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Carpe Diem or Seize your Health?

The Economics of Time Preferences, Health, and Education

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INTRODUCTION

This thesis uses theory from behavioral economics applied to health and educational choices. In the four different chapters, it investigates how time preferences predict individual decision-making. Time preferences are defined as the relative weight an individual gives to future utility compared to present utility. In the thesis, I specifically focus on time preferences in relation to decisions to invest in one's health and to follow medical treatments, discussed in chapters 1 and 2. I am also interested in the transmission of preferences from parents to children, and how this affects real-life outcomes, such as educational attainment and future earnings. This is looked at in chapter 3, and in chapter 4, I study how time preferences and other "hard-to-measure-variables" can affect the relationship between education and health.

When reading this thesis, one might wonder whether a person's time preferences could be normatively seen as "good" or "bad". On this question, I cannot answer. What I do see in my papers is that patient individuals live longer, healthier, and more educated lives. But while the upsides of postponing utility are clear, the potential downsides are not discussed in much detail in this thesis. Being able to wait can both be seen as a positive thing, as a virtue if you like, but also as a symptom of passiveness. This could be a negative trait in a society that moves at a high pace and where a slow reaction on your part, might allow someone else to seize your opportunities. Waiting can also be very difficult in some situations. On this topic, Fredrich Nietzsche writes:

"*Ability to wait is so hard to acquire that great poets have not disdained to make inability to wait the central motive of their poems*"

(Nietzsche (1908), "Human, all too Human", page 96).

He then makes the examples of Greek Heroes and Shakespeare's character Othello, whose destiny could have been completely different if they only would have let their feelings cool for one day more.

Philosopher Matthew Pianalto writes on Nietzschean patience that while it is passive in a sense, it is also active as it requires self-restraint. Patient activities include being calm and waiting to pass judgement. Yet, Pianalto argues that impatience could also be a virtue for Nietzsche as impatience could be seen as a sign of vitality and curiosity (Pianalto 2015). This might appear a bit strange. How can both patience and impatience be virtues? Well, the answer is probably that while there exists heterogeneity in time preferences in the population (Falk et al. 2018) every human being possess both traits to some degree, and both traits can be useful in different situations. What I find in this thesis is that in the context of long-term health and education, having time preferences that put a higher weight on future utility, is preferable.

The first chapter of this thesis investigates the predictive power of time preferences on the risk of early mortality and illness in adulthood. It does so using unique Swedish data from the "Stockholm Birth Cohort" including individuals born in 1953, interviewed in their adolescence in 1966, and followed with register data up to 2018. This dataset is also used in chapter 3 and chapter 4 in this thesis. In chapter 1, the results from looking at the 12,956 individuals in the cohort show groundbreaking results. It appears that patient adolescents are 17–21% less likely to die before age 65. Patient adolescents have fewer hospitalizations and diagnoses in their adult life and are less likely to be diagnosed with conditions associated with lifestyle risk factors. When interviewed about it, patient adolescents also report to be more in favor of sports activities and to prefer that schools should have rules against smoking. The investigated channels for the relationship between time preferences and future health include lifestyle, mother's time preferences, and the adolescent's later educational attainment and future income. Controlling for education and income reduces the coefficient for time preferences on early mortality by one-fourth.

In the second chapter, me and my co-authors Kai Barron, Mette Trier Damgaard, and Christina Gravert use a simple real-effort task implemented via text message to elicit the time preferences of pregnant women in South Africa. We find evidence that high discounters are significantly less likely to report to adhere to the recommendation of taking daily iron supplements during pregnancy. There is some indication that time-inconsistency is also negatively associated with adherence. Together, our results suggest that measuring time preferences could help predict medication adherence and thus be used to improve preventive health care measures.

In chapter three, PhD college Louise Jeppsson and I study parents' time preferences to see how these relate to intergenerational social mobility. When social

mobility is low, we can expect that children of poor individuals get restricted in their life opportunities. We once again make use of the Stockholm Birth Cohort data and investigate if mothers' time preferences are predictors of adolescent cohort members' future educational outcomes. In the chapter, we find that children of patient mothers have higher grades, are more likely to be enrolled in an academic elementary school track, and are more likely to attain post-secondary education. But the results are statistically insignificant for some other educational outcomes, which in some cases could be due to power issues. We also find that mothers' and children's time preferences are correlated. Still, we see that parental time preferences are predictors for educational outcomes, beyond this inter-generational transmission of preferences.

In the fourth chapter, the Stockholm Birth Cohort data is used to shed light on a puzzle in health economics. The question is: Does more education lead to better health? Or is it just selection on often omitted variables that makes educated live longer in Sweden? In this chapter, I show that that one more year of schooling predicts a 17% lower risk of early mortality. This mortality inequality by educational attainment persists for the most part, even when extensive controls are included in the regression. There is only a 2-percentage point change in the mortality risk by years of education when information on health background, gender, socioeconomic variables, as well as adolescents' early educational plans, cognitive ability, and time preferences are added to the regression. Completion of upper secondary and university education even remains a strong predictor of future health after controlling for on grades in years 6 and 9, and the adolescents' applications to upper secondary school. The only thing that really changes the stability of the health by education results is when I change the investigated measure of future health.

To conclude, the effectiveness of health recommendations and treatment plans depends on the extent to which individuals follow them. For the individual, medication adherence and other health investments involve an inter-temporal trade-off between expected future health benefits and immediate effort costs. In this thesis, I use extensive information for people born in 1953 in Stockholm with additional information from their mothers, as well as contemporary data from pregnant women in South Africa. This data allows me to control for new factors and create a better understanding of the relationship between educational attainment and future health. Combined with behavioral economic theory, the data also enables me to show that time preferences are an important factor in understanding everyday health investments, social mobility, and long-run health outcomes. These results can be of great value for practitioners who want to improve screening for vulnerable individuals in different settings. Based on these findings, I also suggest that policymakers working in the health care and educational sector carefully consider the immediate individual costs and gains of their planned interventions. This focus could potentially improve policy targeting of impatient members of society and increase the long-run well-being of these individuals.

Chapter 1

Time Preferences, Illness, and Death

Abstract

This paper investigates the predictive power of time preferences on the risk of early mortality and illness in adulthood. Using a unique Swedish cohort of 12,956 individuals born in 1953, interviewed in 1966, and followed with register data up to 2018, the paper finds that patient adolescents are 17–21% less likely to die before age 65. Patient adolescents have fewer hospitalizations and diagnoses in their adult life and are less likely to be diagnosed with conditions associated with lifestyle risk factors. Patient adolescents are also more in favor of sports activities and school rules on smoking. The investigated channels for the relationship between time preferences and future health include lifestyle, mother's time preferences, and the adolescents' education attainment and future income. Controlling for education and income reduces the coefficient for time preferences on early mortality by one-fourth.

Ethics Approval has been obtained from the Swedish Ethical Review Authority Dnr: 2020-02068.

1.1 Introduction

The top global causes of death are cardiovascular diseases, such as ischemic heart disease and stroke. World Health Organization (2017) describes that most of these diseases can be prevented with population-wide strategies addressing lifestyle factors such as inactivity, diet, smoking, and drinking. However, to create effective strategies nationwide, it helps to understand why people have these lifestyles to begin with. Why do people choose consumption and habits that are bad for their long-term health?

A possible driver, among many, is time preferences, i.e., the relative weight an individual gives to future utility compared with present utility. There is little empirical knowledge of the relationship between time preferences and long-term health outcomes, due to lack of data. Yet, in the short run, we know that time preferences correlate with exercise (Leonard & Shuval 2017) and smoking habits (Harrison et al. 2018). We also know that when food prices go down, people with high discounting rates are more likely to get a high BMI (Courtemanche et al. 2015). One way to interpret these results is that people with higher discounting rates (who are more impatient) are less likely to choose costly habits and forgo utility in the present in order to obtain better future health.

This paper uses a unique dataset from Sweden called the Stockholm Birth Cohort (SBC), with time preference data from 1966, to investigate the relationship between time preferences and long-term health. Golsteyn et al. (2014) use an earlier version of the dataset to investigate the link between adolescents' time preferences and future labor outcomes. Notable, however, is that they also find a relation between adolescent' time preferences and mortality before age 49, which is weakly significant (at the 10% level). In the present paper, I have access to a newly updated version of the SBC data, which include more participants and follow them for a longer period. This longer period is important, since the causes of death vary between different age groups.[1]

In total, the new data I have access to contain time preferences of 12,956 adolescents born in 1953. Adolescents (aged 12 or 13 at the time) were asked whether they preferred US$ 110 (SEK 100) immediately or US$ 1,100 (SEK 1,000) five years later.[2] This enables me to investigate the link between time preferences and early mortality for almost everyone in this age group in Stockholm. The results are

[1]While the majority of deaths in ages 15–44 in Sweden are due to suicide or unintentional injury or poisoning, tumors and cardiovascular diseases are the top killers in ages 45–74 (Statistics Sweden 2020b).

[2]The numbers in parentheses are the actual values in Swedish kronor (SEK) in 1966. US dollars are expressed in 2019 prices. In 1966, the inflation rate in Sweden was 6.6% (Statistics Sweden 2021a).

striking – patient adolescents who prefer the delayed higher rewards are significantly less likely to die before age 65. When controlling for socioeconomic variables, they have a level of mortality that is one-fifth lower than the mean in this age group. Adding controls for cognitive ability and background health to the regression, patient adolescents are still less likely to die before age 65 and have a mortality rate that is one-sixth lower than the sample mean.

Further, access to hospital discharge registers and the Swedish Cause of Death Register, which Golsteyn et al. (2014) did not have, allows my paper to generate a new understanding of time preferences and lifetime health. Using this data, I find that patient adolescents have fewer hospitalizations and fewer diagnoses overall in adulthood, compared with their less patient peers. They are also less likely to be diagnosed with diseases associated with lifestyle risk factors and alcohol use in their adult life.

Time preferences cannot be randomly assigned to people in experiments, as preferences are part of who they are. Hence, cohort datasets with preferences combined with objective long-run hospital data are perhaps the best possible strategy to analyze time preferences and long-term health. Although I cannot claim causality, the rich available diagnosis and survey data in the SBC can suggest plausible channels of the results. In the cross-sectional data, I find that patient adolescents in the sample are more positive to banning smoking at schools and more interested in sports activities. Furthermore, the SBC dataset contains additional time preference information on a sub-sample of 3,651 primary caretakers (mostly mothers) of the adolescents. Using this data, I show that patient mothers are less likely to allow their children to smoke at home.

Other suggested channels between time preferences and future health are educational attainment and future earnings. In regressions, this paper finds that part of the relation between time preferences and early mortality is mediated by these labor variables. When educational attainment and future earnings are added as controls, the correlation between time preferences and early mortality is reduced by 25%.

1.2 Literature on Time Preferences and Long-Term Health

Most existing studies investigating time preferences and health are cross-sectional in nature. Fuchs (1982), Van der Pol (2011), and Cen et al. (2021), for example, all find significant correlations between time preferences and intertemporal self-reported health status. While these types of findings are very interesting, the cross-sectional datasets do not allow researchers to determine whether time preferences affect health outcomes or health status influences preferences. Yet, datasets that follow individuals over time are rare in this field, which makes longitudinal studies hard to come by. In this section, I will go through the longitudinal studies that exist today on the topic of time preferences and health.

Thirumurthy et al. (2015) ask HIV-infected participants in Kenya hypothetical time preference questions. They find that having a high discount rate correlates with a higher mortality rate 48 weeks after enrollment in a medication program. One potential channel for this relationship is different levels of medical adherence, but the paper suffers from both a small sample size (N=220, of whom 13 passed away) and possible reverse causality. The authors would have needed to gather cohort data before the patients fell ill or be able to control initial sickness levels in order to rule out the possibility that illness alters the individual preference for money now versus money later when the experiment took place. Looking at the predictive power of time preferences on health, it is therefore problematic to use cross-sectional data (see the discussions in Fuchs 1982; Van der Pol 2011; or Cen et al. 2021) or short follow-up periods.

Golsteyn et al. (2014) use an earlier version of the SBC dataset with mortality data up to 2001 (N=11,907). Their focus is on labor outcomes, and they find significant relationships between adolescents' time preferences and key future economic variables such as education choices and lifetime income. In addition, they find indications that adolescents' time preferences predict future likelihood of being obese (BMI>30) at military enlistment, as well as weak evidence that it increases the risk of suffering an early death. As for this latter analysis, their last year of observation is at age 48. Yet, this relationship is only significant at the 10% level and disappears when controlling for educational attainment.

Although this is not their focus, the study by Golsteyn et al. (2014) is, to my knowledge, the only existing paper with results on long-term health and time preferences as we think of the concept in economics. The rest of this review will therefore consist of literature from closely related fields. Cadena & Keys (2015), for example, create a dummy variable for participants in the National Longitudinal Survey of Youth (NLSY) in the U.S. who interviewers categorized as "impatient or restless" in waves from 1980 to 1985. This is not a common way to measure time preferences in economics, but the authors find that the measure correlates positively with the participants' reported number of hangovers in the last 30 days, measured in 1983 (N=10,038), and reported smoking, measured in 1998 (N=7,268). In a footnote, the authors describe that it also correlates significantly with BMI, but that the significance disappears when adding controls to the regression.

Self-control is a concept related to time preferences that became famous with the so-called "marshmallow experiments" conducted by Mischel, Shoda, and colleagues. The researchers study how many minutes young children can wait to get two marshmallows (or other treats) instead of just the one marshmallow they have in front of them. The data collection took place at a kindergarten in the Stanford University area from 1968 to 1974 with experiment designs differing in terms of waiting time and treatment assistance to resist temptation (Mischel et al. 2011). In follow-up studies with 131 and 80 children from the original experiments, Ayduk et al. (2000) find no correlation between experimental results and later use of cocaine or crack (at age 27) and Ayduk et al. (2008) find no direct correlation with having features of borderline personality disorder (at age 39). Continuing with self-control and health, Watts et al. (2018) describe their paper as a "conceptual" replication of Mischel and Shoda's work and use data from a sample of 4-year-old children at 10 different sites in the U.S. Here, the early self-control results do not correlate significantly (at the reported 5% level) with mothers' answers regarding their children's depressiveness and antisocial behavior in first grade and at age 15.

Lastly, Moffitt et al. (2011) gather self-control data from 3-11-year-old children in New Zealand (N=1,037) using various techniques. Their data contains self-reported hyperactivity, lack of persistence, and inattention, as well as observational ratings by researchers, teachers, and parents. Later, at age 32, information is gathered on metabolic abnormalities, airflow limitation, C-reactive protein, and periodontal and sexually transmitted diseases. Their results show that children with less self-control in their sample have a significantly higher value on this later combined measure of health problems. Children with less self-control are also more likely to have started smoking at age 15 and have a higher risk of substance dependence as adults. However, they do not display significantly higher rates of depression.

To summarize, there is some evidence in the literature that measures of children's self-control correlate with health problems later in life. These associations are significant when investigating smoking, but the evidence is mixed when it comes to substance abuse and high BMI. Yet, the two papers investigating psychological outcomes in terms of depression, and borderline personality disorder, find no evidence of self-control being a risk factor. Important for this paper is that with age 48 as the last year of observation, Golsteyn et al. (2014) find a weakly significant correlation between adolescents' time preferences and early mortality. Thirumurthy et al. (2015), too, find evidence in this direction, using a smaller sample of HIV patients in Kenya. Although there are some interesting studies in this area, more research is needed in order to understand the connection between time preferences and long-term health.

1.3 Data

The original data for this study consists of all 15,117 children born in 1953 who lived within defined areas in the Stockholm region in 1963. In 1966, when the children in the cohort were 12–13 years old, sociology researchers visited all schools in Stockholm and a set of larger surrounding municipalities to gather data from the cohort members. Data collection with register data for the same individuals continued until 1986 when the project was closed and the data was unidentified. The story of the dataset could have ended here, but Stenberg & Vågerö (2006) were later able to match individuals in the original dataset with an additional later longitudinal set of register data.[3] In the present study, I use a newly updated matching of the sample by Almquist et al. (2020), containing longer follow up periods and more matched individuals.[4] From the original 15,117 children in the cohort, today I have access to time preference data on 12,956 adolescents combined with hospital discharge register data up to 2016 and the national causes of death register up to 2018, when the sample turned 63 and 65 years old, respectively.[5] This rich dataset, named the Stockholm Birth Cohort (SBC), enables me to investigate the predictive power of time preferences on early mortality and illness later in life. In addition, in 1968, a representative sample of 4,021 caretakers, mainly mothers, were targeted for more data collection. Interviews took place in the participants' homes, and through the matching of Almquist et al. (2020) the present study has access to time preference data from 3,478 of these mothers.[6]

[3]See Stenberg & Vågerö (2006) for more information on the data collection. Codebooks with information on the gathered data are available at www.stockholmbirthcohort.su.se/about-the-project

[4]See Almquist et al. (2020) for a description of this new matching and updated sample. This new dataset is superior to the former matching since it contains longer data and more individuals have been matched. One hundred twenty-five out of 167 individuals who died early and were lost in the former matching have now been tracked down and included.

[5]Few students refused to be part of the study and the number of absentees when the researchers visited was seen as normal. In total, 9% of the original cohort did not take part in the school questionnaire study. An additional 5% of the targeted sample are missing due to incomplete answers to specific questions, or because of incomplete matching, thought to be caused mostly by emigration.

[6]This sample consists of 93% mothers. Two percent are fathers, other relatives, or other adults who have the primary care of the child. The remaining 5% of interviewed adults have missing information on their relation to the child.

1.3.1 Time Preferences

The main explanatory variable in this paper is time preferences in a broad sense, including both time-consistent and time-inconsistent preferences. Research has not found any systematic differences in results from time preference measures with real or hypothetical monetary rewards (see for example Matusiewicz et al. 2013; Brañas-Garza et al. 2020). In the contemporary behavioral economics literature, individual time preferences are usually measured by asking participants to choose between different monetary levels of X now or Y later. As an example, *Would you rather receive 100 euro today or 153.8 euro in 12 months?* is one of the hypothetical measures that Falk et al. (2018) use in their worldwide data collection on preferences. In the SBC data collection in 1966, researchers asked a similarly structured question: *If you had to choose between US$ 110 (SEK 100) immediately and US$ 1,100 (SEK 1,000) in five years, what would you choose?*.[7]

Yet, the answers to the question are formulated a bit differently than we are used to today. Instead of just answering that they prefer option X or Y, the participants were offered five response alternatives: definitely the immediate, probably the immediate, not being able to choose, probably the delayed, and definitely the delayed. To mimic modern versions of this question, I create a binary version of the variable called *chose delayed reward*. This variable is classified as 1 if the adolescent probably or definitely chose the later larger amount. This binary categorization is the same as Golsteyn et al. (2014) use in their analysis, and the reason for using it is to reduce noise driven by things other than time preferences (such as general assertiveness in decisions). In robustness analysis, however, all five response alternatives are included and presented.

Table 1.1 shows the full distribution of answers to this question and the main analysis of this paper covers all 12,956 adolescents who answered this question. A large majority of participants (78%) chose the later larger option, which is regarded as the patient choice, implying a lower discount rate.

1.3.2 Diseases and Mortality

To measure health, the main outcomes in this paper are early mortality and the total number of hospitalizations and diagnoses in adulthood. Table 1.2 shows that 1,229 (462) of the 12,956 participants died before age 65 (50). Separating

[7]The numbers in parentheses are the actual values in Swedish kronor (SEK) in 1966. The US dollar amounts are expressed in 2019 prices. For the original Swedish version of this question, please see Table A2 in the Appendix of this paper.

Table 1.1: Time preferences.

Adolescents' time preferences: *If you had to choose between receiving SEK 100 now or SEK 1,000 in 5 years, what would you choose?*	Frequency	Percent
Definitely SEK 100 now	807	6.23
Probably SEK 100 now	851	6.57
Cannot choose	1,195	9.22
Probably SEK 1,000 in 5 years	4,568	35.26
Definitely SEK 1,000 in 5 years	5,535	42.72
Total	12,956	100

With rounded numbers of US$ in 2019 Swedish prices in parentheses, the adolescents were asked to choose between SEK 1,100 (US$ 110) immediately or 11,000 (US$ 1,100) five years later.

mortality by gender, 467 women (7.3%) and 762 men (11.6%) in the sample died before turning 65. This is similar to national numbers for Sweden.[8]

At the end of each period of care at a Swedish hospital, a final medical record is created. It includes all diagnoses relevant for the patient during that hospital visit. In Sweden, regional taxes finance the healthcare system and protocols and data sources vary within the country. I have access to hospital diagnosis data from 1973 in the Stockholm area and from 1983 nationwide. To handle the difference in data coverage I use address data, available for the years 1971, 1975, and 1978–1983 to restrict the sample to the 9,913 individuals who lived in the Stockholm region in all these years. Using this smaller sample, with 2016 being the last year of observation, Table 1.2 shows that the mean participant had 10 diagnoses recorded during six hospitalizations from age 20 to age 63, including hospital visits for childbirth.

In addition to these aggregated hospitalization and diagnosis data, I also have information on specific diagnosis codes. However, individual health data is sensitive information. To protect the participants' anonymity, the SBC must include at least 50 observations for a group of diseases to be included as an outcome variable in this paper. Using this restriction on specific diagnoses, Table 1.2 shows that 6% and 2% of participants were diagnosed with abuse of or dependence on alcohol and drugs, respectively, from age 20 to age 63. Grouping different acute

[8]In Sweden, 8.9% of women and 13.9% of men who died in 2019 were ages 0–64 (Statistics Sweden 2020a). This is comparable to the 7.3% mortality for women and 11.6% mortality for men in ages 12–64, which exclude earlier mortality.

Table 1.2: Mortality, hospitalization, and diagnoses.

Mortality, all causes		Mean	Standard deviation	Frequency	Sample size
Before age 50		0.036	0.19	462	12,956
Before age 65		0.095	0.23	1229	12,956
Ages 34–63 Cause-specific mortality					
All cancers		0.027	0.16	356	12,956
Lung cancer		0.004	0.07	55	12,956
All circulatory conditions		0.015	0.12	191	12,956
Ischemic conditions		0.008	0.09	106	12,956
Ages 34–63 Mortality associated with					
Lifestyle risk factors		0.046	0.21	585	12,956
Alcohol use		0.025	0.16	325	12,956
Tobacco use		0.036	0.19	458	12,956
High BMI		0.025	0.16	324	12,956
Low physical activity		0.015	0.12	196	12,956
Age 20–63 Hospitalization/diagnoses	**Max**	**Mean**	**Standard deviation**	**Frequency having > 0**	**Sample size**
Total number of hospitalizations	293	5.68	9.82	8,450	9,913
Total number of diagnoses	1097	10.21	23.51	8,444	9,913
Acute heart conditions	45	0.14	1.03	509	9,913
Abuse of/dependence on:					
Alcohol	157	0.40	3.71	563	9,913
Psychoactive substances other than nicotine/alcohol (e.g., cannabis/cocaine)	134	0.13	2.11	199	9,913
Age 34–63 Illness (non-mortal) associated with:					
Lifestyle risk factors	880	2.30	11.46	4,345	12,792
Alcohol use	637	1.43	8.66	3,033	12,792
Tobacco use	426	1.27	6.07	3,351	12,792
Drug use	151	0.14	1.91	312	12,792
High BMI	274	1.06	5.00	3,014	12,792
Low physical activity	96	0.35	2.05	1,417	12,792
Sexual risk-taking	43	0.05	0.68	237	12,792

The last point of mortality data is measured on January 30th, 2018. The cause of death categorization is made using ICD 9 from 1987 to 1996 and ICD 10 from 1997 to 2016. It contains information on cause of death for 1,131 individuals who passed away between the ages of 34 and 63. Diagnoses associated with lifestyle risk factors are categorized in ICD 9 and ICD 10 by Stanaway et al. (2018). At the end of each period of care at a Swedish hospital, a final medical record is created. It includes all diagnoses relevant for the patient during that hospital visit. This table presents the full data from hospitalization records in the Stockholm area in the years 1973–2016 and nationwide in 1983–2016. Variables on total number of hospitalizations, diagnoses, and acute heart conditions only include participants who were alive in 1973 and lived in the Stockholm region in 1971, 1975, and 1978–1983, when data on addresses where gathered. Acute heart conditions consist of acute myocardial infarction, cardiac dysrhythmias, and heart failure, classified as 410, 427, and 428 in ICD9, defined by Doyle (2011). I expand the measure by also including the corresponding ICD8 and ICD10 codes for the conditions. For the full set of ICD codes, see Appendix G.

heart conditions together, the table also shows that 5% of the sample in this period were diagnosed with at least one such condition.[9]

Stanaway et al. (2018) is a medical paper that systematically lists diseases associated with health risk behaviors. To my knowledge, it is the most rigorous categorization available of diseases associated with behavioral risk factors. I use their lists of diagnoses associated with tobacco, alcohol, and drug use, low physical activity, high BMI, and sexual risk-taking to create indexes of conditions associated with lifestyle risk factors.[10] Stanaway et al. (2018) categorize both mortal and non-mortal diagnoses in the ICD9 and ICD10 systems. These systems were used at Swedish hospitals from 1987 (age 34 for the participants). Table 2 shows that in ages 34–63, 34% (4,345 out of 12,792) had been diagnosed with at least one condition associated with lifestyle risk factors.

The full list of diseases included for each behavioral risk factor is presented in Appendix G. Some diseases are associated with more than one lifestyle risk factor (death by kidney cancer is, for example, associated with both tobacco use and a high BMI), but please note that not all deaths in the index are caused by lifestyle factors. While alcohol increases the risk of dying from drowning, far from everyone who drowns has consumed alcohol. Worth noting also is that the indexes include conditions associated with lifestyle risk factors but not mortality directly from these factors. the index, therefore, excludes participants who die directly from alcohol poisoning or drug overdoses. This is problematic and can cause downward bias in the estimates. Yet, I still choose to use Stanaway et al.'s categorization since it is the best one currently available.

Studying participants' cause of death, the present paper uses the first-listed diagnoses, reported by physicians as the "terminal cause of death" to the National Board of Health and Welfare (in Swedish: Socialstyrelsen).[11] Table 1.2 shows that from age 34 to age 63, the most common terminal cause of death in the SBC sample is cancer, followed by circulatory disease.[12] These diseases also cause

[9]The definition of an acute heart condition comes from Doyle (2011), who classifies acute myocardial infarction, cardiac dysrhythmias, and heart failure as heart conditions where patients are advised to seek immediate care at their nearest hospital.

[10]In the SBC data, 47 and 11 individuals die in conditions associated with drug use and sexual risk-taking, respectively. As these figures are lower than 50, data for these indexes are not presented in Table 1.2.

[11]More detailed information on frequencies of different forms of mortality is available in this papers' Appendix Table A1. While some of the deceased in the sample only have one diagnosis as cause of death, most have more than one diagnosis. The number of diagnoses a person has could depend on the degree of illness, but also on how well physicians knew their patient, whether the physician had a time constraint, whether the cause of death was clear, and whether an autopsy was performed.

[12]ICD is an acronym for International Statistical Classification of Diseases and Related Health Problems. I use ICD9 and ICD10 to categorize the cause of death, used in Sweden in 1987–1996 and 1997–2016, respectively.

large shares of deaths under age 70 worldwide, and World Health Organization (2016) lists lifestyle factors as being important drivers of both of these diagnoses.

1.3.3 Control Variables and Sample Selection

The top section of Table 1.3 contains descriptive statistics for the full sample, including control variables for socioeconomic factors and gender. The sample contains an almost equal distribution of boys and girls, and the fathers and mothers of the participants were on average 31 and 28 years old when they had their child. In 16% of the families, secondary school was the highest completed level of education among the parents, and in 9% of families, at least one of the parents had studied at university level. Comparing the parents, the fathers' incomes are on average more than five times as high as the mothers'. In the sample, 6,295 mothers and 1,943 fathers have income levels reported as 0, indicating either that they do not have any income or that this information is missing. In addition to linear controls for parental income, dummy variables for "no reported income" are therefore also included in the main regressions. For 107 mothers and 498 fathers, the dataset has missing information on the parents' age when their child was born. Following the convention in the literature, missing values for these control variables are coded as the variable mean, with dummies for missing values in regressions.[13] Comparing the sample with and without information on parental age, I see that adolescents' time preferences, month of birth, and gender are almost identical (see Table A3 in Appendix). Yet, the level of parental education is different: the sample with information on parental age has a higher value on parental completion of upper secondary school. There is, however, no difference between the groups when it comes to reported parental education at the university level.

The SBC dataset contains additional data on cognitive ability for most of the sample as well as additional information that can be interpreted as participants' health at baseline. Table 1.3 shows results from a spatial cognitive ability test with adolescents' results ranging from zero to 39 points. In the task, designed by Härnqvist (1967), participants are asked to mentally fold figures. This design makes it similar to the nonverbal Raven progressive matrices test that measures abstract reasoning and general human intelligence. The Härnqvist spatial cognitive ability test has been used before as a measure of fluid intelligence (see Golsteyn et al. 2014) and an illustration of one of its test questions is available in Figure A1 in

[13]This substitution is also done in Golsteyn et al. (2014). In robustness regressions in this paper (Table B4 in the Appendix), the sample is instead restricted to include only individuals with non-missing information on the parents' age when they had their child (n=12,365).

Table 1.3: Descriptive statistics.

Explanatory variables	Mean	Standard deviation	Min	Max	Sample size
Adolescents: chose delayed reward	0.78	0.41	0	1	12,956
Month of birth	6.29	3.36	1	12	12,956
Female	0.49	0.5	0	1	12,956
Father's age when child was born	31.19	6.34	16	75	12,956
Mother's age when child was born	28.34	5.7	15	48	12,956
Parent upper secondary school	0.16	0.37	0	1	12,956
Parent university level	0.09	0.28	0	1	12,956
Father's total income	24.90	21.39	0	444	12,956
Mother's total income	4.50	6.99	0	115	12,956
Father died before age 65	0.16	0.37	0	1	12,956
Mother died before age 65	0.09	0.29	0	1	12,956
Absence from school	41.59	44.93	0	625	12,955
Ability at age 13	22.73	7.12	0	39	12,920
Additional variables in further analysis					
Score: Sports interests	35.34	8.29	10	50	12,913
Adolescent's opinion: Not smoke at school	0.56	0.5	0	1	12,923
Mothers chose delayed reward in 1968	0.65	0.5	0	1	3,478
Rules by mothers: Adolescent not allowed to smoke at home in 1968	0.64	0.5	0	1	3,174
Used tobacco in 1985 (age 32)	0.52	0.50	0	1	2,575
Attained education in 1993 (age 40)	3.95	1.45	1	7	12,287
Disposable income in 1993 (age 40)	15.91	33.29	-1.83	3182	12,324

Parent university level refers to whether at least one of the parents have any post-secondary education. Income is stated in tens of thousands of SEK and can be negative in a certain year due to, e.g., tax reasons. For 107 and 498 mothers and fathers, respectively, missing observations on age when their child was born are substituted with the variable means of the sample. Parental income is measured in 1963. 6,295 mothers and 1,943 fathers have income information reported as 0 or missing and are all treated as zero income. In regressions, zero income and missing information on parental age at a child's birth are controlled for with dummies. *Absence from school* measures all registered absence hours with a valid excuse recorded for the adolescent in the spring semester of the 6th year of elementary school. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. *Attained education* is measured on a scale from 1 (less than 9 years) to 7 (at doctoral level). *Disposable income* is stated in tens of thousands of SEK.

Appendix A of this paper. Concerning baseline health, the SBC has information on parental mortality as well as adolescents' absence from school.

The latter data is collected from the students' teachers and contains information on all absence hours with a valid excuse recorded for the adolescent in the spring semester in their 6th year of elementary school. As seen in Table 1.3, the average absence is 42 hours, but the variance is large. One student who participated in the SBC data collection has missing information on this variable. This student's teacher noted that the total absence could not be counted, since the student was absent the entire semester. The reason for this absence is not noted. Continuing, parental longevity is a predictor of offspring's all-cause mortality, and the link is thought of as genetic as well as environmental and behavioral (Atkins et al. 2016). In the SBC, 16% of fathers and 9% of mothers die before turning 65, as seen in Table 1.3. However, these numbers could be underestimations, as they may not include all parents who are missing or have died abroad.

Focusing on lifestyle factors, the dataset contains information on opinions about smoking and sports interests. With the maximum total sports interest score being 50 and the minimum 10, participants were asked what they thought about different sports activities. With scores in parentheses, the possible answers were very interesting (5), interesting (4), dull (2), and very dull (1). The listed activities included, among other things, gymnastics, bicycle racing, and winter sports. Lastly, the researchers asked the 13-year-olds and their mothers individually whether they thought that students should be allowed to smoke at school. They also asked the mothers whether their 15-year-old child was allowed to smoke at home. Most mothers, 64%, did not allow their children to smoke at home. This might sound like a low figure, but this was the 1960s and the sale of tobacco products to children and adolescents under the age of 18 was not banned in Sweden until 1997.

The Stockholm Birth Cohort measure of mothers' time preferences differs from the measure used for adolescents. The choices were still between money immediately and in five years, but the hypothetical numbers were ten folded.[14] Detailed information about their choices is available in Appendix A. Most of the existing literature finds that children's and their parents' time preferences are connected.[15]

[14]Expressed in rounded US$ numbers in 2019 Swedish prices and original SEK numbers in 1966 in parentheses, the adolescents were asked whether they would prefer US$ 110 (SEK 100) immediately or US$ 1,100 (SEK 1,000) in five years. Mothers were instead asked a question where the hypothetical incentives were US$ 1,100 (SEK 1,000) immediately or US$ 11,000 (SEK 10,000) in five years.

[15]Chowdhury et al. (2018), Brenøe & Epper (2019), and Gauly (2017) find stable positive relationships, Kosse & Pfeiffer (2012) find significant relations in some timeframes but not in others, while Bettinger & Slonim (2007) do not find any significant relationship between parents' and children's time preferences.

Yet, it is far from clear how important these intergenerational time preferences are for larger outcomes outside the lab.

From the original cohort, a representative sample of 3,870 individuals with available addresses were contacted in 1985 for a follow-up study conducted together with Swedish National Radio called "the culture and leisure survey" (Sehlstedt 2006). One of the included questions concerned smoking habits. After the matching by Almquist et al. (2020), the SBC contain information tobacco use in 1985 (age 32) from 2,575 of these individuals, linked with time preference answers in 1966. Table 1.3 shows that 52% of the respondents reported using tobacco in some form. Although smoking was still a symbol of status and independence, the attitudes to smoking had started to change in Sweden at that point. As an example, Magnusson & Nordgren (1994) show that in 1969, 46% of Swedish physicians reported smoking daily, while in 1988 the number was down to only 15%.

Table 1.3 presents register data from Statistics Sweden on education and income from when the participants were 40 years old. At this age, relatively few participants had died (n=236), and most people in our sample were in the labor market and had finished their schooling. Yet comparing data before and after age 40 (year 1993), the overall educational attainment does increase. As robustness, education and income levels from other years are therefore used. These years are in 1998 (age 45) and 1990 (age 37), which is the first year this data is available in this form. 1990 was also the first year of a large financial crisis in Sweden, which could help explain why some people in the sample returned to school in these years.[16]

1.4 Empirical Strategy

This paper tests the hypothesis that adolescents' time preferences predict future health outcomes. The main measures of health are early mortality and lifetime illness. The probability of early death for individual i is measured before age 50 and 65 and is presented as the outcome in equation 1 below.

$$Prob.Death_i = \beta_0 + \beta_1 Timepref_i + \boldsymbol{\beta_x x_i} + \epsilon_i, \tag{1.1}$$

In equation (1.1), $Timepref_i$ is individual i's time preferences and $\boldsymbol{x_i}$ is the corresponding vector of individual-specific characteristics. Equation (1.1) is estimated with a probit model since mortality is a binary outcome. To ease the

[16]One hundred eight-five individuals in the sample obtained their first post-secondary degree between the ages of 37 and 45. In the same years, the number of people who attained degrees at doctoral level increased by 40% (from 116 participants to 163).

interpretation, this paper displays the average marginal effects of the coefficients in the model. In addition to the binary outcomes, estimates are also done with survival data models, which utilize the full information on if a person dies and when. Firstly, the paper includes graphs of the non-parametric Kaplan-Meier survival estimates (Kaplan & Meier 1958) and secondly, the Appendix contains tables of hazard rates from the Cox model (Cox 1972).

The individual's illness levels, seen in equation (1.B.1), are measured using register data on the total number of diagnoses or the total number of hospitalizations through the participant's adult life.

$$Illness_i = \gamma_0 + \gamma_1 Timepref_i + \boldsymbol{\gamma_x x_i} + \varepsilon_i, \tag{1.2}$$

The illness model includes the same sets of explanatory variables as in equation 1, but due to the large variation in the outcome, participants' total number of diagnoses and hospitalizations from age 20 to age 63 are regressed using OLS, with Poisson regressions available in Appendix. In this period, part of the sample become terminally ill, receive a lot of medical treatment, and pass away. Since my hypothesis is that early death is related to time preferences, this systematic pattern for some individuals with high hospitalization rates followed by mortality (excluding them from further observations) is important to deal with. Results using diagnosis and hospitalization data are therefore presented in two versions: first using the full dataset of all individuals alive at age 20, and then restricted to include only those who survived through the full period of observation, until age 63.

In line with theoretical modelling by Galama & Van Kippersluis (2019), the hypothesis behind this paper is that adolescents' time preferences influence their lifestyle choices, which in turn affect their long-term health. Yet, the link between time preferences and health may also go through other, not mutually exclusive, channels. Income and education might also mediate the relation, and background characteristics could potentially affect both time preferences and health, as illustrated in Figure 1.1.[17] The potential mediating factors are discussed more in the next section, but starting with the issue of confounders, the adolescents' gender and month of birth, as well as an extensive set of socioeconomic factors, are controlled for in the regressions. The socioeconomic controls include the adolescents' fathers' and mothers' age when their child was born, fathers' and mothers' total income, and the highest educational level of any of the parents. Other family

[17]Golsteyn et al. (2014) find that adolescents' time preferences predict future income and educational attainment using SBC data. At the same time, the theory of Galama & Van Kippersluis (2019) predicts that wealth, income, and education increase the marginal value of health and induce a healthy lifestyle.

and socioeconomic factors controlled for in the Appendix are number of siblings, number of older/younger brothers and sisters separately, parental marital status, as well as municipality and school fixed effects.

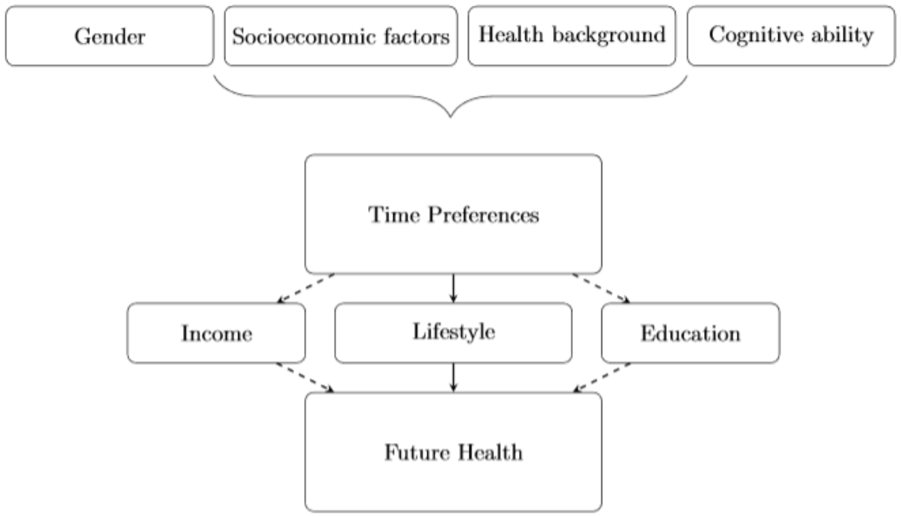

Figure 1.1: Potential Mechanisms.

In addition to these socioeconomic factors, the SBC dataset allows me to test whether the adolescents' cognitive ability (measured at the same time as the time preferences) and health background are confounders in the relationship between time preferences and future health.[18] Andersson et al. (2016), who study risk preferences, advise researchers to control for cognitive ability in preference studies, since this factor correlates with mistake-making in the preference task. Further, Golsteyn et al. (2014) find that individuals' cognitive ability in the SBC is correlated with their answers in the time preference question. Moving to background health, earlier literature using cross-sectional data or data with short follow up periods, like Fuchs (1982), Van der Pol (2011), Thirumurthy et al. (2015), and Cen et al. (2021), cannot determine whether time preferences predict health status or health status predicts time preferences. The longitudinal design of my study largely addresses concerns of reverse causality. Yet, if an adolescent is terminally ill or has parents who died early, this could potentially affect both their time preferences and their risk of early death. To tackle this, additional regressions exclude individuals who die before age 40 and include control variables for parental early mortality and adolescents' absence from school that could be due to illness.

[18]Figure 1.1 presents potential confounders and mediators that the author finds the most relevant when studying time preferences. One could imagine that other individual characteristics or life outcomes (such as risk preferences, criminal activity, and incarceration) could bias or mediate a potential relation. Such suggested variables have either unfortunately not been available in the historical data or are considered to be outside the scope of this study.

1.4.1 Supporting Analysis of Potential Mechanisms

The reader should be reminded that this is not an experimental paper and that while I can test whether time preferences predict future health, I cannot claim causality. Yet, it is still valuable to discuss the channels that could mediate potential results. Previous literature, like Courtemanche et al. (2015), Van der Pol et al. (2017), Leonard & Shuval (2017), and Harrison et al. (2018) to mention a few, finds that time preferences correlate with habits that can affect future health, such as smoking and exercising. This lifestyle channel in the relation between time preferences and future health is also strengthened by predictions from theoretical work by Galama & Van Kippersluis (2019). In the present paper, the described "lifestyle channel" is therefore treated as the main proposed channel between time preferences and long-term health, and it is investigated in two ways: firstly by looking at the participants' disease history and testing whether time preferences matter for the risk of suffering from conditions associated with lifestyle risk factors, and secondly by looking at self-reported smoking at age 32 and the adolescents' sports interests and opinions about rules for smoking. In this latter analysis, mothers' time preferences are also used to investigate whether family preferences matter in this context.

There can, however, be other channels besides lifestyle risk factors through which time preferences affect long-term health. In the SBC, adolescents' time preferences predict future income and educational attainment (Golsteyn et al. 2014), and research in health economics finds strong correlations between educational attainment and health (Grossman 2015).[19] Already in a paper from 1982, Fuchs discussed the potential mediating effect of educational attainment in the relationship between time preferences and future health. Yet, my paper is the first with access to long-term data to test whether educational attainment or future income are channels in this context. This is done using the framework of Baron & Kenny (1986).[20] The equations below illustrate the procedure where $\boldsymbol{\alpha}$ are the intercepts, $\boldsymbol{\theta}$ the coefficients for individual i's time preferences, and δ_1

[19]While a strong correlation between education and health has been established in the literature, papers using compulsory school reforms as instrumental measures of education find conflicting results; see Grossman (2015) for an overview. The difference between increased quantity and quality of schooling in these reforms are frequently discussed and Fischer et al. (2021) show that more compulsory education in a Swedish reform significantly reduces mortality and increases health, once changes in the academic tracks and peer groups are controlled for.

[20]For an accessible summary of the method, see Adermon et al. (2018).

the coefficient for the mediating factor (future educational attainment or future income in this case). For simplicity, control variables are ignored for now.

$$FutureHealth_i = \alpha_1 + \theta_1 Timepref_i + \varepsilon_i, \quad (1.3)$$

$$FutureHealth_i = \alpha_2 + \theta_2 Timepref_i + \delta_1 Mediator_i + \epsilon_i, \quad (1.4)$$

$$Mediator_i = \alpha_3 + \theta_3 Timepref_i + \mu_i, \quad (1.5)$$

If the mediator is exogenous, given that I control for time preferences this means that there is zero covariance between the residuals ϵ_i and μ_i. If this strong assumption holds, then $\theta_1 - \theta_2$ can be interpreted as the mediating role of the tested variable in the relationship between time preferences and heath. This can be deduced by substituting equation (1.5) in equation (1.4), which gives us $\theta_1 - \theta_2 = \delta_1\theta_3$. Measurement error, which is common in self-reported data, could bias the mediation effect downward. This is, however, less of a concern when using high-quality Swedish register data. Yet, the assumption of exogeneity does not hold if another variable affects both future health and future education, even after controlling for time preferences. An omitted variable like that would lead to an overestimation of δ_1 and bias the mediating effect of future education upward. The extensive controls already mentioned are therefore very important for this identification. Nevertheless, the paper is humble to the fact that coefficients could be biased due to other unobserved characteristics that might affect education and income, as well as time preferences.

Continuing with the validity of the main results, this paper measures participants' health using mortality and hospital data, where participants' total numbers of hospitalizations and diagnoses are seen as overall measures of bad health. Since one's condition must be reasonably serious to be admitted to a hospital, selection into treatment is less of a concern in the medical records that I use, compared with using data from family doctors or other forms of primary care. Even so, the participants' propensity to seek medical treatment could still bias the results. To tackle this concern of potential selection bias, I categorize diagnoses specifically for acute heart conditions, where the patients cannot treat themselves and immediate medical care is advised. If adolescents' time preferences also predict future suffering from acute heart conditions, it strengthens the idea that time preferences predict actual future health.[21]

1.5 Main Results

This first part of the results section investigates the connection between time preferences and early death. Figure 1.2 presents graphs for the full sample and gender-specific samples, using unrestricted Kaplan-Meier survival estimates (Kaplan & Meier 1958). Starting at the top of Figure 2, there is no visible difference in mortality based on time preferences when the full sample is young and survival rates are high. At around age 40, when mortality rates increase, the two lines separate and participants who chose the delayed reward as adolescents die at a lower rate. At the right end of the graph, a bit more than 9% have died before age 65 in the more patient group. This can be compared with an 11% mortality rate in the group of participants who were less patient as adolescents.

