assessments. Table 7 reports results testing additional empirical hypotheses predicted by this time-inconsistent interpretation.

The first column examines another implication of the conceptual framework: individuals with time-inconsistent preferences should express greater levels of regret. When asked to examine past choices, those with non-stable preferences will be

[38] The difference in overall dropout rates between the NLSY and Add Health can most easily be explained by a downward trend in dropout rates and the difference in cohorts sampled.

more likely to express disappointment at their past mistakes. In contrast, those with stable exponential discount rates (even those with low levels of δ) should be more likely to say that they are satisfied with their previous choices. In 2006, the NLSY asked a number of questions related to self-esteem and self-worth, with respondents indicating their level of agreement with each survey item.

We construct a "regret index" based on respondents' answers to three questions closely related to regret, normalized to mean zero and standard deviation one.[39] This measure is designed to be consistent with the definition of regret traditionally used by psychologists, namely as "a backward looking emotion signaling an unfavorable evaluation of a decision" (Zeelenberg and Pieters 2007). On this measure, the impatient show about one-tenth of one standard deviation more regret, conditional on the regular set of controls as well as three threshold-based measures of completed education.[40] Thus, at each level of completed schooling, the impatient are less satisfied.

As discussed in the conceptual framework, the linear and cumulative nature of the educational investment process allows for straightforward predictions about how an impatient individual should behave. It proves much more difficult to form clear predictions for how investments in work experience and firm tenure should differ for the impatient. Nevertheless, we examine job switching, overall experience, and firm tenure outcomes as these combine to create the second canonical type of human capital (Mincer 1958).[41] In columns 2 and 3, we find significant divergence in the career paths of the patient and the impatient. In column 2, 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 one-third of an employer switch after completing their education. Importantly, these results are conditional on completed education, and thus are not simply the result of differences in educational investment leading to different career paths. 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 3, we find that, in fact, the job switches among the impatient are less likely to come with a substantial (greater than 10 percent) increase in wages. Topel and Ward (1992) estimate that the first 10 years of young males' careers determine 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

[39] The three questions are "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," and responses are measured on a four point scale ranging from "strongly agree" to "strongly disagree." Our index is a standardized Cronbach's α-statistic based on the correlations among responses to these three questions.

[40] The magnitude of the effect is comparable in size to the impact of failing to complete high school (0.13) or, conditional on completing high school, failing to complete college (0.09).

[41] This analysis differs from the NLSY-based job search analysis conducted in DellaVigna and Paserman (2005), which focused primarily on job search during unemployment. For a more complete treatment of the role of time-inconsistency in on-the-job search see Drago (2006) and van Huizen (2010).

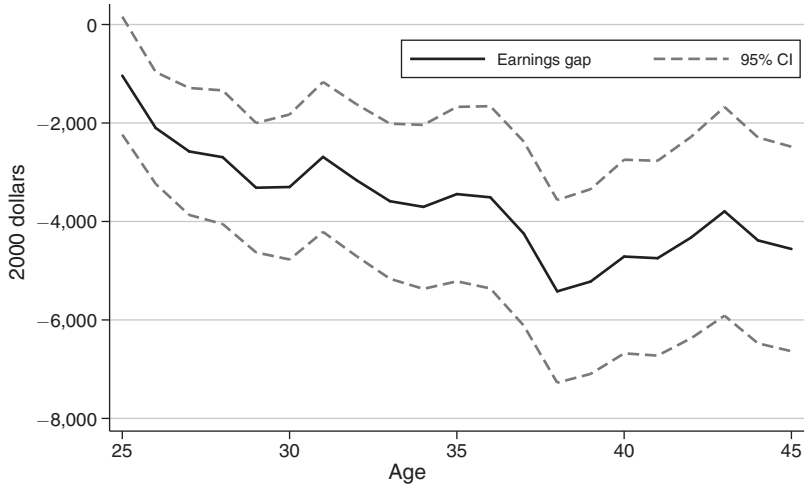

Figure 3. Annual Earnings Gap at Each Age, by Patience

Notes: Figure shows regression-adjusted gaps (using all available background characteristics) in annual earnings (constant year 2000 dollars) between patient and impatient respondents. The sample is limited to individuals with a valid impatience measure and a valid completed schooling variable who remained in the NLSY79 sample until age 45. The impatience measure is described in more detail in the text. The sum of annual gaps is −$76,533, with a standard error of $4,025 ($p$-value < 0.001).