A bit more than 11% of the men who chose the delayed reward as adolescents have passed away before age 65. This number is 15% among the less patient men. For women, the overall mortality in the investigated age group is lower than for men. The difference in mortality linked to time preferences is also much smaller for women in this investigated age span.

Table 1.4 investigates the results in regressions with and without controls. It displays the probit average marginal effects, with probit coefficients and OLS results available in the Appendix. Columns 1–3 look at mortality by age 50, while columns 4–6 use all mortality before age 65 (the last year of observation in the data). Looking at mortality before 65, the table displays a consistent significant correlation between adolescents' time preferences and early mortality. Column 6 includes the full set of controls and shows that those who chose the delayed reward have a 0.02 lower probability of dying before age 65. The coefficient of negative 2 percentage points for time preferences here is large, in fact more than one-fifth of the total mortality by age 65, which is 9.5%.

[21] Doyle (2011) uses acute heart conditions as a way to reduce selection into specific hospitals and argues that for these conditions, all people experiencing symptoms are advised to immediately turn to their nearest hospital for care.

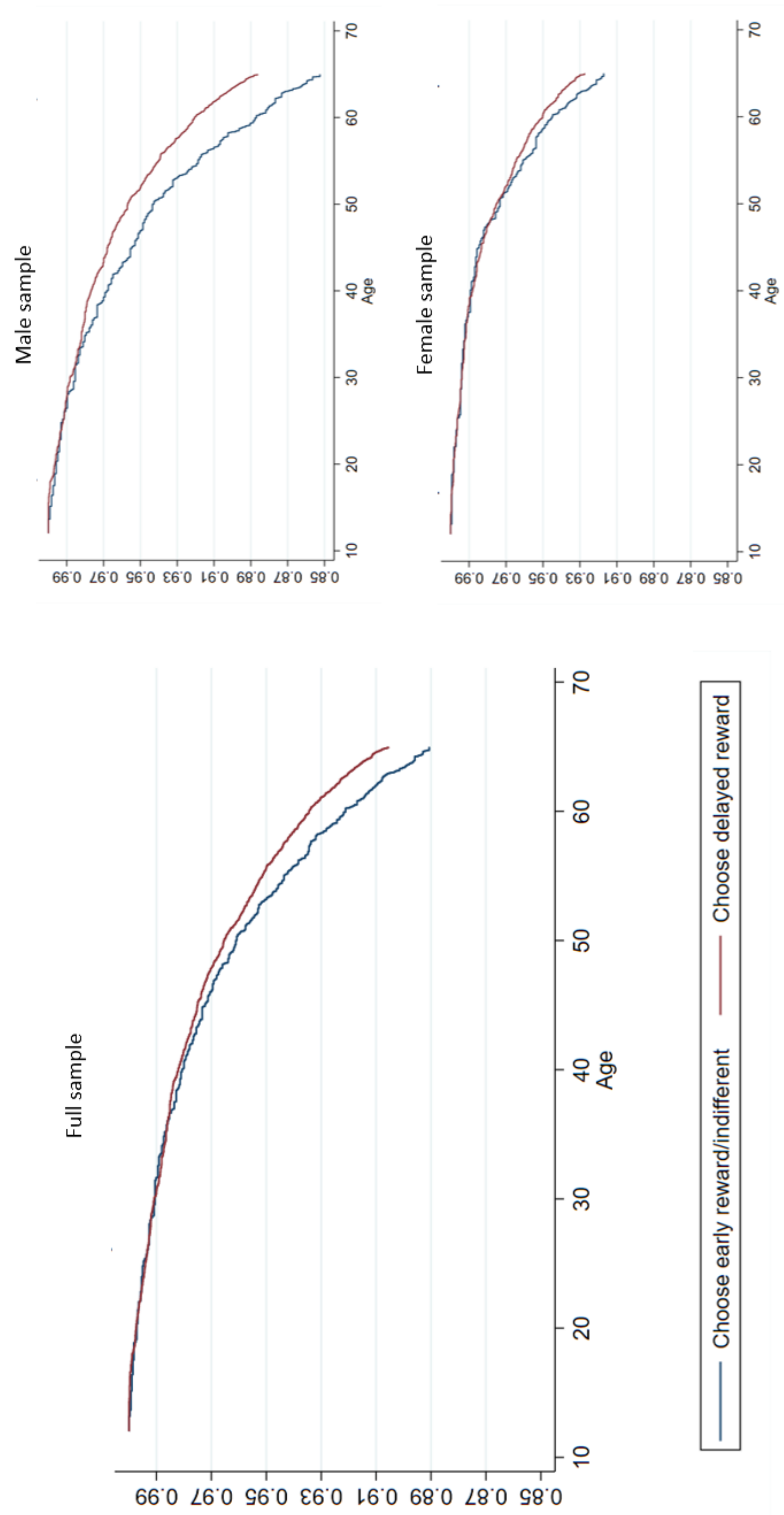

Figure 1.2: Kaplan-Meier survival estimates.

Table 1.4: Time preferences and early death. Probit average marginal effects.

VARIABLES	(1) Death by 50	(2) Death by 50	(3) Death by 50	(4) Death by 65	(5) Death by 65	(6) Death by 65
Adolescents:						
Chose delayed reward	-0.0045	-0.0069*	-0.0062*	-0.016***	-0.021***	-0.020***
	(0.0038)	(0.0039)	(0.0037)	(0.0061)	(0.0061)	(0.0060)
Sex (female)		-0.021***	-0.021***		-0.045***	-0.045***
		(0.0034)	(0.0033)		(0.0052)	(0.0052)
Month of birth			-0.00064			-0.0014*
			(0.00046)			(0.00076)
Fathers:						
Age at child's birth			-0.00065*			0.000032
			(0.00037)			(0.00058)
Income			-0.00017			-0.00018
			(0.00012)			(0.00020)
Mothers:						
Age at child's birth			-0.00030			-0.0014**
			(0.00037)			(0.00063)
Income			-0.00021			-0.000027
			(0.00029)			(0.00047)
Parent(s):						
Upper secondary school			-0.0035			-0.020***
			(0.0046)			(0.0077)
University			-0.0094			-0.021*
			(0.0079)			(0.012)
Missing parental income and age at child's birth			Inc.			Inc.
Observations	12,956	12,956	12,956	12,956	12,956	12,956
Pseudo R-squared	0.0003	0.0105	0.1021	0.0008	0.0103	0.0341
Outcome mean	0.036	0.036	0.036	0.095	0.095	0.095
Chose delayed reward / Outcome mean	-0.13	-0.19	-0.17	-0.17	-0.22	-0.21

Chose delayed reward is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent. *Parent(s): upper secondary school* and *parent(s): university* are binary variables where 1 indicates that at least one of the parents has upper secondary and university education as their highest attained level of education, respectively. Fathers' and mothers' total incomes are in thousands of SEK. Missing information on parental income is treated as zero income. Missing observations on parents' age when the child was born are substituted with the variable means of the sample. In columns 3 and 6, missing income and missing information on parental age at a child's birth are controlled for with dummies. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The results for time preferences and early mortality are stable when adding controls for numbers of siblings, numbers of older and younger brothers and sisters, municipalities, and all 116 headmasters (proxy for schools), shown in Tables B6 and B7 in the Appendix.[22] The stability of coefficient size, particularly when

[22]The results are also robust when using a smaller sample with access to more detailed information on each parent's education (Table B3 in the Appendix). The municipalities controlled for in the municipality fixed effects are Upplands-Väsby, Vallentuna, Österåker, Järfälla, Huddinge, Botkyrka, Salem, Haninge, Tyresö, Täby, Danderyd, Sollentuna, Nacka, Sundbyberg, Solna, Lidingö, Märsta,

adding school and municipality controls, suggests that the controls in the main regressions already to a high degree capture potential bias from socioeconomic elements.

In Table B8 in the Appendix, the binary time preference measure is broken down into its original form with one binary variable for each option. Using the alternative to "definitely choose the immediate payout" as a reference, all other answers have a consistent negative coefficient sign. Students reporting to probably or definitely choose the delayed payment are less likely to die early. The similarities between these two coefficients speak in favor of the binary categorization of time preferences in this paper.

Looking at mortality by age 50 in Table 1.4, the coefficient size is approximately one-sixth of the outcome mean. Still, the coefficient is significant at the 10% level when controlling for gender/socioeconomic factors (columns 2 and 3) and not significant at all in the regression without controls (column 1). These results are very much in line with Golsteyn et al. (2014), who use OLS as their preferred model and find at the 10% significance level that time preferences predict the risk of dying before age 49.

In relation to the outcome mean, the coefficient sizes for time preferences are similar when looking at mortality before age 50 and before age 65. But why do the significance levels differ in Table 1.4 when comparing mortality at different ages? One reason could be that few die before age 50, causing a lack of statistical precision in the regressions. Another thing to keep in mind is that people who die at different ages also die of different causes. It is plausible that time preferences drive some causes of death but not all. The link between time preferences and cause-specific mortality is discussed in more detail later in this paper, but it is worth mentioning already that 18% of the mortality between age 34 and age 49 in this sample is caused by injury, poisoning, or external causes. This number is lower, only 8%, between age 50 and age 63. Instead, cancer and circulatory disease cause a higher fraction of mortality, 41% and 22%, in this older age span, compared with 18% and 9% in the younger (age 34–49).

Comparing columns 4 and 6 in Table 1.4, the coefficient size for time preferences is larger when adding controls. Why? Showcased more thoroughly in Appendix D of this paper, I find that the gender control drives this increase, as women in this sample live longer and are slightly less likely to give patient answers in response to our time preference question. These time preference results for gender are in line with the findings of Falk et al. (2018), who show that women

and Stockholm Municipality. Schools are controlled for using information on which headmaster a participant has.

are on average less patient than men across the world, but that the difference is small.

Table 1.5: Time preferences and early death. Probit average marginal effect. Adding ability, school absence, and parental mortality.

Sample alive at age 40					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
Chose delayed reward	-0.018***	-0.017***	-0.018***	-0.014**	-0.013**
	(0.0056)	(0.0056)	(0.0056)	(0.0056)	(0.0056)
Absence from school		0.00019***			0.00016***
		(0.000049)			(0.000049)
Father died before age 65			0.025***		0.023***
			(0.0060)		(0.0060)
Mother died before age 65			0.019**		0.017**
			(0.0076)		(0.0076)
Ability at age 13				-0.0023***	-0.0022***
				(0.00034)	(0.00033)
Socioeconomic /gender controls	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,702	12,701	12,702	12,668	12,667
Pseudo R-squared	0.0121	0.0142	0.0156	0.0188	0.0233
Outcome mean	0.077	0.077	0.077	0.077	0.077
$\frac{\text{Chose delayed reward}}{\text{Outcome mean}}$	-0.23	-0.22	-0.23	-0.18	-0.17

The table only includes individuals alive at age 40 in 1993 when income and educational attainment are measured. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Absence from school* measures all registered absence hours with a valid excuse recorded for the adolescent in the spring semester of the 6th year of elementary school. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. Socioeconomic/gender controls include month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 1.5 addresses concerns about the validity of the results in Table 1.4 by investigating whether background health and cognitive ability are confounding the results. In Table 1.5, column 1 shows the main results of this paper in a restricted sample, excluding individuals who died before age 40. Looking at the outcome mean in column 1, this restriction reduces the mean mortality to 7.7%, compared with 9.5% in the full sample. Consequently, the coefficient for adolescents who chose the delayed reward is reduced from -0.020 (Table 1.4, column 6) to -0.018 (Table 1.5, column 1). The stability, and even increase, of the coefficient size in relation to the outcome mean speaks against concerns that terminally ill adolescents would drive the main results.

Columns 2 and 3 add adolescents' school absence hours with a valid excuse and parental early mortality as controls. The stability of results in these columns further strengthens the idea that reverse causality – that early mortality would drive time preferences – is not a large concern in this setting. Column 3 in Table 1.5 also confirms earlier findings by Atkins et al. (2016) that parental longevity is a predictor of offspring's all-cause mortality.

Lastly, columns 4 and 5 include information on the adolescents' cognitive ability, which is significantly and strongly related to early mortality. The mean value in the adolescents' ability test is 23, with a standard deviation of 7. Column 4 shows that one more point in this test is associated with a 0.2 percentage point lower mortality rate by age 65. A standard deviation difference in cognitive ability would therefore have a coefficient of the same size as the time preference measure, which is now reduced to -0.014, i.e., -1.4 percentage points.

Adding information on cognitive ability as well as the variables for background health to the regression reduces the coefficient size for choosing the delayed amount, in absolute terms (comparing columns 1 and 5). The coefficient divided by the outcome mean is now -0.17, or roughly one-sixth of the average mortality in the sample. This means that the prediction power of time preferences is still large and significant, even with this extensive set of controls.

In Appendix I of this paper, I use the procedure by Oster (2019) to test how large the effects of unobservable characteristics would have to be for the β for *chose delayed reward* to equal zero. Using Oster's suggested assumptions for the theoretical R_{max}, Table I2 shows that the effects of unobservables must be at least 30 times as large as the effect of all included observable characteristics to erase the relationship between time preferences and death before age 65.[23] This is a high number, considering the large amounts of high-quality controls that are already included.

While the probit model tests whether time preferences are associated with mortality before age 65 and 50, the Cox model (1972) utilizes the full information of the timing of death. Table B11 in Appendix B presents Cox hazard ratios using gender and socioeconomic controls (column 2) and additional controls for cognitive ability and background health (column 3). The results are consistent

[23]For more robustness results using the Oster (2019) procedure, see both Table I1 and I2 in the Appendix. Table I1 presents biased adjusted β at different levels of effects from unobserved factors relative to the effect of observed factors, δ. Table I2 presents the δ that makes the chose the delayed reward β become equal to zero. Both Tables I1 and I2 report results using the R_{max}, suggested by Oster (2019), as well as more conservative R_{max} values.

with the main findings using probit models. Table B11 column 2 shows that patient children have a 21% lower risk of dying at a given point in time. Adding the health and cognitive controls, column 3 shows that patient adolescents have a 17% lower risk of mortality in the period, compared with more impatient peers. The Cox results show that the predictive power of time preferences on early mortality is stable to the choice of econometric model.

1.5.1 Time Preferences and Illnesses

Table 1.6 displays results for adolescents' time preferences, hospitalizations, and diagnoses (ages 20–63). Due to the data access, the sample is, as explained earlier, restricted to participants who lived in Stockholm at the beginning of the period. Some of the included participants died before age 63. As a test of the robustness, results are presented in two versions, and the regressions in columns 2 and 4 are restricted to only include participants who live until at least age 63. The results show that adolescents' time preferences consistently predict the number of hospitalizations and diagnoses throughout the participants' life. Looking at the full sample (columns 1 and 3), adolescents who chose the delayed reward have 0.6 fewer hospitalizations and 1.5 fewer diagnoses in their adult life, compared with the reference group of less patient peers.[24] Compared with the outcome means of 5.7 hospitalizations and 10.2 diagnoses, these coefficients are economically relevant.

The participants who survive the full period have fewer hospitalizations and diagnoses on average, as seen for the restricted samples in columns 2 and 4. This helps explain why the time preference coefficients are stable in sign, but reduced in size, in these samples.

Table B14 in Appendix B also looks at time preferences, hospitalizations, and diagnoses, but with fewer or no controls. In these results, the predictive power of choosing the delayed reward is stronger and the significance levels higher. It is therefore reasonable to deduce that the full set of controls in Table 6 reduce bias, which also reduces the size of the time preference coefficient, in absolute terms. Table B15 in Appendix B presents consistent negative signs for time preference coefficients on future hospitalizations and diagnosis, using Poisson regressions. Further, the consistent negative sign in results for acute heart conditions,

[24]Table B13 investigates the robustness of results in Table 1.6 using: 1) a sample not restricted to participants living in the Stockholm region in 1971–1983 and 2) a sample excluding extreme observations, i.e., participants with a hundred or more hospitalizations or diagnoses. The coefficients are consistent in signs (negative), yet smaller in size in absolute terms in both robustness samples. Outcome means are generally lower compared with Table 6, and the significance levels are sometimes increased and sometimes decreased, depending on the regression.

presented in Table B16 strengthens the idea that patient adolescents enjoy better future health.

Table 1.6: Time preferences (age 12 or 13), hospitalizations, and diagnoses (ages 20–63). OLS coefficients.

VARIABLES	(1) Number of Hospitalizations	(2) Number of Hospitalizations	(3) Number of Diagnoses	(4) Number of Diagnoses
Chose delayed reward	-0.58**	-0.34*	-1.47**	-0.84*
	(0.26)	(0.20)	(0.60)	(0.47)
Constant	8.42***	7.28***	15.9***	13.3***
	(0.67)	(0.58)	(1.56)	(1.29)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	9,885	9,116	9,885	9,116
R-squared	0.029	0.042	0.013	0.018
Outcome mean	5.67	4.87	10.18	8.23
$\frac{\text{Chose delayed reward}}{\text{Outcome mean}}$	-0.10	-0.07	-0.14	-0.10
Sample:	*Alive in 1973*	*Alive in 2016*	*Alive in 1973*	*Alive in 2016*

The sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. The outcome variable in columns 1 and 2 is the number of hospitalizations, and in columns 3 and 4 it is the number of diagnoses, from 1973 to 2016. At the end of each period of care at a Swedish hospital, a final medical record is created. It includes all diagnoses relevant for the patient during that hospital visit. This table presents the full data from hospitalization records in the Stockholm region 1973–2016 and nationwide 1983–2016. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent ”probably” or “definitely” preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who ”probably” or “definitely” preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents‘ age at their child’s birth, fathers’ and mothers’ total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents’ cognitive ability at age 13, absence from school, their fathers’ and mothers’ mortality by age 65, as well as dummy variables for missing observations of parents’ income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

1.5.2 Potential Mechanisms and Channels

This section presents results on potential, not mutually exclusive channels for the relationship between time preferences and future health. The main discussed channel is lifestyle factors, investigated using data on specific diagnoses and information on lifestyle factors when the adolescents grew up, gathered from both mothers and adolescents. After this, the paper looks closer at education and income as potential mediators, and drivers of the results.

1.5.3 Lifestyle Factors

Table 1.7 gathers results on specific diagnoses through the participants’ adult life. All regressions in the table include a full set of gender, socioeconomic, cognitive and background health controls. Columns 1 and 2 look at the likelihood of being diagnosed with dependence on or abuse of alcohol or drugs. In columns 3–9, the outcomes are groups of conditions that Stanaway et al. (2018) classify as associated with various lifestyle factors. At the top of Table 1.7, Panel A includes participants if they were alive at the beginning of the data period (age 20 in columns 1 and 2 and age 34 in columns 3–9), and the lower Panel B uses a restricted dataset that only includes participants who were alive the full period of observation (until age 63).

Columns 1A and 1B in Table 1.7 show that patient adolescents are less likely to be diagnosed with alcoholism later in life. The coefficient sizes are large; around one-fifth of the outcome means. Columns 2A and 2B display a consistent negative sign for the correlation between choosing the delayed reward and later being diagnosed with dependence on or abuse of drugs. Yet, these results are not significant.

The conditions associated with lifestyle risk factors (columns 3–9 in Table 1.7) are categorized by Stanaway et al. (2018) and classified in ICD systems used in Sweden from 1987 (age 34 for the sample). Columns 3A and 3B show that participants who chose the delayed reward at age 13 are less likely to be diagnosed with any type of lifestyle-related health condition in adulthood (ages 34–63), compared with their less patient classmates. These results are highly significant, and they are stable in both samples. Moving on to specific lifestyle factors, the patient adolescents are also less likely to be diagnosed with conditions specifically associated with alcohol and tobacco use (columns 4–5, A and B). Looking at conditions associated with drug use, high BMI, low physical activity, and sexual risk-taking (columns 6–9), signs are consistently negative, but the results are not significant.[25]

Further results on time preferences and cause-specific mortality, where mortality due to other causes are treated as random right censoring, are presented in Appendix C. Described by Palme & Sandgren (2008), this procedure gives consistent Cox hazard rates for each specific cause of death if there is no correlation in the probability of death in the different causes. This is unlikely, as the same risk factors can for example drive the probability of both circulatory diseases and can-

[25]The results in Table 1.7 are stable when using OLS with binary outcomes, but the results disappear in Poisson regressions. This is seen in Table B18 and B19 in the Appendix. This suggests that time preferences can be used to predict the likelihood of ever being diagnosed with lifestyle-related health conditions, but that it cannot be used to tell how many times a person will be diagnosed with them. Yet, future research is needed in order to draw any stronger conclusion on this.

cer. Nevertheless, the cause-specific Cox model (independence between causes) and the original Cox models (the same model for all causes) can be interpreted as bounds for the hazard rate estimates. In Appendix C, Tables C1 and C2 show that patient adolescents are up to 44% and 46% less likely to die of circulatory and ischemic conditions, respectively.[26] These are important diagnoses to look at as 1.5% of the full sample pass away due to circulatory diseases before age 63.

Looking at causes of death associated with lifestyle risk factors, Table C2 shows that the size of hazard rates varies. The range spans from similar levels as all-cause mortality (18%) up to a 24% lower risk of mortality for conditions associated with high BMI and a 34% lower risk of mortality for conditions associated with low physical activity.[27] These large numbers for mortality in these conditions are a bit surprising, as Table 1.7 shows no significant relation between time preferences and non-mortal future health conditions associated with low physical activity and high BMI. When it comes to mortality caused by cancer, the regressions do not display any significant results.

[26]The investigated period is ages 34–63, for which I have coded cause of mortality data.

[27]The cause-specific regressions on conditions associated with various lifestyle risk factors, as well as mortality due to circulatory and ischemic conditions, have no issues with the proportional hazard assumption.

Table 1.7: Diagnoses related to lifestyle. Probit average marginal effects.

	Age 20-63 *Have ≥ 1 diagnosis of:*		*Age 34-63* *Have ≥ 1 diagnosis associated with:*						
	(1A) Dependence on/abuse of Alcohol	(2A) Dependence on/abuse of Drugs	(3A) Lifestyle Risk Factors	(4A) Alcohol Use	(5A) Tobacco Use	(6A) Drug Use	(7A) High BMI	(8A) Low Physical Activity	(9A) Sexual Risk-Taking
Panel A: Sample alive in 1973 or 1987									
Chose delayed reward	-0.011**	-0.0034	-0.030***	-0.027***	-0.020**	-0.0045	-0.0073	-0.0066	-0.0033
	(0.0054)	(0.0032)	(0.010)	(0.0090)	(0.0094)	(0.0032)	(0.0091)	(0.0067)	(0.0026)
Observations	9,885	9,885	12,756	12,756	12,756	12,756	12,756	12,756	12,756
Pseudo R2	0.057	0.044	0.012	0.018	0.008	0.052	0.006	0.007	0.076
Full set controls	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.06	0.02	0.35	0.24	0.27	0.02	0.24	0.11	0.02
$\frac{\text{Chose delayed reward}}{\text{Outcome mean}}$	-0.18	-0.17	-0.09	-0.11	-0.07	-0.23	-0.02	-0.06	-0.17
Panel B: Sample alive in 2016									
Chose delayed reward	-0.0091*	-0.0041	-0.024**	-0.023**	-0.017*	-0.0021	-0.0060	-0.0057	-0.0029
	(0.0049)	(0.0025)	(0.010)	(0.0090)	(0.0095)	(0.0027)	(0.0093)	(0.0068)	(0.0026)
Observations	9,116	9,116	11,840	11,840	11,840	11,840	11,840	11,840	11,840
Pseudo R2	0.050	0.038	0.009	0.016	0.007	0.042	0.005	0.007	0.093
Full set controls	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.04	0.01	0.32	0.22	0.24	0.01	0.23	0.10	0.02
$\frac{\text{Chose delayed reward}}{\text{Outcome mean}}$	-0.23	-0.41	-0.08	-0.10	-0.07	-0.21	-0.03	-0.06	-0.15

In columns 1 and 2, A and B, the sample is restricted to only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. The outcome variables are binary and are constructed using diagnosis data from 1973 to 2016. For columns 3–9 A and B, the binary outcome variables are constructed using nationwide diagnosis data from 1987 to 2016. The index for Conditions Associated with Lifestyle Risk Factors is a combination of indexes for conditions associated with alcohol use, high BMI, tobacco use, low physical activity, sexual risk-taking, and drug use. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Continuing the investigation of lifestyle risk factors as the channel of the results, the Stockholm Birth Cohort also contains information on whether the adolescents are allowed to smoke at home, whether they think that smoking should be allowed in schools, and whether they like sports activities. These factors could be important for the adolescents' habit formation and future behavior. Results on sports interests are presented using OLS in Table 1.8 and results on attitudes to smoking in Table 1.9 using probit average marginal effect. In the regressions, I add available information on the mothers' time preferences as an explanatory variable. Mother' preferences could potentially influence their children's attitudes, especially since their attitudes are measured when the children live at home. Adding mothers' time preferences reduces the sample, which can be seen in some of the columns in Tables 1.8 and 1.9.

Table 1.8 shows that more patient adolescents have a stronger interest in sports activities. This is the case for both the full sample and the smaller sample (with access to the mothers' time preferences) (columns 1–2). Yet, the exact coefficient size is not stable in the two samples, and this cannot be explained by the changes in the outcome mean. Further, the results for mothers' time preferences are insignificant (column 3) and adding this variable does not alter the positive relationship between adolescents' sports interests and time preferences.

Moving to Table 1.9, column 1 shows that patient adolescents to a higher degree think that smoking should not be allowed at schools. This coefficient remains similar in size but is only weakly significant as the sample size decreases in column 2. Focusing on Table 1.9 column 3, there is no evidence that mothers' time preferences matter for their children's opinions on smoking at school. Yet, it is the mothers', and not the adolescents', time preferences that correlate significantly with rules for smoking at home. Column 4 shows that more future-oriented mothers are less likely to let their 15-year-old child smoke at home.[28] This result contributes to the literature on parental time preferences and the smoking behavior of their children. While Brown & Van der Pol (2014) find no direct correlation between mothers' investment planning horizon and their children's smoking behavior, the results of Hübler & Kucher (2016) go in the opposite direction. They find that parents' self-reported patience correlates with their children's smoking habits.[29]Lastly, column 5 presents results using self-reported information on to-

[28]While this paper finds that mothers' time preferences are relevant for rule setting for smoking at home, I find no indication that they would matter for early mortality of their child (not shown) and the sample size is too small to draw conclusions from this. See Appendix H for power analysis.

[29]The question asked to mothers in Brown & Van der Pol (2014) is the following: "In planning your savings and spending, which of the following time periods is most important to you?" Hübler & Kucher (2016) measure parental patience with the following question: "How would you describe yourself: Are you generally an impatient person, or someone who always shows great patience?"

Table 1.8: Attitudes to sports. OLS coefficients.

VARIABLES	(1) OLS Score: Sports interests	(2) OLS Score: Sports interests	(3) OLS Score: Sports interests
Adolescents chose delayed reward	0.79*** (0.17)	1.36*** (0.34)	1.35*** (0.34)
Mothers chose delayed reward			0.30 (0.29)
Constant	41.1*** (0.51)	39.7*** (0.95)	39.5*** (0.97)
Full set of controls	Inc.	Inc.	Inc.
Observations	12,903	3,435	3,435
R-squared	0.084	0.080	0.080
Outcome mean	35.35	34.96	34.96
Chose delayed reward / Outcome mean	0.02	0.04	0.04

The dependent variable is the total score on questions regarding sports interests, listing activities such as gymnastics, bicycle race, winter sport, basketball, running, etc. (max=50 points). *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Mothers: chose delayed reward* where 1 indicates that the mother answered "No, perhaps not" or "No, definitely not" when asked whether she would choose SEK 1,000 immediately over SEK 10,000 in 5 years. The full set of controls includes month of birth, sex, parents' age at child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

bacco use, gathered from a subsample of adolescents in 1985 (age 32). At this point in time, 52% of the sample used tobacco and the results do not show any indication that time preferences predict this behavior.

To summarize the results on time preferences and lifestyle factors, the results using early data suggest that patient individuals are more in favor of rules and interests that promote health. Yet, in this sample consisting of individuals born in 1953 in Stockholm, choosing the delayed reward as an adolescent is not significantly related to the available measure of tobacco use at age 32.[30] Focusing on the diagnosis results, this paper finds that adolescents' time preferences not only predict early mortality and hospitalizations in general, they are also relevant when looking at the likelihood of getting diagnosed with specific conditions related to lifestyle risk factors. Worth noting, however, is that Table H2 in the Appendix shows multiplicity-adjusted p-values for the prediction power of time preferences and the different outcomes related to lifestyle factors in this paper. In general, the predictive power of time preferences on sports interests, smoking rules, and future diagnoses and remain statistically significant, but there are exceptions. Results on dependence on or abuse of alcohol and diagnoses associated with drug use or sexual risk-taking are no longer significant or have a drastically reduced significance after adjustments using the List et al. (2019) procedure. Table H2 also presents P-values adjusted using the more conservative Bonferroni procedure. In this analysis, also the results for having a diagnosis associated with tobacco use are unstable.

[30] Tobacco use is a binary variable where 1 indicates all forms of tobacco usage, including occasional smoking and the use of the popular Swedish snuff. However, the results for the time preferences and tobacco use remain non-significant in regressions looking at the 34% of the sample who report smoking cigarettes daily (not shown).

Table 1.9: Attitudes to smoking. Probit average marginal effects.

VARIABLES	(1) Opinion: Should not be allowed to smoke at school, adolescents	(2) Opinion: Should not be allowed to smoke at school, adolescents	(3) Opinion: Should not be allowed to smoke at school, adolescents	(4) Rules: Not allowed to smoke at home, mothers	(5) Use Tobacco age 32
Adolescents chose delayed reward	0.041***	0.039*	0.040*	-0.028	0.015
	(0.011)	(0.020)	(0.021)	(0.021)	(0.024)
Mothers chose delayed reward			-0.014	0.058***	
			(0.018)	(0.018)	
Full set of controls	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,886	3,438	3,438	3,142	2,552
Pseudo R-squared	0.006	0.011	0.011	0.014	0.031
Outcome mean	0.56	0.56	0.56	0.65	0.52
$\frac{\text{Chose delayed reward}}{\text{Outcome mean}}$	0.07	0.07	0.07	-0.04	0.03

In columns 1–3, the dependent variable is a dummy variable where 1 indicates that the adolescent answered "No, with hesitation" or "No, definitely not" when asked whether students should be allowed to smoke at school. Column 4 has a dummy variable as dependent variable where 1 indicates that the mother answered no to the question on whether their child was allowed to smoke at home. Mothers who answered that "She/he does not smoke" (referring to their child) or "Do not know" were excluded. In Column 5, the dependent variable is whether the respondent reported using tobacco at age 32. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over 100 immediately. *Mothers: chose delayed reward* is a dummy variable where 1 indicates that the mother answers "No, perhaps not" or "No, definitely not" when asked if she would choose 1,000 over SEK 10,000 in 5 years. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

1.5.4 Education and Income

Lifestyle factors are the main proposed channel between time preferences and early mortality. Yet, in the following sections, I look closer at the adolescents' future education and income. These variables could be related to lifestyle factors, as well as to time preferences and health. In Table 1.10, income and educational levels are measured at age 40, forcing me to restrict the sample to include only those who are alive at this age.[31] For reference, Table 1.10 column 1 shows the main results of this paper in this restricted sample. Columns 2–4 show that having a higher income and higher education are both in themselves significantly correlated with lower mortality before age 65. Yet, the coefficient sign for time preferences remains stable, whereas the time preferences coefficient is reduced by about one-fourth of its original size when both future education and income are included. While the results could be biased, making it unwise to focus on the exact coefficient levels, this reduction can be interpreted as a mediation effect. This interpretation is supported by the literature as time preferences predict the composition of individuals with high income and high education (shown in Golsteyn et al. 2014), and educational attainment is found to correlate with health outcomes (see Grossman (2015) for an overview).

1.6 Conclusions

This paper finds that adolescents who have a lower discounting rate than their peers are less likely to suffer from early mortality in adulthood. The difference is large. The coefficient for preferring the delayed reward is roughly one-sixth of the mortality rate in the sample. In Cox models, students who say that they would probably or definitely prefer a delayed over an immediate reward have a 17% lower risk of dying at a given point before age 65. The patient group also have fewer hospitalizations and medical diagnoses, and they are less likely to be diagnosed with diseases associated with lifestyle risk factors as adults. One interpretation of these results is that people with lower discounting (who are more patient) are more likely to make healthy choices to secure their long-term health. This interpretation is strengthened by the results that patient adolescents are more interested in sports and more likely to think that smoking should be

[31]The age is set so that most participants have finished their educations, yet relatively few people in the sample (n= 254) die at age 40 or earlier. The coefficients of time preferences on early death are robust using income and educational data from 1990 and 1998; see Appendix Tables D18 and D19. The significance levels, however, are lowered using data from 1990, which is the first year of available data and the first year of an economic crisis in Sweden. The coefficient for education on early mortality is consistent through all years, and so is the coefficient for income, with the exception of 1998. In this year, the coefficient sizes and significance levels of income on health are lowered.

Table 1.10: Time preferences and early death.
Adding ability, future education, and income. Probit average marginal effect.

Sample alive at age 40 VARIABLES	(1) Death by 65	(2) Death by 65	(3) Death by 65	(4) Death by 65
Chose delayed reward	-0.013**	-0.010*	-0.012**	-0.0097*
	(0.0056)	(0.0057)	(0.0056)	(0.0056)
Attained education in 1993 (age 40)		-0.018***		-0.015***
		(0.0020)		(0.0020)
Disposable income in 1993 (age 40)			-0.0036***	-0.0028***
			(0.00048)	(0.00047)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	12,667	12,246	12,283	12,246
Pseudo R-squared	0.023	0.036	0.036	0.044
Outcome mean	0.077	0.078	0.078	0.078
$\frac{\text{Chose delayed reward}}{\text{Outcome mean}}$	-0.17	-0.13	-0.15	-0.12

The table only includes individuals alive at age 40 in 1993 when income and educational attainment are measured. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. *Attained education* is measured on a scale from 1 (less than 9 years) to 7 (at doctoral level). *Disposable income* is stated in tens of thousands of SEK. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

banned at schools. The results are also in line with theoretical predictions on time preferences and health investments by Galama & Van Kippersluis (2019).

In this paper, time preferences are measured when participants are 12–13 years old and the outcomes are measured over five decades later. Are individual time preferences stable for that long? To my knowledge, there are no papers with long enough data to answer that question. Yet, Meier & Sprenger (2015) study the temporal stability of measured time preferences over a 1-year period (N= 203). They find that 50% of their participants have stable discounting, but that instability in choice also exists. Based on their finding, I speculate that time preferences changed over time for at least part of my sample. However, some habits are hard to change once you have started, even if your preferences change. It is therefore possible that part of the predictive power of adolescents' time preferences on future health is explained by consistent preferences, while another part could be explained by habits formed when the sample was young and the time preferences measured.

Other investigated channels between time preferences and future health are income and educational attainment, which mediate one-fourth of the link between time preferences and future health. The paper also finds that parental time preferences correlate significantly with household rules on smoking. These results and sizes of the relations could be time and context dependent. Readers should, for example, keep in mind that children in Sweden were allowed to buy cigarettes at the time.

The overall mortality in the investigated age group is lower for females than for men. It is possible that we would see greater differences in mortality by time preferences among women if we followed them for a longer period. But that will have to be explored by future papers. Another finding that should be investigated further is the results on smoking. While papers like Cadena & Keys (2015) and Harrison et al. (2018) find significant correlations between smoking and patience, this paper does not. Why is this? I can only make an educated guess: one reason could be the different times and contexts. This investigated cohort grew up in a period when every other man used tobacco. Smoking also grew rapidly for women during these decades, as cigarettes were marketed as a symbol of liberation and equality (Magnusson & Nordgren 1994). Although this paper finds strong links between time preferences and future health, the views on smoking at the time could explain the lack of significant results on tobacco use.

The papers by Epper et al. (2020) and Golsteyn et al. (2014) show that time preferences are an important variable when looking at individual earnings and incomes. The unique Stockholm Birth Cohort enables me to continue their work

of looking at time preferences outside the lab setting and investigate their role in relation to important outcomes for real people. This paper is the first to have access to preference and long-run hospital data to analyze the relationship between time preferences and mortality before age 65. The results are clear: a simple time preference question among adolescents in 1966 (long before the famous marshmallow experiments) has the power to predict participants' future mortality and health status in adulthood. The results are strong and significant when adjusting the p-values for multiple hypothesis testing and including numerous high-quality control variables.[32] Using the Oster (2019) procedure to investigate unobserved selection, it is seen that very large external effects from unobservables, not included in this paper, are needed to erase the relation between time preferences and future health.[33]

The predictive power of time preferences could be of interest for future work on the timing of costs in the health insurance market. Brot-Goldberg et al. (2017) show that patients' out of pocket expenses for medical care cause them to underconsume healthcare, relative to what would be optimal in a dynamic setting. Allowing for heterogeneous time preferences could expand the scope of this research field further, to explore determinants of individual variance in healthcare utilization in insurance systems with deductibles.

The main contribution of this paper is the new results on the role of time preferences on long-term health. Combined with the findings by Falk et al. (2018), which shows that time preferences vary both internationally and within national populations, the conclusions of this paper motivate a policy discussion on how to design health interventions. Tailoring interventions to fit the members of society that have high discount rates (who are less patient) could potentially lead to more cost-effective solutions. The results also suggest that future research should study immediate costs and gains of health care investments in order to target the future well-being of this impatient group. Examples of paths to explore include making medicines taste better, increasing taxes on unhealthy foods, and incentivizing exercise.

[32]For results tables with adjusted p-values, see Appendix H.

[33]Using the Rmax, suggested by Oster (2019), Table I2 in Appendix I shows that the effects from unobservables must be 30 times as large as the effects from all included observable characteristics to erase the link between time preferences and death before 65. The equivalent numbers for participants' total number of hospitalizations and diagnoses are 3 times and 5 times, respectively.

Appendices 1

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1.A Detailed Descriptive Statistics

Table A1. Mortality and cause of death.

Cause of Death	Frequency
All cancers	356
Stomach cancer	15
Colon and rectal cancer	44
Liver cancer	17
Lung cancer	55
Skin cancer	14
Breast cancer	42
Prostate cancer	7
Circulatory	191
Ischemic	106
Cerebrovascular	27
Respiratory	35
COPD	15
Metabolic	21
Diabetes	3

Age of Death - All Causes	Frequency
< 20	34
20–29	86
30–39	116
40–49	226
50–59	426
60–64	341
Total	1229

Death by Conditions Associated with:	Frequency
Lifestyle risk factors	590
Alcohol use	325
Tobacco use	463
Drug use	47
Having a high BMI	324
Low physical Activity	196
Sexual risk-taking	11

The full data contains matched information on 12,956 individuals born in 1953. The last point of mortality data is measured on January 30, 2018. The cause of death categorization is made using ICD 9 from 1987 to 1996 and ICD 10 from 1997 to 2016. The data contains information on cause of death for 1,131 individuals who passed away between the ages of 34 and 63. Stanaway et al. (2018) categorize diagnoses associated with lifestyle risk factors using the ICD9 and ICD10 system, used at Swedish hospitals from 1987, when the SBC sample were 34 years old. See Appendix G for an extensive list of ICD codes.

Table A2. Time preferences for adolescents and their mothers.

Adolescents' time preferences:

If you had to choose between SEK 100 immediately or SEK 1,000 in five years, what would you choose?

Om du fick välja mellan 100 kr nu och 1000 kr om fem år, vilket skulle du välja?

		Frequency	Percent
Definitely SEK 100 immediately	*Säkert 100 kr nu*	807	6.23
Probably SEK 100 immediately	*Troligen 100 kr nu*	851	6.57
Cannot choose	*Kan inte välja*	1,195	9.22
Probably SEK 1,000 in 5 years	*Troligen 1000kr om fem år*	4,568	35.26
Definitely SEK 1,000 in 5 years	*Säkert 1000 kr om fem år*	5,535	42.72
Total		12,956	100

Mothers' time preferences:

If you could choose between 1,000 SEK immediately and 10,000 SEK in five years, would you choose 1,000 SEK immediately?

Om Ni fick välja mellan 1000 kronor nu och 10 000 kronor om 5 år, skulle Ni då ta 1000 kronor nu?

		Frequency	Percent
Yes, definitely	*Ja, absolut*	705	20.27
Yes, perhaps	*Ja, kanske*	307	8.83
Do not know	*Vet inte*	203	5.84
No, perhaps not	*Nej, kanske inte*	276	7.94
No, definitely not	*Nej, absolut inte*	1,987	57.13
Total		3,478	100

Swedish original text in italics. With rounded numbers of US$ in 2019 Swedish prices in parentheses, the adolescents were asked about SEK 1,100 (US$ 110) immediately or SEK 11,000 (US$ 1,100) in 5 years, while the mothers were asked about SEK 11,000 (US$ 1,100) immediately or SEK 110,000 (US$ 11,000) in 5 years.

Table A3. Balance table.

Variable	(1) Sample Without Information on Parents' Age	(2) Sample With Information on Parents' Age	(3) Difference
Adolescents: chose delayed reward	0.795	0.779	-0.016
	(0.404)	(0.415)	(0.017)
Female	0.506	0.494	-0.012
	(0.500)	(0.500)	(0.021)
Month of birth	6.220	6.296	0.076
	(3.406)	(3.361)	(0.142)
Parent upper secondary school	0.178	0.255	0.078***
	(0.383)	(0.436)	(0.018)
Parent university	0.073	0.089	0.016
	(0.260)	(0.285)	(0.012)
Observations	591	12,365	12,956

Table A4. Thoughts on smoking and sport interests.

Question to adolescents: *Do you think that students should be allowed to smoke at school?*

	Frequency	Percent
Yes, definitely	1,462	11.31
Yes, with hesitation	1,608	12.44
Don't know	2,603	20.14
No, with hesitation	1,343	10.39
No, definitely not	5,907	45.71
Total	12,923	100

Question to mothers: *Is your daughter/son allowed to smoke at home?*

	Frequency	Percent
No	2,047	62.16
Yes, with some restrictions	87	2.64
Yes	409	12.42
Yes, if she/he wanted to	631	19.16
She/he does not smoke	38	1.15
Do not know	81	2.46
Total	3,293	100

Questions to adolescents: Total number of points on questions about sport interests

	Frequency	Percent
10–20	695	5.38
21–30	2,896	22.43
31–40	5,282	40.90
41–50	4,040	31.29
Total	12,913	100

The sports interest index is composed of responses to questions about participation in voluntary gymnastics, in a bicycle race, in high jump, in a winter sport, working as a sports coach, playing basketball for a club, doing cross-country running, visiting an athletics event, sailing, and taking part in an athletic discipline. With scores in parentheses, the answer alternatives are: very interesting (5), interesting (4), dull (2) very dull (1).

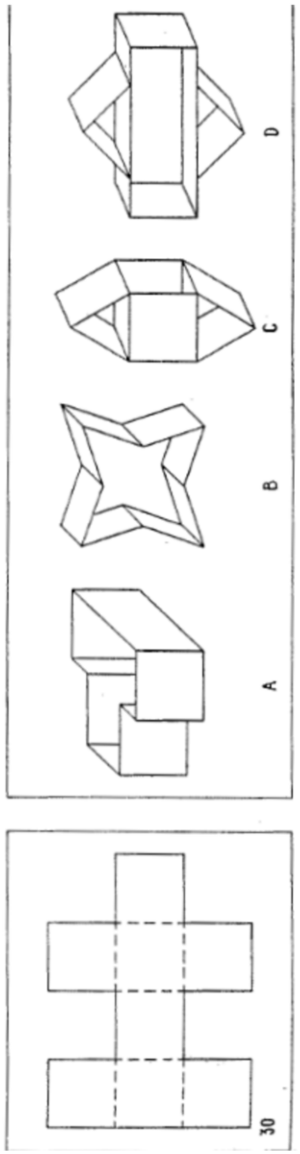


Figure A1.

1.B Robustness

Table B1. Time preferences and early death – probit coefficients.

VARIABLES	(1) Probit Death by 50	(2) Probit Death by 50	(3) Probit Death by 50	(4) Probit Death by 65	(5) Probit Death by 65	(6) Probit Death by 65
Adolescents:						
Chose delayed reward	-0.057	-0.089*	-0.087*	-0.094***	-0.13***	-0.12***
	(0.049)	(0.050)	(0.052)	(0.036)	(0.036)	(0.037)
Sex (female)		-0.27***	-0.29***		-0.27***	-0.28***
		(0.043)	(0.046)		(0.031)	(0.032)
Month of birth			-0.0090			-0.0084*
			(0.0065)			(0.0046)
Fathers:						
Age at child's birth			-0.0091*			0.00020
			(0.0052)			(0.0036)
Income			-0.0024			-0.0011
			(0.0017)			(0.0012)
Mothers:						
Age at child's birth			-0.0042			-0.0086**
			(0.0053)			(0.0039)
Income			-0.0030			-0.00016
			(0.0041)			(0.0029)
Parent(s):						
Upper secondary school			-0.050			-0.12***
			(0.065)			(0.047)
University			-0.13			-0.13*
			(0.11)			(0.072)
Constant	-1.76***	-1.62***	-1.16***	-1.24***	-1.09***	-0.78***
	(0.043)	(0.049)	(0.15)	(0.031)	(0.036)	(0.10)
Missing parental income and age at child's birth			Inc.			Inc.
Observations	12,956	12,956	12,956	12,956	12,956	12,956
Outcome mean	0.036	0.036	0.036	0.095	0.095	0.095
Pseudo R-squared	0.0003	0.0105	0.1021	0.0008	0.0103	0.0341

Adolescents: chose delayed reward is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Parent(s): upper secondary school* and *parent(s): university* are binary variables where 1 indicates that at least one of the parents has upper secondary school and university education, respectively. Fathers' and mothers' total incomes are in thousands of SEK. Missing information on parental income is treated as zero income. Missing observations on parents' age and when the child was born are substituted with the variable means of the sample. In regressions, missing income and missing information on parental age at a child's birth are controlled for with dummies. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B2. Time preferences and early death – OLS coefficients.

VARIABLES	(1) Death by 50	(2) Death by 50	(3) Death by 50	(4) Death by 65	(5) Death by 65	(6) Death by 65
Adolescents:						
Chose delayed reward	-0.0046	-0.0072*	-0.0073*	-0.016**	-0.022***	-0.021***
	(0.0041)	(0.0041)	(0.0040)	(0.0065)	(0.0065)	(0.0064)
Sex (female)		-0.021***	-0.021***		-0.045***	-0.046***
		(0.0033)	(0.0032)		(0.0052)	(0.0051)
Month of birth			-0.00062			-0.0014*
			(0.00047)			(0.00076)
Fathers:						
Age at child's birth			-0.00059			0.000039
			(0.00036)			(0.00060)
Income			-0.00011			-0.00016
			(0.000074)			(0.00015)
Mothers:						
Age at child's birth			-0.00026			-0.0014**
			(0.00043)			(0.00067)
Income			-0.00028			-0.000090
			(0.00031)			(0.00047)
Parent(s):						
Upper secondary school			-0.0039			-0.019***
			(0.0041)			(0.0067)
University			-0.0076			-0.020**
			(0.0058)			(0.0100)
Constant	0.039***	0.052***	0.081***	0.11***	0.13***	0.19***
	(0.0036)	(0.0044)	(0.010)	(0.0058)	(0.0069)	(0.017)
Missing parental income and age at child's birth			Inc.			Inc.
Observations	12,956	12,956	12,956	12,956	12,956	12,956
Outcome mean	0.036	0.036	0.036	0.095	0.095	0.095
R-squared	0.000	0.003	0.058	0.001	0.006	0.026

Adolescents: chose delayed reward is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Parent(s): upper secondary school* and *parent(s): university* are binary variables where 1 indicates that at least one of the parents has upper secondary school and university education as their highest level of attained education, respectively. Fathers' and mothers' total incomes are in thousands of SEK. Missing information on parental income is treated as zero income. Missing observations on parents' age when the child was born are substituted with the variable means of the sample. In columns 3 and 6, missing income and missing information on parental age at a child's birth are controlled for with dummies. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B3. Time preferences and early death.
Robustness, Restricted sample I. – probit average marginal effect.
Control for marital status

VARIABLES	(1) Death by 50	(1) Death by 50	(1) Death by 50	(2) Death by 65	(2) Death by 65	(2) Death by 65
Adolescents:						
Chose delayed reward	-0.0066	-0.0066	-0.0066	-0.027**	-0.027**	-0.027**
	(0.0074)	(0.0074)	(0.0074)	(0.012)	(0.012)	(0.012)
Sex (female)	-0.024***	-0.024***	-0.024***	-0.053***	-0.053***	-0.053***
	(0.0067)	(0.0067)	(0.0067)	(0.010)	(0.010)	(0.010)
Month of birth	-0.000072	-0.000063	-0.000065	0.0011	0.0011	0.0011
	(0.00091)	(0.00091)	(0.00091)	(0.0015)	(0.0015)	(0.0015)
Fathers:						
Age at child's birth	-0.00084	-0.00084	-0.00084	-0.0022*	-0.0022*	-0.0022*
	(0.00074)	(0.00073)	(0.00073)	(0.0011)	(0.0011)	(0.0011)
Income	0.00017	0.00016	0.00017	0.00021	0.00021	0.00021
	(0.00014)	(0.00014)	(0.00014)	(0.00026)	(0.00026)	(0.00026)
Education	-0.0027*	-0.0026*	-0.0026*	-0.0047*	-0.0047*	-0.0046*
	(0.0015)	(0.0015)	(0.0015)	(0.0024)	(0.0024)	(0.0024)
Mothers:						
Age at child's birth	-0.00087	-0.00088	-0.00087	-0.0013	-0.0013	-0.0013
	(0.00083)	(0.00083)	(0.00083)	(0.0013)	(0.0013)	(0.0013)
Income	-0.00051	-0.00052	-0.00053	-0.0014	-0.0015	-0.0015
	(0.00064)	(0.00065)	(0.00065)	(0.00099)	(0.00100)	(0.00100)
Education	-0.00050	-0.00052	-0.00055	-0.0037	-0.0037	-0.0037
	(0.0018)	(0.0018)	(0.0018)	(0.0028)	(0.0028)	(0.0028)
Mother is married		-0.0049			-0.0034	
		(0.0098)			(0.017)	
Mother is married and the husband has the same surname as the child			-0.0054			-0.0056
			(0.0093)			(0.015)
Missing parental income and age at child's birth	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	3,292	3,292	3,292	3,292	3,292	3,292

This table includes only participants with full information in a more detailed measure on parental education. The table reports the probit average marginal effect. Out of the 3,292 mothers, 2,909 are married. 2,810 of the mothers are married to someone who has the same last name as their child. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. Fathers' and mothers' total incomes are in thousands of SEK. Missing information on parental income is treated as zero income. Missing observations on parents' age when the child was born are substituted with the variable means of the sample. In regressions, missing income and missing information on parental age at a child's birth are controlled for with dummies. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B4. Time preferences and early death.
Robustness, Restricted sample II – probit average marginal effect.

VARIABLES	(1) Death by 50	(2) Death by 65
Adolescents:		
Chose delayed reward	-0.0038	-0.017***
	(0.0034)	(0.0060)
Sex (female)	-0.015***	-0.040***
	(0.0030)	(0.0052)
Month of birth	-0.00055	-0.0012*
	(0.00043)	(0.00075)
Fathers:		
Age at child's birth	-0.00036	0.00027
	(0.00035)	(0.00059)
Income	-0.00012	-0.00015
	(0.00011)	(0.00020)
Mothers:		
Age at child's birth	-0.00047	-0.0016**
	(0.00039)	(0.00067)
Income	-0.00016	0.00021
	(0.00031)	(0.00049)
Parent(s):		
Upper secondary school	-0.0039	-0.020***
	(0.0042)	(0.0076)
University	-0.011	-0.022*
	(0.0075)	(0.012)
Missing parental income and age at child's birth	Inc.	Inc.
Observations	12,365	12,365

This table includes only participants with full information on parents' age when the child was born. The table reports the probit average marginal effect. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. Fathers' and mothers' total incomes are in thousands of SEK. Missing information on parental income is treated as zero income. Missing observations on parents' age when the child was born are substituted with the variable means of the sample. In regressions, missing income and missing information on parental age at a child's birth are controlled for with dummies. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B5. Siblings data.

Number of siblings:	0	1	2	3	4	5	6	7	8 or more
Frequency:	1,569	4,829	3,593	1,791	701	269	106	49	38

Table B6. Time preferences and early death. Sibling controls. – Probit average marginal effect.

VARIABLES	(1a) Death by 50	(1b) Death by 50	(1c) Death by 50	(2a) Death by 65	(2b) Death by 65	(2c) Death by 65
Adolescents:						
Chose delayed reward	-0.0062*	-0.0055	-0.0055	-0.020***	-0.019***	-0.019***
	(0.0037)	(0.0037)	(0.0037)	(0.0060)	(0.0060)	(0.0060)
Number of siblings		0.0012			0.0030	
		(0.0011)			(0.0019)	
Number of older sisters			0.00013			0.0027
			(0.0023)			(0.0038)
Number of younger sisters			-0.00033			0.0047
			(0.0024)			(0.0039)
Number of older brothers			0.0030			0.0037
			(0.0021)			(0.0036)
Number of younger brothers			0.0021			0.00083
			(0.0023)			(0.0039)
Socioeconomic/gender controls	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,956	12,945	12,945	12,956	12,945	12,945
Outcome mean	0.036	0.036	0.036	0.095	0.095	0.095

The table reports the probit average marginal effect. Adolescents are asked what they would choose if they could receive SEK 100 immediately or SEK 1,000 in 5 years. Those who answered that they would definitely choose the immediate reward are the reference in this table. The set of socioeconomic/gender controls include month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Stata does not allow fixed effects estimations in probit models since they create biased results in the model. Regressions with municipality and school fixed effects (Table B7) are therefore regressed using OLS. Columns 1 and 4 include the same full set of controls as in the main results in Table 4 in the paper but are regressed here with OLS instead of probit average marginal effect. Columns 2 and 5 include additional school principal fixed effects, and columns 3 and 6 add municipality fixed effects.

Table B7.
Time preferences and early death. Municipality and school fixed effects – OLS.

VARIABLES	(1) OLS Death by 50	(2) OLS Death by 50	(3) OLS Death by 50	(4) OLS Death by 65	(5) OLS Death by 65	(6) OLS Death by 65
Adolescent chose delayed reward	-0.0073*	-0.0064	-0.0067*	-0.021***	-0.021***	-0.020***
	(0.0040)	(0.0040)	(0.0040)	(0.0064)	(0.0065)	(0.0064)
Constant	0.081***	0.097***	0.095***	0.19***	0.21***	0.21***
	(0.010)	(0.012)	(0.012)	(0.017)	(0.020)	(0.019)
Municipality fixed effects			Inc.			Inc.
School fixed effects		Inc.			Inc.	
Socioeconomic /gender controls	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,956	12,956	12,956	12,956	12,956	12,956
R square	0.058	0.067	0.059	0.026	0.035	0.028

Adolescents: chose delayed reward is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. Municipality fixed effects use information on what municipality the adolescents' school is located in. School fixed effects use information on which headmaster a participant has. The full set of socioeconomic/gender controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B8. Early death and time preferences (all categories).

VARIABLES	(1) Death by 50 Probit average marginal effect	(2) Death by 65 Probit average marginal effect	(3) Death by 50 Probit	(4) Death by 65 Probit
Reference timing: Definitely immediate				
Probably immediate	-0.0076	-0.0079	-0.11	-0.048
	(0.0082)	(0.014)	(0.12)	(0.083)
Indifferent	-0.0073	-0.00041	-0.10	-0.0025
	(0.0076)	(0.012)	(0.11)	(0.076)
Probably delay	-0.014**	-0.023**	-0.20**	-0.14**
	(0.0062)	(0.010)	(0.088)	(0.064)
Definitely delay	-0.0090	-0.022**	-0.13	-0.13**
	(0.0060)	(0.010)	(0.085)	(0.063)
Constant			-1.09***	-0.77***
			(0.16)	(0.11)
Socioeconomic /gender controls	Inc.	Inc.	Inc.	Inc.
Observations	12,956	12,956	12,956	12,956
Pseudo R-squared	0.103	0.034	0.103	0.034
Outcome mean	0.036	0.095	0.036	0.095

The table reports the probit coefficients and probit average marginal effects. Adolescents are asked what they would choose if they could receive SEK 100 immediately or SEK 1,000 in 5 years. Those who answered that they would definitely choose the immediate reward are the reference in this table. Socioeconomic/gender controls include month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B9. Time preferences and early death,
Adding ability, school absence, and parental mortality – probit

Sample alive at age 40

VARIABLES	(1) Probit Death by 65	(2) Probit Death by 65	(3) Probit Death by 65	(4) Probit Death by 65	(5) Probit Death by 65
Chose delayed Reward	-0.12***	-0.12***	-0.12***	-0.097**	-0.096**
	(0.039)	(0.039)	(0.039)	(0.039)	(0.040)
Absence form School		0.0013***			0.0011***
		(0.00034)			(0.00035)
Father died before age 65			0.18***		0.16***
			(0.042)		(0.042)
Mother died before age 65			0.13**		0.12**
			(0.054)		(0.054)
Ability at age 13				-0.016***	-0.015***
				(0.0024)	(0.0024)
Constant	-0.93***	-0.98***	-1.01***	-0.61***	-0.73***
	(0.11)	(0.11)	(0.11)	(0.12)	(0.12)
Socioeconomic /gender controls	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,702	12,701	12,702	12,668	12,667
Pseudo R-squared	0.0121	0.0142	0.0156	0.0188	0.0233
Outcome mean	0.077	0.077	0.077	0.077	0.077

The table reports the probit coefficients and only includes individuals alive at age 40 in 1993 when income and educational attainment are measured. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Absence from school* measures all registered absence hours with a valid excuse that the adolescent had in the spring term of the 6th year of elementary school. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. Socioeconomic/gender controls include month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B10.
Time preferences and early death,
Adding ability, school absence, and parental mortality - OLS

Sample alive at age 40

VARIABLES	(1) OLS Death by 65	(2) OLS Death by 65	(3) OLS Death by 65	(4) OLS Death by 65	(5) OLS Death by 65
Chose delayed Reward	-0.018***	-0.018***	-0.018***	-0.014**	-0.014**
	(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)
School sick Absence		0.00021***			0.00019***
		(0.000061)			(0.000061)
Father died before age 65			0.029***		0.026***
			(0.0072)		(0.0071)
Mother died before age 65			0.021**		0.019**
			(0.0090)		(0.0090)
Ability at age 13				-0.0024***	-0.0023***
				(0.00036)	(0.00036)
Constant	0.15***	0.14***	0.14***	0.20***	0.18***
	(0.016)	(0.016)	(0.016)	(0.018)	(0.018)
Socioeconomic /gender controls	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,702	12,701	12,702	12,668	12,667
R-squared	0.007	0.008	0.009	0.010	0.013
Outcome mean	0.077	0.077	0.077	0.077	0.077

The table reports the OLS coefficients and only includes individuals alive at age 40 in 1993 when income and educational attainment are measured. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. Socioeconomic/gender controls include month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

In the Cox model, the outcome $h_{1i}(t)$ is the mortality hazard (risk of mortality) for individual i, and $h_0(t)$ is the baseline risk:

$$h_{1i}(t) = h_0(t)exp(\gamma Timepref_i + \boldsymbol{\rho_x x_i}) \tag{1.B.1}$$

$Timepref_i$ and $\boldsymbol{x_i}$ are individual i's time preferences and a vector of controls. In the Cox model, a hazard rate equal to 1 is interpreted as a factor having "no effect" on the mortality hazard. A variable estimate greater (smaller) than 1 indicates a larger (smaller) risk of dying at any point in time over the investigated period. The Cox model assumes that the hazard rate is constant over the investigated period, which is not trivial to assume in this sample. It becomes non-trivial since all participants in the SBC are born in the same year, which inhibits me from conditioning the effect given a participant's age without controlling for time. Instead of looking at mortality controlling for age, I therefore test the stability of the results by restricting the sample. If the assumption of constant hazard rate holds, then we should see stable coefficient sizes in different age groups of the sample. While the main Cox regressions in Table B12 include all individuals, robustness versions therefore exclude the minority of deaths that occur before the participant have turned 40 and 50 years old, respectively.

Looking at Table B12, the patient adolescents have, depending on the model specifications, a 15.9–21% lower risk of dying at any point in time (ages 40–65 or 50–65), compared with their less patient peers.

To interpret the hazard ratio as the risk of dying at any point, we have to assume that the hazard ratio is constant over time. This can be tested in at least three different ways. Plots comparing Kaplan-Meier observed survival curves with predicted Cox curves, and results using Schoenfeld residuals (all displayed in Appendix E), show that this proportional hazard assumption holds. However, this assumption can also be investigated graphically, by scaling the survival probability with natural logarithms and investigating whether the curves for individuals of the different "treatments" are parallel over time (Cleves et al. 2010).[34] This is done in Figure E2 in the Appendix.

A potential explanation for problems with the constant hazard assumption using this method is the low mortality rates in the decades before ages 40 and 50. This could generate noise and low statistical power when investigating the

[34]The survival probability is scaled by $-ln(-ln(survival probability))$ on the y axis, and the analysis time on the x axis is scaled by ln. This follows from the general proportional hazard function $h(t|\mathbf{x}) = h_0(t)\exp(\mathbf{x}\beta_x)$, and with $S(t)$ being the Kaplan-Meier estimation of the survival function, this leads to $S(t|\mathbf{x}) = S_0^{\exp(\mathbf{x}\beta_x)}$, which gives $-ln(-ln(S(t|\mathbf{x}))) = -ln(-ln(S_0(t))) - \mathbf{x}\beta_x$ If the proportional-hazard assumptions hold, the plotted curve should be roughly parallel. When control variables are included, Cox estimates instead of Kaplan-Meier estimates are used. See Cleves et al. (2010) for more information.

relationship at each point in continuous time. The results of time preferences on early mortality in these lower age groups should therefore be viewed with caution. Restricting the sample to include only individuals who are alive at age 40 or age 50 generate highly stable Cox hazard ratios. This is shown in Table B12, where patient children have a 16.9–18.8% lower risk of dying at any point in time between the ages of 41–65, and 51–65, respectively. To conclude, these Cox results show that choosing delayed rewards at age 12 and 13 have a stable predictive power on the likelihood of early death after age 40 and before age 65.

Table B11. Time preferences and early death – Cox model.

VARIABLES	(1) Hazard Rate Death by 65	(2) Hazard Rate Death by 65	(3) Hazard Rate Death by 65
Chose delayed reward	0.841***	0.790***	0.833***
	(0.0554)	(0.0525)	(0.0559)
Socioeconomic /gender controls		Inc.	Inc.
Controls for ability /health background			Inc.
Observations	12,956	12,956	12,919
Mean mortality	0.095	0.095	0.095

The table reports the hazard rate in a Cox model of survival time ages 13–65. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent ”probably” or “definitely” preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who ”probably” or “definitely” preferred the earlier amount or were indifferent. The full set of socioeconomic/gender controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. The “controls for ability/health background information” include information of the adolescents' cognitive ability at age 13, absence from school, and their fathers' and mothers' mortality by age 65. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Doyle (2011) is a paper in health economics that uses hospitalization for an acute heart condition to reduce selection into specific hospitals. Doyle argues that for these conditions, people experiencing symptoms are advised to immediately turn to their nearest hospital for care. Based on this argument, I look at diagnosis of acute heart conditions to investigate time preferences and future health, reducing any potential bias from selection into treatment. As presented in Table B16 column 1, only 5% of the full sample suffer from acute heart conditions between the ages of 20 and 63. The weakly significant coefficient of almost a one percentage point difference for choosing the delayed reward can therefore

Table B12. Time preferences and early death. Restricted sample – Cox model.

VARIABLES	(1) Hazard Rate Death by 65 Sample alive at 40	(2) Hazard Rate Death by 65 Sample alive at 40	(3) Hazard Rate Death by 65 Sample alive at 50	(4) Hazard Rate Death by 65 Sample alive at 50
Chose delayed reward	0.819***	0.831**	0.812**	0.819**
	(0.0602)	(0.0622)	(0.0690)	(0.0708)
Full set of controls		Inc.		Inc.
Observations	12,702	12,667	12,455	12,421

The table reports the hazard rate in a Cox model of survival time. Columns 1–2 and 3–4 are restricted to only include participants alive at age 40 and age 50, respectively. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

be seen as large in this setting. In column 3, results are presented using the Poisson model, utilizing not only *whether* a person has suffered from an acute heart condition, but also *how many times* it has happened. Here, choosing the delayed reward is negatively and significantly related to suffering from an acute heart conditions. Although the coefficient sign is stable and negative throughout Table B16, the significance levels are unstable. Restricting the sample to include only those who survive until 2016 reduces the significance dramatically (see columns 2 and 4). One potential explanation is that severe cases of heart conditions with fatal outcomes are part of driving the results.

Table B13.
Time preferences (age 12 or 13), hospitalizations, and diagnoses (ages 20–63).
Robust samples

VARIABLES	(1) OLS Number of Hospitalizations	(2) OLS Number of Hospitalizations	(3) OLS Number of Diagnoses	(4) OLS Number of Diagnoses
Panel A: Sample not restricted to living in the Stockholm region 1971, 1975, 1978–1983.				
Chose delayed reward	-0.39*	-0.23	-1.03**	-0.60
	(0.22)	(0.17)	(0.50)	(0.39)
Constant	8.48***	6.96***	15.8***	12.6***
	(0.64)	(0.55)	(1.45)	(1.14)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	12,885	11,840	12,885	11,840
R-squared	0.028	0.041	0.014	0.019
Outcome mean	5.62	4.80	9.90	7.98
Panel B: Sample excluding individuals with > 100 diagnoses/hospitalizations.				
Chose delayed reward	-0.55***	-0.40**	-0.81**	-0.46
	(0.21)	(0.19)	(0.33)	(0.28)
Constant	7.91***	6.56***	12.7***	10.5***
	(0.56)	(0.48)	(0.93)	(0.83)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	9,871	9,109	9,795	9,072
R-squared	0.041	0.053	0.034	0.040
Outcome mean	5.46	4.77	8.62	7.40
Sample:	*Alive in 1973*	*Alive in 2016*	*Alive in 1973*	*Alive in 2016*

The outcome variable in columns 1 and 2 is the number of hospitalizations, and in columns 3 and 4 the number of diagnoses, from 1973 to 2016. The hospitalization and diagnosis data contain full information on hospitalizations in the Stockholm area and nationwide from 1973 and 1983, respectively. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B14. Time preferences (age 12 or 13), hospitalizations, and diagnoses (ages 20–63). Different controls

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	OLS
VARIABLES	Number of Hospitalizations	Number of Hospitalizations	Number of Diagnoses	Number of Diagnoses
No controls				
Chose delayed reward	-1.14***	-0.88***	-2.26***	-1.58***
	(0.27)	(0.21)	(0.61)	(0.47)
Constant	6.57***	5.56***	12.0***	9.49***
	(0.25)	(0.19)	(0.55)	(0.43)
Observations	9,913	9,138	9,913	9,138
R-squared	0.002	0.002	0.002	0.002
Outcome mean	5.68	4.88	10.2	8.25
Gender controls				
Chose delayed reward	-0.86***	-0.57***	-2.00***	-1.27***
	(0.26)	(0.21)	(0.60)	(0.48)
Constant	5.31***	4.18***	10.8***	8.04***
	(0.26)	(0.22)	(0.60)	(0.51)
Gender control	Inc.	Inc.	Inc.	Inc.
Observations	9,913	9,138	9,913	9,138
R-squared	0.015	0.026	0.004	0.007
Outcome mean	5.68	4.88	10.2	8.25
Socioeconomic /gender controls				
Chose delayed reward	-0.80***	-0.52**	-1.88***	-1.16**
	(0.26)	(0.21)	(0.60)	(0.48)
Constant	7.04***	6.21***	13.3***	11.4***
	(0.61)	(0.52)	(1.46)	(1.16)
Socioeconomic/ gender controls	Inc.	Inc.	Inc.	Inc.
Observations	9,913	9,138	9,913	9,138
R-squared	0.018	0.032	0.006	0.011
Outcome mean	5.68	4.88	10.2	8.25
Sample:	*Alive in 1973*	*Alive in 2016*	*Alive in 1973*	*Alive in 2016*

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. The outcome variable in columns 1 and 2 is the number of hospitalizations, and in columns 3 and 4 the number of diagnoses, from 1973 to 2016. At the end of each period of care at a Swedish hospital, a final medical record is created. It includes all diagnoses relevant for the patient during that hospital visit. This table presents the full data from hospitalization records in the Stockholm region. 1973–2016 and nationwide 1983–2016. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent ”probably” or “definitely” preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who ”probably” or “definitely” preferred the earlier amount or were indifferent. The socioeconomic /gender controls include month of birth, sex, parents’ age at their child’s birth, fathers’ and mothers’ total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes a dummy variable for missing observations of parents’ income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B15. Time preferences (age 12 or 13), hospitalizations, and diagnoses (ages 20–63). Poisson coefficients.

	(1)	(2)	(3)	(4)
VARIABLES	Number of Hospitalizations	Number of Hospitalizations	Number of Diagnoses	Number of Diagnoses
Chose delayed reward	-0.093**	-0.063	-0.13**	-0.094*
	(0.042)	(0.038)	(0.053)	(0.052)
Constant	2.19***	2.04***	2.86***	2.70***
	(0.11)	(0.12)	(0.15)	(0.15)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	9,885	9,116	9,885	9,116
Sample:	*Alive in 1973*	*Alive in 2016*	*Alive in 1973*	*Alive in 2016*

The sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. The outcome variable in columns 1 and 2 is the number of hospitalizations, and in columns 3 and 4 it is the number of diagnoses, from 1973 to 2016. At the end of each period of care at a Swedish hospital, a final medical record is created. It includes all diagnoses relevant for the patient during that hospital visit. This table presents the full data from hospitalization records in the Stockholm region 1973–2016 and nationwide 1983–2016. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent ”probably” or “definitely” preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who ”probably” or “definitely” preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents‘ age at their child’s birth, fathers’ and mothers’ total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents’ cognitive ability at age 13, absence from school, their fathers’ and mothers’ mortality by age 65, as well as dummy variables for missing observations of parents’ income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B16. Time preferences and acute heart conditions – age 20–63. Probit marginal effects at mean and Poisson.

VARIABLES	(1) *Binary* Acute Heart Conditions	(2) *Binary* Acute Heart Conditions	(3) *Poisson* Acute Heart Conditions	(4) *Poisson* Acute Heart Conditions
Socioeconomic + Gender controls				
Chose delayed reward	-0.011**	-0.0051	-0.50***	-0.42*
	(0.0052)	(0.0052)	(0.18)	(0.23)
Socioeconomic /gender controls	Inc.	Inc.	Inc.	Inc.
Observations	9,913	9,138	9,913	9,138
Outcome Mean	0.05	0.04	0.14	0.11
Pseudo R-squared	0.029	0.032	0.044	0.045
Full set of controls				
Chose delayed reward	-0.0092*	-0.0037	-0.47***	-0.39*
	(0.0052)	(0.0052)	(0.18)	(0.23)
Socioeconomic /gender controls	Inc.	Inc.	Inc.	Inc.
Controls for ability /health background	Inc.	Inc.	Inc.	Inc.
Observations	9,885	9,116	9,885	9,116
Outcome Mean	0.05	0.04	0.14	0.11
Pseudo R-squared	0.037	0.039	0.058	0.056
Sample:	*Alive in 1973*	*Alive in 2016*	*Alive in 1973*	*Alive in 2016*

Columns 1–2 report the probit marginal effects at mean. Column 3–4 report poison coefficients. The sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. *Acute heart conditions* consist of acute myocardial infarction, cardiac dysrhythmias, and heart failure, classified as 410, 427, and 428 in ICD9 and corresponding codes in ICD8 and ICD10. For the full set of ICD codes, see Appendix F. The outcome variables are constructed using diagnosis data from 1973 to 2016. The diagnosis data contain full information on hospitalizations in the Stockholm area and nationwide from 1973 and 1983, respectively. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent The full set of socioeconomic/gender controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. The controls for ability/health background include information on the adolescents' cognitive ability at age 13, absence from school, and their fathers' and mothers' mortality by age 65. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B17. Diagnoses related to lifestyle – probit.

Panel A Sample alive in 1973 or 1987	*Age 20-63 Have ≥ 1 diagnosis of dependence on/abuse of:*		*Age 34-63 Have ≥ 1 diagnosis associated with:*						
	(1A) Alcohol	(2A) Drugs	(3A) Lifestyle Risk Factors	(4A) Alcohol Use	(5A) Tobacco Use	(6A) Drug Use	(7A) High BMI	(8A) Low Physical Activity	(9A) Sexual Risk-Taking
Chose delayed Reward	-0.10**	-0.073	-0.083***	-0.088***	-0.063**	-0.083	-0.024	-0.035	-0.077
	(0.050)	(0.069)	(0.028)	(0.030)	(0.029)	(0.058)	(0.030)	(0.036)	(0.061)
Observations	9,885	9,885	12,756	12,756	12,756	12,756	12,756	12,756	12,756
Pseudo R2	0.057	0.044	0.012	0.018	0.008	0.052	0.006	0.007	0.076
Full set controls	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.06	0.02	0.35	0.24	0.27	0.02	0.24	0.11	0.02
Panel B Sample alive in 2016	*Age 20-63 Have ≥ 1 diagnosis of dependence on/abuse of:*		*Age 34-63 Have ≥ 1 diagnosis associated with:*						
	(1B) Alcohol	(2B) Drugs	(3B) Lifestyle Risk Factors	(4B) Alcohol Use	(5B) Tobacco Use	(6B) Drug Use	(7B) High BMI	(8B) Low Physical Activity	(9B) Sexual Risk-Taking
Chose delayed reward	-0.11*	-0.14	-0.070**	-0.080**	-0.055*	-0.056	-0.020	-0.032	-0.076
	(0.057)	(0.084)	(0.030)	(0.032)	(0.031)	(0.071)	(0.032)	(0.038)	(0.067)
Observations	9,116	9,116	11,840	11,840	11,840	11,840	11,840	11,840	11,840
Pseudo R2	0.050	0.038	0.009	0.016	0.007	0.042	0.005	0.007	0.093
Full set controls	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.04	0.01	0.32	0.22	0.24	0.01	0.23	0.10	0.02

For columns 1–2 A and B, the sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. The outcome variables are binary and are constructed using diagnosis data from 1973 to 2016. At the end of each period of care at a Swedish hospital, a final medical record is created. It includes all diagnoses relevant for the patient during that hospital visit. In this paper, I have access to the full information from hospitalization records in the Stockholm region1973–2016 and nationwide 1983–2016. For columns 3–9 A and B, the binary outcome variables are constructed using nationwide diagnosis data from 1987 to 2016. The categorization is made using ICD 9 from 1987 to 1996 and ICD 10 from 1997 to 2016. The index for Conditions Associated with Lifestyle Risk Factors is a combination of indexes for conditions associated with alcohol use, having a high BMI, tobacco use, low physical activity, sexual risk-taking, and drug use. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B18. Diagnoses related to lifestyle – OLS.

Panel A **Sample alive in 1973 or 1987**	*OLS Age 20-63 Have ≥ 1 diagnosis of dependence on/abuse of:*			*OLS Age 34-63 Have ≥ 1 diagnosis associated with:*						
	(1A) Alcohol	(2A) Drugs	:	(3A) Lifestyle Risk Factors	(4A) Alcohol Use	(5A) Tobacco Use	(6A) Drug Use	(7A) High BMI	(8A) Low Physical Activity	(9A) Sexual Risk-Taking
Chose delayed Reward	-0.0115*	-0.00366		-0.030***	-0.027***	-0.020**	-0.0047	-0.0070	-0.0064	-0.0046
	(0.00587)	(0.00357)		(0.010)	(0.0093)	(0.0097)	(0.0036)	(0.0093)	(0.0070)	(0.0032)
Observations	9,885	9,885		12,756	12,756	12,756	12,756	12,756	12,756	12,756
R-squared	0.024	0.009		0.015	0.020	0.009	0.012	0.006	0.005	0.013
Full set controls	Inc.	Inc.		Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.06	0.02		0.35	0.24	0.27	0.02	0.24	0.11	0.02
Panel B **Sample alive in 2016**	*OLS Age 20-63 Have ≥ 1 diagnosis of dependence on/abuse of:*			*OLS Age 34-63 Have ≥ 1 diagnosis associated with:*						
	(1B) Alcohol	(2B) Drugs	:	(3B) Lifestyle Risk Factors	(4B) Alcohol Use	(5B) Tobacco Use	(6B) Drug Use	(7B) High BMI	(8B) Low Physical Activity	(9B) Sexual Risk-Taking
Chose delayed reward	-0.0096*	-0.0049		-0.025**	-0.023**	-0.017*	-0.0020	-0.0057	-0.0056	-0.0042
	(0.0054)	(0.0031)		(0.011)	(0.0093)	(0.0098)	(0.0030)	(0.0095)	(0.0070)	(0.0032)
Observations	9,116	9,116		11,840	11,840	11,840	11,840	11,840	11,840	11,840
R-squared	0.017	0.005		0.011	0.016	0.007	0.006	0.006	0.005	0.014
Full set controls	Inc	Inc.		Inc	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.04	0.01		0.32	0.22	0.24	0.01	0.23	0.10	0.02

For columns 1–2 A and B, the sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. The outcome variables are binary and are constructed using diagnosis data from 1973 to 2016. The diagnosis data contain full information on hospitalizations in the Stockholm area and nationwide from 1973 and 1983, respectively. For columns 3–9 A and B, the binary outcome variables are constructed using nationwide diagnosis data from 1987 to 2016. The categorization is made using ICD 9 from 1987 to 1996 and ICD 10 from 1997 to 2016. The index for Conditions Associated with Lifestyle Risk Factors is a combination of indexes for conditions associated with alcohol use, having a high BMI, tobacco use, low physical activity, sexual risk-taking, and drug use. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent ”probably” or “definitely” preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who ”probably” or “definitely” preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table B19. Diagnoses related to lifestyle – Poisson.

Panel A **Sample alive in 1973 or 1987**	*Poisson Age 20-63 Have ≥ 1 diagnosis of dependence on/abuse of:*			*Poisson Age 34-63 Have ≥ 1 diagnosis associated with:*						
	(1A) Alcohol	(2A) Drugs	:	(3A) Lifestyle Risk Factors	(4A) Alcohol Use	(5A) Tobacco Use	(6A) Drug Use	(7A) High BMI	(8A) Low Physical Activity	(9A) Sexual Risk-Taking
Chose delayed reward	0.021	0.26		-0.057	-0.026	-0.15	-0.12	-0.16	-0.16	-0.43
	(0.19)	(0.29)		(0.085)	(0.11)	(0.097)	(0.24)	(0.10)	(0.14)	(0.30)
Observations	9,885	9,885		12,756	12,756	12,756	12,756	12,756	12,756	12,756
Pseudo R2	0.088	0.116		0.047	0.066	0.031	0.083	0.028	0.021	0.044
Full set controls	Inc.	Inc.		Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.39	0.13		2.29	1.42	1.26	0.14	1.06	0.35	0.046
Panel B **Sample alive in 2016**	*Poisson Age 20-63 Have ≥ 1 diagnosis of dependence on/abuse of:*			*Poisson Age 34-63 Have ≥ 1 diagnosis associated with:*						
	(1B) Alcohol	(2B) Drugs	:	(3B) Lifestyle Risk Factors	(4B) Alcohol Use	(5B) Tobacco Use	(6B) Drug Use	(7B) High BMI	(8B) Low Physical Activity	(9B) Sexual Risk-Taking
Chose delayed reward	0.0020	0.20		-0.090	-0.075	-0.13	0.080	-0.16	-0.14	-0.10
	(0.23)	(0.45)		(0.086)	(0.12)	(0.10)	(0.34)	(0.11)	(0.16)	(0.25)
Observations	9,116	9,116		11,840	11,840	11,840	11,840	11,840	11,840	11,840
Pseudo R2	0.105	0.157		0.043	0.062	0.031	0.097	0.03	0.029	0.058
Full set controls	Inc	Inc.		Inc	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	0.24	0.071		1.63	1.01	0.98	0.084	0.87	0.29	0.033

For columns 1–2 A and B, the sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983. The outcome variables are binary and are constructed using diagnosis data from 1973 to 2016. The diagnosis data contain full information on hospitalizations in the Stockholm area and nationwide from 1973 and 1983, respectively. For columns 3–9 A and B, the binary outcome variables are constructed using nationwide diagnosis data from 1987 to 2016. The categorization is made using ICD 9 from 1987 to 1996 and ICD 10 from 1997 to 2016. The index for Conditions Associated with Lifestyle Risk Factors is a combination of indexes for conditions associated with alcohol use, having a high BMI, tobacco use, low physical activity, sexual risk-taking, and drug use. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent ”probably” or “definitely” preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who ”probably” or “definitely” preferred the earlier amount or were indifferent. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table B20. Attitudes to smoking – probit.

VARIABLES	(1) Opinion: Should not be allowed to smoke at school, adolescents	(2) Opinion: Should not be allowed to smoke at school, adolescents	(3) Opinion: Should not be allowed to smoke at school, adolescents	(4) Rules: Not allowed to smoke at home, mothers	(5) Use Tobacco age 32
Adolescents: chose delayed reward	0.10***	0.10*	0.10*	-0.076	0.038
	(0.027)	(0.053)	(0.053)	(0.057)	(0.062)
Mothers: chose delayed reward			-0.036	0.16***	
			(0.046)	(0.050)	
Constant	0.18**	0.44***	0.46***	0.081	1.03***
	(0.081)	(0.15)	(0.15)	(0.17)	(0.18)
Full set of controls	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,886	3,438	3,438	3,142	2,552
Outcome mean	0.006	0.011	0.011	0.014	0.031
Pseudo R-squared	0.56	0.56	0.56	0.65	0.52

In columns 1–3, the dependent variable is a dummy variable where 1 indicates that the adolescent answered "No, with hesitation" or "No, definitely not" when asked whether students should be allowed to smoke at school. Column 4 has a dummy variable as dependent variable where 1 indicates that the mother answered no to the question of whether their child was allowed to smoke at home Mothers who answered that "She/he does not smoke" (referring to their child) or "Do not know" were excluded. In Column 5, the dependent variable is whether the respondent reported using tobacco at age 32. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Mothers: chose delayed reward* is a dummy variable where 1 indicates that the mother answers "No, perhaps not" or "No, definitely not" when asked if she would choose SEK 1,000 immediately over SEK 10,000 in 5 years. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B21 Time preferences and early death.
Adding future education and income – probit coefficients.

Sample alive at age 40 VARIABLES	(1) Death by 65	(2) Death by 65	(3) Death by 65	(4) Death by 65
Chose delayed reward	-0.096**	-0.072*	-0.087**	-0.069*
	(0.040)	(0.040)	(0.040)	(0.040)
Attained education		-0.13***		-0.10***
in 1993 (age 40)		(0.014)		(0.014)
Disposable income			-0.026***	-0.020***
in 1993 (age 40)			(0.0034)	(0.0034)
Constant	-0.73***	-0.52***	-0.43***	-0.34**
	(0.12)	(0.13)	(0.13)	(0.13)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	12,667	12,246	12,283	12,246
Pseudo R-squared	0.023	0.036	0.036	0.044
Outcome mean	0.077	0.078	0.078	0.078

The table reports the probit coefficients and only includes individuals alive at age 40 in 1993 when income and educational attainment are measured. *Chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely preferred SEK 1,000 in 5 years over SEK 100 immediately. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. *Attained education* is measured on a scale from 1 (less than 9 years) to 7 (at doctoral level). *Disposable income* is stated in tens of thousands of SEK. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B22. Time preferences and early death.
Adding future education and income – probit average marginal effect.
Robustness, attained education, and disposable income at age 37.

VARIABLES	(1) Sample Alive at 37 Death by 65	(2) Sample Alive at 37 Death by 65	(3) Sample Alive at 37 Death by 65	(4) Sample Alive at 37 Death by 65
Adolescents:				
Chose delayed reward	-0.013**	-0.0092	-0.011**	-0.0082
	(0.0057)	(0.0058)	(0.0058)	(0.0057)
Attained education		-0.019***		-0.017***
in 1990 (age 37)		(0.0020)		(0.0021)
Disposable income			-0.0042***	-0.0033***
in 1990 (age 37)			(0.0010)	(0.00099)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	12,716	12,324	12,357	12,324

The table only includes individuals alive at age 37 in 1990 when income and educational attainment are measured. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. *Attained education* is measured on a scale from 1 (less than 9 years) to 7 (at doctoral level). *Disposable income* is stated in tens of thousands of SEK. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table B23. Time preferences and early death.
Adding future education and income – probit average marginal effect.
Robustness, attained education, and disposable income at age 45.

VARIABLES	(1) Sample Alive at 45 Death by 65	(2) Sample Alive at 45 Death by 65	(3) Sample Alive at 45 Death by 65	(4) Sample Alive at 45 Death by 65
Adolescents:				
Chose delayed reward	-0.012**	-0.0094*	-0.011**	-0.0090*
	(0.0053)	(0.0055)	(0.0055)	(0.0055)
Attained education		-0.016***		-0.015***
in 1998 (age 45)		(0.0019)		(0.0021)
Disposable income			-0.0014*	-0.00094
in 1998 (age 45)			(0.00072)	(0.00062)
Full set of controls	Inc.	Inc.	Inc.	Inc.
Observations	12,570	12,093	12,121	12,093

The table only includes individuals alive at age 45 in 1998 when income and educational attainment are measured. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. *Attained education* is measured on a scale from 1 (less than 9 years) to 7 (at doctoral level) *Disposable income* is stated in tens of thousands of SEK. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

1.C Results on Time Preferences and Cause Specific Mortality

Table C1. Time preferences and cause-specific mortality – Cox model.

Death by age 63 due to following condition: VARIABLES	(1) All Cause Hazard Rate	(2) Circulatory Hazard Rate	(3) Ischemic Hazard Rate	(4) Cancer Hazard Rate	(5) Lung Cancer Hazard Rate
Adolescents:					
Chose delayed reward	0.821***	0.561***	0.537***	0.898	0.867
	(0.0583)	(0.0881)	(0.113)	(0.112)	(0.273)
Sex (female)	0.560***	0.357***	0.192***	1.071	1.140
	(0.0355)	(0.0576)	(0.0489)	(0.115)	(0.315)
Full set of controls	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,919	12,919	12,919	12,919	12,919
Mean mortality	0.084	0.015	0.008	0.027	0.004

The table reports the hazard rate in a Cox model. This table only includes mortality in disease groups that include more than 50 patients. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent. *Sex* is a dummy variable for gender, where 1=female; this variable coefficient is displayed for comparative purposes. In addition to gender, the full set of controls includes month of birth, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table C2. Time preferences and dying from lifestyle conditions – Cox model.

Death by age 63 due to conditions associated with: VARIABLES	(1) Lifestyle Risk Factors Hazard Rate	(2) Alcohol Use Hazard Rate	(3) Tobacco Use Hazard Rate	(4) High BMI Hazard Rate	(5) Low Physical Activity Hazard Rate
Adolescents:					
Chose delayed reward	0.827**	0.712***	0.814*	0.763**	0.665**
	(0.0793)	(0.0896)	(0.0878)	(0.0957)	(0.106)
Sex (female)	0.629***	0.491***	0.650***	0.711***	0.679***
	(0.0533)	(0.0578)	(0.0620)	(0.0799)	(0.0993)
Full set of controls	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,919	12,919	12,919	12,919	12,919
Mean mortality	0.046	0.025	0.036	0.025	0.015

The table reports the hazard rate in a Cox model. The index for Conditions Associated with Lifestyle Risk Factors is a combination of indexes of conditions associated with alcohol use, having a high BMI, tobacco use, low physical activity, sexual risk taking, and drug use. This table only includes indexes for lifestyle risk factors that include more than 50 patients. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent. *Sex* is a dummy variable for gender, where 1=female; this variable coefficient is displayed for comparative purposes. In addition to gender, the full set of controls includes month of birth, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

1.D Gender Aspects

Table D1. Adolescents' time preferences by gender.

If you had to choose between SEK 100 immediately or SEK 1,000 in five years, what would you choose?

	Female Sample		**Male Sample**	
	Frequency	Percent	Frequency	Percent
Definitely 100 SEK immediately	401	6.26	406	6.19
Probably 100 SEK immediately	511	7.98	340	5.19
Cannot choose	773	12.07	422	6.44
Probably 1,000 SEK in 5 years	2,370	37.02	2,198	33.54
Definitely 1,000 SEK in 5 years	2,347	36.66	3,188	48.64
Total	6,402	100	6,554	100

1,100 SEK (US$ 110) immediately or 11,000 SEK (US$ 1,100) in 5 years, expressed in rounded numbers in 2019 Swedish prices.

Table D2. Mortality by gender.

	Female Sample		**Male Sample**	
	Frequency	Percent	Frequency	Percent
Death by 50	163	2.55	299	4.56
Death by 65	467	7.29	762	11.63

This sample consists of a total of 12,956 individuals, 6,402 women and 6,554 men.

Table D3. Time preferences and early death – Cox model, split sample by gender.

	(1)	(2)	(3)	(4)
VARIABLES	Female Sample Hazard Rate Death by 65	Female Sample Hazard Rate Death by 65	Male Sample Hazard Rate Death by 65	Male Sample Hazard Rate Death by 65
Adolescents				
Chose delayed reward	0.848	0.881	0.745***	0.795***
	(0.0860)	(0.0905)	(0.0650)	(0.0701)
Full set of controls		Inc.		Inc.
Observations	6,402	6,388	6,554	6,531

The table reports the hazard rate in a Cox model of survival time. *Adolescents' Chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The full set of controls includes month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes information on the adolescents' cognitive ability at age 13, absence from school, their fathers' and mothers' mortality by age 65, as well as dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table D4. Time preferences and early death, split on gender.
Probit average marginal effect.