Source: Authors' calculations from NLSY79 1979–2004

changes that do not lead to wage improvements is particularly damaging to their lifetime wage profile. Although there are potentially alternative explanations for each of the differences in behavior examined in Table 7, the impatience gap for each outcome is consistent with a short-run impatience interpretation.

E. *Lifetime Labor Market Consequences*

The results presented to this point have shown that the human capital investment decisions of the impatient deviate in significant ways from similar patient individuals. The final set of results provides a measure of how costly these deviations are for the lifetime earnings of the impatient. In most investment decisions, suboptimal choices result in relatively small initial differences with the full cost only later materializing. The earnings consequences of underinvesting in human capital follow exactly this pattern. As shown in Figure 3, the early career differences in earnings are relatively small. This figure plots the impatience gap in annual earnings (constant 2000 dollars) from a set of age-by-age earnings regressions that include the full set of background characteristics and a complete set of birth year dummies.[42] The exact values of the coefficients and standard errors are reported in more detail in Table A-8 of the online Appendix. Initially, there is little difference between these groups' annual earnings, but by the time this cohort has reached middle age, the

[42] We impute values for the biennially missing survey years (post-1994) based on the earnings before and after the missing year (linear interpolation).

impatient consistently earn on the order of 10 to 15 percent less annually than do the patient.

The appropriate significance test here is an *F*-test of the null hypothesis that the sum of the annual differences is zero, rather than testing for a statistically significant difference at any particular age.[43] Comparing the sum of the differences in annual earnings between groups yields a *p*-value less than 0.0001. Figures A-1 and A-2 in the online Appendix decompose the differences in earnings into hours worked and the hourly wage and show that the difference in earnings derives both from lower hourly wages (especially later in the career) and from fewer annual hours.[44]

The cumulative impact of the annual differences is substantial. By middle age (respondents are 39–46 in 2004), impatient respondents have earned more than $75,000 less on average than have patient respondents over their lifetimes, 13 percent less in percentage terms. To be clear, this cumulative difference in lifetime earnings reflects a number of factors beyond suboptimal educational investment. Additional calculations (adjusting this gap for completed schooling) suggest that roughly 40 percent of this earnings gap is attributable to differences in educational investment. The impatient, therefore, suffer economically meaningful losses as a result of their early-in-life underinvestment.

III. Conclusion

In this paper, we have found that individuals identified as impatient by an interviewer accumulate significantly less human capital. Crucially, much of the divergence in human capital arises through time-inconsistent investment patterns. The increased likelihood of dropping out of high school or college despite an objective signal that one's personal value of completion exceeds the cost suggests that lower educational attainment among this group derives in part from present-biased preferences. Further, other patterns of behavior, such as expressing greater regret or churning through jobs without corresponding salary increases, provide additional evidence of time-dependent investment decisions.

These educational investment choices have a profound impact on posteducational income. By their mid-40s, the peak earning years of the lifecycle, the impatient earn 10 to 15 percent less annually, comparable to the estimates for the returns to an additional year of school in the compulsory schooling literature.[45] In a cumulative sense, the impatient have earned 13 percent less than their patient counterparts over their lifetimes.

Finally, our findings are also consistent with a growing literature, both in economics and psychology, on the value of self-regulation and the role of "soft skills" in young people's development. The fact that many dropouts fail to complete their personally optimal level of schooling supports an expanded role for policies to

[43] Although these point estimates consistently find an advantage for the patient, the choice to examine cumulative differences would be especially important if the impatient had initially higher earnings levels.

[44] Much of the difference in hours derives from more frequent and longer lasting spells of unemployment; specific results on the unemployment spells are available from the authors upon request. The *p*-values testing that the sum of the annual differences is zero are less than 0.0001 for both differences in hourly wages and annual hours.

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

encourage students to obtain additional schooling, although the coarse measure of impatience used in this study precludes a precise accounting of the share of individuals who might benefit. Programs designed to improve noncognitive skills at early ages (Heckman et al. 2010, for instance) or to provide immediate payoffs to encourage additional human capital investment (such as Fryer 2010) are two promising potential approaches. Policies that are specifically designed to encourage completion, such as the University of Baltimore's Finish4Free program that pays the entire cost of a student's final semester if she graduates on time, may be especially effective.[46] More stringent constraints, such as longer compulsory schooling periods, may also have similar benefits (Oreopoulos 2007). Regardless of the design of policy, the results in this paper suggest that encouraging the delay of gratification during human capital formation is likely to have large and long-lasting payoffs.

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