VARIABLES	(1) Female Sample Death by 50	(2) Female Sample Death by 65	(3) Male Sample Death by 50	(4) Male Sample Death by 65
Adolescents:				
Chose delayed reward	-0.0025	-0.012	-0.011*	-0.029***
	(0.0043)	(0.0072)	(0.0060)	(0.0097)
Month of birth	-0.00082	-0.000049	-0.00042	-0.0027**
	(0.00058)	(0.00095)	(0.00072)	(0.0012)
Fathers:				
Age at child's birth	-0.00026	0.00087	-0.0010*	-0.00084
	(0.00046)	(0.00073)	(0.00057)	(0.00090)
Income	-0.00019	-0.000032	-0.00012	-0.00041
	(0.00014)	(0.00023)	(0.00020)	(0.00031)
Mothers:				
Age at child's birth	0.00013	-0.0014*	-0.00080	-0.0014
	(0.00045)	(0.00080)	(0.00059)	(0.00099)
Income	-0.000031	0.000042	-0.00045	-0.00016
	(0.00029)	(0.00055)	(0.00052)	(0.00075)
Parent(s):				
Upper secondary school	0.00038	-0.013	-0.0084	-0.026**
	(0.0053)	(0.0096)	(0.0075)	(0.012)
University	-0.0063	-0.0059	-0.013	-0.036*
	(0.0095)	(0.014)	(0.012)	(0.019)
Missing parental income and age at child's birth	Inc.	Inc.	Inc.	Inc.
Observations	6,402	6,402	6,554	6,554
Pseudo R-squared	0.0810	0.0181	0.1067	0.0345

Adolescents: chose delayed reward is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Parent(s): upper secondary school* and *Parent(s): university* are binary variables where 1 indicates that at least one of the parents has upper secondary school and university education as their highest level of attained education, respectively. Fathers' and mothers' total incomes are in thousands of SEK. Missing information on parental income is treated as zero income. Missing observations on parents' age when the child was born are substituted with the variable means of the sample. In regressions, missing income and missing information on parental age at a child's birth are controlled for with dummies. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table D5. Time preferences and early death, split on gender.
Probit average marginal effect.

VARIABLES	(1) Female Sample Death by 50	(2) Female Sample Death by 65	(3) Male Sample Death by 50	(4) Male Sample Death by 65
Adolescents chose delayed reward	-0.0012	-0.0078	-0.0087	-0.024**
	(0.0043)	(0.0071)	(0.0060)	(0.0097)
Absence form School	0.000077**	0.00014**	0.000056	0.00024***
	(0.000037)	(0.000067)	(0.000053)	(0.000081)
Father died before age 65	0.0072	0.015*	0.0048	0.025**
	(0.0050)	(0.0086)	(0.0067)	(0.010)
Mother died before age 65	0.012**	0.016	-0.011	0.0076
	(0.0057)	(0.010)	(0.0095)	(0.014)
Ability at age 13	-0.00024	-0.0017***	-0.0011***	-0.0033***
	(0.00030)	(0.00048)	(0.00033)	(0.00053)
Socioeconomic / Gender controls	Inc.	Inc.	Inc.	Inc.
Observations	6,388	6,388	6,531	6,531
Pseudo R-squared	0.0892	0.0252	0.1116	0.0460

The table only includes individuals alive at age 40 in 1993 when income and educational attainment are measured. *Adolescents: chose delayed reward* is a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. *Absence from school* measures all registered absence hours with a valid excuse that the adolescent had in the spring term of the 6th year of elementary school. *Ability at age 13* is a variable consisting of the adolescent's total score on a spatial intelligent test. Socioeconomic/gender controls include month of birth, sex, parents' age at their child's birth, fathers' and mothers' total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

1.E Test of Cox Assumptions

Cox assumptions of models investigating all-cause mortality

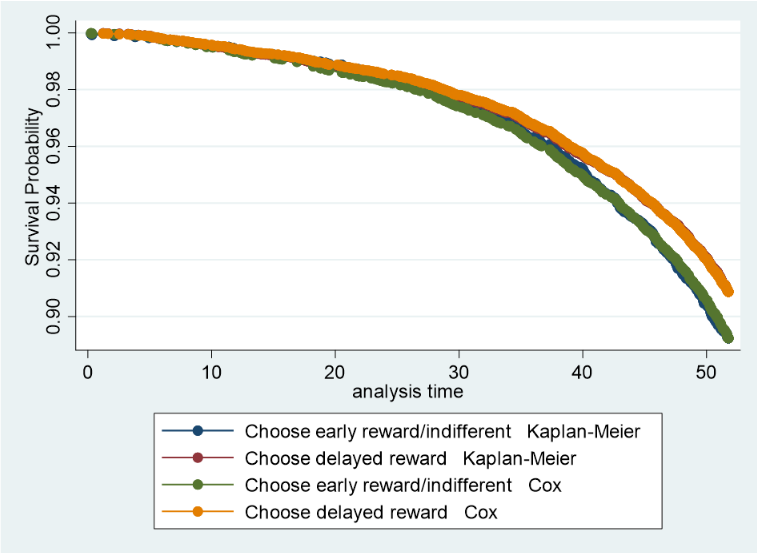


Figure E1. Plots of Kaplan-Meier observed survival curves and predictive curves using Cox.

Table E1. Test of proportional-hazards assumption using Schoenfeld residuals

	Rho	Chi2	Prob>chi2
Adolescents: Chose delayed reward	-0.01815	0.41	0.5245

This table presents a test of whether the log hazard-ratio function is constant over time. The null hypothesis in this test is a zero slope. The proportional-hazards assumption does not hold if this null hypothesis is rejected.

The closeness of plots using Kaplan-Meier observed survival curves and Cox predictive curves in Figure E1 shows no indication of proportional-hazards assumption violations. Neither does the test of proportional-hazards assumption using Schoenfeld residuals in Table E1. The log-log plots in Figure E2, however, are not parallel. This is not in line with the proportional-hazards assumption and could be due to the continuous-time and few individuals dying early, generating noise.

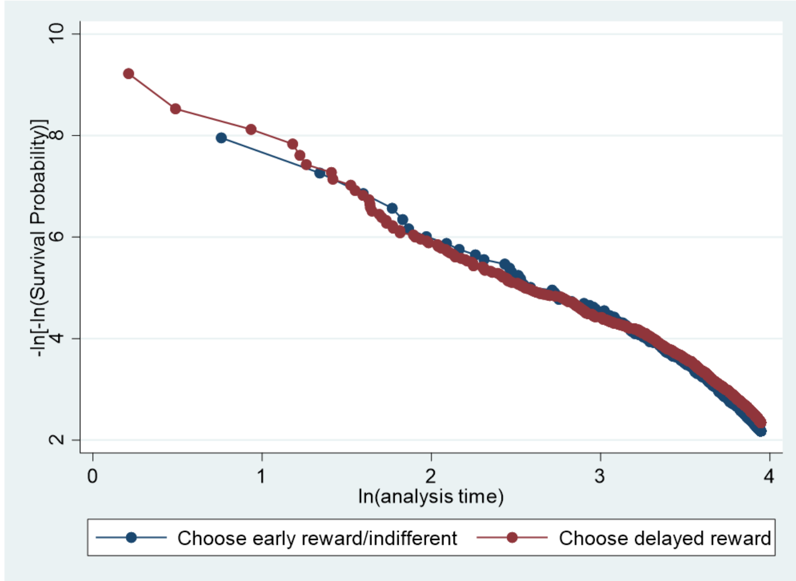
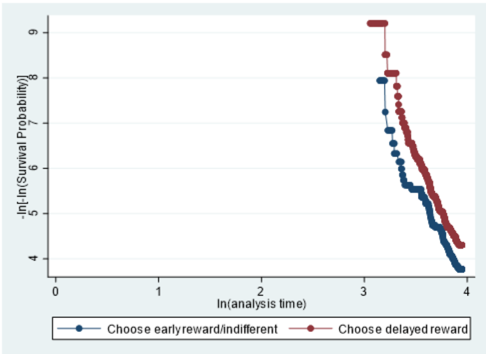


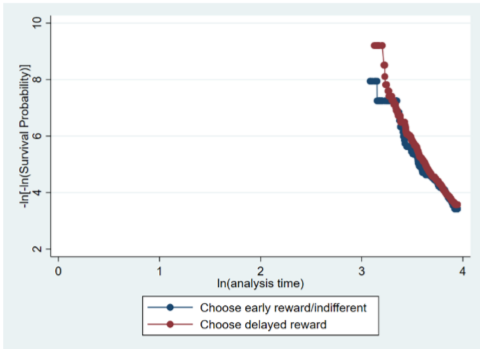
Figure E2. Log-log plots of survival.

Cox assumptions of models investigating cause-specific mortality

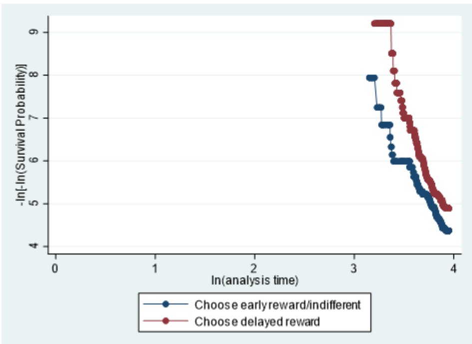
Looking at the results for circulatory and ischemic conditions, where the regression results are precise enough to generate significant results, the plots using Kaplan-Meier observed survival curves and Cox predictive curves are very close, as seen in Figure E3. Neither the close curves, nor the Schoenfeld residuals in Table E2 show any indication of proportional-hazards assumption violations. For these outcomes, the log-log plots in Figure E4 are also parallel, which is in line with the proportional-hazards assumption.



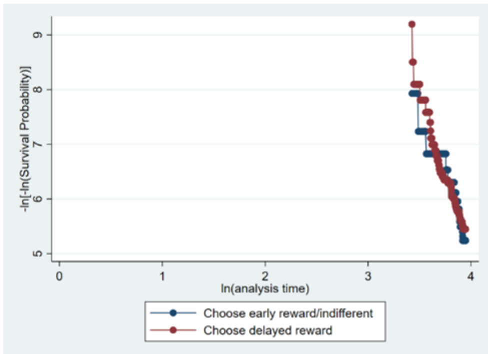
Circulatory



Cancer

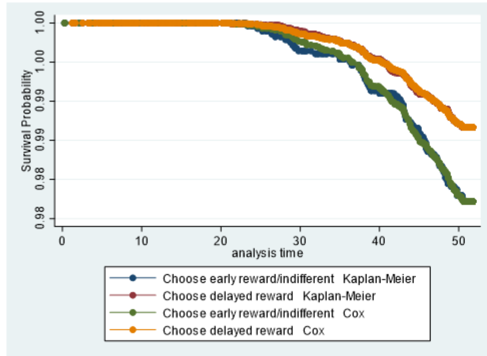


Ischemic

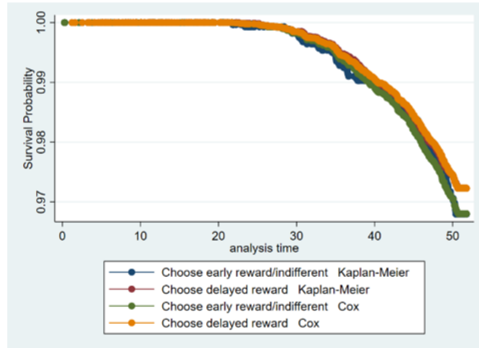


Lung cancer

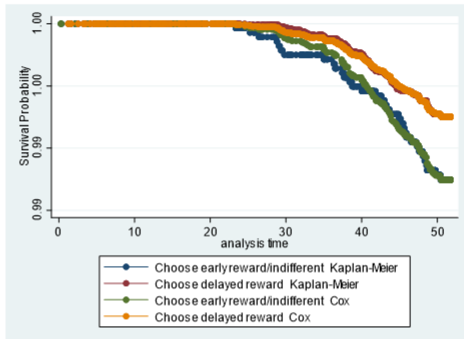
Figure E3. Plots of Kaplan-Meier observed survival curves and predictive curves using Cox.



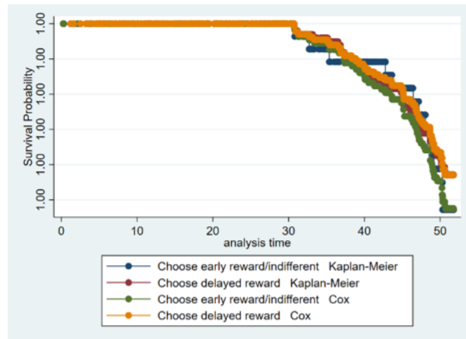
Circulatory



Cancer



Ischemic



Lung cancer

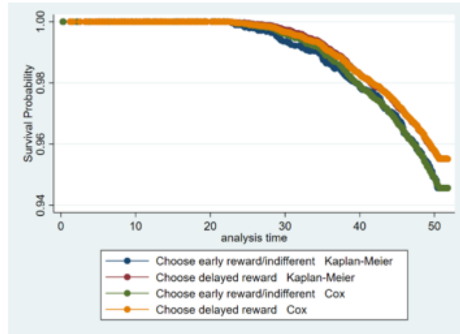
Figure E4. Log-log plots of survival.

Table E2, Test of proportional-hazards assumption using Schoenfeld residuals.

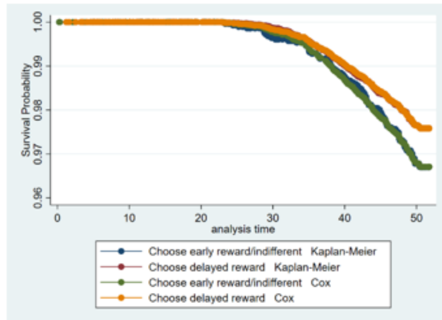
Explanatory variable is Adolescents: Chose delayed reward			
Dependent variable	Rho	Chi2	Prob>chi2
Death by:			
Circulatory	0.02532	0.12	0.7264
Ischemic	0.09256	0.91	0.3407
Cancer	-0.01405	0.07	0.7909
Lung cancer	-0.10017	0.55	0.4574

This table presents a test of whether the log hazard-ratio function is constant over time. The null hypothesis in this test is a zero slope, and if this null hypothesis is rejected, this means that the proportional-hazards assumption does not hold.

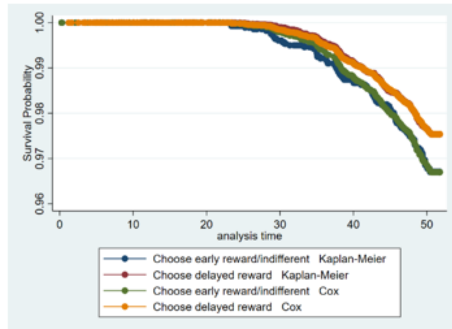
Moving on to mortality caused by conditions associated with lifestyle risk factors, the plots in Figure E5 using Kaplan-Meier observed survival curves and Cox predictive curves are also very close. The log-log plots in Figure E6 are roughly parallel, and the Schoenfeld residuals in Table E3 do not show any indication of proportional-hazards assumption violations.



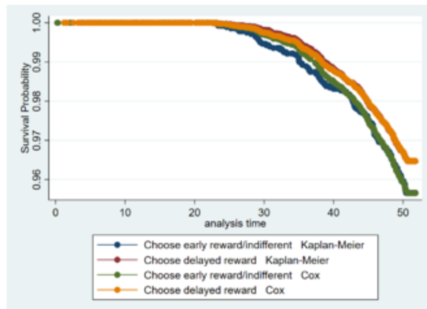
Lifestyle risk factors



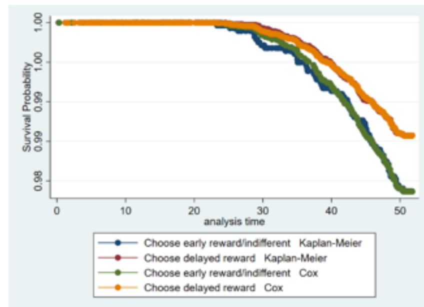
Alcohol use



Having a high BMI



Tobacco use



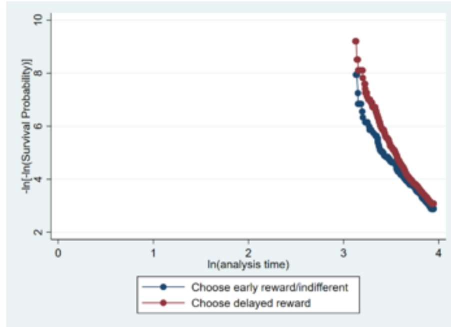
Low physical activity

Figure E5. Plots of Kaplan-Meier observed survival curves and predictive curves using Cox.

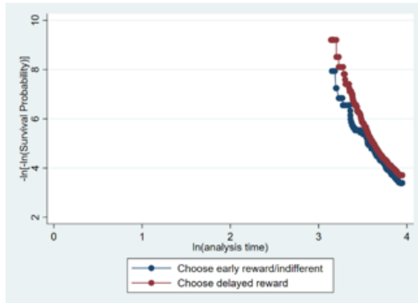
Table E3. Test of proportional-hazards assumption using Schoenfeld residuals.

Explanatory variable is Adolescents: Chose delayed reward			
Dependent variable	rho	chi2	Prob>chi2
Death by diseases associated with:			
Lifestyle risk factors	0.03239	0.62	0.4314
Alcohol use	-0.00198	0.00	0.9715
Tobacco use	0.06730	2.10	0.1476
Having a high BMI	0.06446	1.37	0.2424
Low physical activity	0.04581	0.41	0.5213

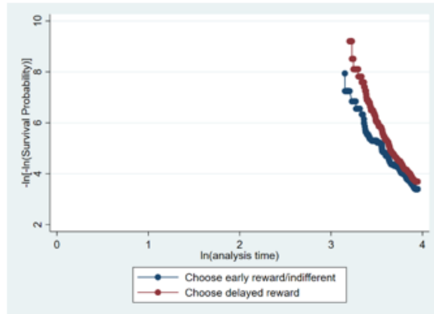
This table presents a test of whether the log hazard-ratio function is constant over time. The null hypothesis in this test is a zero slope, and if this null hypothesis is rejected, this means that the proportional-hazards assumption does not hold.



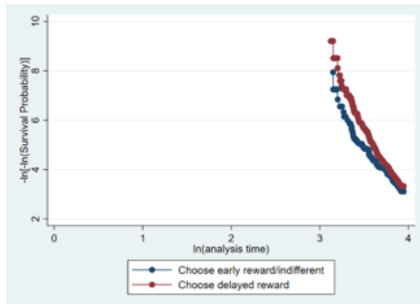
Lifestyle risk factors



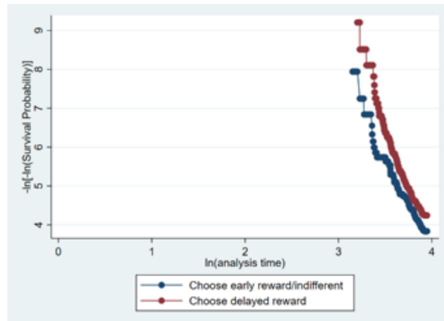
Alcohol use



Having a high BMI



Tobacco use



Low physical activity

Figure E6. Log-log plots of survival.

1.F ICD Codes

Table F1 ICD codes for acute heart conditions and diagnoses of dependence on/abuse of alcohol and drugs.

Direct diagnoses of dependence on/abuse of alcohol and drugs	ICD10	ICD9	ICD8
Alcohol abuse and dependence syndrome	F100, F101, F102	305A 303	3030 3031 3032 3039
Abuse and dependence syndrome, psychoactive substances other than nicotine and alcohol, e.g., cannabis and cocaine.	F12.0 F12.1 F12.2 F13.0 F13.1 F13.2 F14.0 F14.1 F14.2 F15.0 F15.1 F15.2 F16.0 F16.1 F16.2 F18.0 F18.1 F18.2 F19.0 F19.1 F19.2	304 305X	3040 3041 3042 3043 3044 3045 3046 3047 3032 3039 3048 3049
Acute heart conditions*	**ICD10**	**ICD9**	**ICD8**
Acute myocardial infarction	I21 I22 I51.3 M21.9	410*	410 411 426 429
Cardiac dysrhythmias	I47.1 I47.2 I47.9	427*	4279 4272 9681
Heart failure	I50 I46.9	428*	4270 428 429 7824

* Acute heart conditions consist of acute myocardial infarction, cardiac dysrhythmias, and heart failure, classified as 410, 427, and 428 in ICD9. Doyle (2011) makes this definition, and I expand the measure by also including the corresponding ICD8 and ICD10 codes for the conditions.

Table F2. ICD codes for cause of death.

	ICD10	ICD9
All cancer	C	14-20
Stomach cancer	C16	151
Colon cancer	C18	153
Liver cancer	C22	155
Lung cancer	C34	162C 162D 162E 162F 162W 162X 199B
Skin cancer	*C43*	172
Breast cancer	C50	174
Prostate cancer	C61	185
Circulatory	I	39-45
Ischemic	I20 - I25	410-413 4140 4141 4148 4149 4230 4269 4292 4295 4296 4298
Cerebrovascular	I60- I69	430-434 436 I67 438
Respiratory	J	0340 46-51
COPD	J40- J49	490 492 494 496 4789 4910 -4912 4918 4930 4931 4939
Metabolic	E	24-27
Diabetes	E11 E10	250

ICD9 was used at Swedish hospitals from 1987, when the SBC sample were 34 years old.

Table F3. ICD lists for causes of death/ non-fatal cause list associated with lifestyle risk factors from Stanaway et al. (2018)

Tobacco related diagnoses

	Causes of Death		Non-fatal cause	
Cause	**ICD10**	**ICD9**	**ICD10**	**ICD9**
Drug-susceptible tuberculosis	A15-A19.9, B90-B90.9, K67.3, K93.0, M49.0, N74.1, P37.0	010-019.9, 137-137.9, 138.0-138.9, 730.4-730.6	A10-A14, A15-A18.89, A19-A19.9, B90-B90.9, K67.3, K93.0, M49.0, N74.0-N74.1, P37.0	010-019.9, 137-137.9, 320.4, 730.4-730.6
Multidrug-resistant tuberculosis without extensive drug resistance	U84.3		U84.3	
Extensively drug-resistant tuberculosis				
Lower respiratory infections	A48.1, A70, B97.4-B97.6, J09-J15.8, J16-J16.9, J20-J21.9, P23.0-P23.4, U04-U04.9	079.6, 466-469, 470.0, 480-482.8, 483.0-483.9, 484.1-484.2, 484.6-484.7, 487-489	A48.1, A70, B96.0-B96.1, B97.21, B97.4-B97.6, J09-J18.2, J18.8-J18.9, J19.6-J22.9, J85.1, P23-P23.9, U04-U04.9, Z25.1	079.82, 466-469, 470.0, 480-484, 484.1-490.9, 510-511.9, 513.0-513.9, 770.0, V01.82, V04.7, V04.81, V12.61
Lip and oral cavity cancer	C00-C08.9, D10.0-D10.5, D11-D11.9	140-145.9, 210.0-210.6, 235.0	C00-C07, C08-C08.9, Z85.81-Z85.810	140-145.9, V76.42
Nasopharynx cancer	C11-C11.9, D10.6	147-147.9, 210.7-210.9	C11-C11.9	147-147.9
Other pharynx cancer	C09-C10.9, C12-C13.9, D10.7	146-146.9, 148-148.9	C09-C10.9, C12-C13.9	146-146.9, 148-148.9
Esophageal cancer	C15-C15.9, D00.1, D13.0	150-150.9, 211.0, 230.1	C15-C15.9, Z85.01	150-150.9
Stomach cancer	C16-C16.9, D00.2, D13.1, D37.1	151-151.9, 211.1, 230.2	C16-C16.9, Z12.0, Z85.02-Z85.028	151-151.9, 209.23, V10.04
Colon and rectum cancer	C18-C21.9, D01.0-D01.3, D12-D12.9, D37.3-D37.5	153-154.9, 209.1, 209.5, 211.3-211.4, 230.3-230.6, 569.0	C18-C19.0, C20, C21-C21.8, Z12.1-Z12.13, Z85.03-Z85.048, Z86.010	153-154.9, 209.1-209.17, V10.05-V10.06, V76.41, V76.5-V76.52
Liver cancer	C22-C22.9, D13.4	155-155.9, 211.5	C22-C22.4, C22.7-C22.9	155-155.9
Liver cancer due to hepatitis B				
Liver cancer due to hepatitis C				
Liver cancer due to alcohol use				
Liver cancer due to NASH				
Liver cancer due to other causes				
Pancreatic cancer	C25-C25.9, D13.6-D13.7	157-157.9, 211.6-211.7	C25-C25.9, Z85.07	157-157.9
Larynx cancer	C32-C32.9, D02.0, D14.1, D38.0	161-161.9, 212.1, 231.0, 235.6	C32-C32.9, Z85.21	161-161.9, V10.21
Tracheal, bronchus, and lung cancer	C33-C34.9, D02.1-D02.3, D14.2-D14.3, D38.1	162-162.9, 212.2-212.3, 231.1-231.2, 235.7	C33, C34-C34.92, Z12.2, Z80.1-Z80.2, Z85.1-Z85.20	162-162.9, 209.21, V10.1-V10.20, V16.1-V16.2, V16.4-V16.40
Breast cancer	C50-C50.9, D05-D05.9, D24-D24.9, D48.6, D49.3	174-175.9, 217-217.8, 233.0, 238.3, 239.3, 610-610.9	C50-C50.629, C50.8-C50.929, Z12.3-Z12.39, Z80.3, Z85.3, Z86.000	174-175.9, V10.3, V16.3
Cervical cancer	C53-C53.9, D06-D06.9, D26.0	180-180.9, 219.0, 233.1, 622.1-622.2, 622.7	C53-C53.9, Z12.4, Z85.41	180-180.9, V10.41, V72.32
Prostate cancer	C61-C61.9, D07.5, D29.1, D40.0	185-185.9, 222.2, 236.5	C61-C61.9, Z12.5, Z80.42, Z85.46	185-185.9, V10.46, V16.42, V76.44
Kidney cancer	C64-C65.9, D30.0-D30.1, D41.0-D41.1	189.0-189.1, 189.5-189.6, 223.0-223.1	C64-C64.2, C64.9-C65.9, Z80.51, Z85.52-Z85.54	189-189.1, 189.5-189.6, 209.24
Bladder cancer	C67-C67.9, D09.0, D30.3, D41.4-D41.8, D49.4	188-188.9, 223.3, 233.7, 236.7, 239.4	C67-C67.9, Z12.6-Z12.79, Z80.52, Z85.51	188-188.9, V10.51, V16.52, V76.3

Acute lymphoid leukemia	C91.0	204.0	C91.0-C91.02	204.0-204.02
Chronic lymphoid leukemia	C91.1	204.1	C91.1-C91.12	204.1-204.12
Acute myeloid leukemia	C92.0, C92.3-C92.6, C93.0, C94.0, C94.2, C94.4-C94.5	205.0, 205.3, 206.0, 207.0	C92.0-C92.02, C92.3-C92.62, C93.0-C93.02, C94.0-C94.02, C94.2-C94.22, C94.4-C94.5	205.0-205.02, 205.3-205.32, 206.0-206.02, 207.0
Chronic myeloid leukemia	C92.1	205.1, 206.1, 207.1	C92.1-C92.12	205.1-205.12, 206.1-206.12, 207.1
Other leukemia	C91.2-C91.9, C92.2, C92.7-C92.9, C93.1-C93.9, C94.1, C94.3, C94.6-C95.9	204.2-204.9, 205.2, 205.8-205.9, 206.2-207, 207.2-208.9		
Ischemic heart disease	I20-I25.9	410-414.9	I20-I21.6, I21.9-I25.9, Z82.4-Z82.49	410-414.9, V17.3
Ischemic stroke	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.3, I67.5-I67.6, I69.3	433-435.9, 437.0-437.1, 437.5-437.8	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.848, I69.3-I69.4	433-435.9, 437.0-437.2, 437.4-437.9
Intracerebral hemorrhage	I61-I62, I62.1-I62.9, I68.1-I68.2, I69.1-I69.2	431-432.9, 437.2	I60-I62, I62.9, I67.0-I67.1, I69.0-I69.298	430-432.9, 437.3
Subarachnoid hemorrhage	I60-I60.9, I62.0, I67.0-I67.1, I69.0	430-430.9		
Atrial fibrillation and flutter	I48-I48.9	427.3	I48-I48.92	427.3-427.32
Aortic aneurysm	I71-I71.9	441-441.9		
Peripheral artery disease	I70.2-I70.8, I73-I73.9	440.2, 440.4, 443.0-443.9	I70.2-I70.92, I73-I73.9	440.2-440.29, 440.4-440.9, 443-443.2, 443.8-443.9
Chronic obstructive pulmonary disease	J41-J44.9	491-492.9, 496-499	J41-J42.4, J43-J44.9	491-492.9, 496-499
Asthma	J45-J46.9	493-493.9	J45-J46.0, Z82.5	493-493.92, V17.5
Peptic ulcer disease	K25-K28.9, K31, K31.1-K31.6, K31.8	531-534.9	K25-K28.9	531-534.91
Gallbladder and biliary diseases	K80-K83.9	574-576.9	K80-K80.81, K81-K83.9, K87-K87.1	574-576.9
Alzheimer disease and other dementias	F00-F03.9, G30-G31.1, G31.8-G31.9	290-290.9, 294.1-294.9, 331-331.2	F00-F03.91, F06.2, G30-G31.1, G31.8-G32.89	290-290.9, 294.0-294.9, 331-331.2, 331.6-331.7, 331.82, 331.89-331.9
Parkinson disease	G20-G20.9	332-332.0	G20-G20.9	332-332.0
Multiple sclerosis	G35-G35.9	340-340.9	G35-G35.0	340-340.9
Diabetes mellitus type 2	E11-E11.1, E11.3-E11.9			
Diabetes mellitus			E08-E08.11, E08.3-E08.9, E12-E12.1, E12.3-E13.11, E13.3-E14.1, E14.3-E14.9, R73-R73.9	249-249.31, 249.5-249.91, 362.01-362.07, 790.2-790.29
Cataract			H25-H26.9, H28-H28.8	366-366.9
Age-related macular degeneration			H35.3-H35.389	362.5-362.57
Rheumatoid arthritis	M05-M06.9, M08.0-M08.8	714-714.3, 714.8-714.9	M05-M05.9, M08-M09.8	714-714.9
Pedestrian road injuries	V01-V04.9, V06-V09.9		V01-V04.99, V06-V09.9	E811.7, E812.7, E813.7, E814.7, E815.7, E816.7, E817.7, E818.7, E819.7, E822.7, E823.7, E824.7, E825.7, E826.0, E827.0, E828.0, E829.0
Low back pain			V10-V19.9	E800.3, E801.3, E802.3, E803.3, E804.3, E805.3, E806.3, E807.3, E810.6, E811.6, E812.6, E813.6, E814.6, E815.6, E816.6, E817.6, E818.6, E819.6, E820.6, E821.6, E822.6, E823.6, E824.6, E825.6, E826.1
Cyclist road injuries	V10-V19.9		V20-V29.9	E810.2-E810.3, E811.2-E811.3, E812.2-E812.3,

				E813.2-E813.3, E814.2-E814.3, E815.2-E815.3, E816.2-E816.3, E817.2-E817.3, E818.2-E818.3, E819.2-E819.3, E820.2-E820.3, E821.2-E821.3, E822.2-E822.3, E823.2-E823.3, E824.2-E824.3, E825.2-E825.3
Motorcyclist road injuries	V20-V29.9		V30-V79.9, V87.2-V87.3	E810.0-E810.1, E811.0-E811.1, E812.0-E812.1, E813.0-E813.1, E814.0-E814.1, E815.0-E815.1, E816.0-E816.1, E817.0-E817.1, E818.0-E818.1, E819.0-E819.1, E820.0-E820.1, E821.0-E821.1, E822.0-E822.1, E823.0-E823.1, E824.0-E824.1, E825.0-E825.1
Motor vehicle road injuries	V30-V79.9, V87.2-V87.3		V80-V80.929, V82-V82.9	E810.4-E810.5, E811.4-E811.5, E812.4-E812.5, E813.4-E813.5, E814.4-E814.5, E815.4-E815.5, E816.4-E816.5, E817.4-E817.5, E818.4-E818.5, E819.4-E819.5, E820.4-E820.5, E821.4-E821.5, E822.4-E822.5, E823.4-E823.5, E824.4-E824.5, E825.4-E825.5, E826.3-E826.4, E827.3-E827.4, E828.4, E829.4
Other road injuries	V80-V80.9, V82-V82.9		V00-V00.898, V05-V05.99, V81-V81.9, V83-V86.99, V88.2-V88.3, V90-V98.8	E800-E800.2, E801-E801.2, E802-E802.2, E803-E803.2, E804-E804.2, E805-E805.2, E806-E806.2, E807-E807.2, E810.7, E820.7, E821.7, E826.2, E827.2, E828.2, E830-E838.9, E840-E849.9, E929.1
Other transport injuries	V00-V00.8, V05-V05.9, V81-V81.9, V83-V86.9, V88.2-V88.3, V90-V98.8	E800-E807, E830-E838, E840-E849	W00-W19.9	E880-E886.99, E888-E888.9, E929.3
Falls	W00-W19.9	E880-E886, E888	W20-W31.9, W35-W38.9, W40-W43.9, W45.0-W45.2, W46-W46.2, W49-W52	E916-E921.99, E928.1-E928.6
Other exposure to mechanical forces	W20-W31.9, W35-W38.9, W40-W43.9, W45.0-W45.2, W46-W46.2, W49-W52	E916-E921	W52.0-W62.9, W64-W64.9, X20-X29.9	E905-E906.99
Non-venomous animal contact	W52.0-W62.9, W64-W64.9	E906	H65-H70.93	381-383.9
Otitis media	H70-H70.9	381-383.9	X85-X92.9, X96-X98.9, Y00-Y04.9, Y06-Y08.9, Y87.1-Y87.2	E961-E964, E965.5-E965.9, E967-E969
Physical violence by other means	X85-X92.9, X96-X98.9, Y00-Y04.9, Y06-Y08.9, Y87.1	E961-E964, E967-E969	V01-V04.99, V06-V09.9	E811.7, E812.7, E813.7, E814.7, E815.7, E816.7, E817.7, E818.7, E819.7, E822.7, E823.7, E824.7, E825.7, E826.0, E827.0, E828.0, E829.0

Diagnoses related to low physical activity

	Causes of Death		Non-fatal cause	
Cause	**ICD10**	**ICD9**	**ICD10**	**ICD9**

Colon and rectum cancer	C18-C21.9, D01.0-D01.3, D12-D12.9, D37.3-D37.5	153-154.9, 209.1, 209.5, 211.3-211.4, 230.3-230.6, 569.0	C18-C19.0, C20, C21-C21.8, Z12.1-Z12.13, Z85.03-Z85.048, Z86.010	153-154.9, 209.1-209.17, V10.05-V10.06, V76.41, V76.5-V76.52
Breast cancer	C50-C50.9, D05-D05.9, D24-D24.9, D48.6, D49.3	174-175.9, 217-217.8, 233.0, 238.3, 239.3, 610-610.9	C50-C50.629, C50.8-C50.929, Z12.3-Z12.39, Z80.3, Z85.3, Z86.000	174-175.9, V10.3, V16.3
Ischemic heart disease	I20-I25.9	410-414.9	I20-I21.6, I21.9-I25.9, Z82.4-Z82.49	410-414.9, V17.3
Ischemic stroke	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.3, I67.5-I67.6, I69.3	433-435.9, 437.0-437.1, 437.5-437.8	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.848, I69.3-I69.4	433-435.9, 437.0-437.2, 437.4-437.9
Diabetes mellitus type 2	E11-E11.1, E11.3-E11.9			
Diabetes mellitus			E08-E08.11, E08.3-E08.9, E12-E12.1, E12.3-E13.11, E13.3-E14.1, E14.3-E14.9, R73-R73.9	249-249.31, 249.5-249.91, 362.01-362.07, 790.2-790.29

Diagnoses related to high BMI

	Causes of Death		Non-fatal cause	
Cause	**ICD10**	**ICD9**	**ICD10**	**ICD9**
Esophageal cancer	C15-C15.9, D00.1, D13.0	150-150.9, 211.0, 230.1	C15-C15.9, Z85.01	150-150.9
Colon and rectum cancer	C18-C21.9, D01.0-D01.3, D12-D12.9, D37.3-D37.5	153-154.9, 209.1, 209.5, 211.3-211.4, 230.3-230.6, 569.0	C18-C19.0, C20, C21-C21.8, Z12.1-Z12.13, Z85.03-Z85.048, Z86.010	153-154.9, 209.1-209.17, V10.05-V10.06, V76.41, V76.5-V76.52
Liver cancer due to hepatitis B				
Liver cancer due to hepatitis C				
Liver cancer due to alcohol use				
Liver cancer due to other causes				
Gallbladder and biliary tract cancer	C23-C24.9, D13.5	156-156.9	C23, C24-C24.9	156-156.9
Pancreatic cancer	C25-C25.9, D13.6-D13.7	157-157.9, 211.6-211.7	C25-C25.9, Z85.07	157-157.9
Breast cancer	C50-C50.9, D05-D05.9, D24-D24.9, D48.6, D49.3	174-175.9, 217-217.8, 233.0, 238.3, 239.3, 610-610.9	C50-C50.629, C50.8-C50.929, Z12.3-Z12.39, Z80.3, Z85.3, Z86.000	174-175.9, V10.3, V16.3
Uterine cancer	C54-C54.9, D07.0-D07.2, D26.1-D26.9	182-182.9, 233.2	C54-C54.3, C54.8-C54.9, Z85.42, Z86.001	182-182.9
Ovarian cancer	C56-C56.9, D27-D27.9, D39.1	183-183.0, 220-220.9, 236.2	C56-C56.2, C56.9, Z80.41, Z85.43	183-183.0, 183.8-183.9, V10.43, V16.41
Kidney cancer	C64-C65.9, D30.0-D30.1, D41.0-D41.1	189.0-189.1, 189.5-189.6, 223.0-223.1	C64-C64.2, C64.9-C65.9, Z80.51, Z85.52-Z85.54	189-189.1, 189.5-189.6, 209.24
Thyroid cancer	C73-C73.9, D09.3, D09.8, D34-D34.9, D44.0	193-193.9, 226-226.9	C73, Z85.850	193-193.9
Non-Hodgkin lymphoma	C82-C86.6, C96-C96.9	200-200.9, 202-202.9	C82-C85.29, C85.7-C86.6, C96-C96.9	200-200.9, 202-202.98
Multiple myeloma	C88-C90.9	203-203.9	C88-C90.32	203-203.9
Acute lymphoid leukemia	C91.0	204.0	C91.0-C91.02	204.0-204.02
Chronic lymphoid leukemia	C91.1	204.1	C91.1-C91.12	204.1-204.12

Acute myeloid leukemia	C92.0, C92.3-C92.6, C93.0, C94.0, C94.2, C94.4-C94.5	205.0, 205.3, 206.0, 207.0	C92.0-C92.02, C92.3-C92.62, C93.0-C93.02, C94.0-C94.02, C94.2-C94.22, C94.4-C94.5	205.0-205.02, 205.3-205.32, 206.0-206.02, 207.0
Chronic myeloid leukemia	C92.1	205.1, 206.1, 207.1	C92.1-C92.12	205.1-205.12, 206.1-206.12, 207.1
Other leukemia	C91.2-C91.9, C92.2, C92.7-C92.9, C93.1-C93.9, C94.1, C94.3, C94.6-C95.9	204.2-204.9, 205.2, 205.8-205.9, 206.2-207, 207.2-208.9		
Ischemic heart disease	I20-I25.9	410-414.9	I20-I21.6, I21.9-I25.9, Z82.4-Z82.49	410-414.9, V17.3
Ischemic stroke	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.3, I67.5-I67.6, I69.3	433-435.9, 437.0-437.1, 437.5-437.8	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.848, I69.3-I69.4	433-435.9, 437.0-437.2, 437.4-437.9
Intracerebral hemorrhage	I61-I62, I62.1-I62.9, I68.1-I68.2, I69.1-I69.2	431-432.9, 437.2	I60-I62, I62.9, I67.0-I67.1, I69.0-I69.298	430-432.9, 437.3
Subarachnoid hemorrhage	I60-I60.9, I62.0, I67.0-I67.1, I69.0	430-430.9		
Hypertensive heart disease	I11-I11.9	402-402.9	I11-I11.2, I11.9	402-402.91
Atrial fibrillation and flutter	I48-I48.9	427.3	I48-I48.92	427.3-427.32
Asthma	J45-J46.9	493-493.9	J45-J46.0, Z82.5	493-493.92, V17.5
Gallbladder and biliary diseases	K80-K83.9	574-576.9	K80-K80.81, K81-K83.9, K87-K87.1	574-576.9
Alzheimer disease and other dementias	F00-F03.9, G30-G31.1, G31.8-G31.9	290-290.9, 294.1-294.9, 331-331.2	F00-F03.91, F06.2, G30-G31.1, G31.8-G32.89	290-290.9, 294.0-294.9, 331-331.2, 331.6-331.7, 331.82, 331.89-331.9
Diabetes mellitus type 1	E10-E10.1, E10.3-E10.9, P70.2	775.1		
Diabetes mellitus			E08-E08.11, E08.3-E08.9, E12-E12.1, E12.3-E13.11, E13.3-E14.1, E14.3-E14.9, R73-R73.9	249-249.31, 249.5-249.91, 362.01-362.07, 790.2-790.29
Chronic kidney disease due to diabetes mellitus type 2	E11.2			
Chronic kidney disease due to hypertension	I12-I13.9	403-404.9	I12-I13.9	403-404.93
Chronic kidney disease due to glomerulonephritis	N03-N06.9	581-583.9	N03-N06.9, N08-N08.8	581-583.9
Chronic kidney disease due to other causes	N02-N02.9, N07-N08.8, N15.0, Q61-Q62.8	589-589.9, 753-753.3	N02-N02.9, N07-N07.9, Q60-Q63.2, Q63.8-Q63.9, Q64.2-Q64.9	753.0-753.4, 753.6-753.9
Cataract			H25-H26.9, H28-H28.8	366-366.9
Osteoarthritis			M16-M17.9	
Low back pain				
Gout			M10-M10.19, M10.3-M10.9	274-274.9, 712.0-712.09

Diagnoses related to sexual risk taking

	Causes of Death		Non-fatal cause	
Cause	**ICD10**	**ICD9**	**ICD10**	**ICD9**
HIV/AIDS - Drug-susceptible Tuberculosis	B20.0			
HIV/AIDS - Multidrug-resistant Tuberculosis without extensive drug resistance				
HIV/AIDS - Extensively drug-resistant Tuberculosis				
HIV/AIDS resulting in other diseases	B20.1-B23.9, B24.0	042-044.9	B20.1-B23.8, B24-B24.0, B97.81, C46-C46.52, C46.7-C46.9	176-176.9
Syphilis	A50-A53.9, I98.0, K67.2, M03.1, M73.1	090-097.9	A50-A53.9, I98.0, K67.2, M73.1-M73.8	090-097.9
Chlamydial infection	A55-A56.8, K67.0	099	A55-A56.8, K67.0, N74.4	099.41, 099.5
Gonococcal infection	A54-A54.9, K67.1, M73.0	098-098.9	A54-A54.9, K67.1, M73.0, N74.3	098-098.9
Trichomoniasis			A59-A59.9	131-131.9
Genital herpes			A60-A60.9	054.1, 054.11-054.19
Other sexually transmitted infections	A57-A58, A63-A63.8, B63	099.0-099.9	A57-A58, A63-A64.0, B63, N70-N71.9, N73-N74, N74.2, N74.8	099-099.40, 099.49, 099.50-099.9, 613-615.9
Cervical cancer	C53-C53.9, D06-D06.9, D26.0	180-180.9, 219.0, 233.1, 622.1-622.2, 622.7	C53-C53.9, Z12.4, Z85.41	180-180.9, V10.41, V72.32

Alcohol related diagnoses

	Causes of Death		Non-fatal cause	
Cause	**ICD10**	**ICD9**	**ICD10**	**ICD9**
Drug-susceptible tuberculosis	A15-A19.9, B90-B90.9, K67.3, K93.0, M49.0, N74.1, P37.0	010-019.9, 137-137.9, 138.0-138.9, 730.4-730.6	A10-A14, A15-A18.89, A19-A19.9, B90-B90.9, K67.3, K93.0, M49.0, N74.0-N74.1, P37.0	010-019.9, 137-137.9, 320.4, 730.4-730.6
Multidrug-resistant tuberculosis without extensive drug resistance	U84.3		U84.3	
Extensively drug-resistant tuberculosis				
Lower respiratory infections	A48.1, A70, B97.4-B97.6, J09-J15.8, J16-J16.9, J20-J21.9, P23.0-P23.4, U04-U04.9	079.6, 466-469, 470.0, 480-482.8, 483.0-483.9, 484.1-484.2, 484.6-484.7, 487-489	A48.1, A70, B96.0-B96.1, B97.21, B97.4-B97.6, J09-J18.2, J18.8-J18.9, J19.6-J22.9, J85.1, P23-P23.9, U04-U04.9, Z25.1	079.82, 466-469, 470.0, 480-484, 484.1-490.9, 510-511.9, 513.0-513.9, 770.0, V01.82, V04.7, V04.81, V12.61
Lip and oral cavity cancer	C00-C08.9, D10.0-D10.5, D11-D11.9	140-145.9, 210.0-210.6, 235.0	C00-C07, C08-C08.9, Z85.81-Z85.810	140-145.9, V76.42
Nasopharynx cancer	C11-C11.9, D10.6	147-147.9, 210.7-210.9	C11-C11.9	147-147.9
Other pharynx cancer	C09-C10.9, C12-C13.9, D10.7	146-146.9, 148-148.9	C09-C10.9, C12-C13.9	146-146.9, 148-148.9
Esophageal cancer	C15-C15.9, D00.1, D13.0	150-150.9, 211.0, 230.1	C15-C15.9, Z85.01	150-150.9
Colon and rectum cancer	C18-C21.9, D01.0-D01.3, D12-D12.9, D37.3-D37.5	153-154.9, 209.1, 209.5, 211.3-211.4, 230.3-230.6, 569.0	C18-C19.0, C20, C21-C21.8, Z12.1-Z12.13, Z85.03-Z85.048, Z86.010	153-154.9, 209.1-209.17, V10.05-V10.06, V76.41, V76.5-V76.52
Liver cancer due to alcohol use				
Larynx cancer	C32-C32.9, D02.0, D14.1, D38.0	161-161.9, 212.1, 231.0, 235.6	C32-C32.9, Z85.21	161-161.9, V10.21
Breast cancer	C50-C50.9, D05-D05.9, D24-D24.9, D48.6, D49.3	174-175.9, 217-217.8, 233.0, 238.3, 239.3, 610-610.9	C50-C50.629, C50.8-C50.929, Z12.3-Z12.39, Z80.3, Z85.3, Z86.000	174-175.9, V10.3, V16.3
Ischemic heart disease	I20-I25.9	410-414.9	I20-I21.6, I21.9-I25.9, Z82.4-Z82.49	410-414.9, V17.3

Ischemic stroke	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.3, I67.5-I67.6, I69.3	433-435.9, 437.0-437.1, 437.5-437.8	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.848, I69.3-I69.4	433-435.9, 437.0-437.2, 437.4-437.9
Intracerebral hemorrhage	I61-I62, I62.1-I62.9, I68.1-I68.2, I69.1-I69.2	431-432.9, 437.2	I60-I62, I62.9, I67.0-I67.1, I69.0-I69.298	430-432.9, 437.3
Hypertensive heart disease	I11-I11.9	402-402.9	I11-I11.2, I11.9	402-402.91
Alcoholic cardiomyopathy	I42.6	425.5	I42.6	425.5
Atrial fibrillation and flutter	I48-I48.9	427.3	I48-I48.92	427.3-427.32
Cirrhosis and other chronic liver diseases due to alcohol use				
Pancreatitis	K85-K86.9	577-577.9, 579.4	K85-K86.9	577-577.9
Epilepsy	G40-G41.9	345-345.9	G40-G41.9, Z82.0	345-345.91
Alcohol use disorders	F10-F10.9, G31.2, G72.1, P04.3, Q86.0, R78.0, X45-X45.9, X65-X65.9, Y15-Y15.9	291-291.9, 303-303.9, 305.0, 357.5, 790.3, E860	F10-F10.99, G31.2, R78.0, X45-X45.9, X65-X65.9, Y15-Y15.9, Z81.1	291-291.9, 303-303.93, 305-305.03, 571.0-571.1, 571.3, 790.3, E860-E860.19, V11.3
Diabetes mellitus			E08-E08.11, E08.3-E08.9, E12-E12.1, E12.3-E13.11, E13.3-E14.1, E14.3-E14.9, R73-R73.9	249-249.31, 249.5-249.91, 362.01-362.07, 790.2-790.29
Diabetes mellitus type 2	E11-E11.1, E11.3-E11.9			
Pedestrian road injuries	V01-V04.9, V06-V09.9		V01-V04.99, V06-V09.9	E811.7, E812.7, E813.7, E814.7, E815.7, E816.7, E817.7, E818.7, E819.7, E822.7, E823.7, E824.7, E825.7, E826.0, E827.0, E828.0, E829.0
Cyclist road injuries	V10-V19.9		V10-V19.9	E800.3, E801.3, E802.3, E803.3, E804.3, E805.3, E806.3, E807.3, E810.6, E811.6, E812.6, E813.6, E814.6, E815.6, E816.6, E817.6, E818.6, E819.6, E820.6, E821.6, E822.6, E823.6, E824.6, E825.6, E826.1
Motorcyclist road injuries	V20-V29.9		V20-V29.9	E810.2-E810.3, E811.2-E811.3, E812.2-E812.3, E813.2-E813.3, E814.2-E814.3, E815.2-E815.3, E816.2-E816.3, E817.2-E817.3, E818.2-E818.3, E819.2-E819.3, E820.2-E820.3, E821.2-E821.3, E822.2-E822.3, E823.2-E823.3, E824.2-E824.3, E825.2-E825.3
Motor vehicle road injuries	V30-V79.9, V87.2-V87.3		V30-V79.9, V87.2-V87.3	E810.0-E810.1, E811.0-E811.1, E812.0-E812.1, E813.0-E813.1, E814.0-E814.1, E815.0-E815.1, E816.0-E816.1, E817.0-E817.1, E818.0-E818.1, E819.0-E819.1, E820.0-E820.1, E821.0-E821.1, E822.0-E822.1, E823.0-E823.1, E824.0-E824.1, E825.0-E825.1

Other road injuries	V80-V80.9, V82-V82.9		V80-V80.929, V82-V82.9	E810.4-E810.5, E811.4-E811.5, E812.4-E812.5, E813.4-E813.5, E814.4-E814.5, E815.4-E815.5, E816.4-E816.5, E817.4-E817.5, E818.4-E818.5, E819.4-E819.5, E820.4-E820.5, E821.4-E821.5, E822.4-E822.5, E823.4-E823.5, E824.4-E824.5, E825.4-E825.5, E826.3-E826.4, E827.3-E827.4, E828.4, E829.4
Other transport injuries	V00-V00.8, V05-V05.9, V81-V81.9, V83-V86.9, V88.2-V88.3, V90-V98.8	E800-E807, E830-E838, E840-E849	V00-V00.898, V05-V05.99, V81-V81.9, V83-V86.99, V88.2-V88.3, V90-V98.8	E800-E800.2, E801-E801.2, E802-E802.2, E803-E803.2, E804-E804.2, E805-E805.2, E806-E806.2, E807-E807.2, E810.7, E820.7, E821.7, E826.2, E827.2, E828.2, E830-E838.9, E840-E849.9, E929.1
Falls	W00-W19.9	E880-E886, E888	W00-W19.9	E880-E886.99, E888-E888.9, E929.3
Drowning	W65-W70.9, W73-W74.9	E910	W65-W70.9, W73-W74.9	E910-E910.99
Fire, heat, and hot substances	X00-X06.9, X08-X19.9	E890-E899, E924	X00-X06.9, X08-X19.9	E890-E899.09, E924-E924.99, E929.4
Poisoning by carbon monoxide	X47-X47.9	E862, E868-E869	J70.5, X47-X47.9	E862-E862.99, E868-E869.99
Poisoning by other means	X46-X46.9, X48-X48.9	E856-E857, E861, E863-E865, E867	X40-X44.9, X49-X49.9, Y10-Y14.9, Y16-Y19.9	E850.3-E858.99, E866-E866.99
Unintentional firearm injuries	W32-W34.9	E922	W32-W34.9	E922-E922.99, E928.7
Venomous animal contact	X20-X29.9	E905		
Non-venomous animal contact	W52.0-W62.9, W64-W64.9	E906	W52.0-W62.9, W64-W64.9, X20-X29.9	E905-E906.99
Environmental heat and cold exposure	L55-L55.9, L56.3, L56.8-L56.9, L58-L58.9, W88-W94.9, W97.9, W99-W99.9, X30-X32.9, X39-X39.9	E900-E902, E926	L55-L55.9, L58-L58.9, W88-W94.9, W97.9, W99-W99.9, X30-X32.9, X39-X39.9	E900-E902.99, E926-E926.99, E929.5
Exposure to forces of nature	X33-X38.9	E907-E909	X33-X38.9	E907-E909.9
Other unintentional injuries	W39-W39.9, W77-W77.9, W81-W81.9, W85-W87.9, X50-X54.9, X57-X58.9	E903-E904, E923, E925, E927-E928	W39-W39.9, W77-W77.9, W81-W81.9, X50-X58.9	E903-E904.99, E913.2-E913.39, E923-E923.99, E927-E928.09, E928.8-E928.89
Self-harm by firearm	X72-X74.9	E955	X72-X74.9	E955-E955.9
Self-harm by other specified means	X60-X64.9, X66-X71.9, X75-X84.9, Y87.0	E950-E954, E956-E959	X60-X64.9, X66-X67.9, X69-X71.9, X75-X75.9, X77-X84.9, Y87.0	E950-E954, E956-E958.0, E958.2-E959
Physical violence by firearm	X93-X95.9	E965	X93-X95.9	E965-E965.4
Physical violence by sharp object	X99-X99.9	E966	X99-X99.9	E966
Sexual violence			Y05-Y05.9	E960-E960.1
Physical violence by other means	X85-X92.9, X96-X98.9, Y00-Y04.9, Y06-Y08.9, Y87.1	E961-E964, E967-E969	X85-X92.9, X96-X98.9, Y00-Y04.9, Y06-Y08.9, Y87.1-Y87.2	E961-E964, E965.5-E965.9, E967-E969

Drug related diagnoses				
	Causes of Death		Non-fatal cause	
Cause	ICD10	ICD9	ICD10	ICD9
HIV/AIDS - Drug-susceptible Tuberculosis	B20.0		B20.0	
HIV/AIDS - Multidrug-resistant Tuberculosis without extensive drug resistance				
HIV/AIDS - Extensively drug-resistant Tuberculosis				
HIV/AIDS resulting in other diseases	B20.1-B23.9, B24.0	042-044.9	B20.1-B23.8, B24-B24.0, B97.81, C46-C46.52, C46.7-C46.9	176-176.9
Acute hepatitis B	B16-B16.9, B17.0, B19.1, P35.3	070.2-070.3	B16-B16.9, B17.0, B18.0-B18.1, B19.1-B19.11	070.2-070.31, 070.42, 070.52
Acute hepatitis C	B17.1, B19.2	070.7	B17.1-B17.11, B18.2, B19.2-B19.21	070.41, 070.44, 070.51, 070.7-070.71
Liver cancer due to hepatitis B				
Liver cancer due to hepatitis C				
Cirrhosis and other chronic liver diseases due to hepatitis B				
Cirrhosis and other chronic liver diseases due to hepatitis C				
Opioid use disorders	F11-F11.9, P96.1, R78.1	304.0, 305.5	F11-F11.99, R78.1	304.0-304.03, 305.5-305.53, E850.0-E850.29
Cocaine use disorders	F14-F14.9, R78.2	304.2, 305.6	F14-F14.99, R78.2	304.2-304.23, 305.2-305.23, 305.6-305.63
Amphetamine use disorders	F15-F15.9	304.4, 305.7	F15-F15.99	304.4-304.43, 305.7-305.73
Cannabis use disorders			F12-F12.99	304.3-304.33
Other drug use disorders	F13-F13.9, F16-F16.9, F18-F19.9, P04.4, R78.3-R78.5	292-292.9, 304.1, 304.5-304.8, 305, 305.1, 305.3-305.4, 305.8-305.9, 760.7	F13-F13.99, F16-F19.99, P96.1, R78.3-R78.9	292-292.9, 304, 304.1-304.13, 304.5-304.93, 305.1-305.13, 305.3-305.43, 305.8-305.93
Self-harm by firearm	X72-X74.9	E955	X72-X74.9	E955-E955.9
Self-harm by other specified means	X60-X64.9, X66-X71.9, X75-X84.9, Y87.0	E950-E954, E956-E959	X60-X64.9, X66-X67.9, X69-X71.9, X75-X75.9, X77-X84.9, Y87.0	E950-E954, E956-E958.0, E958.2-E959

Stanaway et al. (2018) categorize diagnoses associated with lifestyle risk factors using the ICD9 and ICD10 system, used at Swedish hospitals from 1987, when the SBC sample were 34 years old.

Table F4 List of cause of death conditions associated lifestyle risk factors.

Alcohol use (n=325)

Drug-susceptible tuberculosis
Multidrug-resistant tuberculosis without extensive drug resistance
Extensively drug-resistant tuberculosis
Lower respiratory infections
Lip and oral cavity cancer
Nasopharynx cancer
Other pharynx cancer
Esophageal cancer
Colon and rectum cancer
Liver cancer due to alcohol use
Larynx cancer
Breast cancer
Ischemic heart disease
Ischemic stroke
Intracerebral hemorrhage
Hypertensive heart disease
Alcoholic cardiomyopathy
Atrial fibrillation and flutter
Cirrhosis and other chronic liver diseases due to alcohol use
Pancreatitis
Epilepsy
Alcohol use disorders
Diabetes mellitus type 2
Pedestrian road injuries
Cyclist road injuries
Motorcyclist road injuries
Motor vehicle road injuries
Other road injuries
Other transport injuries
Falls
Drowning
Fire, heat, and hot substances
Poisoning by carbon monoxide
Poisoning by other means
Unintentional firearm injuries
Venomous animal contact
Non-venomous animal contact
Environmental heat and cold exposure
Exposure to forces of nature
Other unintentional injuries
Self-harm by firearm
Self-harm by other specified means
Physical violence by firearm
Physical violence by sharp object
Physical violence by other means

Sexual risk-taking (n=11)

HIV-AIDS – Drug-susceptible Tuberculosis
HIV/AIDS - Multidrug-resistant Tuberculosis without extensive drug resistance
HIV/AIDS - Extensively drug-resistant Tuberculosis
HIV/AIDS resulting in other diseases
Syphilis
Chlamydial infection
Gonococcal infection
Other sexually transmitted diseases
Cervical cancer

Tobacco use (n=458)

Drug-susceptible tuberculosis
Multidrug-resistant tuberculosis without extensive drug resistance
Extensively drug-resistant tuberculosis
Lower respiratory infections
Lip and oral cavity cancer
Nasopharynx cancer
Other pharynx cancer
Esophageal cancer
Stomach cancer
Colon and rectum cancer
Liver cancer
Liver cancer due to hepatitis B
Liver cancer due to hepatitis C
Liver cancer due to alcohol use
Liver cancer due to NASH
Liver cancer due to other causes
Pancreatic cancer
Larynx cancer
Tracheal, bronchus, and lung cancer
Breast cancer
Cervical cancer
Prostate cancer
Kidney cancer
Bladder cancer
Acute lymphoid leukemia
Chronic lymphoid leukemia
Acute myeloid leukemia
Chronic myeloid leukemia
Other leukemia
Ischemic heart disease
Ischemic stroke
Intracerebral hemorrhage
Subarachnoid hemorrhage
Atrial fibrillation and flutter
Aortic aneurysm
Peripheral artery disease
Chronic obstructive pulmonary disease
Asthma
Peptic ulcer disease
Gallbladder and biliary diseases
Alzheimer disease and other dementias
Parkinson disease
Multiple sclerosis
Diabetes mellitus type 2
Rheumatoid arthritis
Pedestrian road injuries
Cyclist road injuries
Motorcyclist road injuries
Motor vehicle road injuries
Other road injuries
Other transport injuries
Falls
Other exposure to mechanical forces
Non-venomous animal contact
Otitis media
Physical violence by other means

Drug use (n=47)

HIV-AIDS – Drug-susceptible Tuberculosis
HIV/AIDS - Multidrug-resistant Tuberculosis without extensive drug resistance
HIV/AIDS - Extensively drug-resistant Tuberculosis
HIV/AIDS resulting in other diseases
Acute hepatitis B
Acute hepatitis C
Liver cancer due to hepatitis B
Liver cancer due to hepatitis C
Cirrhosis and other chronic liver diseases due to hepatitis B
Cirrhosis and other chronic liver diseases due to hepatitis C
Opioid use disorders
Cocaine use disorders
Amphetamine use disorders
Other drug use disorders
Self-harm by firearm
Self-harm by other specified means

Having a high BMI (n=324)

Esophageal cancer
Colon and rectum cancer
Liver cancer due to hepatitis B
Liver cancer due to hepatitis C
Liver cancer due to alcohol use
Liver cancer due to other causes
Gallbladder and biliary tract cancer
Pancreatic cancer
Breast cancer
Uterine cancer
Ovarian cancer
Kidney cancer
Thyroid cancer
Non-Hodgkin lymphoma
Multiple myeloma
Acute lymphoid leukemia
Chronic lymphoid leukemia
Acute myeloid leukemia
Chronic myeloid leukemia
Other leukemia
Ischemic heart disease
Ischemic stroke
Intracerebral hemorrhage
Subarachnoid hemorrhage
Hypertensive heart disease
Atrial fibrillation and flutter
Asthma
Gallbladder and biliary diseases
Alzheimer disease and other dementias
Diabetes mellitus type 1
Chronic kidney disease due to diabetes mellitus type 2
Chronic kidney disease due to hypertension
Chronic kidney disease due to glomerulonephritis
Chronic kidney disease due to other causes

Low physical activity (n=196)

Colon and rectum cancer
Breast cancer
Ischemic heart disease
Ischemic stroke
Diabetes mellitus type 2

The categorization of condition is created by Stanaway, J.D. et al. (2018)

1.G Power Calculations

To calculate statistical power, the process assumed to generate data must be specified. If we focus on the main analysis in the study, it is assumed to look as follows: $Earlydeath(i) = a + v(1)Chosedelayedrewards(i) + \mathbf{v(x)X} + e$.

where i represents the individual, a is the constant, and e is the error term. X is vector of control variables. To make a calculation of the statistical power, information on the effect size and variance and covariance between the variables is required. The covariance between variables X and choosing the delayed reward are unknown and variables X are therefore ignored in these power calculations to simplify the calculations. The variance in a variable is calculated using the formula:

$$s^2 = \frac{\sum(x_i - \bar{x})^2}{n-1} \tag{1.G.1}$$

where $\bar{x}$ is the mean of the variable, x_i is an observation for a particular individual, and n is the sample size. Re-organizing a classical power calculation, we can get the effect size d on the left-hand side like this:

$$d = \sqrt{\frac{12.35s^2}{n}} \tag{1.G.2}$$

Using this formula, we can calculate what effect size we have the power to detect, assuming $\alpha = 0.05$, $\beta = 0.2$, and thereby $1 - \beta = 0.8$. In the investigated Stockholm birth cohort sample, 10,103 out of 12,956 (78%) participants chose the delayed reward. This gives $s^2 = 0.172$ and a smallest detectable effect size of 0.0128. The sample mean for this variable is 0.095, meaning that I am only able to detect unneglectable relations with all-cause mortality.

Looking at mothers' time preferences, 2,263 out of 3,478 respondents are characterized as patient. This gives $s^2 = 0.227$ and $d = 0.028$ which is a large number in the context. The smallest effect size of mothers' time preferences on their children's mortality that I can detect is roughly one-third of the sample mean of the outcome. I consider this too large for regressions to be valuable in this context.

These simple power calculations highlight the importance of large sample sizes when studying all-cause mortality at early ages. Splitting the sample, in terms of gender or other characteristics, increases the smallest detectable effect further.

1.H Adjust for Multiple Hypothesis Testing

The List et al. (2019) procedure aims to generate multiple hypotheses adjusted p-values controlling for the familywise error rate. The method incorporates information about the dependence between the different tests and allows the p-values to be correlated. This is the preferred method of adjusting p-values in this paper, since there is a high likelihood that the p-values are correlated. All main regressions in my paper investigate the hypothesis that time preferences predict future health, and the regressions are similar to each other. The explanatory variable is *chose delayed reward* and the outcome variables are *death by age 50 and 65*, or the participants' *total number of hospitalizations and diagnoses*. The drawback of the List et al. (2019) method is that it does not allow for inclusion of control variables. What H1 and H2 test is therefore the pure predictive power of time preferences on different outcomes, not including controls. Results from the more conservative and classical Bonferroni procedure are also included for comparison.

Table H1 Multiple main outcomes, unadjusted and adjusted P-values

Outcome	Diff. in mean	P-values		
		Unadjusted	Multiplicity adjusted	
			List et al. (2019)	Bonferroni
Death by 50	0.0046	0.2553	0.2553	1
Death by 65	0.0163	0.0113**	0.02**	0.0453**
Total number of hospitalizations	0.9476	0.0003***	0.0003***	0.0013***
Total number of diagnoses	1.8310	0.0003***	0.0003***	0.0013***

The explanatory variable is *Chose delayed reward*, a dummy variable where 1 indicates that the adolescent ”probably” or “definitely” preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group in this variable consists of adolescents who ”probably” or “definitely” preferred the earlier amount or were indifferent.

Table H2. Multiple outcomes related to lifestyle factors, unadjusted and adjusted P-values

Outcome	Diff. in mean	P-values		
		Unadjusted	Multiplicity adjusted	
			List et al. (2019)	Bonferroni
Dependence on/abuse of:				
Alcohol	0.0103	0.0377**	0.221	0.4897
Drugs	0.0035	0.252	0.4403	1
Diagnosis associated with:				
Lifestyle risk factors	0.0392	0.0003***	0.0003***	0.0043***
Alcohol use	0.0266	0.003***	0.0247**	0.039**
Tobacco use	0.0257	0.006***	0.047**	0.078*
Drug use	0.0064	0.062*	0.292	0.806
High BMI	0.0141	0.1197	0.4453	1
Low physical activity	0.0085	0.2226	0.5273	1
Sexual risk-taking	0.0089	0.009***	0.0677*	0.1213
Sports Interests	1.2516	0.0003***	0.0003***	0.0043***
Adolescent opinion: smoking	0.0449	0.0003***	0.0003***	0.0043***
Mother rules: smoking	0.0292	0.144	0.4533	1
Use tobacco age 32	0.0141	0.541	0.541	1

The explanatory variable is *Chose delayed reward*, a dummy variable where 1 indicates that the adolescent "probably" or "definitely" preferred SEK 1,000 in 5 years over SEK 100 immediately. The reference group in this variable consists of adolescents who "probably" or "definitely" preferred the earlier amount or were indifferent.

1.I Unobservable Selection (Oster 2019)

Table I1. Bias adjusted β for *chose the delayed reward*

	(1) Baseline effect (Std. error) [R^2]	(2) Controlled effect (Std. error) [R^2]	(3) Bias adjusted β $R_{max} = 1.3\,\widetilde{R_2}$	(4) Bias adjusted β $R_{max} = 2\,\widetilde{R_2}$	(5) Bias adjusted β $R_{max} = 3\,\widetilde{R_2}$
Panel A δ=0.5					
Death by 65	-0.0151 (0.0057) [0.001]	-0.0141 (0.0057) [0.013]	-0.0139	-0.0135	-0.013
Hospitalizations	-1.0963 (0.2359) [0.002]	-0.5817 (0.2356) [0.029]	-0.4964	-0.30026	-0.02113
Diagnosis	-2.1984 (0.5666) [0.002]	-1.4696 (0.5701) [0.013]	-1.3465	-1.0566	-0.6417
Panel B δ=1					
Death by 65	-0.0151 (0.0057) [0.001]	-0.0141 (0.0057) [0.013]	-0.0138†	-0.013†	-0.0118†
Hospitalizations	-1.0963 (0.2359) [0.002]	-0.5817 (0.2356) [0.029]	-0.4106†	-0.0145†	0.5564†
Diagnosis	-2.1984 (0.5666) [0.002]	-1.4696 (0.5701) [0.013]	-1.2228†	-0.6361†	0.216†

Due to limitations in the Oster (2019) procedure, all estimations (including the binary mortality outcome) are made using OLS. $\widetilde{R_2}$ is the R^2 value in the corresponding model with controls included. †Multiple solutions are generated. The solution that minimizes the squared difference to the estimated treatment effect in the controlled regression is selected, as suggested by Oster (2019).

Table I2. Finding the $\tilde{\delta}$ that makes *chose the delayed reward* β =0 at different R_{max}

	(1) Baseline effect (Std. error) [R^2]	(2) Controlled effect (Std. error) [R^2]	(3) $\tilde{\delta}$ for β=0 given $R_{max} = 1.3\,\widetilde{R_2}$	(4) $\tilde{\delta}$ for β=0 given $R_{max} = 2\,\widetilde{R_2}$	(5) $\tilde{\delta}$ for β=0 given $R_{max} = 3\,\widetilde{R_2}$
Death by 65	-0.0151 (0.0057) [0.001]	-0.0141 (0.0057) [0.013]	30.24	9.62	4.88
Hospitalizations	-1.0963 (0.2359) [0.002]	-0.5817 (0.2356) [0.029]	3.23	1.02	0.52
Diagnosis	-2.1984 (0.5666) [0.002]	-1.4696 (0.5701) [0.013]	5.17	1.71	0.88

Due to limitations in the Oster (2019) procedure, all estimations (including the binary mortality outcome) are made using OLS. $\widetilde{R_2}$ is the R^2 value in the corresponding model with controls included.

Chapter 2

Time Preferences and Medication Adherence: A Field Experiment with Pregnant Women in South Africa

Abstract

The effectiveness of health recommendations and treatment plans depends on the extent to which individuals follow them. For the individual, medication adherence involves an inter-temporal trade-off between expected future health benefits and immediate effort costs. Therefore examining time preferences may help us to understand why some people fail to follow health recommendations and treatment plans. In this paper, we use a simple, real-effort task implemented via text message to elicit the time preferences of pregnant women in South Africa. We find evidence that high discounters are significantly less likely to report to adhere to the recommendation of taking daily iron supplements daily during pregnancy. There is some indication that time-inconsistency also negatively affects adherence. Together our results suggest that measuring time preferences could help predict medication adherence and thus be used to improve preventive health care measures.

This chapter is co-authored with Kai Barron, Mette Trier Damgaard, and Christina Gravert. The AEA RCT Registry trial number associated with this project is AEARCTR-0004018. Ethics Approval has been obtained from Pharma Ethics Ltd, Reference No:181021588.

2.1 Introduction

Failing to correctly adhere to prescribed medication schedules can be extremely harmful to an individual's health and well-being. However, the rate of adherence to medication plans is estimated to only around 50% (Haynes et al. 2002, World Health Organization 2003). Non-adherence is even a substantial problem in settings where information and medication is free and accessible, and the costs of failing to adhere are extremely high.[1] Several behavioral approaches have been suggested to address adherence, but the evidence of their effectiveness has shown mixed results (Guinart & Kane 2019, Anderson et al. 2020, Shih & Cohen 2020). Two of the primary approaches have been the use of *incentives* (see, e.g., DeFulio & Silverman 2012, Petry et al. 2012, Bassett et al. 2015) and *text-message reminders* (see, e.g., Lester et al. 2010, Pop-Eleches et al. 2011, Thirumurthy & Lester 2012, Mbuagbaw et al. 2013). These studies typically use a "one size fits all" approach, applying the intervention uniformly across the target population. However, it is likely that there is substantial heterogeneity in the demand for, and effectiveness of, medication adherence interventions. In addition, if different underlying mechanisms are generating poor adherence for different individuals, this will imply that different interventions will be effective for different sub-populations. Being able to better tailor interventions based on the preferences or characteristics of individuals could improve the effectiveness of the interventions while also reducing costs.

This paper investigates whether measured time preferences can predict an individual's propensity to adhere to their prescribed medication. Time preferences are typically heterogeneous across individuals (see, e.g., Falk et al. 2018). If a relationship between time preferences and adherence exists, it would provide one possible avenue for the screening of individuals to identify those at risk of low adherence.[2] Improved screening could be especially policy-relevant for preventive measures and chronic diseases, where the benefits of medication are not immediate and non-adherence is not directly observable.

In order to investigate the relationship between individual time preferences and medication adherence, we conduct a low cost, text-message-based study in which we contact a total of 694 pregnant women in South Africa to elicit their time preferences and collect information about medication adherence to recommendations to take daily iron supplements intended to prevent anaemia during pregnancy.[3] This allows us to analyze whether heterogeneity in time preferences measured with a simple and scalable task is predictive of heterogeneity in medication adherence. This low-cost approach could be used to identify those who would benefit most from interventions that target attention or procrastination and thus, reduce overall costs of interventions. In addition, early identification of and targeting of interventions to individuals who are unlikely to comply with treatment regimes can improve their health outcomes. In comparison, waiting to intervene until the individual has failed to take the prescribed medication can involve large health costs. For example, during pregnancy, but also for e.g. HIV or tuberculosis patients, early consistent compliance is important to avoid irreversible health outcomes later on.

Medication adherence can be modeled as a situation in which one has to exert immediate effort in order to obtain some benefit (or to reduce some cost) in the future. Since we are interested in an inter-temporal trade-off that involves effort in the earlier period, it is important to measure time preferences in the effort domain. To do so, we create a simple text-message task. Our task is loosely based on the work by Augenblick et al. (2015), who develop a real-effort task to measure time preferences in the lab. The main difference between their method and ours is that our version is simpler and can be implemented in a wider range of settings (e.g. via a basic phone), which makes it suitable for resource-limited settings.[4] In our task, we ask participants to complete a short, incentivized word task within a specified number of days. If the participant completes the task, she is rewarded with a fixed payment of credit for her phone. The magnitude and date of this payment is always held constant, however, the difficulty of the task depends on *when* the participant completes it, with the task requiring more effort as time passes. In addition, prior to the start of the task, we elicit the participant's plan regarding when she will complete the task. This allows us to measure: (i) how patient the participant is and hence whether she anticipates that she will complete the task early or with a delay, and (ii) whether she behaves time-consistently or not.

In order to place structure on our empirical analysis, in Section 2.3 we develop a simple theoretical framework that examines how time preferences might influence medication adherence. In Section 2.4, we then provide a detailed de-

[1]In the case of HIV treatment, researchers find problems with medication adherence even though the costs of failing to adhere (even temporarily) is extremely high. A meta-analysis of 84 studies find that only an average of 64% of patients reported medication adherence of $\geq 90\%$, with lower estimates in countries with lower scores on the Human Development Index (Ortego et al. 2011).

[2]The current literature on the relation between time preference and medical adherence is scarce. Studies apply different hypothetical time preference measures or incentivised time preferences in the monetary domain, and the results are mixed (Chapman et al. 2001; Sloan et al. 2009; Brandt & Dickinson 2013; Mørkbak et al. 2017; Van der Pol et al. 2017.)

[3]These iron supplements are available at no cost at their local health clinic.

[4]Haushofer et al. (2018) also adjusted the incentivized task by Augenblick et al. (2015) for measuring time preferences to a mobile phone design. The employ a multiple price list design to determine how many rows of numbers the women need to text to a phone number of the research center on specific days. While the technological constraints are lower than in the original task, the task still requires detailed in-person instructions and a significant amount of time.

scription of our experimental design and discuss how we we classify women, based on their inter-temporal choices in our real-effort task, into the following groups: *On-timers* (who have largely time-consistent preferences), *Late-or-Never-Doers* (who have present-biased preferences) or *Early-Doers* (who are either future biased or sophisticated about their present bias). In addition, we classify participants based on their exponential daily discount factor δ as being either High- or Low-Discounters. Section 2.5 explains the experimental timeline and sample selection.

In Section 2.6, we report our results which are based on a final sample of 480 women for which we have data on both time preferences and medication adherence. We find that the level of stated adherence in our sample is high, with the majority of women reporting that they take their iron pills every day. Despite the low variation in the outcome variable, we find a significant correlation between our measure of the discount rate, δ, and missing days in taking iron supplements. Surprisingly, we find that a large share of the women (ca. 25%) are *Early-Doers*, who do the task earlier than planned. Only 9% do the task later than planned or not at all (*Late-or-Never-Doers*). The remaining 66% do the task as planned (*On-timers*).[5] Given the high share of women, who do the task on the first day, we do not have enough power to detect a significant correlation between time inconsistency and adherence when controlling for the discount rate. Our measured time preferences are significantly associated with self-reported difficulty in remembering to take one's pills. In Section 2.7, we discuss the robustness of our results to demographics, general busyness, and cognitive ability of the women, and we present evidence for several self-reported health outcomes.

A related paper to ours is Haushofer et al. (2018) who among other behavioral measures implement a time preference elicitation task to predict adherence to chlorination. In contrast to our paper, they employ a time-preference treatment consisting of interactive lectures, case stories, exercises and drawings to affect patience in their sample and show that their treatment decreased diarrhea episodes in children, a proxy for more chlorinated water. Their time-preference elicitation task was part of a large battery of surveys and interventions run with household enumerators, while our approach is more light touch and could in the future easily be implemented by our project partner or transferred to other mobile health settings. Our paper focuses on the possibility to predict adherence using time preferences whereas Haushofer et al. (2018) aims to change preferences and thus change behavior. Brandt & Dickinson (2013) also studies the effect of

[5]These individuals did the task when they said they would, e.g. due to having time-consistent preferences in the sense of $\beta = 1$ (Laibson 1997, O'Donoghue & Rabin 2015).

time-preferences on medication adherence in an incentivized way. Investigating 47 asthmatic patients, they find a positive correlation between individual time preferences and adherence levels in taking asthma medication. In another small, but non-incentivized study (n=79) of chronic diabetes patients, Mørkbak et al. (2017) document evidence that indicates a link between present-bias and both: (i) the age of onset of the disease, and (ii) the prognosis after diagnosis. However, in general, the literature in this area is scarce and the results are mixed. Larger surveys focusing on hypertension, diabetes, or chronically ill patients have generated mixed results regarding the association between medical adherence and hypothetical time-preference measures (Chapman et al. 2001, N=195 and N=124; Sloan et al. 2009, N=1530; Van der Pol et al. 2017, N=1849). We document evidence that is consistent with Brandt & Dickinson (2013), namely that individual time preferences are predictive of patterns of adherence. Interestingly, our results suggest that only measuring the discount factor δ, rather than δ and β has significant predictive power to identify individuals that struggle with medication adherence. Given that the elicitation of time-inconsistent preferences is more difficult than only eliciting the discount rate, our findings could be good news for health care providers aiming to identify at-risk individuals.

More generally, our study contributes to the literature designing and evaluating behavioral interventions to address medication non-adherence (see, e.g., Lester et al. 2010, Pop-Eleches et al. 2011, Thirumurthy & Lester 2012, Bassett et al. 2015) as well as the literature developing tools for measuring time preferences with real-effort tasks, particularly in low-resource settings (see, e.g., Augenblick et al. 2015, Andreoni et al. 2015, Augenblick 2018, Augenblick & Rabin 2018, DellaVigna & Pope 2018, Haushofer et al. 2018, Cohen et al. 2020).

2.2 Context

In this study, we focus on the effect of time preferences on the medication adherence of expectant mothers in South Africa. In 2014, the South African National Department of Health (NDoH) developed a text message based information and reminder system called MomConnect. This platform aims to assist expectant mothers through their pregnancy, and in the early period after birth. It does this by, for example, reminding them to schedule pregnancy check-ups, providing them with a description of how babies develop, informing them about the health benefits of breastfeeding and informing them about symptoms that would indicate that they should seek medical help. When we ran this study, nearly 2 million women had joined MomConnect, making it one of the largest mHealth programs of its kind. Similar programs have been developed in other places, for example in India.

One of the aims of the program is to improve medication adherence among expectant mothers in South Africa, since pregnancy and early infancy are critical periods for the development of a child. In this paper, we focus on studying adherence to the specific recommendation that pregnant women should take daily iron supplements to prevent anaemia. Anaemia during pregnancy has negative health effects for both mothers and babies. During the last two trimesters of pregnancy, iron is essential for the mother as her body needs to produce more blood and grow both the placenta and the fetus. Anemia is associated with an elevated risk of maternal mortality, problems with lymphocyte stimulation (related to the immune systems), risk of pre-term delivery, and risk of low birth weight (see, e.g., Allen 2000, Lozoff et al. 2006, Kalaivani et al. 2009, Abu-Saad & Fraser 2010, Balarajan et al. 2011). The World Health Organization estimates that in 2016 the rate of anaemia amongst women of reproductive age was around 25% in South Africa and 33% globally (World Health Organization 2020). This is in spite of the fact that in South Africa the government runs a program to supply free iron supplements to all pregnant women. Health workers are instructed to provide pregnant woman with a supply of the supplements at the first antenatal visit and to follow-up by checking for signs of anaemia during the second visit (for further evidence documenting the status of anaemia and iron supplement intake in the South African context, see, e.g. Nojilana et al. 2007, Phatlhane et al. 2016, Tunkyi & Moodley 2016, Mbhenyane & Cherane 2017, Harika et al. 2017, Symington et al. 2019).

In summary, all women we sample from are recommended to take iron supplements and all should have access to free supplements[6]. This makes the context ideal for testing our research question because it enables us to abstract from budget and availability constraints. At the same time, the South African setting is one in which WHO numbers suggest that there is scope for reducing anaemia and where a suitable platform for scalable interventions is well-established.

2.3 Theoretical Framework and Hypotheses

In this section, we provide a simple theoretical framework to illustrate the effect of time preferences on the decision to take iron supplements. The theoretical framework informs our experimental design and the interpretation of our results.

[6]We control for whether they actually have access by asking them.

A pregnant woman's decision of whether to follow the recommendation to take iron supplements daily during pregnancy has similar characteristics to an investment decision: It requires an immediate cost and involves a future benefit. The immediate cost c includes the effort cost of getting and taking supplements, the cognitive cost of remembering to take the supplements, and costs of short term side effects such as an upset stomach. In general, the cost would also involve costs of buying the supplements but in our setting pills are typically available for free at the health centers. The future benefits b_t capture all health benefits to the mother and her baby, e.g. the reduced risk of maternal mortality, the reduced risk of pre-term delivery, and the reduced risk of low birth weight. If the expectant mothers do not take iron supplements, they receive the best alternative payoff which, without loss of generality, we normalize to 0.

As with other investment decisions, the decision to take daily supplements is an inter-temporal decision problem. Allowing for the present-biased time preferences (Phelps & Pollak 1968, Laibson 1997, O'Donoghue & Rabin 1999) as captured by the $\beta\delta-$model (O'Donoghue & Rabin 1999), the net benefit of taking the supplements in period t are:

$$-c+\beta\sum_{s=t+1}^{\infty}\delta^{s-t}b_s. \tag{2.1}$$

where β is an additional discount factor between present and future periods, applied on top of the usual exponential discount factor δ. The expectant mother has time-consistent preferences if $\beta = 1$ and she has present-biased preferences whenever $\beta < 1$. As suggested by O'Donoghue & Rabin (1999) individuals may or may not correctly anticipate future present bias. Let $\hat{\beta} \in [\beta; 1]$ denote the prediction of β in future periods. The standard time-consistent *exponential* discounter then has $\beta = \hat{\beta} = 1$, the *sophisticated* present-biased individual has $\hat{\beta} = \beta < 1$, and the *fully naive* present-biased individual has $\beta < \hat{\beta} = 1$. With this notation the expectant mother anticipates that the future net benefit of doing the task in a future period is $-c + \hat{\beta}\sum_{s=t+1}^{\infty}\delta^{s-t}b_s$. Hence, naive present-biased individuals mispredict their future net benefit. The distinction between naivety and sophistication may be of importance, when individuals have opportunities to delay doing a task (e.g. to later in the day)[7], as sophisticates will anticipate that they may not do the task if they delay. As shown by (O'Donoghue & Rabin 1999), sophisticates may then do the task sooner than a time-consistent individual would have done and

[7]Note that there is no option to delay from day to day in our setting, as iron pills have to be taken daily.

they may use commitment devices to ensure that they take supplements. This gives the following two hypotheses:

Hypothesis 1. Adherence is increasing in the exponential discount factor δ, i.e. women who discount the future more are less likely to take supplements.

Hypothesis 2. For naives, adherence is increasing in the present-bias parameter β, i.e. women who display time-inconsistent delay are less likely to take supplements.

2.4 Measuring Time Preferences in the Effort Domain

In order to test our hypotheses, it is necessary to elicit the time preferences of pregnant women. Traditionally, time preferences have been elicited in the monetary domain, where participants choose between either more money now or more money later. However, recent papers have emphasized the importance of measuring time preferences within the specific domain of interest (see, e.g., Ubfal 2016, Augenblick et al. 2015, Cohen et al. 2020). Since adhering to medication can be viewed as a type of (cognitive) effort task, we investigate time preferences in the effort domain. For this purpose, we design a simplified version of the experiment used by Augenblick et al. (2015)[8] which is suitable for a text-message based implementation.

2.4.1 Experimental Design

The experiment begins on day $t = 0$ when participants are informed that they can earn phone credits worth 20 South African Rand (equivalent to 1.4 USD) if they complete a word task. The task involves writing a list of words backwards. Participants are given two examples and are told that they will receive text messages containing the relevant word lists in the coming days. Importantly, the longer participants wait to do the task the more words they will need to write to earn the 20 Rand phone credits. The reason for this increasing effort cost is to make procrastination expensive. The participants can choose between writing four words on day $t = 1$, six words on day $t = 3$, or ten words on day $t = 5$. Irrespective of *when* they complete the task they will receive the phone credits on day $t = 7$. At time $t = 0$, participants are fully informed about this procedure

[8] Augenblick et al. (2015) use a real-effort task to measure the time preferences of university students during a six-week period. The students decide when they want to do tedious tasks and are paid a varying piece-rate. The tedious task is either to transcribe Greek letters or to play a modified and not very enjoyable, Tetris-style game. The experiment is implemented both in a computer lab and in an online setting where participants use their own computers.

and are asked *whether* and *when* they expect to do the task. We provide a fixed payment of 5 Rand for their answer to this question on day $t = 0$ and we do not incentivize how accurately their choice on day $t = 0$ matches subsequent choices.

On day $t = 1$, participants receive a new message with a list of four words: "baby, parent, bottle, mom". A participant who replies with these words written backwards, has completed the task. If the participant does not complete the task, she gets two additional chances to do the task: on day $t = 3$ and on day $t = 5$ when new lists of words are sent. The time-line of the text-message task can be seen in Figure 2.1 and the full set of messages for the task can be found in Appendix.

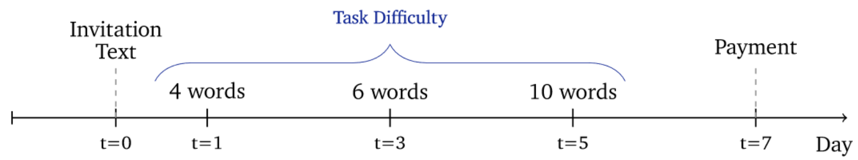


Figure 2.1: Timeline of the Text-Message-Based Real-Effort Task.

We developed this specific word task for several reasons. First, the task had to be suitable for the text-message implementation. The majority of the effort tasks commonly used in the economics literature are either too long, or infeasible for a limited contact context such as this (e.g. implemented over text-message).[9] Second, in our setting, it is important that participants can complete the task at any time throughout a day. This way the task might mimic the underlying effort and cognitive constraints that drive time preferences and medication adherence. In pilot tests, we found that although the word task was considered tedious and frustrating, it did not take long to do.

2.4.2 Interpreting Choices in the Time-Preference Elicitation

We follow the approach in Augenblick (2018) and Augenblick & Rabin (2018) to identify time preferences from a comparison of future and immediate effort choices. The initial plan of *whether* and *when* to do the task is a future effort choice. Behavior in the subsequent periods, implicitly give us an immediate effort choice. However, the simplicity of our task implies that we cannot identify precise estimates of the time-preference parameters in the $\beta\delta$-model, instead we

[9] See, e.g., Charness et al. 2018 for a review of experimental real effort tasks. The task closest to ours is the one used by Gerhards & Gravert (2020), which asks participants to solve five letter anagrams within a certain time period.

classify the women based on their behavior as either *On-timers* (who largely have time-consistent preferences), *Late-or-Never-Doers* (who have present-biased preferences) or *Early-Doers* (who are either future biased or sophisticated about their present bias)[10] and additionally we classify participants based on their exponential daily discount factor δ as either *High* or *Low Discounters*. We discuss the details of the classifications in this subsection.

To illustrate the elicitation mechanism, let k denote the time period when an effort decision is made, let t denote the time period when the task is performed, and let e_t denote the effort level, i.e. number of written words where $e_1 = 4$, $e_3 = 6$ and $e_5 = 10$. The wage level, w, is the amount of money paid out at time $T = 7$. In our experiment, $w = 20$ if the participant completes the task at any point in time, and $w = 0$ otherwise. For tractability we assume that the disutility of effort is captured by a function $C(e_t) = \frac{1}{\phi}e_t$ where ϕ can be interpreted as the "exchange rate" between effort and money as in Augenblick (2018).[11] We assume that both effort and monetary payments are discounted by a quasi-hyperbolic discounting function that discounts costs by the discount factor 1 when $t = k$ and $\beta\delta^{t-k}$ when $t > k$.

In this setting, where the payment for the task does not depend on when the task is completed, utility maximization is equivalent to effort-cost minimization subject to a participation constraint. The participation constraint ensures that the discounted effort cost of doing the task at the chosen time t^* does not exceed the discounted payment from doing the task. That is at time $k \geq 0$ the participant should expect to do the task at time

$$t^\star = \underset{t\in\{1,3,5\},t\geq k}{\text{argmin}} \{\beta^{1(k<t)}\delta^{t-k} \cdot \frac{1}{\phi}e_t\} \tag{2.2}$$

subject to the participation constraint $\beta\delta^{T-k} \cdot 20 \geq \beta^{1(k<t^\star)}\delta^{t^\star-k} \cdot \frac{1}{\phi}e_{t^\star}$ where $1(k < t)$ is an indicator function for whether the effort allocation is in the future relative to the point in time when the decision is made. In both Equation 2.2 and in the participation constraint, β is replaced by $\hat{\beta}$ when the participant makes

[10]Note that we classify people based on their *observed behavior* and not based on *preferences* which are inherently unobserved. For example, an individual with time-consistent preferences will do as she plans while a person with present-biased preferences may either do as planned, do it later, or not do it after all. Hence, we cannot distinguish whether an individual who acts as planned has time-consistent preferences or present-biased preferences.

[11]Augenblick (2018) assume the more general $C(e_t) = \frac{1}{\phi\gamma}(e)^\gamma$, where γ determines the function curvature and assume convexity. In our experiment, convexity of the effort function would imply that each word is increasingly annoying to write. However, it is also plausible that reversing the order of letters in a word gets easier with practice and that the effort function is therefore concave. For simplicity we therefore assume that the cost function is linear, i.e. $\gamma = 1$.

a prediction about future present bias. This allows us to capture sophistication ($\hat{\beta} = \beta < 1$) and naivete ($\beta < \hat{\beta} = 1$) about future present bias.

2.4.2.1 Future Effort Choices: Eliciting the Exponential Discount Factor

At time $k = 0$ the participant states whether and when she plans to do the task and therefore implicitly states anticipated future effort at time $t = 1$, $t = 3$ and $t = 5$. As mentioned above we do not incentivize the accuracy with which the future effort choice matches effort choices made at later points in time (i.e. for $k > 0$). This is to reduce the extent to which (sophisticated) participants use their answer at time $k = 0$ as a commitment device to discipline future behavior and it is important because our categorization of individuals is based on a comparison between future and immediate effort choices, and hence to get variation in behavior, we do not specifically want to encourage (or discourage) time-consistent behavior.

In our main analysis, we focus on the case were individuals are naive about future present bias at time $k = 0$ when they make their future effort plan.[12] This naivete assumption leaves room for discrepancies between planned future effort from the perspective of time $k = 0$ and actual behavior at time $k > 0$. In contrast, full sophistication at time $k = 0$ implies fully time-consistent behavior.[13]

Solving the problem in Equation (2.2) for $k = 0$ (when assuming naivete at time $k = 0$) involves doing a number of pairwise comparisons of the discounted cost of exerting effort at $t \in \{1, 3, 5\}$. Since subjects are making the plan at time $k = 0$, all effort costs and payments are in the future and hence β is irrelevant. Table 2.1 summarizes the conditions generated by the pairwise comparisons:

[12]This is in line with Augenblick & Rabin (2018) who identify the present-bias parameter β from a comparison between immediate and future effort choices but elicit sophistication as captured by $\hat{\beta}$ from *incentivized* predictions about future effort. The assumption is also supported by their empirical results which suggest limited sophistication regarding future effort

[13]If the women are sophisticated about their present bias at time $k = 0$, the analysis is somewhat more complicated as the individual then takes into account that even if she would like to complete the task on a particular day from the perspective of time $k = 0$, when she arrives at that particular day, she may procrastinate due to her present-bias. A fully sophisticated individual will realize this and will therefore correctly estimate when she will actually do the task (which may not be equivalent to the optimal date from the $k = 0$ perspective). Therefore an individual who is fully sophisticated at time $k = 0$ will behave in a time-consistent way and act exactly as planned (even though she is present-biased)

Table 2.1: Planned Future Effort

	Timing optimal		Participation constraint
$t = 1$ if	$\delta^2 > \frac{2}{3}$	and	$\delta^6 \geq \frac{1}{5\phi}$
$t = 3$ if	$\delta^2 \in \left[\frac{3}{5}; \frac{2}{3}\right]$	and	$\delta^4 \geq \frac{3}{10\phi}$
$t = 5$ if	$\delta^2 < \frac{3}{5}$	and	$\delta^2 \geq \frac{1}{2\phi}$
Plan not doing it			if none of the above hold

Notes: The table gives conditions under which the alternative possible timings are optimal perspective of period $k = 0$ if individuals are exponential discounters or naively present-biased at $k = 0$. Further details are provided in the appendix.

Table 2.1 clearly shows that a participant may plan not to do the task, if the participation constraints are not satisfied, e.g. because the exchange rate ϕ is such that the wage paid is insufficient. If at least one of the participation constraint holds, then the anticipated optimal timing for the effort only depends on the size of her exponential discount factor, δ. A participant with a low level of patience (i.e. a low δ) will plan to do the task later. Therefore, the plan revealed in the first part of the experiment can (if we assume naivete or standard exponential discounting at time $k = 0$) be used to classify the individual as a High or Low Discounter.[14] We will classify participants as Low Discounters if they anticipate doing the task in period $t = 1$ and as High Discounters otherwise.[15]

2.4.2.2 Future vs Immediate Effort Choices: Eliciting Time-Inconsistency

The second part of the elicitation involves comparing the time $k = 0$ plan of future effort to immediate effort choices made in periods $k = 1$, $k = 3$ and $k = 5$, in order to elicit possible time-inconsistency. Solving for the optimal timing in Equation (2.2) for $k = \{1, 3, 5\}$ also amounts to doing a number of pairwise comparisons. However, in contrast to period $k = 0$, we now allow for both sophistication and naivete at time $k \geq 1$ in our analysis. This is to allow for a situation where sophisticated women realize that they may not carry out the task if they delay it, only once they receive the first message about actually doing the task. This situation yields an interesting special case.

Figure 2.2 illustrates the theoretical predictions of planned and actual behavior for different combinations of the parameters δ and β and for different assumptions regarding the level of sophistication of the women.[16] In particular, we consider full naivety ($\beta < \hat{\beta} = 1$) and full sophistication ($\beta = \hat{\beta} < 1$) at time $k \geq 1$. The figure clearly illustrates that planned behavior is determined only by the size of the exponential discount factor δ as discussed in the previous subsection. Actual behavior in contrast depends on both β and δ as well as on the level of sophistication. The light gray areas in Figure 2.2 indicate that the task is carried out as planned. This may happen for a number of reasons: i) people are time-consistent ($\beta = 1$), ii) people are future biased ($\beta > 1$) but to a sufficiently low degree, or iii) people have present-biased preferences ($\beta < 1$) but to a sufficiently low degree or they are sophisticated and do the task on time to avoid a delay which again may imply that the task is not done. The blue shaded areas indicate situations where individuals plan to do the task but fail to do it. This may happen if people have strongly present-biased preferences ($\beta < 1$). Purple areas indicate that the task is carried out with delay which also may happen if people have present-biased preferences. Finally, the green area indicates that the task is carried out earlier than planned which may happen in special circumstances if the individual is present-biased and sophisticated at time $k = 1$ but not at time $k = 0$. Specifically, consider a participant who at time $k = 0$ naively prefers that the task is done at time $t = 3$ over doing it at time $t = 1$ which again is preferred over time $t = 5$. Then, if at time $k = 1$ she still prefers that the task is done but now is willing to delay the task until period $t = 5$, she may realize that if she does delay, the task will end up being delayed to period $t = 5$ where it will not be done. Then it ends up being better to do the task now (i.e. earlier than planned) than to delay. This effect is similar to the result in O'Donoghue & Rabin (1999) that sophistication may make individuals do a task early.

We group participants in our experiment according to this color code as the colors represent different behaviors that can serve as noisy measures of underlying time preferences:

- **On-timers**: According to our model the task is carried out as planned, if people have time-consistent preferences, if they have nearly time-consistent preferences, or in some cases if they have strongly present-biased preferences and are sophisticated about this.

- **Late-or-never-doers**: These are women who are present-biased and possibly naive about it.

- **Early-doers**: These are women who are either future-biased or they have present-biased preferences and are sophisticated about it.

[14] For a fully sophisticated individual the optimal timing anticipated in period $k = 0$ depends not only depend on δ but also on β. This is since actual behaviour depends on both δ and β as illustrated by Figure 2.2. The fully sophisticated individual realizes this and adjusts her time $k = 0$ anticipation to reflect this.

[15] We group participants who anticipate doing the task on day $t = 3$, $t = 5$ or never into High Discounters because we have very few people in our sample who plan to do the task at time $t = 5$ or never.

[16] Further details are in the appendix

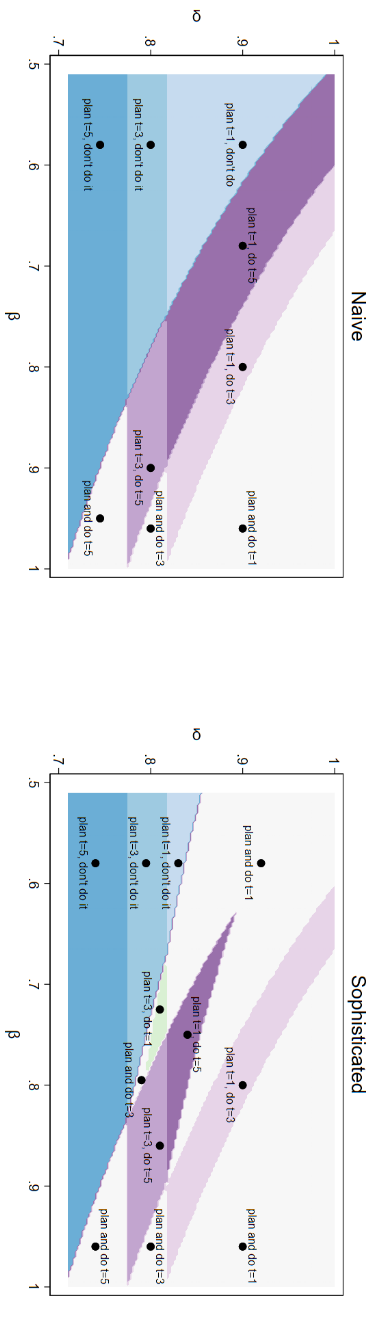


Figure 2.2: Model Implied Planned and Actual Behavior for Different Levels of β and δ

Notes: The figure shows the planned and actual behavior predicted by the $\beta\delta$ model assuming naivite ($\beta < \hat{\beta} = 1$) in the left panel and sophistication ($\beta = \hat{\beta} < 1$) at time $k \geq 1$ in the right panel. For the figure we have set $\phi = 1$.

2.5 Implementation and Sample Selection

The study presented in this paper is part of a larger research project.[17] The data collection took place from the 19th of March to the 29th of June 2019. In total, a sample of 18,400 women was drawn randomly from the population of MomConnect users. We used the following criteria: i) on the 19th of March 2019, there were between 105 and 130 days until their expected due date, and ii) the women were 18 years or older. We sampled from the entire country and did not place a restriction on language. We have information on their preferred language, whether they live in an urban or rural area and whether they signed up with a smart phone or an older mobile phone without smart-phone capabilities.

This sample of women received a text-message invitation in English 105 days prior to their estimated due date asking whether they would like to participate in a research study on healthy pregnancy behavior for which they could earn phone credits. In line with our pre-study expectations, approximately 24% (4226) of the contacted women opted in to participate.[18] These women were then randomized into six different treatment arms that were run in parallel. In total, 694 of the women were randomly assigned to the treatment arm relevant for the current paper.

A time-line of their participation can be seen in Figure 2.3. In an initial survey, participants were asked some baseline questions, including how many older children they had and whether they thought iron supplements were important for a healthy mother and child.[19] Fifteen days after opting in to the study, the women received the instructions for the real-effort time-preference task of writing words backwards. A total of 546 participants took part in the time-preference task. Approximately five weeks later, in the final week of data collection for this study, the women were asked to complete a short survey consisting of eight questions including questions about iron intake, iron deficiency and symptoms, perceived difficulty of remembering to take iron supplements, and experienced side effects.[20]

[17]Further details regarding the other treatment arms of this project can be found in the companion paper (Barron et al. 2022).

[18]In a representative text message based survey in Mexico during the N1H1 pandemic, response rates were 5.8%. Studies that provide respondents with free mobile phones, unsurprisingly, usually have higher response rates Pop-Eleches et al. (2011).

[19]In the theoretical framework in Section 2.3, we assume that taking iron supplements has perceived health benefits. Empirically we find support for this as almost all mothers respond that they think that iron supplements are very important in order to be i) a healthy mother and ii) having a healthy baby. On a scale from 0 (not important) to 7 (very important), 94 % of the participants responds with a 5 or higher in each of the two questions (see Figure 2.C.1 and 2.C.2 in the Appendix).

[20]During the period between the time-preference elicitation task and the final survey, the participants also received additional text messages and reminders relating to a healthy pregnancy.

For our main analysis, we limit our sample to women who took part in the time-preference task *and* answered all eight questions of the final survey. This leaves us with a final sample of 480 women.[21]

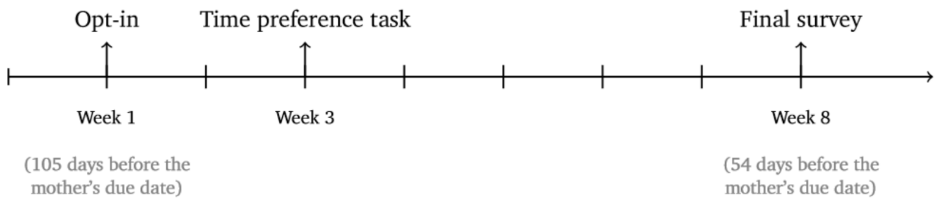


Figure 2.3: Timeline of the Experiment

2.6 Results

2.6.1 Demographics

Table 2.C.1 in the appendices reports some basic demographic information for the individuals in our final sample. The average woman was born in 1992, making her 27 years old at the time of our data collection. Thirty-five percent of our sample has English as their preferred language. Twenty-nine percent of the women live in urban areas and on average the participants have one older child and 12 years of schooling. The table also tests whether there is biased selection on observables into our final analysis sample. In comparison to the full sample of women who opted in, our final sample shows a slightly lower share of urban women. Otherwise, there are no observable differences.

2.6.2 Behavior in the Time-Elicitation Task

Among the 480 women in our final sample, 333 (70%) reported that they planned to do the task on the first day, whilst 69 (14%) and 63 (13%) women answered that they would wait and do it on day 3 or 5, respectively. Fifteen women (3%) stated that they did not plan to do the task. In practice, 432 (90%) of the women

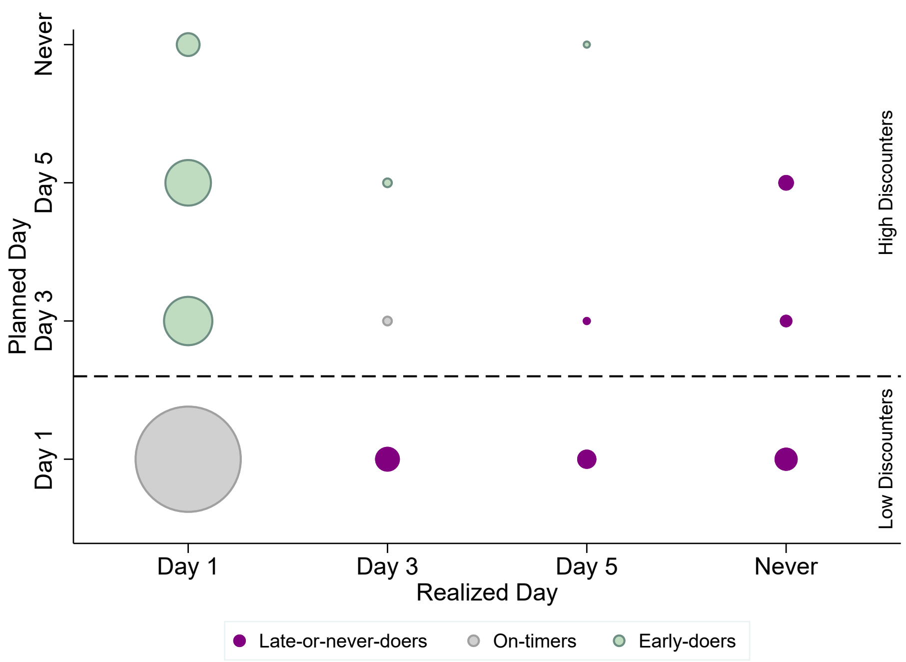
[21]Table 2.C.2 in the Appendix tests for selection on time preferences into the final sample. We elicit time-preferences for 66 women who are not in our final sample because they do not complete the final survey. There are no statistically significant differences between the time-preference measures for the women in the final sample and those not included in the final sample. However, there is a slight over-representation of Late-Doers among the women excluded because of missing survey responses. This would potentially work against finding the hypothesized effect.

actually did the task on the first day.[22] This implies that a large fraction of our sample (121 women) actually did the task earlier than they had planned. Yet, the majority of the women (301 participants) did the task as planned. Only 43 of our participants did the task later then planned or not at all, despite having stated that they would do it.

As discussed in section 2.4.2.1 and section 2.4.2.2 we use this behavior to classify the women in two ways. First, we classify women into Early-Doers, Late-Doers and On-Timers. Second, we classify the women as being either Low or High Discounters based on when they planned to do the task. Individuals that planned to do the task on day 1 are called "Low discounters", while everyone else is labelled "High discounters". Figure 2.4 reports the distribution of women according to the categorizations, showing the On-Timers in grey, the Early-Doers in green and the Late-Doers in purple and Low Discounters below the dashed line while High Discounters are those above the dashed line.

[22]Women got paid independently of whether they made mistakes or not (i.e. they were paid for completion as opposed to being fully correct). We chose this implementation in order to avoid that women who completed the task nearly perfectly (e.g. using capital letters instead of lower case letters) did not get payed, and to avoid discriminating against women with learning difficulties. We do not view this as deception as participants were told that payment depended on completion of the task, and not that "completion" required everything to be completely correct. Our programming was very strict in terms of what was considered a mistake. A comma sign between words or the use of a capital letter would being classified as mistakes. Therefore, a fifth of our sample, was classified as having mistakes. In order to not lose too much power, we therefore classify women as doing the task if they attempted to do the task on a particular day, irrespective of whether it was recorded as correct or not.

Figure 2.4: Categorization



Notes: Markers weighted by observations (size), colored using indicators of present-future bias.

By the construction, an individual cannot be classified as both a Low Discounter who plan to do the task on the first possible day and as an Early-Doer. At the same time, since many of our participants chose to do the task on the first day, 136 out of 147 High Discounters are also classified as Early-Doers. This means that the High Discounter and Early-Doer groups are nearly overlapping. Therefore we focus on the High Discounters and Late-Doers in our empirical analysis.

2.6.3 Self-reported Adherence

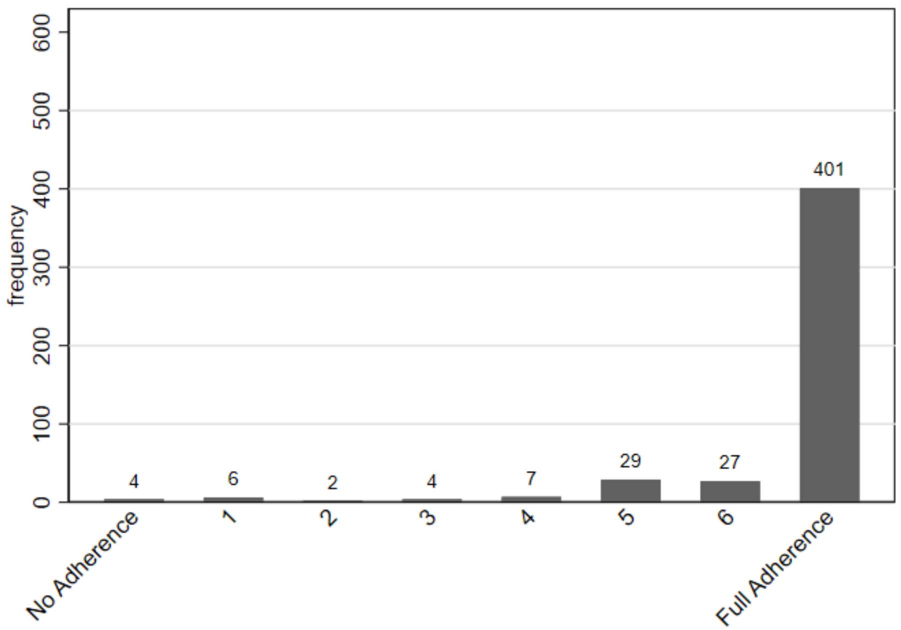
Our main outcome variable is self-reported adherence. The variable is measured as a response to the question: "How many days did you take your iron pills last week? (1–7)". We ask about the past week, rather than about the entire pregnancy, because imperfect and motivated recall becomes more of an issue when asking individuals to report outcomes from a longer time window. It is a common practice in surveys to use short, recent time intervals in order to avoid recall bias.[23] However, it is important to keep in mind that even when considering

[23]For example in time-use and household-expenditure surveys. For a discussion of the pros and cons of different recall lengths in the domain of health, see, e.g. Clarke et al. (2008) and Stull et al. (2009).

the shorter period of a week, taking an iron pill on a particular day may not be a particularly memorable moment, and self-reported medication adherence should therefore be seen as a proxy for actual adherence. In addition, research suggests that self-reported estimates tend to be upward biased (Wilson et al. 2009). However, self-stated measures of medication adherence are widely used in the the literature and have been found to correlate strongly with objective measures.[24] This suggests that the over-reporting shifts the measured distribution of adherence to the right, but remains informative regarding the relative adherence of different individuals (i.e. regarding who adheres more and who adheres less). Stated adherence thus provides a good proxy of the variation in adherence, even if the level effects should be viewed with caution. Since the mothers could not have anticipated this question in that particular week, the measurement should be representative of the average week during the pregnancy.

[24]See for example the review of HIV medication adherence by Simoni et al. (2006) who find significant correlations between individual's self-reported adherence and virus levels in 85% of the reviewed studies. Note that this is found despite large differences in the recall period used across studies. Seven days is the most common recall period, but recall periods may be up to 6 months long. In addition, more recent studies, such as Marrone et al. (2016) also find strong correlation between stated medication adherence and virus load among HIV positive patients when asking patients about the number of pills a patient missed in the last 7 days.

Figure 2.5: Iron Intake Last Week



Notes: The figure reports the distribution of the answers to the question: *How many days did you take your iron pills last week? 0 to 7.* In total 79 out of the 480 respondents reported missing at least one of their iron pills.

Figure 2.5 reports the distribution of self-reported adherence, showing that individuals in our sample tended to display a high degree of adherence to their iron supplements, with only 79 out of 480 reporting that they did not take their iron pills on every day during the preceding week.

2.6.4 Hypothesis Testing

The central question that we ask in this paper is whether we can use elicited time preferences from an extremely simple, low-cost, real-effort task to predict which individuals will be more likely to adhere to their iron supplements.

2.6.4.1 The Relationship between the Discount Factor and Adherence

Our first hypothesis is that self-reported adherence is increasing in the discount factor δ, i.e. women who discount future effort more are more likely to delay and therefore less likely to take their supplements. We investigate this question in Table 2.2. The first column reports the results from an OLS regression, showing the relationship between the number of pills taken during the last week and whether

an individual is classified as a High Discounter according to our time-preference task.[25] In line with the hypothesis, we find that High Discounters take fewer pills than Low Discounters, with results being significant at the 5% level. In columns 2 and 3, we provide an additional test of this hypothesis. Since the key distinction in adherence behavior appears to be between full adherence (i.e. taking the pills on all seven days) and partial adherence (i.e. taking pills on fewer than seven days), we construct a binary variable that reflects whether an individual missed an iron pill on at least one day, or not. Replacing the continuous outcome variable with this binary outcome variable, columns 2 (OLS) and 3 (Logit) provide further support in favor of the hypothesis, showing that High Discounters are more likely to be partial adherers. Being a High Discounter is therefore significantly correlated with not fully adhering to the prescribed medication plan.[26]

Table 2.2: Adherence and High vs Low Discounters

	OLS Nr of Pills (1)	OLS Missed Pills =1 (2)	Logit Missed Pills =1 (3)
High Discounters	-0.267**	0.082**	0.573**
	(0.126)	(0.039)	(0.256)
Constant	6.779***	0.111***	-2.045***
	(0.070)	(0.025)	(0.222)
Failure Dummy	Yes	Yes	Yes
Observations	480	480	480
R^2	0.016	0.014	

Notes: Regressions include the 480 participants that answered all eight questions of the final survey. Missed Pills =1 is a dummy variable which is 0 if the participant reported having taken all 7 pills last week, and which is 1 if she missed one pill or more. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Failure Dummy is a dummy for technical problems leading to payment delay. Regressions include the 480 participants that answered all eight questions of the final survey. robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

[25] For some women, there was a payment failure after they finished the time-preference task. Because of an error in the code, they only received their payment for the task a few days later. We therefore control for this payment failure in all regressions. The failure cannot have had an effect on the time-preference task, but it could plausibly affect the motivation to answer questions in later stages of the experiment.

[26] We conducted several exercises to test the robustness of this result to the inclusion of additional covariates. Table 2.C.6 in the appendices reports these results and shows that the estimates are robust to adding a measure of self-reported risk aversion, controlling for the respondent's language, and controlling for their education level. The results are also robust when excluding participants who did not anticipate doing the task (see Table 2.C.8 in the Appendix).

2.6.4.2 The Relationship between Time-Consistency and Adherence

Our second hypothesis is that adherence is lower for individuals who display time-inconsistent delay. To examine this hypothesis, Table 2.3 examines the relationship between adherence behavior and discounting, including our type classification of individuals as Late-Doers. Columns 1a and b show that the effect for High Discounters shown above is robust to the inclusion of the Late-Doer dummy. In addition, the point estimates for the Late-Doers dummy are consistent with our hypothesis that people who plan to do the time-preference task early, but then procrastinate or fail to do it, take fewer pills and are more likely to have missed a pill. However, these effects are neither significant in regressions for the full sample, nor in regressions using the sub-samples of High and Low discounters, respectively (see columns 2a, 2b, 3a, and 3b). One potential explanation for the lack of significance is the unanticipated low degree of variation in the outcome variable which reduced the power of or the analysis. [27]

In table 2.C.5 in the appendix, we also show the same regressions as in table 2.3, but including also the Early-Doers as an explanatory variable. As mentioned earlier, there is a large overlap between the Early-Doer and High Discounter groups in our sample. Therefore, it is no surprise that table 2.C.5 does not display any significant relations between being an Early-Doer and adherence.

[27] These results are robust to excluding participants that stated that they did not think they would do the task (see Table 2.C.8 and 2.C.9 in the Appendix), and are also robust to controlling for risk preferences (see Table 2.C.7 in the Appendix).

Table 2.3: Discounting, Late Doers and Adherence

	Full Sample	Full Sample	High Discounters	High Discounters	Low Discounters	Low Discounters
	OLS	OLS	OLS	OLS	OLS	OLS
	Nr of Pills	If Missed Pills	Nr of Pills	If Missed Pills	Nr of Pills	If Missed Pills
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
High Discounters	-0.286**	0.086**				
	(0.128)	(0.039)				
Late Doers	-0.383	0.074	-1.269	0.262	-0.140	0.022
	(0.237)	(0.064)	(0.821)	(0.174)	(0.189)	(0.065)
Constant	6.837***	0.099***	6.635***	0.176***	6.803***	0.102***
	(0.074)	(0.027)	(0.110)	(0.045)	(0.074)	(0.028)
Failure Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	480	480	147	147	333	333
R^2	0.025	0.017	0.054	0.024	0.010	0.008

Notes: Results in column 1a and 1b are shown for the 480 participants who have done the full survey and use the full information on all attempts to do the task at any of the possible days. Column 2a-2b and 3a-3b show results using the subsamples of High discounters and Low discounters, respectively.
High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it.
Missed Pills =1 is a dummy variable which is 0 if the participant reported having taken all 7 pills last week. OLS Regressions.
Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

2.7 Heterogeneous Effects and Robustness

This section further explores the interpretation and robustness of the results above. To do this, we examine the role played by external circumstances and personal characteristics.

2.7.1 The Role of "Busyness"

One question that might come to mind is whether our results are driven by time preferences or simply by the fact that some women are busier than others. It may be the case that our simple time-preference task is providing a measurement of how busy and cognitively constrained mothers are in their everyday lives, as opposed to being a "clean" measure of time preferences.[28]

To investigate this, we approximate busyness in three ways. First, throughout their pregnancy, the mothers receive multiple messages as part of the larger experiment which they are asked to respond to. One might expect that women who are busier, in general, would take a longer time to answer these messages. Second, the timing of messages depends on the individual estimated due date of each expectant mother. Since the women have different due dates that are as good as random, they receive the same message on different days of the week. This provides us with exogenous variation in which day of the week a given message is received. We can use this variation to examine the role of being busy under the assumption that busyness varies between weekdays and the weekend. Lastly, it is plausible that women who already have kids at home might be busier than those who are pregnant with their first child. We use each of these three measures of busyness to provide evidence about whether busyness is a central mechanism driving our results.

First, we examine how quickly the expectant mothers replied to other messages, unrelated to the time-preference task. At the end of the first week after signing up for the study, participants received an incentivized text message asking them to reply with the first 4 digits of their ID number. This was nine days before the time-preference task and the purpose of the question was to see if the participant was still actively engaged and responsive in the study.[29] Table 2.C.10 in the Appendix shows that there is no correlation between answering the text

[28] However, it is worth noting that in the domain of effort, it is not obvious that one can cleanly delineate the concept of time preferences from the busyness of that individual's life (i.e. from the various demands placed on time and mental capacities). Nor is it clear that it is always preferable to have a measurement of time preferences over effort that completely abstracts away from the context of their everyday life.

[29] This task was also designed to allow us to check whether the cellphone number remained associated with the correct person throughout the study.

message in the first hour or not answering at all and on the other hand when they planned to do, or actually did the time-preference task. We take this as evidence that our time-preference task is not driven by a general state of being busy when receiving the texts.[30]

Second, we examine whether the day-of-the week of receiving the message informing them about the time-reference task influenced their anticipated or actual behavior in the task. For some women, Day 1 falls on a Friday, Day 3 on a Sunday, and Day 5 on a Tuesday. If a woman is less busy on weekends, then she might decide to do the task on Sunday (i.e on day 3), thus looking like a High Discounter to us. However, Table 2.C.11 in the appendices investigates if there is any difference in planning or completion of the task, depending on the day that the task was received. Doing so, Table 2.C.11 find no significant day-of-the-week differences in any of the outcomes from the time-reference task, indicating that this is not a large concern in this setting.

Third, we replicate our regressions from Table 2.2 and 2.3, but now include "number of kids" as a control (see Tables 2.C.12 and 2.C.13 in the appendices.) The "number of kids" is in itself not significant, except for in column 3a and 3b in Table 2.C.13 for the sub-sample of Low discounters. In these regressions, mothers with more kids report higher adherence. However, these exercises also show that our main results on time preference remain unchanged when the "number of kids"variable is included. Overall, these results indicate that individual heterogeneity in general "busyness" of the expectant mothers is not the primary driver of our results.

2.7.2 Self-Perception of Recall Difficulty

One mechanism that could be driving our results is that there is heterogeneity in the ease with which different women are able to remember to take their medication. To explore this, we use the answers to one of the survey questions in which we asked mothers to report whether they found it difficult to remember to take their iron supplements: *"Do you find it difficult to remember to take the iron pills?" Yes or No.* In Table 2.4, we examine whether this recall difficulty variable is related to our time-preference measures. The results show that High Discounters are more likely to report that they found it difficult to remember to take their iron supplements (Column 1). These results are robust when including *Late-doers* (Column 2). Although the sign is consistently positive, and in line with thinking that *Late-doers* also find it harder to remember to take their iron supplements, these results for *Late-doers* are not significant in any specification.

[30] All text messages in this experiment were sent out at 7.00 AM.

Table 2.4: Self-Reported Recall Difficulty

	Full Sample Difficult to remember (1)	Full Sample Difficult to remember (2)	High Disc. Difficult to remember (3)	Low Disc. Difficult to remember (4)
High Discounters	0.076**	0.081**		
	(0.033)	(0.033)		
Late Doers		0.091	0.099	0.088
		(0.058)	(0.144)	(0.063)
Constant	0.054***	0.040**	0.117***	0.043**
	(0.020)	(0.020)	(0.040)	(0.019)
Failure Dummy	Yes	Yes	Yes	Yes
Observations	480	480	147	333
R^2	0.017	0.024	0.009	0.015

Notes: Results in column 1 and 2 are shown for the 480 participants who have done the full survey and use the full information on all attempts to do the task at any of the possible days. "Disc." is short for Discounters. Column 3 and 4 show results using the subsamples of High discounters and Low discounters, respectively. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it. Difficult to remember is a dummy variable where 1 indicates that the participant thinks that remembering her iron pills is difficult, and 0 that she does not find it difficult. OLS Regressions. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

These results provide support for our main results as they show that in addition to being predictive of adherence outcomes, our High-discount measure is also related to measurements of recall difficulty. One further interesting implication of these results is that they point towards a potential relationship between time preferences in the effort domain and recall difficulty – individuals think that they will wait with doing the task also report finding it more difficult to remember to do tasks that involve exerting effort.

However, it is important to keep in mind potential caveats to the results reported in this table. While the measurement of recall difficulty was completed several weeks after the time-preference task, it was completed at the same time as subjects self-reported their iron intake during the previous week. Therefore, cognitive mechanisms could induce subjects who reported missing taking iron pills during the previous week to inflate their statements regarding the recall difficulty in comparison to individuals who reported taking their iron pills every day. In particular, a preference for consistency, excuse-driven behavior or ex-post justification could induce a correlation between the two measurements (iron intake and recall difficulty). While this is not an issue for our main results, it is a potential alternative explanation for the results in Table 2.4. Nevertheless, in spite of this caveat, we view these results to be supportive of our main results and also point towards an interesting possible relationship between memory and time preferences that warrants further investigation.

2.7.3 Schooling and Language

In this section, we explore whether educational factors could play a role in generating the relationship between time preferences and adherence that we observe. This would be the case, for example, if education influenced both measured time preferences and adherence.

While the task required no special knowledge of the English language it is plausible that those with more years of schooling and those who have English as their preferred language found it easier to complete the task, which might have affected their willingness to complete the time-preference task. For example, Golsteyn et al. (2014) find that 13-year-old adolescents' time preferences correlate strongly with their later school attainment and one could also hypothesize the opposite causality that schooling could affect elicited time preferences.

In terms of adherence it is also plausible that individuals with more education display different adherence behavior. Research by Nielsen et al. (2019) on Danish children diagnosed with type 1 diabetes finds that maternal education is strongly correlated with their child's metabolic control, which in turn depends strongly on adherence. This suggests that more educated mothers find it easier to follow the doctors' recommendations.

In our sample, 42% of participants report having completed 12 years of schooling, which is the length of South African primary and secondary school. However, it is also important to note that there is a high rate of repetition in South African schools, so completing 12 years of schooling often does not imply that the individual completed secondary (high) school (see, e.g, Lam et al. 2011, Branson et al. 2014, Van der Berg et al. 2019). In terms of the distribution, 34% report having completed more than 12 years of schooling and 25% report having less than 12 years of schooling. In Tables 2.C.6 and 2.C.7 in the appendix, we replicate our main regressions including years of schooling. While only being significant on the 10% level, our results are still in line with those of Nielsen et al. (2019); mothers with more years of education display better adherence. This is interesting in view of the fact that our study takes place in a completely different context to that of Nielsen et al. (2019). Our results gives suggestive evidence that women with higher education take more pills and are less likely to miss pills, compared to women reporting lower levels of education. Looking at the High discount variables, we see that the directions of the coefficients remain consistent with our main results, but lose some significance. This is likely to be explained by the intertwined relationship between time preferences and schooling. Interestingly, the coefficient signs for *Late-doers* stays consistent, but the significance level is increased when adding the variable for education. Column 3 in Table 2.C.7 in the appendix shows that *Late-doers* reports to have taken fewer iron pills the past week, compared to other participants. The results are significant on the 10% level.

Tables 2.C.6 and 2.C.7 in the appendix also show that women who reported English as their preferred language are less likely to report that they missed pills. However, the inclusion of these variables does not affect our main results.

2.7.4 Health Outcomes

Health outcomes are difficult to measure in our setting and while it was not the main focus of the paper, we nevertheless elicited several self-reported indicators of iron deficiency in the survey. We find no relationship between being a High Discounter in the effort task and the stated level of iron in the blood as confirmed by a doctor (Table 2.5, columns 1–3). We also find no significant estimates for the question "How many days did you feel very tired or dizzy last week? Please reply a number from 0 to 7." (columns 4–6). This is not surprising because feeling dizzy or tired during pregnancy could result from a number of causes and is thus only indicative of low iron in the blood. With one exception, there is also no significant

relationship between being a Late-Doer and the stated health measures. Column 3 shows that in the sub-sample of High Discounters, Late-Doers are less likely to report that they have low iron levels. [31] Given that the results only hold in this sub-sample, they do not lead to a general conclusion.

[31] Table 2.C.14 in the appendix show that these surprising results are not driven by the 40 people in the reference group who answer "Don't know", when asked if they have low iron levels. The results are reduced in size but the negative sign and coefficient for Late-Doers in the High Discounting subgroup holds when excluding the women who say "Don't know" from the sample.

Table 2.5: Health outcomes

	Full Sample Low Iron (1)	Full Sample Low Iron (2)	High Discounters Low Iron (3)	Low Discounters Low Iron (4)	Full Sample Tired/Dizzy (5)	Full Sample Tired/Dizzy (6)	High Discounters Tired/Dizzy (7)	Low Discounters Tired/Dizzy (8)
High Disc.	0.024	0.023			0.244	0.264		
	(0.032)	(0.032)			(0.175)	(0.175)		
Late Doers		-0.016	-0.117***	0.011		0.388	0.742	0.292
		(0.049)	(0.034)	(0.061)		(0.309)	(0.695)	(0.344)
Constant	0.109***	0.112***	0.113***	0.125***	2.130***	2.070***	2.343***	2.060***
	(0.025)	(0.027)	(0.037)	(0.030)	(0.131)	(0.135)	(0.203)	(0.147)
Failure Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	480	480	147	333	480	480	147	333
R^2	0.003	0.003	0.012	0.008	0.008	0.012	0.013	0.009

Results in column 1-2 and 5-6 are shown for the 480 participants who have done the full survey and use the full information on all attempts to do the task at any of the possible days. "Disc." is short for Discounters. Column 3 and 7 show results using the subsample of High discounters and column 4 and 8 show results for the subsample of Low discounters. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Tired or Dizzy is a measure from 0 to 7 of how many days last week the participant felt tired or dizzy. Low Iron Levels is a dummy variable where 1 indicates that a person does have low iron levels and 0 does not have low iron levels, had low iron levels before or don't know. OLS Regressions. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

2.8 Conclusion

In recent years, there has been a shift in health care towards a greater focus on prevention rather than treatment (Centers for Disease Control and Prevention, (CDC) 2009). Treating illness is more resource intensive and less effective than preventing illness. While in medicine, research concentrates on genetic research and biomarkers to predict susceptibility to particular illnesses, behavioral science can complement these approaches when it comes to illnesses that are behavior based rather than genetic or a combination of both. Thus, from a health policy perspective being able to predict health behavior and to intervene before problems arise is an important step towards improving health care and reducing long-term costs.

In this paper, we show that time-preferences correlate with medication adherence. In a field study with a final sample of 480 pregnant women in South Africa, we show that our low-cost and simple time-preference elicitation task allows us to predict self-reported adherence rates, even in a sample that shows little overall variation in reported adherence. Women who plan to delay completing the time-preference task are less likely to have full medication adherence compared to those who plan to do the task at the earliest possible time. There is some indication that women who are time-inconsistent are also less likely to take iron pills every day.

Our findings suggest limited predictive power of demographic observables which include where the women live, their age, and the number of older kids. Yet, in many cases health campaigns will target individuals based on such observables.

Reviewing randomized control trials aimed to improve medical adherence, Kini & Ho (2018) recommend patient education, medication regime management, clinical pharmacist consultation, cognitive behavioral therapy, medication-taking reminders, and incentives to promote adherence. The authors raise concerns about feasibility and scalability due to the high costs of a number of these interventions. One way to address cost concerns is to improve the screening process to exclude people with low expected effect from the treatment.

In this paper, we show that the minority of participants who expect themselves to procrastinate an effort task, who we classify as High discounters, are much more likely to later report problems with their medication adherence. These are the types of participants who should be targeted in order to achieve cost-effective interventions.

Better predictions of adherence enables better ex-ante policy targeting. This may be of key importance when it comes to reducing the annoyance cost or even backlash an intervention may cause among individuals who do not need the intervention and feel distracted and annoyed by unnecessary interventions and nudges. Previous studies on nudging and generic health campaigns, usually nudged everyone in the same way. With effect sizes of around 2–8% in most nudging studies, this means that many individuals were nudged without changing their behavior (DellaVigna & Linos 2020). Combining diagnostic tools with nudges or other behavioral interventions could improve the effectiveness of nudges in heterogeneous populations. A recent paper by Campos-Mercade et al. (2020) took a similar approach to ours by showing that prosociality, as measured in an incentivized game, predicts adherence to health recommendations during a pandemic.

Individual level data from time preferences experiments has already been used successfully to optimize work contracts for health care workers giving out polio vaccine in Pakistan Callen et al. 2018. Similar techniques could be used to address health care interventions in other settings as well. Our low-cost diagnostic measurement tool that can be implemented over basic text messages might be especially beneficial for use in developing countries where people might have infrequent access to their health care providers and non-adherence might be harder to detect in time. In several countries (such as India or Kenya), similar mHealth communication systems to MomConnect already exist to improve the health of women and children. In our sample, sorting the women in high and low discounters was sufficient to predict whether they would adhere to their medication several weeks later. This is good news for policy makers, as it simplifies the procedure compared to eliciting present-bias or other forms of dynamic inconsistency. While the elicitation of precise estimates for $delta$ and $beta$ has its place in the literature, the practical application of using preferences as a diagnostic tool in preventive healthcare will depend on the ease with which it can be implemented and understood by policy makers.

This paper is a first step in the direction of developing more targeted nudges based on individuals' preferences and characteristics, such as patience. Further research should test our tool or similar tools in a variety of health settings.

Appendices 2

Index

A. Text messages in the Effort Task
B. Technical Appendix for the Interpretation of the Time-Preference Task
C. Tables and Figures

2.A Text messages in the Effort Task

Day 0

MCN: Up for a word task?
Earn airtime by writing words backward like this:
baby, parent = ybab, tnerap
Complete the task and get R20 in 7 days time.
The sooner you do it, the easier it is.
You choose when to do it:
Do it tomorrow (1 day) - write 4 words
Do it in 3 days - 6 words
Do it in 5 days - 10 words.
We will send you words tomorrow.
In how many days do you think you will answer?
Reply "1" "3" "5" or "No days".
Receive R5 now for this answer.
For more info, text MORE.

MCN is an acronym which signals to the mothers that the text comes from Mom-Connect. If the mother Reply "1" "3" "5" or "No days" she gets the following text:

You will now receive R5 for answering.
Tomorrow you will receive words to write backwards

If the mother replies with the word "MORE" she also receives the following information:

In this question, we ask when you think you will write words backwards.
We do this to investigate the importance of timing when doing tedious tasks.
Reply "1" "3" "5" or "No days" and receive R5 today for this answer.
In the following days, we'll send you the words.
If you write them backwards, you will get R20 in a week's time.

Day 1

MCN: Please reply by writing these 4 words backwards:
baby, parent, bottle, mom
Do it today and get R20 airtime in 6 days' time.
If you don't do it today, you get another chance if
you reply to a text in 2 days with 7 words to write backwards.

If the mother replies with the words written backwards she receives the following information:
Thank you, you will receive R20 in airtime in 6 days.

Day 3

MCN: Please reply by writing these 6 words backwards:
baby, parent, bottle, mom, sleep, child.
Do it today and get R20 airtime in 4 days' time.
If you don't do it today, you get another chance if
you reply to a text in 2 days with 10 words to write backwards

If the mother replies with the words written backwards she receives the following information:
Thank you, you will receive R20 in airtime in 4 days.

Day 5

MCN: Please reply by writing these 10 words backwards:
baby, parent, bottle, mom, sleep, child, play, love, dad, happy.
Last chance to do the task for your R20 airtime in 2 days' time.

If the mother replies with the words written backwards she receives the following information:
Thank you, you will receive R20 in airtime in 2 days.

Day 7

If the mother replies with the words written backwards at any of the days of the experiment, she receives the following information:
MCN: You will now receive your R20 for the word task you did. Have a great day!

2.B Technical Appendix for the Interpretation of the Time-Preference Task

This appendix provides the technical details related to the interpretation of future and immediate effort choices in the time-preference task.

Preferred Behavior at Time $k = 0$

Assuming that the individual is naive about possible present bias at time $k = 0$, the table below provides conditions for when the different possible timings are preferred from the point of view of time $k = 0$. That is given the discount factor δ these are the plans the individual would like to implement ex ante if possible.

Table 2.B.1: Pairwise Comparisons and Conditions for Optimality at $k = 0$

	Preferred to $t = 1$	Preferred to $t = 3$	Preferred to $t = 5$	Preferred to never
$t = 1$		$\delta^2 \geq \frac{2}{3}$	$(\delta^4 \geq \frac{2}{5})$	$\delta^6 \geq \frac{1}{5\phi}$
$t = 3$	$\delta^2 \leq \frac{2}{3}$		$\delta^2 \geq \frac{3}{5}$	$\delta^4 \geq \frac{3}{10\phi}$
$t = 5$	$(\delta^4 \leq \frac{2}{5})$	$\delta^2 \leq \frac{3}{5}$		$\delta^2 \geq \frac{1}{2\phi}$
Never	$\delta^6 < \frac{1}{5\phi}$	$\delta^4 < \frac{3}{10\phi}$	$\delta^2 < \frac{1}{2\phi}$	

Notes: conditions in brackets are implied by other conditions in the row and are thus never binding.

Deriving Actual Behavior at time $k > 0$

This section derives optimal behaviour in periods $k = 1$, $k = 3$ and $K = 5$. Consider the behavior of an individual with present-biased preferences. We solve the problem backwards as the sophisticated agent would do.

Period $t = 5$

When period 5 arrives $k = 5$ the agent will do the task if the participation constraint is satisfied i.e. if

$$\beta\delta^2 \geq \frac{1}{2\phi} \tag{2.B.1}$$

Consider an individual who planned to to the task in period $t = 5$. Recall that for these individuals $\frac{3}{5} > \delta^2 \geq \frac{1}{2\phi}$ if they are time consistent or naive at time $k = 0$. For individuals with time-consistent preferences ($\beta = 1$), the participation constraint in Equation (2.B.1) is identical to the original participation constraint and it is satisfied for anyone who planned $t = 5$. For people who are present-biased($\beta < 1$) and naive ($\hat{\beta} = 1$) at time $k = 0$, the participation constraint may

not be satisfied if β sufficiently low even if the individual originally planned to do the task at time $t = 5$. Note that when δ is close to the lower bound in the interval $I_5 = [\frac{1}{2\phi}; \frac{3}{5}]$ and the individual thus planned to do the task at time $t = 5$ then a β just below unity is sufficient to violate the participation constraint in Equation (2.B.1). If δ is close to the upper bound in I_5 then a smaller value of β is required for violations of Equation (2.B.1). For an individual with future bias ($\beta > 1$), the participation constraint may be satisfied now even if it was not satisfied at the planning stage ($k = 0$) and the individual may therefore do the task even if she did not plan to do it (i.e. women with $\delta < \sqrt{\frac{1}{2\phi}}$ may now do the task).

Period $t = 3$

When period 3 arrives, i.e. $k = 3$, the individual does the task in period $t = 3$ if

$$\beta\delta^4 \geq \frac{3}{10\phi} \text{ and } \beta\delta^2 \geq \frac{3}{5} \tag{2.B.2}$$

or if

$$\beta\delta^4 \geq \frac{3}{10\phi} \text{ and } \beta\delta^2 < \frac{3}{5} \text{ and } \hat{\beta}\delta^2 < \frac{1}{2\phi}. \tag{2.B.3}$$

In Equation (2.B.2), the first inequality ensures that the individual prefers that the task is done now to not at all and the second inequality ensures that the individual prefers doing the task now to delaying to time $t = 5$. These are the conditions that are required to ensure that the individual prefers doing the task at time $t = 3$. We can compare this to the conditions for planning at time $k = 0$ to the the task at $t = 3$. For women who are time-consistent or naive at time $k = 0$, such a plan implies that $\delta^2 \in \left[\frac{3}{5}; \frac{2}{3}\right]$ and $\delta^4 \geq \frac{3}{10\phi}$ (see in Table 2.1). A time-consistent individual thus also carries out the task as planned if she planned to do it at time $t = 3$. However, the conditions in Equation (2.B.2) may not be satisfied for an individual with present-biased preferences ($\beta < 1$) even if she originally (naively) planned $t = 3$ and as a result she may delay the task. This may either happen because the individual no longer prefers that the task is done (the first inequality is not satisfied) or because the individual prefers that the task is done in the next period. Realizing this the woman may also do the task in period $t = 3$ if she knows that by postponing she risks that she will never actually do the task even if she prefers doing the task now at time $t = k = 1$ to never doing it. This is captured by the conditions in Equation (2.B.3). The first inequality in Equation (2.B.3) ensures that the individual prefers that the task is done now to not at all and the second inequality implies that she would prefer to delay to the next period while the third inequality states that the individual predicts that the task will not be carried out if it is delayed. Clearly a smaller $\hat{\beta}$ makes is more likely that the second inequality is satisfied. Intuitively the stronger the predicted future present bias the less likely it is that the women will predict that the task will be done in period $t = 5$ if it is delayed. For an individual who is naive about her future present bias at time $k = 3$ the second inequality reduces to the $k = 0$ non-participation constraint for doing the task in period $t = 5$. For an individual who is sophisticated about her future present bias at time $k = 3$ the condition is equivalent to the actual non-participation constraint when $k = 5$ (see above).

Period $t = 1$

When period 1 arrives, i.e. $k = 1$, the individual does the task in period $t = 1$ if

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 \geq \frac{2}{3} \text{ and } \beta\delta^4 \geq \frac{2}{5} \tag{2.B.4}$$

or if

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 < \frac{2}{3} \text{ and } \beta\delta^4 \geq \frac{2}{5} \text{ and } \left(\hat{\beta}\delta^2 < \frac{3}{5} \text{ or } \hat{\beta}\delta^4 < \frac{3}{10\phi}\right) \tag{2.B.5}$$

or if

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 < \frac{2}{3} \text{ and } \beta\delta^4 < \frac{2}{5} \text{ and } \left(\hat{\beta}\delta^2 < \frac{3}{5} \text{ or } \hat{\beta}\delta^4 < \frac{3}{10\phi}\right) \text{ and } \hat{\beta}\delta^2 < \frac{1}{2\phi} \tag{2.B.6}$$

or if

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 \geq \frac{2}{3} \text{ and } \beta\delta^4 < \frac{2}{5} \text{ and } \left(\hat{\beta}\delta^2 \geq \frac{3}{5} \text{ and } \hat{\beta}\delta^4 \geq \frac{3}{10\phi}\right) \tag{2.B.7}$$

The inequalities in Equation (2.B.4) are the conditions that ensure that the individual at time $k = 1$ prefers to do the task now (i.e. at time $t = 1$) rather than to delay to a future period. If this is the case, she does the task immediately.

The inequalities in Equation (2.B.5) are the conditions that describe a situation where the individual at time $k = 1$ prefers that the task is done in period $t = 3$ rather than at time $t = 1$ ($\beta\delta^2 < \frac{2}{3}$) but also prefers doing it in period $t = 1$ to period $t = 5$ ($\beta\delta^4 \geq \frac{2}{5}$). Note that these two conditions also imply that $\delta^2 > \frac{3}{5}$, i.e. that the individual prefers at time $k = 1$ that the task is done at time $t = 3$ to at time $t = 5$. However, when one of the inequalities in the bracket holds she predicts that if she delays to period $k = 3$, she will delay again to time $k = 5$ (and possibly never do the task). Therefore it is better to do the task immediately to avoid unnecessary delay.

The conditions in Equation (2.B.6) ensure that the individual would actually like the task to be done but would prefer that it is done in a later time period ($\beta\delta^2 < \frac{2}{3}$ and $\beta\delta^4 < \frac{2}{5}$) but she predicts that the task will not be done if it is delayed. Therefore it is again optimal to do the task now to avoid delaying and not getting the task done.

Finally, Equation (2.B.7) describes a situation where the individual prefers that the task is done to not at all but prefers at time $k = 1$ that it is done in period $t = 5$ to that it is done in period $t = 1$ ($\beta\delta^4 < \frac{2}{5}$) which again is better than if it is done in period $t = 3$ ($\beta\delta^2 \geq \frac{2}{3}$). Note that these two conditions together also imply $\delta^2 \leq \frac{3}{5}$, i.e. that the individual at time $k = 1$ prefers if the task is delayed from period $t = 3$ to $t = 5$. However, by delaying from period $t = 1$ she predicts that the task will be done in period $t = 3$ rather than delayed to period $t = 5$. Then it is better to do the task now.

For a time-consistent individual with $\beta = \hat{\beta} = 1$ this reduces to

$$\delta^6 \geq \frac{1}{5\phi} \text{ and } \delta^2 \geq \frac{2}{3}$$

We note that the situations captured by Equation (2.B.5)[32], (2.B.6)[33] and (2.B.7)[34], cannot arise (i.e. all inequalities cannot be satisfied simultaneously), as the time-consistent individual will have the same preferences when making decisions at time $k = 3$ and $k = 5$ as she does at time $k = 1$. Therefore she will continue to rank the utility associated with doing the task in the different periods in the same way. As a result, the individual does the task at time $t = 1$ only if the conditions in the equation above satisfied.

For a naive $\beta \neq \hat{\beta} = 1$ the conditions reduce to

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 \geq \frac{2}{3} \text{ and } \beta\delta^4 \geq \frac{2}{5}$$

[32] In particular $\delta^2 < \frac{2}{3}$ and $\delta^4 \geq \frac{2}{5}$ imply $\delta^2 \geq \frac{3}{5}$ which contradicts $\delta^2 < \frac{3}{5}$. In addition, $\delta^4 < \frac{3}{10\phi}$ and $\delta^6 \geq \frac{1}{5\phi}$ imply $\delta^2 \geq \frac{2}{3}$ which contradicts $\delta^2 < \frac{2}{3}$. Hence, the situation cannot arise.

[33] One can show that $\delta^4 < \frac{3}{10\phi}$ and $\delta^6 \geq \frac{1}{5\phi}$ imply $\delta^2 \geq \frac{2}{3}$ which contradicts $\delta^2 < \frac{2}{3}$. At the same time, $\delta^2 < \frac{1}{2\phi}$ and $\delta^6 \geq \frac{1}{5\phi}$ imply $\delta^4 \geq \frac{2}{5}$ which contradicts $\delta^4 < \frac{2}{5}$. Hence, the situation described by Equation (2.B.6) cannot arise.

[34] In particular $\beta\delta^2 \geq \frac{2}{3}$ and $\beta\delta^4 < \frac{2}{5}$ imply $\delta^2 < \frac{3}{5}$ which contradicts $\delta^2 \geq \frac{3}{5}$.

Again the situations captured by Equation (2.B.5)[35], (2.B.6)[36] and (2.B.7)[37] cannot arise (i.e. all inequalities cannot be satisfied simultaneously), as the naive individual (wrongly) *predicts* that he will have the same preferences when making decisions at time $k = 3$ and at time $k = 5$ as a time-consistent individual. Therefore, the individual does the task at time $t = 1$ only if the conditions in the first equation are satisfied because she thinks that she will choose to act as a time-consistent individual in future periods. Note that the conditions in the first equation differ from the comparable conditions for the time-consistent individual because of the present-bias parameter. When $\beta < 1$ the conditions are less likely to be satisfied i.e. it is less likely that a naive individual will do the task in period $t = 1$ compared to a time-consistent individual. In contrast, it is more likely that the conditions will be satisfied if $\beta > 1$ i.e. in the case of future bias.

For a sophisticated individual with $\beta = \hat{\beta} \neq 1$ the conditions reduce to

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 \geq \frac{2}{3} \text{ and } \beta\delta^4 \geq \frac{2}{5}$$

or if

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 < \frac{2}{3} \text{ and } \beta\delta^4 \geq \frac{2}{5} \text{ and } \left(\beta\delta^2 < \frac{3}{5} \text{ or } \beta\delta^4 < \frac{3}{10\phi}\right)$$

or if

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 < \frac{2}{3} \text{ and } \beta\delta^4 < \frac{2}{5} \text{ and } \left(\beta\delta^2 < \frac{3}{5} \text{ or } \beta\delta^4 < \frac{3}{10\phi}\right) \text{ and } \beta\delta^2 < \frac{1}{2\phi}$$

or if

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 \geq \frac{2}{3} \text{ and } \beta\delta^4 < \frac{2}{5} \text{ and } \beta\delta^4 \geq \frac{3}{10\phi}$$

The first condition here is identical to that for naively present-biased individuals. But the remaining conditions do not become irrelevant because the sophisticated individual in contrast to the naive individual realizes that preferences are different in future periods meaning that the ranking of the utility associated with the different timings as well as the participation constraints may not be satisfied in future periods.

[35] In particular $\beta\delta^2 < \frac{2}{3}$ and $\beta\delta^4 \geq \frac{2}{5}$ imply $\delta^2 \geq \frac{3}{5}$ which contradicts $\delta^2 < \frac{3}{5}$. In addition, $\delta^4 < \frac{3}{10\phi}$ and $\beta\delta^6 \geq \frac{1}{5\phi}$ imply $\beta\delta^2 \geq \frac{2}{3}$ which contradicts $\beta\delta^2 < \frac{2}{3}$. Hence, the situation cannot arise.

[36] One can show that $\delta^4 < \frac{3}{10\phi}$ and $\beta\delta^6 \geq \frac{1}{5\phi}$ imply $\beta\delta^2 \geq \frac{2}{3}$ which contradicts $\beta\delta^2 < \frac{2}{3}$. At the same time, $\delta^2 < \frac{1}{2\phi}$ and $\beta\delta^6 \geq \frac{1}{5\phi}$ imply $\beta\delta^4 \geq \frac{2}{5}$ which contradicts $\beta\delta^4 < \frac{2}{5}$. Hence, the situation described by Equation (2.B.6) cannot arise.

[37] In particular $\beta\delta^2 \geq \frac{2}{3}$ and $\beta\delta^4 < \frac{2}{5}$ imply $\delta^2 < \frac{3}{5}$ which contradicts $\delta^2 \geq \frac{3}{5}$.

Optimal Behavior under Different Assumptions

Now let us characterize optimal behavior under different assumptions regarding the individual's time preferences.

Time-Consistent Preferences

First consider the time-consistent individual ($\beta = \hat{\beta} = 1$). She will plan and do the task in accordance with the plan as detailed in the table below.

Table 2.B.2: Planned and Actual Behavior Predicted for Individuals with Time-Consistent Preferences

	Timing optimal		Participation constraint
Plan and do $t = 1$ if	$\delta^2 > \frac{2}{3}$	and	$\delta^6 \geq \frac{1}{5\phi}$
Plan and do $t = 3$ if	$\delta^2 \in \left[\frac{3}{5}; \frac{2}{3}\right]$	and	$\delta^4 \geq \frac{3}{10\phi}$
Plan and do $t = 5$ if	$\delta^2 < \frac{3}{5}$	and	$\delta^2 \geq \frac{1}{2\phi}$
Plan not to do it			if none of the above hold

We note that the participation constraint is what ensure that the utility from doing it in the stated period is positive and the conditions on δ stated under "Timing optimal" are the conditions that ensure that the utility is maximized when the task is done at the specified point in time. Note that it is therefore not possible that for given timing t the conditions for optimal timing are met but the the participation constraint is not met in period t but it is met in a future period. Therefore the conditions above fully describe the optimal choice and behavior of the time-consistent individual.

Present-Bias and Naivete

Now, let's consider the behavior of a naive individual with $\beta \neq \hat{\beta} = 1$. This individual will ex-ante plan to behave exactly as the time-consistent individual but will behave as described by the table below.

Table 2.B.3: Actual Behavior Predicted for Individuals with Naive Time-Inconsistent Preferences

	Timing optimal		Participation constraint
Do $t = 1$ if	$\beta\delta^2 > \frac{2}{3}$ and $\beta\delta^4 > \frac{2}{5}$	and	$\beta\delta^6 \geq \frac{1}{5\phi}$
Do $t = 3$ if	$\beta\delta^2 \in \left[\frac{3}{5}; \frac{2}{3}\right]$	and	$\beta\delta^4 \geq \frac{3}{10\phi}$
Do $t = 5$ if	$\beta\delta^2 < \frac{3}{5}$	and	$\beta\delta^2 \geq \frac{1}{2\phi}$
Don't do it			if none of the above hold

That is the individual may delay doing the task or fail to do the task if $\beta < 1$ in which case she is naively present biased. The individual may do the task early if $\beta > 1$ in which case she is naively future biased. Note, however, that doing the task early is not possible if the individual planned to do the task at time $t = 1$.

Time-Inconsistent Preferences and Sophistication

Now, let's consider the behavior of an individual who is naive at time $k = 0$ and sophisticated at time $k = 1$ that is $\beta \neq \hat{\beta} = 1$ when planning at time $k = 0$ but $\beta = \hat{\beta} \neq 1$ at time $k \geq 1$. This individual will ex-ante plan to behave exactly as the time-consistent individual but will behave as described by the table below.

Table 2.B.4: Actual Behavior Predicted for Individuals with Sophisticated Time-Inconsistent Preferences at time $k \geq 1$

	Timing optimal
Do $t = 1$ if	$\beta\delta^2 > \frac{2}{3}$ and $\beta\delta^4 > \frac{2}{5}$ and $\beta\delta^6 \geq \frac{1}{5\phi}$
or if	$\beta\delta^6 \geq \frac{1}{5\phi}$ and $\beta\delta^2 < \frac{2}{3}$ and $\beta\delta^4 < \frac{2}{5}$ and $\left(\beta\delta^2 < \frac{3}{5} \text{ or } \beta\delta^4 < \frac{3}{10\phi}\right)$
or if	$\beta\delta^6 \geq \frac{1}{5\phi}$ and $\beta\delta^2 < \frac{2}{3}$ and $\beta\delta^4 < \frac{2}{5}$ and $\left(\beta\delta^2 < \frac{3}{5} \text{ or } \beta\delta^4 < \frac{3}{10\phi}\right)$ and $\beta\delta^2 < \frac{1}{2\phi}$
or if	$\beta\delta^6 \geq \frac{1}{5\phi}$ and $\beta\delta^2 \geq \frac{2}{3}$ and $\beta\delta^4 < \frac{2}{5}$ and $\beta\delta^4 \geq \frac{3}{10\phi}$
Do $t = 3$ if	$\beta\delta^2 \geq \frac{3}{5}$ and $\beta\delta^4 \geq \frac{3}{10\phi}$
or if	$\beta\delta^4 \geq \frac{3}{10\phi}$ and $\beta\delta^2 < \frac{3}{5}$ and $\beta\delta^2 < \frac{1}{2\phi}$
Do $t = 5$ if	$\beta\delta^2 < \frac{3}{5}$ and $\beta\delta^2 \geq \frac{1}{2\phi}$
Don't do it	if none of the above hold

An individual who is sophisticated at time $k = 0$ and thus realizes already when asked when she expects to do the task, that she may procrastinate, she will predict her own behavior and the plan will coincide perfectly with the behavior detailed in the table above. That is in this case planned behavior depends not only on her realization of δ but also on her realization of β.

For an individual, who is naive at the time when the plan is made but who becomes sophisticated at time $k = 1$, may delay the task (or fail to do it) if $\beta < 1$ and may do it early if $\beta > 1$ (and if task was not planned for $t = 3$). However, compared to the naive individual, she is more likely to do the task earlier because she is disciplined by her sophistication. This is what is reflected in the additional situations which can lead to task completion in periods $t = 1$ and $t = 3$ compared to those for the naive individual.

Doing It Early: Present-Biased Sophisticates

O'Donoghue & Rabin (1999) show that it is possible that a person who is sophisticated about her present bias at the time when she may choose to do a task, may choose to do the task early compared to a time-consistent individual. In this respect we are interested in showing whether and in what circumstances doing it earlier than planned cannot be rationalized by sophistication at time $k = 1$. Note that sophistication at time $k = 0$ implies that the task is done as planned. It may imply that the task is done earlier than a time-consistent individual would have done but it cannot rationalize doing the task earlier than planned.

To show that sophistication at time $t = 1$ also cannot explain doing the task early, consider first an individual who at time $k = 0$ planned to do the task in period $t = 5$. Then (assuming naivety at time $k = 0$), we know that $\delta^2 \in [\frac{1}{2\phi}; \frac{3}{5})$ for this plan to be optimal. Note that the interval $I_5 = [\frac{1}{2\phi}; \frac{3}{5})$ is non-empty if $\phi > \frac{5}{6}$ i.e. people can only plan to do the task at time $t = 5$ if $\phi > \frac{5}{6}$. By Equation (2.B.3), for someone who is sophisticated (i.e. $\hat{\beta} = \beta$)) doing it at time $t = 3$, i.e. one period early, is optimal if $\beta\phi \in (\frac{3}{10\delta^4}; \frac{1}{2\delta^2})$. This interval is non-empty if $\delta^2 > \frac{3}{5}$ which is never satisfied when $\delta^2 \in I_5$. That is it is never optimal to plan at time $k = 0$ to do the task at $t = 5$ but then at time $k = 3$ choose to do the task at time $t = 3$ instead. Similarly, consider whether the individual might already to the task in period $t = 1$. First, note that Equation (2.B.5) implies that $\delta^2 > \frac{3}{5}$ and therefore this cannot be satisfied. Equation (2.B.7) implies $\delta^2 \leq \frac{3}{5}$ and $\beta\delta^2 \geq \frac{3}{5}$ which is only jointly satisfied if $\beta \geq 1$, i.e. only if the individual is future biased. Finally, Equation (2.B.6) implies $\beta\phi \in (\frac{1}{5\delta^6}; \frac{1}{2\delta^2})$. This interval is non-empty if $\delta^4 > \frac{2}{5}$ which is never satisfied when $\delta^2 \in I_5$. That is it is never optimal to plan at time $k = 0$ to do the task at $t = 5$ but then at time $k = 1$ choose to do the task at time $t = 1$ instead.

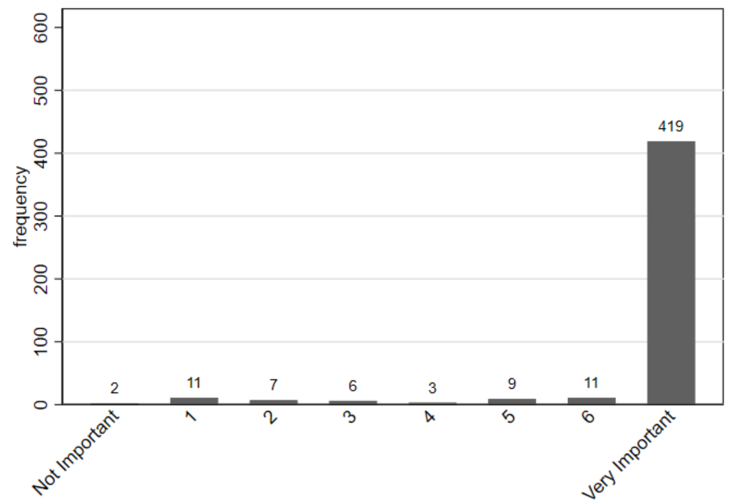
Now consider an individual who at time $k = 0$ planned to do the task in period $t = 3$. Then (assuming naivety at time $k = 0$), we know that $\delta^2 \in I_3 = [\frac{3}{5}; \frac{2}{3})$ for this plan to be optimal. We check whether the conditions for doing it early are satisfied for $\beta = \hat{\beta} < 1$. First, note that in Equation (2.B.5) $\beta\delta^4 \geq \frac{2}{5}$ and $\beta\delta^2 < \frac{3}{5}$ implies $\delta > \frac{2}{3}$ which conflicts with $\delta^2 \in I_3$. In addition, $\beta\delta^6 \geq \frac{1}{5\phi}$ and $\beta\delta^4 < \frac{3}{10\phi}$ implies $\delta^2 > \frac{2}{3}$ which also conflicts with $\delta^2 \in I_3$. Hence, Equation (2.B.5) cannot be satisfied in this case. By the same line of argument, Equation (2.B.7) implies $\delta^2 > \frac{2}{3}$ and thus cannot be satisfied if the plan $t = 3$ is optimal. By the same argument a situation cannot arise where $\beta\delta^4 < \frac{3}{10\phi}$ holds in Equation (2.B.6) when the individual planned $t = 3$. However, it is possible that we jointly have the following conditions:

$$\beta\delta^6 \geq \frac{1}{5\phi} \text{ and } \beta\delta^2 < \frac{2}{3} \text{ and } \beta\delta^4 < \frac{2}{5} \text{ and } \left(\beta\delta^2 < \frac{3}{5} \text{ and } \beta\delta^4 \geq \frac{3}{10\phi}\right) \text{ and } \beta\delta^2 < \frac{1}{2\phi}$$

while we also have $\delta^2 \in [\frac{3}{5}; \frac{2}{3})$ and $\delta^2 \geq \frac{3}{10\phi}$. By similar arguments as above, one can show that $\beta\delta^6 \geq \frac{1}{5\phi}$ and $\beta\delta^2 < \frac{1}{2\phi}$ imply that $\delta^4 \geq \frac{2}{5}$. Hence, the situation can arise when the individual at time $k = 0$ prefers to do the task at time $t = 3$ but also prefers doing the task at time $t = 1$ to doing it at time $t = 5$ and when at time $k = 1$ she instead prefers delaying to either period but knows that if it is delayed to $k = 3$ it will be delayed again and ultimately will not be done.

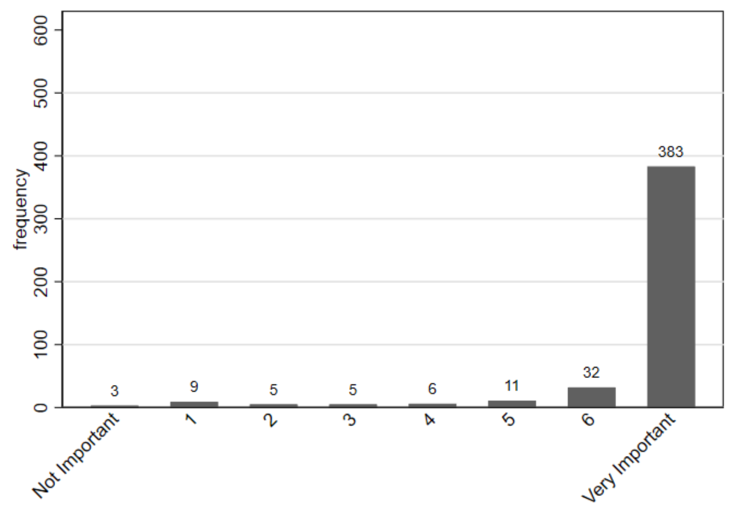
2.C Tables and Figures

Figure 2.C.1: Iron Intake Important for Healthy Mothers



Notes: To be a healthy mom, is it important to take iron pills? How important do you think it is? Reply with a number from 0 (not important) to 7 (very important). In total 468 women in our sample answered this question.

Figure 2.C.2: Iron Intake Important for Healthy Babies



Notes: To have a health baby, are iron pills important? How important do you think it is? Reply with a number from 0 (not important) to 7 (very important). In total, 454 women in our sample answered this question.

Table 2.C.1: Testing for Selection into the Sample

	Out-of-sample	In-sample	Treatment Comparison
Birthyear	1991	1992	0.63
	(5.84)	(5.34)	
English	0.67	0.65	-0.01
	(0.47)	(0.48)	
Urban	0.39	0.29	-0.10**
	(0.49)	(0.46)	
Number of Previous Children	1.05	0.98	-0.07
	(1.01)	(1.13)	
N	214	480	

Notes (i) Standard deviations are reported in parentheses, (ii) The Treatment Comparison column reports the difference between the means of the In-sample and Out-of-sample groups, with a Wald test used to test for a statistically significant difference, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.C.2: Testing for Selection on Time Preferences into the Sample

	Out-of-sample	In-sample	TreatComparison
High Discounters	0.36	0.31	-0.06
	(0.48)	(0.46)	
Late Doers	0.15	0.09	-0.06
	(0.36)	(0.29)	
Early Doers	0.26	0.28	0.03
	(0.44)	(0.45)	
On Timers	0.59	0.63	0.04
	(0.50)	(0.48)	
N	66	480	

Notes High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it. Early doers planned to do the task late but did it sooner OR did not plan to do it but did it in the end. On timers are people who do the task when they planned.
Standard deviations are reported in parentheses. The Treatment Comparison column reports the difference between the means of the In-sample and Out-of-sample groups, with a Wald test used to test for a statistically significant difference, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.C.3: Descriptive Statistics

	Means (std)
Time Preference Variables	
Time Preference Plan	1.78
	(1.45)
Attempt on Day 1	0.90
	(0.30)
Success fraction day 1 (conditional)	0.81
	(0.40)
Attempt on Day 3	0.04
	(0.19)
Success fraction day 3 (conditional)	0.67
	(0.49)
Attempt on Day 5	0.02
	(0.14)
Success fraction day 5 (conditional)	0.50
	(0.53)
Future Bias	0.28
	(0.45)
Present Bias	0.09
	(0.29)
Consistent	0.63
	(0.48)
Questionnaire	
Q1.Weekly Iron Intake	6.59
	(1.17)
Q2.Difficulty Remembering [=1]	0.10
	(0.30)
Q3.Failure to Carry out plans	4.64
	(3.74)
Q4.Willingness to take risks	4.26
	(3.84)
Q5.Iron pills – Stomach feels bad	0.12
	(0.33)
Q6.Weekly days tired / dizzy	2.35
	(1.81)
Q7.Low iron levels [=1]	0.10
	(0.31)
Q8.Years of Schooling	12.04
	(2.54)
N	480

Notes: (i) The table reports means and standard deviations for variables that we use in our main analysis, e.g. *Time Preference Plan* is the average number of days respondents plan to take to complete the task, *Attempt on day 1* is a binary indicator variable for an attempt on the first day, whereas *Success fraction on day x* reports the rate of success, conditional making an attempt on day x, *Future Bias*, *Present Bias* and *Consistent* are defined in the main text.

Table 2.C.4: Variable Definitions

Variable	Description
Birthyear	Expectant mother's year of birth
Language	Indicator [=1] if respondent's mother tongue language is English.
Urban	Indicator [=1] if respondent resides in an Urban area.
Numer of Previous Children	Number of children born to respondent prior to current pregnancy.
Q1.Weekly Iron Intake	How many days did you take your iron pills last week? (Please reply a number from 0 to 7)
Q2.Difficulty Remembering [=1]	Do you find it difficult to remember to take the iron pills? (Reply with yes or no.)
Q3.Failure to Carry out plans	How often do you plan to do something and then don't do it? (Reply 0 (never), 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 (always))
Q4.Willingness to take risks	In general, how willing are to take risks? (Please reply on a scale from 0 (completely unwilling) to 10 (very willing)
Q5.Iron pills – Stomach feels bad	Keep going! Does your stomach feel bad if you take iron pills? (Reply yes or no.)
Q6.Weekly days tired / dizzy	How many days did you feel very tired or dizzy last week? (Please reply a number from 0 to 7.)
Q7.Low iron levels [=1]	Did your doctor or nurse tell you that you have low iron levels? (Reply 1) Yes 2) No 3) Not anymore 4) Don't know ... recoded to "yes" =1, else =0)
Q8.Years of Schooling	How many years did you go to school? Reply with number of years.

Notes: (i) The table describes variables used in the main analysis.

Table 2.C.5: Adherence and time consistency

	Full Sample OLS Nr of Pills (1a)	Full Sample OLS If Missed Pills (1b)	High Discounters OLS Nr of Pills (2a)	High Discounters OLS If Missed Pills (2b)	Low Discounters OLS Nr of Pills (3a)	Low Discounters OLS If Missed Pills (3b)
High Discounters	-1.152*	0.317**				
	(0.673)	(0.160)				
Late Doers	-0.180	0.020	-0.918	-0.013	-0.140	0.022
	(0.188)	(0.065)	(1.100)	(0.401)	(0.189)	(0.065)
Early Doers	0.945	-0.252	0.353	-0.277		
	(0.681)	(0.165)	(0.740)	(0.362)		
Constant	6.816***	0.105***	6.282***	0.453	6.803***	0.102***
	(0.074)	(0.027)	(0.749)	(0.365)	(0.074)	(0.028)
Failure Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	480	480	147	147	333	333
R^2	0.036	0.025	0.055	0.030	0.010	0.008

Results in column 1a and 1b are shown for the 480 participants who have done the full survey and use the full information on all attempts to do the task at any of the possible days. Column 2a-2b and 3a-3b show results using the subsamples of High discounters and Low discounters, respectively. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it. Early doers planned to do the task late but did it sooner OR did not plan to do it but did it in the end. By the construction of our task, no one can be a low discounter (plan to do the task on day one) and be an Early doer (do the task before they planned to do it) at the same time. The reference group for inconsistent discounter is on timers who do the task when they planned. Missed Pills =1 is a dummy variable which is 0 if the participant reported having taken all 7 pills last week. OLS and Logit Regressions. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2.C.6: Adherence and Discounting. Robustness, Risk, Language, and Education

	OLS Nr of Pills (1)	OLS If Missed Pills (2)	OLS Nr of Pills (3)	OLS Missed Pills =1 (4)	OLS Nr of Pills (5)	OLS Missed Pills =1 (6)
High Discounters	-0.271**	0.087**	-0.272**	0.085**	-0.248*	0.074*
	(0.125)	(0.039)	(0.125)	(0.039)	(0.127)	(0.039)
Risk Taking	-0.004	0.004				
	(0.013)	(0.004)				
English Speaking			0.154	-0.078**		
			(0.114)	(0.037)		
Years of School					0.031	-0.014*
					(0.026)	(0.008)
Constant	6.798***	0.090***	6.686***	0.158***	6.404***	0.286***
	(0.085)	(0.031)	(0.095)	(0.034)	(0.335)	(0.097)
Failure Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	480	480	480	480	480	480
R^2	0.016	0.016	0.020	0.024	0.021	0.024

Results are shown for the 480 participants who have done the full survey and use the full information on all attempts to do the task at any of the possible days. Risk-taking is a measure from 0 to 10, where the participant answers the flowing question: In general, how willing are to take risks? Please reply on a scale from 0 (completely unwilling) to 10 (very willing). English Speaking is a dummy variable where 1 indicate that English is their preferred language and, 0 indicate that they prefer another language. The variable Years of School is the participants reported number of years of education. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and not planning to do the task or planning to do the task on day 3 or 5 is denoted with a 1. Failure Dummy is a dummy for technical problems leading to payment delay. OLS Regressions. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2.C.7: Discounting, Late Doers and Adherence - Robustness, Risk, Language, and Education

	Full Sample OLS Nr of Pills (1)	Full Sample OLS If Missed Pills (2)	Full Sample OLS Nr of Pills (3)	Full Sample OLS If Missed Pills (4)	Full Sample OLS Nr of Pills (5)	Full Sample OLS If Missed Pills (6)
High Discounters	-0.291^{**}	0.091^{**}	-0.293^{**}	0.089^{**}	-0.268^{**}	0.077^{**}
	(0.128)	(0.040)	(0.128)	(0.039)	(0.130)	(0.039)
Late Doers	-0.384	0.075	-0.395^{*}	0.080	-0.377	0.071
	(0.237)	(0.065)	(0.236)	(0.063)	(0.241)	(0.067)
Risk Taking	-0.005	0.005				
	(0.013)	(0.004)				
English			0.165	-0.080^{**}		
			(0.114)	(0.037)		
Years of School					0.030	-0.014^{*}
					(0.026)	(0.008)
Constant	6.861^{***}	0.078^{**}	6.740^{***}	0.147^{***}	6.472^{***}	0.273^{***}
	(0.087)	(0.033)	(0.093)	(0.034)	(0.345)	(0.100)
Failure Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	480	480	480	480	480	480
R^2	0.025	0.019	0.029	0.028	0.029	0.026

Results are shown for the 480 participants who have done the full survey and use the full information on all attempts to do the task at any of the possible days. Risk-taking is a measure from 0 to 10, where the participant answers the flowing question: In general, how willing are to take risks? Please reply on a scale from 0 (completely unwilling) to 10 (very willing). English Speaking is a dummy variable where 1 indicate that English is their preferred language and, 0 indicate that they prefer another language. The variable Years of School is the participants reported number of years of education. Failure Dummy is a dummy for technical problems leading to payment delay. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it. Missed Pills =1 is a dummy variable which is 0 if the participant reported having taken all 7 pills last week.
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 2.C.8: Adherence and Discounting - Restricted sample

	OLS Nr of Pills (1)	OLS Missed Pills =1 (2)	Logit Missed Pills =1 (3)
High Discounters	-0.238^{*}	0.084^{**}	0.582^{**}
	(0.126)	(0.041)	(0.264)
Constant	6.760^{***}	0.113^{***}	-2.030^{***}
	(0.069)	(0.025)	(0.222)
Failure Dummy	Yes	Yes	Yes
Observations	465	465	465
R^2	0.013	0.014	

From the 480 participants that answered all eight questions of the final survey, the regressions in this table exclude the 15 particpants answering that they do not plan to do the task or writing words backwards. Missed Pills =1 is a dummy variable which is 0 if the participant reported having taken all 7 pills last week, and which is 1 if she missed one pill or more. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Failure Dummy is a dummy for technical problems leading to payment delay. Regressions include the 480 participants that answered all eight questions of the final survey. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2.C.9: Discounting, Late Doers and Adherence - Restricted sample

	OLS Nr of Pills (1a)	OLS If Missed Pills (1b)	High Discounters OLS Nr of Pills (2a)	High Discounters OLS If Missed Pills (2b)	Low Discounters OLS Nr of Pills (3a)	Low Discounters OLS If Missed Pills (3b)
High Discounters	-0.255**	0.087**				
	(0.128)	(0.041)				
Late Doers	-0.380	0.073	-1.267	0.257	-0.140	0.022
	(0.237)	(0.064)	(0.819)	(0.174)	(0.189)	(0.065)
Constant	6.819***	0.102***	6.622***	0.182***	6.803***	0.102***
	(0.072)	(0.027)	(0.120)	(0.048)	(0.074)	(0.028)
Failure Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	465	465	132	132	333	333
R^2	0.022	0.017	0.060	0.024	0.010	0.008

From the 480 participants that answered all eight questions of the final survey, the regressions in column 1a and 1b exclude the 15 participants answering that they do not plan to do the task or writing words backwards. Column 2a-2b and 3a-3b is restricted in the same way and show results using the subsamples of High discounters and Low discounters, respectively. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it. Missed Pills =1 is a dummy variable which is 0 if the participant reported having taken all 7 pills last week. OLS and Logit Regressions. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 2.C.10: How Quickly They Answer Other Messages

	High Discounters (1)	Actually do task 1,3,5 (2)	Actually Delay (3)
Answer First Hour	-0.061	0.003	-0.002
	(0.048)	(0.071)	(0.025)
No Answer	-0.023	0.003	0.006
	(0.072)	(0.106)	(0.039)
Constant	0.394***	1.185***	0.064***
	(0.046)	(0.078)	(0.025)
Failure Dummy	Yes	Yes	Yes
Observations	480	460	460
R^2	0.014	0.001	0.000

Column 1 in this table include all 480 participants in our main sample. In column 2 and 3, the sample is restricted further, as the main explanatory variable here is when the participants did the word task. These regressions therefore only include participants who actually made an attempt to reply in this task, excluding 20 individuals. Variable definitions: No Answer is a binary variable for the 61 participants that did not reply to an additional question asking them too reply with their first 4 digits in their social security number. Answer First Hour is a dummy variable where 1 denotes a person that answered the 4 digits social security number question within the first hour, which 270 women did. Plan to Delay is a dummy variable where planning to do the task on day 1 is denoted 0 and planning not to do the task or planning to do the task on day 3 or 5 is denoted with a 1. The variable Actually Delay is a binary variable where 0 denotes if a person performs the task on day 1, and 1 denotes if a person delays to do the task untill to day 3 or 5. Failure Dummy is a dummy for technical problems leading to payment delay. OLS regressions. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 2.C.11: Day of the Week

	High Discounters (1)	Actually do task 1,3,5 (2)	Actually Delay (3)
Monday	-0.106	0.050	0.039
	(0.078)	(0.098)	(0.039)
Tuesday	-0.062	0.116	0.043
	(0.082)	(0.123)	(0.040)
Wednesday	-0.105	0.058	0.006
	(0.078)	(0.115)	(0.032)
Thursday	-0.082	0.163	0.063
	(0.082)	(0.127)	(0.042)
Friday	-0.061	0.106	0.051
	(0.085)	(0.119)	(0.042)
Saturday	0.038	0.011	0.004
	(0.090)	(0.109)	(0.034)
Constant	0.410***	1.122***	0.038
	(0.064)	(0.072)	(0.025)
Failure Dummy	Yes	Yes	Yes
Observations	480	460	460
R^2	0.021	0.007	0.010

Column 1 in this table include all 480 participants in our main sample. In column2 and 3, the sample is restricted further, as the main explanatory variable here is when the participants did the word task. These regressions therefore only include participants who actually made an attempt to reply in this task, excluding 20 individuals. High discounting is a dummy variable where planning to do the task on day 1 is denoted 0 and planning not to do the task or to do the task on day 3 or 5 is denoted with a 1. The variable Actually Delay is a binary variable where 0 denotes if a person performs the task on day 1, and 1 denotes if a person procrastinates to day 3 or 5. Failure Dummy is a dummy for technical problems leading to payment delay. OLS regressions. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 2.C.12: Vitamin Adherence and Discounting. Robustness, nr Kids.

	OLS Nr of Pills (1)	OLS If Missed Pills (2)	Logit If Missed Pills (3)
High Discounters	-0.291**	0.089**	0.610**
	(0.126)	(0.040)	(0.258)
Number of Kids	0.015	-0.011	-0.080
	(0.052)	(0.020)	(0.161)
Constant	6.767***	0.121***	-1.968***
	(0.092)	(0.034)	(0.281)
Failure Dummy	Yes	Yes	Yes
Observations	473	473	473
R^2	0.018	0.016	

From the 480 participants that answered all eight questions of the final survey, the regressions in this table include only the 473 individuals from which we have information on how many kids they already have. The variable Number of Kids contains this information on how many kids the participant already has. Missed Pills =1 is a dummy variable which is 0 if the mother reported having taken all 7 pills last week, and which is 1 if she missed one pill or more. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and not planning to do the task or planning to do the task on day 3 or 5 is denoted with a 1. Failure Dummy is a dummy for technical problems leading to payment delay. OLS and Logit Regressions. Robust standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 2.C.13: Discounting, Late Doers and Adherence - Robustness Kids

	Full Sample OLS Nr of Pills (1a)	Full Sample OLS If Missed Pills (1b)	High Discounters OLS Nr of Pills (2a)	High Discounters OLS If Missed Pills (2b)	Low Discounters OLS Nr of Pills (3a)	Low Discounters OLS If Missed Pills (3b)
High Discounters	-0.311**	0.092**				
	(0.129)	(0.040)				
Late Doers	-0.390	0.075	-1.256	0.257	-0.172	0.032
	(0.237)	(0.064)	(0.822)	(0.175)	(0.186)	(0.064)
Number of kids	0.019	-0.012	-0.096	0.030	0.132**	-0.053***
	(0.052)	(0.020)	(0.072)	(0.024)	(0.057)	(0.019)
Constant	6.825***	0.110***	6.716***	0.152***	6.689***	0.149***
	(0.094)	(0.034)	(0.120)	(0.053)	(0.099)	(0.035)
Failure Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	473	473	144	144	329	329
R^2	0.027	0.019	0.063	0.034	0.024	0.028

From the 480 participants that answered all eight questions of the final survey, the regressions in column 1a and b table include only the 473 individuals from which we have information on how many kids they already have. Column 2a-2b and 3a-3b are restricted in the same way and show results using the subsamples of High discounters and Low discounters, respectively. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it. Missed Pills =1 is a dummy variable which is 0 if the participant reported having taken all 7 pills last week. The variable Number of Kids contains this information on how many kids the participant already has. OLS Regressions. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 2.C.14: Health outcomes - excluding individuals who don't know their iron levels

	Full Sample Low Iron (1)	Full Sample Low Iron (2)	High Discounters Low Iron (3)	Low Discounters Low Iron (4)
High Discounters	0.031	0.031		
	(0.036)	(0.035)		
Late Doers		-0.019	-0.134***	0.015
		(0.052)	(0.039)	(0.066)
Constant	0.117***	0.120***	0.130***	0.133***
	(0.027)	(0.029)	(0.042)	(0.032)
Failure Dummy	Yes	Yes	Yes	Yes
Observations	440	440	131	309
R^2	0.004	0.004	0.014	0.008

Results in column 1-2 are shown for the 440 participants who have done the full survey and who did not answer Don't know to the question about their iron levels. Column 3 and 4 show results using the subsamples of High discounters and Low discounters, respectively and is also restricted to exclude individuals who anser that they Don't know if they have low iron levels. High Discounters is a dummy variable where planning to do the task on day 1 is denoted 0 and planning to do the task on day 3 or 5, or not planning to do the task is denoted with a 1. Late doers are people who planned to do the word task sooner, did it later or did not do it. Low Iron Levels is a dummy variable where 1 indicates that a person does have low iron levels and 0 does not have low iron levels, had low iron levels before or don't know. OLS and Logit Regressions. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Chapter 3

Can Mothers' Time Preferences Predict Children's Educational Outcomes?

Abstract

This paper is the first to study if parents' time preferences are associated with adolescents' future educational outcomes. We combine time preferences data on mothers and their adolescents, measured in 1968 and 1966, with register data on education and labour outcomes up to 2015. The results show that children of patient mothers have higher grades, are more likely to be enrolled in an academic elementary school track, and are more likely to attain post-secondary education. Yet, we find no significant association between mothers' time preferences and adolescents' completion of upper secondary school or the likelihood to be enrolled in a theoretical upper secondary program. The unique Swedish data also allow us to shed some light on potential mechanisms. We find evidence of intergenerational transmission of preferences for both time and education, as well as a strong correlation between mothers' time preferences and whether their adolescent children apply for further education after year 9 of elementary school.

This chapter is co-authored with Louise Jeppsson. Ethics Approval has been obtained from the ethical advisory board at the University of Gothenburg, Department of Economics.

3.1 Introduction

Patience is a virtue. To be able to wait and to tolerate that some things take time is often seen as a valuable trait.[1] Clear signs of this are portrayed in everyday life as parents try to teach their children to save their weekly allowance or to wait for dessert until after dinner. In economics, we often think about these decisions in terms of time preferences. Individuals' time preferences are heterogeneous within populations and are characterised by individuals' evaluation of present versus future utility (see, e.g., Falk et al. 2018). Being an individual who focuses more on future utility is associated with a higher likelihood of choosing academic school tracks (Angerer et al. 2021). It is also a predictor of better grades in school, and higher educational attainments, higher future earnings and income (Golsteyn et al. 2014). Higher levels of education might not be beneficial for all individuals, but the research suggests that an impatient individual could be less likely to choose effort and forgo utility now, in order to invest in education and thereby get better future labour market outcomes. However, many important decisions about educational investments are made early in life, and it is therefore unlikely that young individuals make these decisions completely autonomously. Parents' preferences could thus be an important piece of missing information in existing empirical research on time preferences and educational outcomes.

The aim of this study is to investigate the association between parental time preferences and their children's future educational outcomes. We study this using the unique Stockholm Birth Cohort (SBC) data set. The data contain information on 12,956 adolescents, born in 1953 and interviewed and tested in school in 1966. In this interview, the adolescents were asked: "If you had to choose between US$110 now or US$1100 in five years, which would you choose?".[2] For 3478 of these individuals, the SBC also includes similar survey data from their primary caretakers, mainly mothers, gathered in 1968. In these interviews, the mothers were asked a similar time preferences question as the adolescents, but with incentive levels of US$1100 now or US$11,000 in five years. Using this unique survey data of mothers and their children's preferences, combined with school records and register data on grades, school tracks, and educational attainment for the same individuals, this paper is the first to be able to investigate whether intergenerational time preferences matter for long-run, real-life outcomes. Our theory is that parents' time preferences are associated both with preferences for

[1]For a historical and contemporary discussion of patience as a moral virtue, see the philosophy paper by Kawall (2013).

[2]The US dollars are expressed in rounded numbers in the 2019 year's Swedish price levels. The original question asked adolescents in 1966 to choose between 1000 SEK in five years or 100 SEK now.

their child's future education and with their children's own preferences. Through these mechanisms, parents' time preferences are expected to be positively associated with their children's future educational outcomes.

This paper is also related to the literature on intergenerational social mobility. Research in this field has shown a general stickiness in mobility in education, income, and social class across generations. In the context of the United Kingdom, using data on men born in 1970, Blanden et al. (2007) estimate an intergenerational earnings persistence of around 0.3 and show that a large share of this persistence is accounted for by educational variables. In Sweden, where social mobility is high compared with many other countries (see, e.g., Corak 2013), and where education is free for all, research by Adermon et al. (2021) still estimates a 0.52 long-run persistence in human capital, measured using participants grade point averages (GPAs) and family members' numbers of years in school. Understanding the transmission of family preferences and how this relates to offspring's long-term outcomes should be relevant for this strand of literature. Krusell & Smith (1998) were the first to suggest that intergenerational transmissions of time preferences could be one explanation for stickiness in social mobility. Assuming that impatience is imperfectly transferred from parents to children, affecting consumption and investment patterns, Krusell and Smith describe why some families stay richer while others stay poor. To investigate this empirically, however, one would have to have access to time preference and control variables from both children and their parents, combined with long-run follow-up data on outcome variables for the child. To our knowledge, this is the first paper to have such access.

The most closely related papers to ours are by Golsteyn et al. (2014) and Björklund et al. (2010). These papers use an earlier, less extensive matching version of the SBC data. Golsteyn et al. (2014) use the SBC data matched with occupational data up to 2009 and investigate the relationship between children's time preferences and future educational and labour market outcomes. The authors estimate significant correlations between adolescents' time preferences and key future economic variables such as grades, education choices, labour supply, and lifetime income and earnings. Still, Golsteyn et al. (2014) lack information on the preferences in the parental generation, which we argue is important information under the assumption that adolescents cannot make educational choices in isolation from their parents' influence.

Björklund et al. (2010) investigate which family characteristics matter for sibling similarities in long-term income. The paper has access to income data from 1990 to 2001 (ages 33 to 52) and finds that parents' income, occupation, education, social support, involvement in schoolwork and attitudes, the number of books in the home, and the mother's age are important in explaining sibling similarities in income. Björklund et al. (2010) also look at mothers' patience levels and specifically focus on answers to the questions "Do you like to make long-term plans?" and "Do you think it is worth planning for the future?" which could be seen as proxy measures for time preferences. The authors find these variables important for sibling similarities in adult incomes and a negative correlation between children's long-term income and mothers answering, "Do not know", "No, perhaps not", or "No definitely not" to these questions. These results are, however, sensitive to the choice of econometric specification. Further, the paper does not include the adolescents' own patience and therefore cannot study the importance of preference transmission in this context.

Our results are in line with the thoughts of Krusell & Smith (1998) that parental time preferences matter for their offspring's future outcomes. But it does not matter only via transmissions of time preference from parent to child, which is the focus of Krusell & Smith (1998). By stepwise inclusion of both mothers' and adolescents' time preferences in our regression analysis, we find that mothers' time preferences are a predictor of their children's educational outcomes, in their own right. We find that adolescents with mothers who chose to delay the reward, i.e. more patient mothers, are more likely to choose an elementary school track that is preparatory for upper secondary school. Adolescents with patient mothers receive a higher grade point average (GPA) in the 9^{th} grade and are significantly more likely to attain any post-secondary education. These results are robust to a large battery of robustness checks. With respect to educational outcomes at the upper secondary school level, this paper suffers from low statistical power. We do not estimate any robust associations. A small positive association might still exist between mothers' time preferences and adolescents' upper secondary school track choice, GPA, and completion, but if so, we lack the power to identify these associations.

In addition to the main analysis of educational outcomes, we make thorough attempts to investigate potential mechanisms between parental time preferences and children's educational attainment. Inspired by Doepke & Zilibotti (2017), we develop a theoretical framework wherein parents can affect children's educational outcomes through influencing their children's preferences and/or by directly altering their children's educational choices.

First, we find evidence of intergenerational correlations of time preferences between mothers and adolescents, as assumed by Krusell & Smith (1998). This is in line with existing empirical research. Brenøe & Epper (2019) find transmission

of impatience across generations, using data from Danish adults gathered in 2010 and data from their parents gathered in 1976. Since the data for the parental generation were collected before they had children, the researchers could exclude any potential transmission mechanism from child to parent.

Using Australian data, Brown & Van der Pol (2015) find that the parental-offspring correlation in preferred planning horizon (a proxy for time preference) is stronger for mothers, compared with fathers. Further, Chowdhury et al. (2018) find significant parental-child correlations when investigating preferences within Bangladeshi families. Also, Gauly (2017) and Kosse & Pfeiffer (2012) find associations between German parents' and children's time preferences, while on the other hand Bettinger & Slonim (2007) find no significant relationship between parents' and children's patience levels in the United States.

Second, we find novel results of a relationship between mothers' time preferences and adolescents' preferences for future education. We estimate a weakly significant relationship between mothers' time preferences (measured when the child was in grade 8) and whether the adolescent wanted to apply to upper secondary school (answered when in grade 6). We also estimate a strongly significant association between mothers' time preference and whether the adolescents in their last term of grade 9 made an application for upper secondary school. However, it is not obvious that actual application is a demonstration of the individual adolescents' own preferences. We admit that it could well be that a parent in the background forced the adolescent to apply. While our data is not detailed enough to distinguish between these two mechanisms, we interpret the results as suggestive evidence that the patience levels of mothers correlate with adolescents' future educational outcomes through restrictions they put on their children's choice lists or with their children's preferences for future education.

To the best of our knowledge, this is the first paper to explicitly investigate the relationship between parental time preference and children's future educational outcomes. Identifying a causal effect and mechanisms for parental time preferences on future outcomes for their children is challenging, since preferences cannot be randomly assigned to individuals. However, the SBC data on time preferences, preferences for education, future educational and labour outcomes, and an extensive set of controls allow us to shed unique light on how intergenerational preferences within families are associated with important long-run outcomes for the child.

In Section 2 of this paper, we provide our theoretical framework and hypotheses. Section 3 describes the empirical strategy, Section 4 gives a detailed description of the data, and Section 5 presents the main results and robustness test. In

Section 6, we further investigate potential mechanisms, and Section 7 concludes the paper with a discussion.

3.2 Theoretical Framework

In this paper, our aim is to investigate how one specific parental characteristic, parental time preferences, is associated with children's future educational outcomes. It is already established in existing research that adolescents' own time preferences matter for educational outcomes. The main idea in this paper is that parents' time preferences should matter for their children's educational outcomes as well. The underlying assumption that motivates this study is the assumption that young adolescents, age 13, are not empowered to make decisions about educational investments for themselves without influence from their parents. Doepke et al. (2019) provide an extensive review of the literature on the economics of parenting. The authors make the statement that parenting decisions are a key factor in their offspring's accumulation of human capital, and findings in the reviewed literature show the particular importance of early life parental investments to facilitate skill acquisition. Hence, we find it likely that not only the adolescents' own preferences and characteristics but also their parents' preferences and characteristics should matter for the adolescents' educational outcomes. Our prior belief is that more patient parents, who focus more on future utility than present, are more favourable towards their children's educational investments, which could benefit their children's long-run outcomes.

For our main analysis we propose and test the following hypothesis:

Hypothesis 3. Adolescents with more patient mothers receive higher GPAs, choose more theoretical education, and attain higher levels of education.

In addition to our main hypothesis, the appendix presents an analysis where we investigate the following:

Hypothesis 4. Due to higher educational investments, adolescents with more patient mothers have higher lifetime earnings and incomes.

The rationale behind our second hypothesis is that if mothers' time preferences are positively associated with higher educational investments, this could serve as a mechanism for higher lifetime earnings and income. While being outside the scope of this educational paper, we do not rule out that other mechanisms, such as health, could explain a potential relationship between mothers' time preferences and children's future income.

Following the analysis on the association between mothers' time preferences and educational and labour outcomes, we explore potential mechanisms for *why* mothers' time preferences could affect adolescents' educational outcomes. Doepke & Zilibotti (2017) look at intergenerational preference transmission and suggest that parents can affect their children's choices in two ways. The first is by influencing children's preferences, and the second is by directly imposing restrictions on their children's choice lists.

In our context, which is educational investments, this theory is applied as follows (see Figure 3.1): First, in line with previous research, we assume an intergenerational transmission of time preferences across generations (3), which could affect how children value their own educational investments. Second, we assume that patient mothers have a stronger preference for higher levels of education (4) and may influence their children's views on future education (5) and/or directly alter their children's educational choices (6). The latter can, for example, be done by forcing children to go to school or making sure that they do their homework on time. The proposed mechanisms, portrayed in Figure 3.1, give the following hypotheses:

Hypothesis 5. Parents' and children's time preferences are positively correlated.

Hypothesis 6. Parents who are more patient are more likely to prefer higher educational attainment for their children.

Hypothesis 7. Parents' and children's preferences for the children's educational attainment are positively correlated.

Hypothesis 8. Parents with stronger preferences for higher educational attainment of their child are also more likely to restrict their children's choice lists in this direction.

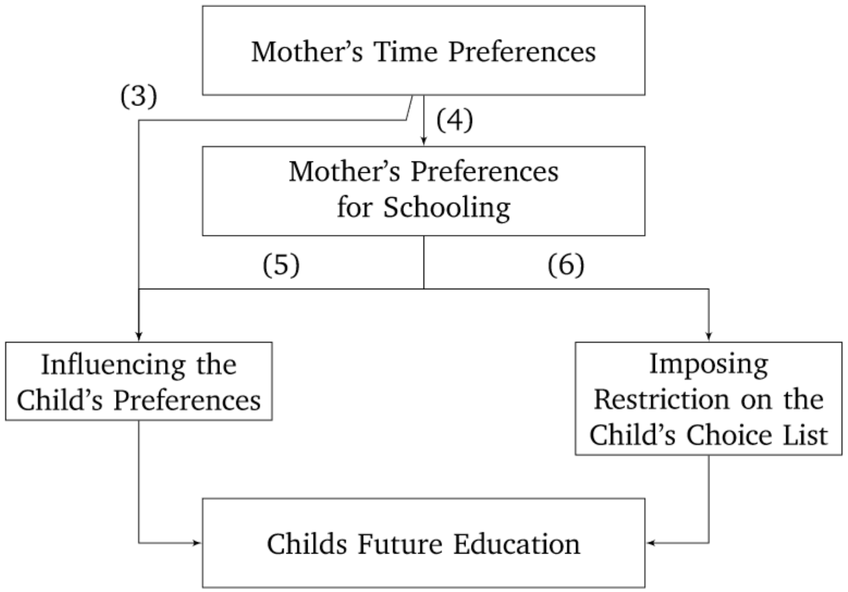


Figure 3.1: Potential Mechanisms

3.3 Empirical Strategy

This study investigates the association between parental time preferences and adolescents' future educational outcomes. Based on data availability, parental time preferences in this study mainly refer to mothers' time preferences.[3] We estimate the regression model in equation (1) using ordinary least squares (OLS) for continuous outcomes:

$$\begin{aligned} y_i = \beta_0 + \beta_1 MotherTP_i + \beta_2 AdolTP_i + + \beta_3 Adol.female_i \\ + \beta_4 \mathbf{X}_i^p + \beta_5 \mathbf{D}_i^p + \beta_6 BM_i + \epsilon_i \end{aligned} \quad (3.1)$$

We estimate the regression model in equation (2) using a probit model for binary outcomes, where Φ is the standard normal cumulative distribution function:

$$\begin{aligned} Pr(y_i = 1) = \Phi(\beta_0 + \beta_1 MotherTP_i + \beta_2 AdolTP_i \\ + \beta_3 Adol.female_i + \beta_4 \mathbf{X}_i^p + \beta_5 \mathbf{D}_i^p + \beta_6 BM_i) \end{aligned} \quad (3.2)$$

[3]Of the primary caretakers interviewed in the SBC data, 89% are the adolescents' mothers while 2% are the fathers, substitute mothers, or other relatives. In 9% of the caretaker data, information on the primary caretaker exact relationship to the children is missing.

For regression results using our probit model, we report the average marginal effects (AME).

The outcome variables of interest,y_i, include educational outcomes such as GPA, school track, and educational attainment of the adolescent i. $MotherTP_i$ is the key variable of interest; this is our measure of the mother's time preferences, using a binary measure of time preferences as our preferred measure. The time preference measure is presented and discussed in more detail in the following section, but it is worth mentioning here that an alternative categorisation of the measure, including information on the mothers' assertiveness in their time preferences answers, are used in robustness regressions.

With respect to our educational outcome variables of interest, we present three sets of regression results. In the first set of results, we investigate the raw correlation between mothers' time preferences and adolescents' future educational outcomes, adding a control only for the gender of the adolescent, $Adol.female_i$ and a linear control for adolescent i's birth month, BM_i, to control for potential school starting age effect.[4] In the second set of results, we add an additional vector of controls for parents' age at childbirth and parents' socioeconomic characteristics, $\mathbf{X}_i^p$, and a vector of binary indicators for missing parental characteristics, $\mathbf{D}_i^p$. In our third set of results, equivalent to the regression models presented in equations (1) and (2), we further add a control for the adolescent's own time preferences, $AdolTP_i$. Again, we use a binary measure of time preferences in our main regressions and include a set of assertiveness categories of the time preference choice for robustness.

Existing research has found a robust and positive relationship between adolescents' own time preferences and future educational outcomes (Golsteyn et al. 2014, Angerer et al. 2021). However, at the same time, another related strand of literature estimates an intergenerational correlation between parents and their children's time preferences, suggesting that $AdolTP_i$ could be considered a bad control, since adolescents' time preferences might be an outcome of their mothers' time preferences. Indeed, intergenerational transmission of time preferences is considered a potential mechanism for why parental time preferences might affect children's educational outcomes in our theoretical framework and are exactly what our third hypothesis aims to test in a later section of this paper. Hence, by adding a potential bad control, we risk introducing omitted variable biases. If adolescents' own time preferences are measured with error, our measure for mothers' time preferences might pick up some of the measurement error for ado-

[4]See, for example, Fredriksson & Öckert (2013), who find that school starting age increased educational attainment among Swedish cohorts born between 1935 and 1955.

lescents. At the same time, we are particularly interested in the potential association between mothers' time preferences and adolescents' future educational outcomes beyond the mechanism of intergenerational transmission of time preferences. Therefore, we find it important to present all our main regression results both with and without adding the control for adolescents' own time preferences. We interpret the regression results with adolescents' own time preferences included as the association between mothers' time preferences and adolescents' future educational outcomes beyond the intergenerational transmission of preferences, since these mechanisms are controlled for by adding $AdolTP_i$.

One potential concern is that our results could be confounded by between-municipality or between-school differences in educational practices. To test the robustness of our main results, we rerun all our main regressions with municipality fixed effects and school headmaster fixed effects added.[5]

To further address concerns about omitted variables that might bias our estimates we introduce several additional control variables to the regression model to test the robustness of our results. The additional controls are the marital status of the mother, the adolescent's number of siblings, the number of books at home, and the adolescent's cognitive ability. The marital status of the mother and the adolescent's number of siblings might be associated both with the mother's time preferences and the adolescent's future educational outcomes. For example, Paola & Gioia (2014) find a relationship between individual time preferences and marriage stability. One might suspect that the marital status of the mother could also be positively related to the adolescent's educational outcomes since cohabiting parents might have more time resources available to spend on their children. With respect to adolescent's number of siblings, previous research has found a relationship between sibling number and children's educational outcomes (see, for example, Sen & Clemente 2010, and Silles 2010) and we do not dismiss the possibility that mothers' time preferences, at the same time, might be related to fertility decisions. In Section 4.3, we elaborate on the importance of using the best data available to control for mothers' cognitive ability, since this may be correlated with measurement errors in our time preference measure (Andersson et al. 2016).

Finally, we evaluate the robustness of our results with respect to omitted variable bias using the method of Oster (2019) and adjust for multiple hypothesis testing using the procedure by List et al. (2019).

[5]Not all schools have separate headmasters; some schools in our sample have the same headmaster, which implies that our school headmaster fixed effect is not fully equivalent to school fixed effect.

3.4 Data

The Stockholm Birth Cohort (SBC) contains survey data from a cohort of individuals born in Stockholm in 1953. The data were collected at all schools in Stockholm in 1966 when the adolescents were 12 to 13 years old. The data set also contains information on a selected representative sample of primary caregivers, mainly mothers, gathered in their homes in 1968.[6] Register data for the same individuals were gathered until 1986, when the project got cancelled and the data were unidentified. However, Stenberg & Vågerö (2006) started working with the data again and matched information on the participants with new longer register data.

This paper uses an updated version of the SBC by Almquist et al. (2020), who employ a probability matching procedure to connect the original data set with an additional longitudinal set of register data. This combined data set enables us to follow the individuals with outcomes up to the year 2015, when the cohort was age 62. From the 4021 primary caregivers who were asked to participate, we have access to time preference data from 3478, who agreed to participate, answered a time preference question, and were matched with data from their children by Almquist et al. (2020).

Due to data availability, the study focuses on the preferences of primary caretakers which for the most part in this data set means mothers and not fathers. The reason the researchers in the 1960' focused on interviewing mothers is probably that gender roles were more conservative in Sweden then, and mothers, in general, were considered the primary caregivers.

In the original school survey, 613 girls and 740 boys did not participate, mainly because they were not present in school the day that the survey was administrated. Today, we have access to matched register and time preference data from 12,956 adolescents. But because of the research question, the main investigated sample in this paper is the 3478 pairs of primary caregivers and adolescents for whom we have access to their time preferences. The representativeness of this sample is discussed in Section 4.4.

3.4.1 Time preferences

Our key explanatory variable is the adolescent's primary caregiver's time preferences. As mentioned, this sample mainly consists of mothers, which is why the words *mother* and *primary caregiver* are used as synonyms in this context. The

[6]For more information on the data collection and the history of the data set, please see Stenberg & Vågerö (2006).

time preference question mothers answered in the survey was the following: "If you could choose between US$ 1100 now and US$ 11,000 in five years, would you choose US$ 1100 now?".[7] The distribution of the mothers' answers is presented in Table 3.1. The majority of mothers, 65%, say that they will probably or certainly choose the larger delayed reward. These answers are grouped together in a binary measure of mothers who "chose the delayed reward". The advantage of this binary measure, instead of using all five categories as we do in robustness regressions, is that it reduces noise in the measure that could be driven by general assertiveness in decisions, rather than time preference. This is the same construction of a binary measure that Golsteyn et al. (2014) and Norrgren (2021) use for adolescents' time preferences. In our paper, the mothers who chose the delayed reward are considered to be more patient and to have a lower discount rate, compared with those who probably or certainly chose the immediate reward or were indifferent.

When it comes to time preferences, research has not found any systematic differences in results from measures with hypothetical or real monetary rewards (see, for example, Matusiewicz et al. 2013; Brañas-Garza et al. 2020), and hypothetical measures are therefore often used. When, for example, Falk et al. (2018) embarked on a worldwide data collection on preferences, one of their measures was the hypothetical question "Would you rather receive 100 Euro today or 153.8 Euro in 12 months?".

Table 3.1: Summary statistics: Time preferences

Variable	Mean	Std Dev	Min	Max	N
Binary time preferences					
Mother chose delayed reward	0.651	0.477	0	1	3478
Categorical time preferences					
Mother certainly chose immediate reward	0.203	0.402	0	1	3478
Mother probably chose immediate reward	0.088	0.284	0	1	3478
Mother indifferent immediate/delayed reward	0.058	0.234	0	1	3478
Mother probably chose delayed reward	0.079	0.27	0	1	3478
Mother certainly chose delayed reward	0.571	0.495	0	1	3478

3.4.2 Education outcomes

Table 3.2 presents the summary statistics of our outcome variables of interest. Educational outcomes include grade point average (GPA) in 9th grade and GPA

[7]The US dollars are expressed in rounded numbers in the 2019 year's price levels. The original question asked primary caregivers (mainly mothers) in 1968 to choose between 10,000 SEK in five years or 1000 SEK now.

in upper secondary school. GPA in 9th grade is retrieved from individual school records, and GPA in upper secondary school is retrieved from Statistics Sweden (SCB), including records from between 1970 and 1978.[8] At that time, Sweden applied a relative grading system, and students received grades ranging from 1 to 5. It is therefore reassuring to find that the mean GPA in our sample is close to 3 in both 9th grade and upper secondary school. In the regression analysis, GPA is standardised to have a zero mean and unit variance.

It is important to note that GPA might not be directly comparable across study programs. In addition to this measure, educational outcomes in this study relate to the choice of school tracks, and we create two such binary variables. First, for adolescents who had preparatory education for upper secondary school grade 9 attended, and second, for adolescents who completed a theoretical program in upper secondary school (as opposed to vocational school). Again, information on elementary school programs is retrieved from individual school records and on upper secondary school programs from SCB, including records from between 1970 and 1978.[9] As seen in Table 3.2, approximately 56% of our sample attended and elementary school preparing for upper secondary school. Further, almost 76% of the sample of adolescents who completed upper secondary school completed a theoretical program and not vocational training.

Our final educational outcomes are binary indicators for completion of upper secondary school and whether an individual attained any post-secondary education. This variable is created from a seven-step measure of educational attainment, retrieved from SCB and measured at age 40. A majority of the sample, 81%, completed upper secondary education. Further, in our sample, 40% attained some form of post-secondary level education.[10]

Table 3.2: Summary statistics: Outcomes

Variable	Mean	Std Dev	Min	Max	N
Educational outcomes					
GPA 9th grade	3.264	0.841	1	5	3226
GPA upper secondary school	3.439	0.689	1.2	5	1655
Elementary school preparing for upper sec. school	0.555	0.497	0	1	3250
Theoretical program in upper sec. school	0.758	0.428	0	1	1656
Upper secondary school completed	0.813	0.39	0	1	3303
Post-secondary education	0.401	0.49	0	1	3303

[8]Hence, we do not have access to GPAs for any individuals who completed upper secondary education later than 1978.

[9]Hence, we do not have access to information on the upper secondary school programs for any individuals who completed upper secondary education later than 1978.

[10]In this time period, upper secondary education could be two to four years. Neither in the measure for upper secondary education nor in the measure for post-secondary level education do we distinguish the length or type of education.

3.4.3 Control variables

Summary statistics of control variables are presented in Table 3.3 and include adolescents' time preferences, gender, and birth month. In cases of missing information on the adolescents' birth month, the variable mode is substituted, which in our sample is equal to five (the month of May). Approximately 77% of adolescents in our sample chose the delayed reward, and 47.4 % of our adolescents are female. Table 3.3 also contains detailed information on the socioeconomic status of the adolescents' families, including parents' age at childbirth, income in the year 1963, and the highest level of education in 1968. The average age at childbirth is 28 and 31 years old for mothers and fathers, respectively, and the mean educational level is higher for fathers compared with mothers.

In the 1960s in Sweden, it was common, for mothers who could afford it, not to participate in the labour market.[11] This likely explains why almost 50% of the mothers in our sample do not have any reported income of their own. When there is no available parental information on income, income is assumed to be zero. Whenever information on the educational level is missing, the variable mode is substituted. Any missing information on age at childbirth, income, or education is controlled for using dummy variables in the regression analysis. The bottom rows of Table 3.3 report the summary statistics of these variables.

When deciding which variables to control for in this setting, we also have to think about what time preferences really are. Preferences are generally not thought of as an isolated part of the brain, but as identity traits that might relate to other parts of an individual's personality. The literature therefore discusses what we are actually trying to measure with time preference questions. For example, Golsteyn et al. (2014) discuss that time preferences could be related to an individual's imagination and whether one can picture oneself having the monetary reward in the future. Cognitive ability might also be important in this context, and Andersson et al. (2016) discuss the importance of controlling for this, since it might be correlated with measurement errors in time preference measures. While we have access to an extensive set of control variables for our analysis, we cannot be sure that we are controlling for everything that potentially could bias the results. At the same time, adding too many controls can also be a problem, since we risk overcontrolling for things that are themselves driven by time preferences. Adolescents' cognitive ability and the number of books in the participants' households are such variables that could potentially be driven by mothers' time preferences. Being aware of this problem, we still use them in our robustness section to proxy for mothers' cognitive ability, since they are the best variables available.

[11] Taxation was also based on joint incomes between spouses and not on individual income as in Sweden today. The joint taxation made it less disadvantageous for a low-earning spouse not to participate in the open labour market.

Table 3.3: Summary statistics: Controls

Variable	Mean	Std Dev	Min	Max	N
Adolescent's time preferences (binary)					
Adolescent chose delayed reward	0.774	0.418	0	1	3478
Adolescent's time preferences (all categories)					
Adolescent certainly chose immediate reward	0.064	0.246	0	1	3478
Adolescent probably chose immediate reward	0.064	0.244	0	1	3478
Adolescent indiff. immediate/delayed reward	0.098	0.297	0	1	3478
Adolescent probably chose delayed reward	0.344	0.475	0	1	3478
Adolescent certainly chose delayed reward	0.43	0.495	0	1	3478
Adolescent's characteristics					
Adolescent female	0.474	0.499	0	1	3478
Adolescent birth month	6.249	3.379	1	12	3478
Parental characteristics					
Mother's income	4.569	7.498	0	115	3478
Father's income	25.736	22.737	0	444	3478
Mother's highest level of education	2.659	1.965	1	8	3478
Father's highest level of education	3.302	2.515	1	8	3478
Mother's age at childbirth	28.375	5.651	15.671	46.752	3478
Father's age at childbirth	31.207	6.323	15.663	63.83	3478
Missing parental characteristics					
No available info on mother's income	0.495	0.5	0	1	3478
No available info on father's income	0.146	0.353	0	1	3478
No available info on mother's education	0.047	0.212	0	1	3478
No available info on father's education	0.054	0.227	0	1	3478
Missing info on parents' age at childbirth	0.041	0.199	0	1	3478

3.4.4 Sample representativeness

In the data, we have access to matched time preference data from 3478 mothers and adolescents. Yet, in total, we have access to time preference measures for 12,956 adolescents. To check the representativeness of our matched sample, we compare adolescents with and without available information from the mothers. The groups of adolescents are not statistically different in terms of time preferences, their month of birth, and the age of their parents. Our matched sample is, however, different in terms of gender, as it has a slightly higher number of boys. Their fathers also have a slightly higher income, and it is more likely that at least one of the parents has a university or upper secondary school education level. Hence, our matched sample is somewhat positively selected on parents' socioeconomic status. The balance table with respect to control variables is presented in Table 3.D.1 in the appendix.

For the outcome variables, those in our matched sample have slightly higher grades in school, are slightly less likely to have completed upper secondary school, but are more likely to have completed a theoretical upper secondary school program and more likely to have attained any post-secondary education. There is no significant difference between the groups with respect to future earnings at different ages. However, our matched sample has a slightly higher disposable income at age 40, as well as slightly higher long-term disposable income. The balance table is presented in Table 3.D.2 in the appendix.

3.5 Main Results and Robustness

In this section, we provide the main results with respect to our first hypothesis on mothers' time preferences and adolescents' future educational outcomes in Section 5.1. In Section 5.2, we present the results from several robustness tests. Our second hypothesis, with respect to mothers' time preferences and adolescents' future earnings and income, is explored in Section 5.3. Mechanism testing is performed explicitly in Section 6, but here in the main results, both mothers' and adolescents' time preferences are already added step-wise in the regression analysis. This is done to test whether the mothers' time preferences, in themselves, have predictive power regarding the long-run outcomes.

3.5.1 Mothers' time preferences and adolescents' future educational outcomes

In Tables 3.4 to 3.6, we examine our first hypothesis, that adolescents with more patient mothers receive higher GPAs, choose more theoretical education, and attain higher levels of education.[12] In line with hypothesis 1, we estimate a positive and significant association between mothers who chose the delayed reward and adolescents' GPAs in both 9^{th} grade and upper secondary school, see Table 3.4 columns 1a and 2a. Adding controls for parental characteristics in columns 1b and 2b decreases the magnitude of the association by around 40 percent and 30 percent, respectively, but the positive association remains.

In columns 1c and 2c we add the control for adolescents' own time preferences. Doing so, we expect a dramatical decrease in the coefficient magnitude *if* the relationship between mothers' time preferences and adolescents' future educational outcomes only go through the mechanism of intergenerational transmission of time preferences. Yet, as evident in Table 3.4, including adolescents' time

[12]Binary indicators for missing information on parental characteristics are included in the regressions but not shown in results tables to conserve space. These estimates are available upon request.

preferences has a marginal effect on the estimated relationship between mothers' time preferences and adolescents' future educational outcomes. This is in line with our theory that parents' time preferences may affect their children's educational outcomes through channels beyond the intergenerational transmission of preference. Adolescents with more patient mothers receive approximately 0.09 standard deviations higher GPA in elementary and upper secondary school, see columns 1c and 2c. Even when adolescents' own time preferences are included, the estimated relationship between mothers' time preferences and adolescents' 9^{th} grade GPA is statistically significant at the 1 percent significance level, but only marginally significant for upper secondary school GPA. However, it is important to note that we lose a lot of statistical power in the regressions with GPA in upper secondary school due to a large drop in the number of observations. Comparing the coefficient estimates of mothers' time preferences and adolescents' time preferences suggests that the relative importance of mothers' time preferences is larger for 9^{th} grade GPA than for GPA in upper secondary school. As seen in Table 3.4, column 1c, the magnitude of the coefficient estimate for mothers' time preferences is approximately half the size of the coefficient estimate for adolescents' own time preferences.

Table 3.4: Hypothesis 1: Time preferences and grades

	GPA 9th grade (standardised) OLS (1a)	GPA 9th grade (standardised) OLS (1b)	GPA 9th grade (standardised) OLS (1c)	GPA upper secondary school (standardised) OLS (2a)	GPA upper secondary school (standardised) OLS (2b)	GPA upper secondary school (standardised) OLS (2c)
Mother chose delayed reward	0.177***	0.102***	0.093***	0.150***	0.104**	0.092*
	(0.036)	(0.035)	(0.035)	(0.051)	(0.051)	(0.051)
Adolescent chose delayed reward			0.200***			0.303***
			(0.038)			(0.063)
Adolescent female	0.039	0.044	0.064*	0.250***	0.237***	0.260***
	(0.035)	(0.033)	(0.033)	(0.048)	(0.048)	(0.048)
Mother's income		0.005*	0.005*		0.009**	0.010***
		(0.003)	(0.003)		(0.004)	(0.004)
Father's income		0.001	0.001		0.001	0.001
		(0.001)	(0.001)		(0.001)	(0.001)
Mother's age at childbirth		0.016***	0.016***		0.004	0.004
		(0.004)	(0.004)		(0.006)	(0.006)
Father's age at childbirth		0.001	0.001		0.003	0.004
		(0.004)	(0.004)		(0.005)	(0.005)
Mother's highest educational level		0.095***	0.092***		0.061***	0.059***
		(0.011)	(0.011)		(0.016)	(0.016)
Father's highest educational level		0.094***	0.093***		0.059***	0.058***
		(0.009)	(0.009)		(0.013)	(0.013)
Adolescent birth month	-0.011**	-0.011**	-0.011**	-0.001	-0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)
Controls for missing parental info	No	Yes	Yes	No	Yes	Yes
Observations	3226	3226	3226	1655	1655	1655
R^2	0.009	0.195	0.202	0.021	0.102	0.114
ymean	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Research has found a direct link between adolescents' own time preferences and future educational track choices (Angerer et al. 2021), but it is an open question whether adolescents make these choices in isolation from parental influence. If parents influence their adolescents' choices, parental time preferences might also correlate with educational track choices, in line with hypothesis 1. Table 3.5 presents the estimated association between mothers' time preferences and adolescents' choice of school program in elementary school (columns 1a–1c), and upper secondary school (columns 2a–2c).[13] Including all controls, adolescents with mothers who chose to delay the reward are, on average, 4.6 percentage points, or 8.2 percent more likely to enrol in an elementary school program that is preparatory for upper secondary school, see column 1c. The coefficient magnitude is slightly less than half the size of the coefficient estimates for the adolescents' own time preferences, and both are statistically significant at one percent level. However, we do not estimate a significant association between the mothers' time preferences and the adolescents' choice to enrol in a theoretical upper secondary school program and not vocational training. Again, the sample size is reduced when moving from an outcome at the elementary school level to an outcome at the upper secondary school level. The magnitude of the coefficient estimate is small, and hence we cannot say for sure whether the lack of significant association between mothers' time preferences and upper secondary school program is a result of low power.

[13] Again, the inclusion of parental characteristics to the regressions in columns 1b and 2b decrease the magnitude of the coefficient estimate for mothers' time preferences, while the estimated magnitude is almost unaffected by the inclusion of adolescents' own time preferences in columns 1c and 2c.

Table 3.5: Hypothesis 1: Time preferences and choice of school program

	Elementary school is prep. for upper secondary school Probit AME (1a)	Elementary school is prep. for upper secondary school Probit AME (1b)	Elementary school is prep. for upper secondary school Probit AME (1c)	Theoretical upper secondary program Probit AME (2a)	Theoretical upper secondary program Probit AME (2b)	Theoretical upper secondary program Probit AME (2c)
Mother chose delayed reward	0.096***	0.052***	0.046***	0.043*	0.022	0.020
	(0.018)	(0.017)	(0.017)	(0.022)	(0.021)	(0.021)
Adolescent chose delayed reward			0.118***			0.029
			(0.018)			(0.025)
Adolescent female	0.040**	0.044***	0.055***	-0.102***	-0.104***	-0.102***
	(0.017)	(0.016)	(0.016)	(0.021)	(0.020)	(0.020)
Mother's income		0.003	0.003		0.004**	0.004**
		(0.002)	(0.002)		(0.002)	(0.002)
Father's income		0.003***	0.003***		0.002*	0.002*
		(0.001)	(0.001)		(0.001)	(0.001)
Mother's age at childbirth		0.005**	0.005**		0.004*	0.004*
		(0.002)	(0.002)		(0.003)	(0.003)
Father's age at childbirth		0.003	0.003		0.000	0.000
		(0.002)	(0.002)		(0.002)	(0.002)
Mother's highest educational level		0.047***	0.045***		0.021***	0.021***
		(0.005)	(0.005)		(0.006)	(0.006)
Father's highest educational level		0.050***	0.049***		0.031***	0.031***
		(0.004)	(0.004)		(0.005)	(0.005)
Adolescent birth month	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001
	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Controls for missing parental info	No	Yes	Yes	No	Yes	Yes
Observations	3250	3250	3250	1656	1656	1656
Pseudo R^2	0.009	0.195	0.204	0.015	0.123	0.124
ymean	0.555	0.555	0.555	0.758	0.758	0.758

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

We continue to evaluate hypothesis 1 by looking at the estimated relationship between mothers' time preferences and adolescents' future educational attainment in Table 3.6. When parental characteristics are added as controls in columns 1b and 1c, we do not estimate a significant relationship between mothers' time preferences and completion of upper secondary school. The magnitude of the coefficient estimate is small and statistically insignificant. Also, the magnitude for the coefficient estimate for adolescents' own time preferences is small in column 1c, though statistically significant at the 5 percent level.

In columns 2a–2c, both mothers' and adolescents' time preferences are significantly associated with the completion of any post-secondary education at the 1 percent level. Focusing on the results in column 2c, adolescents with mothers who chose to delay the reward are, on average, 4.7 percentage points, or 12 percent, more likely to complete any post-secondary education. The coefficient estimate for adolescents' own time preferences is about twice the magnitude of the mothers' time preferences.

Table 3.6: Hypothesis 1: Time preferences and educational attainment

	Upper secondary school completion Probit AME (1a)	Upper secondary school completion Probit AME (1b)	Upper secondary school completion Probit AME (1c)	Any tertiary education Probit AME (2a)	Any tertiary education Probit AME (2b)	Any tertiary education Probit AME (2c)
Mother chose delayed reward	0.042***	0.016	0.015	0.091***	0.051***	0.047***
	(0.014)	(0.014)	(0.014)	(0.018)	(0.017)	(0.017)
Adolescent chose delayed reward			0.030**			0.096***
			(0.015)			(0.019)
Adolescent female	0.092***	0.089***	0.093***	0.033*	0.031**	0.040**
	(0.013)	(0.013)	(0.013)	(0.017)	(0.016)	(0.016)
Mother's income		-0.000	-0.000		0.002	0.002
		(0.002)	(0.002)		(0.002)	(0.001)
Father's income		0.002**	0.002**		0.001	0.001
		(0.001)	(0.001)		(0.001)	(0.001)
Mother's age at childbirth		0.005***	0.005***		0.005**	0.005**
		(0.002)	(0.002)		(0.002)	(0.002)
Father's age at childbirth		-0.000	0.000		0.004**	0.004**
		(0.001)	(0.001)		(0.002)	(0.002)
Mother's highest educational level		0.020***	0.020***		0.038***	0.036***
		(0.005)	(0.005)		(0.005)	(0.005)
Father's highest educational level		0.030***	0.030***		0.044***	0.043***
		(0.004)	(0.004)		(0.004)	(0.004)
Adolescent birth month	-0.000	0.001	0.001	-0.002	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Controls for missing parental information	No	Yes	Yes	No	Yes	Yes
Observations	3303	3303	3303	3303	3303	3303
Pseudo R^2	0.018	0.114	0.115	0.007	0.150	0.156
ymean	0.813	0.813	0.813	0.401	0.401	0.401

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

3.5.2 Robustness checks

The positive and significant association between mothers' time preferences and GPA in 9th grade is robust when using all five categories of the time preference measures instead of the binary time preference measures, see Appendix Table 3.E.1.

Appendix tables 3.E.2 and 3.E.4 present the regression results for choice of study programs and educational attainment when we use the five-step categorical measure, which includes participants' assertiveness in their time preference decisions. Appendix Tables 3.E.3 and 3.E.5 present the ordinary least squares (OLS)/linear probability model result. Again, our main results are robust to the alternative time preferences measure as well as the choice of the econometric model.

To further test the robustness of our results, we add a set of binary controls for the municipality and for the school headmaster and rerun our main results. In addition, we run OLS regressions adding municipality and school headmaster fixed effects. In Appendix Tables 3.E.6–3.E.11, we show that our main results with respect to future education are robust to the inclusion of municipality and school headmaster fixed effect. The one exception is that mothers' time preferences are no longer marginally significantly associated with GPA in upper secondary school when the municipality or headmaster fixed effect is included.

Next, we add several additional control variables separately and then together to the regression analysis. The included control variables in this exercise are the following: mother is married, adolescent's number of siblings, number of books in adolescent's home, and adolescent's cognitive ability. Regression results are presented in Appendix Tables 3.E.12–3.E.17. In most regressions, the new set of variables shows significant associations with the selected educational outcomes. Adding these control variables slightly reduces the magnitude of the coefficient estimate for mothers' time preferences. But again, our results with respect to future education is otherwise robust to the inclusion of additional controls. The one exception is that mothers' time preferences are no longer marginally significantly associated with GPA in upper secondary school when the adolescents' cognitive ability is added to the regression.

To get an understanding of how sensitive our results are to potential selection on unobservable characteristics, we apply the method described in Oster (2019). Models with and without control variables are compared, and the included variables in the latter models are the adolescent's gender and month of birth, the mother's and father's age at childbirth, their separate incomes in 1963, their education in 1968, and binary indicator variables for missing information on mother's and father's characteristics. Oster (2019) suggests an R_{max} of 1.3, meaning that the theoretically highest achievable R^2 for this model is 30% higher than the one achieved when using all high-quality controls available. Using this R_{max}, column 3 in Appendix Table 3.G.1 shows that to erase the link between mother's time preferences and adolescent's future educational outcomes, the selection on unobservables has to be two to five times as large as the selection on observable characteristics already controlled for in the model. Furthermore, Appendix Table 3.G.1 presents results using tougher assumption on R_{max} and bias-adjusted β's are presented in Appendix Table 3.G.2.

Finally, since we investigate the association between mothers' time preferences and several educational outcomes, we adjust for multiple hypothesis testing in Appendix Table 3.H.1. Since educational outcomes are similar to each other, there is a high likelihood that the p-values between the different models are correlated. The adjusting procedure by List et al. (2019) is therefore selected, since it allows the p-values to be correlated. The drawback of the List et al. (2019) method is that it does not allow for the inclusion of control variables, and Appendix Table 3.H.1 can therefore be said to test the pure predictive power of mothers' time preferences in this setting. The first output column of this table displays the raw difference in mean between adolescents whose mothers chose or did not choose the delayed reward. The following columns display unadjusted and adjusted p-values for each outcome. Overall, Appendix Table 3.H.1 shows that our estimates are robust to the adjustment for multiple hypothesis testing.

3.5.3 Incomes and earnings

The results of the analysis of a relationship between mothers' time preferences and adolescents' future earnings and incomes, hypothesis 2, is presented in Appendix Section 8.1. However, our results are inconclusive, see Appendix Tables 3.A.3–3.A.2. Significant associations between mothers' time preferences and future earnings and disposable income are estimated for some, but not all, ages, and these significant results generally do not survive our battery of robustness checks. Hence, we do not find any convincing evidence that adolescents with more patient mothers have higher lifetime earnings and incomes. One possible explanation could be that mothers' time preferences are more important at an early age, when adolescents live under the same roof as their mothers. Thus, adolescents' views on education might be influenced by the socialisation of their mothers, and/or mothers might directly restrict the adolescents' educational choices. However, when adolescents' grow older, move from home, and enter the labour market, there might no longer be a strong link between parents' time preferences and their adult children's labour outcomes.

3.6 Potential Mechanisms

In this section of the paper, we try to shed some additional light on *why* mothers' time preferences might affect adolescents' educational outcomes. Section 2 provided the theoretical framework of potential mechanisms and the associated hypotheses to be tested. To some extent, we have already started to analyse one of our suggested mechanisms, intergenerational transmission of time preferences, in Section 5, where we presented our main results. However, in this section of the paper, we analyse this mechanism and estimate the intergenerational correlation more formally together with the other mechanisms in our theoretical framework. Since the SBC data were not collected for the specific purpose of exploring mechanisms for an association between mothers' time preferences and adolescents' educational outcomes, our analysis is limited by data availability. Hence, we have tried to identify variables in this rich and unique data set that allow us to test our mechanisms as well as possible.

3.6.1 Mechanism and data availability

While the adolescents' time preferences are discussed earlier in this paper, Table 3.7 presents additional variables used in the analysis of mechanisms between mothers' time preferences and adolescents' educational outcomes. While 49% of our adolescents said they wanted to apply to upper secondary school when asked in 6th grade, 62% applied for it when they had their first chance to do so (in the second term of grade 9). The majority of mothers wanted their children to try to complete upper secondary school. Only 12% preferred that their children leave school soon to start working. Hypotheses 3 and 4 are tested with the data on the mothers' and children's time preferences and whether the mothers wanted their children to continue after elementary school and try to complete upper secondary school. The data on mothers' preferences for education, together with survey answers from the children on whether they wanted to continue to upper secondary school, asked at age 13, are used also to test hypothesis 5.

The register application data on future schooling at grade 9 are placed as an outcome in the results table that tests hypothesis 5, whether parents' and children's preferences for future educational attainment are correlated. Whether adolescents applied to higher education at this age could be seen as an expression of their preferences for schooling, but it could also have been the result of the adolescents being forced by their parents to apply. Therefore, one could also argue that the result of this regression can be seen as a test of hypothesis 6, that mothers' time preferences influence children's future schooling by imposing direct restrictions on their children's choice lists.

Continuing with hypothesis 6, the "restriction of children's choice lists" is interpreted and tested further in two different ways. The first is by assuming that mothers can impose restrictions via household rules and force their children to invest in their education. Table 3.7 shows that 78% of mothers do not allow their children to stay at home from school when they are not ill, 75% have rules for when their adolescents should be home in the evenings, and 19% report testing their adolescents on their homework. A second way in which parents can impose restrictions on children's future possibilities is to engage or not to engage in behaviour that facilitates their children's future schooling. This is investigated using available information on whether the mothers report having been to a PTA meeting in the last year (53%) and if they read their child's schoolbooks (35%). Adding these five measures of parental engagement together with equal weights, (both mothers' rule setting in the household and engagement in their children's education) generates an index with a mean of 2.6 in the sample.

Table 3.7: Summary statistics: Variables used to investigate potential channels

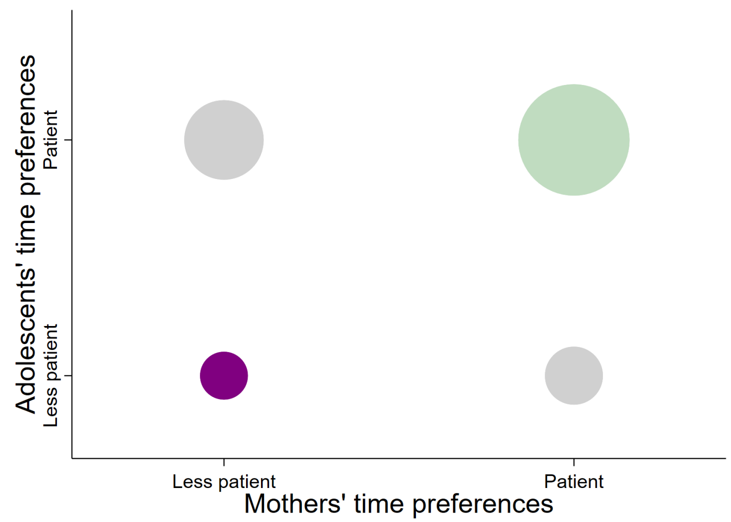
Variable	Mean	Std Dev	Min	Max	N
Adolescent want: Apply upper secondary school	0.493	0.5	0	1	3429
Adolescent applied upper secondary school (at year 9)	0.621	0.485	0	1	3467
Mother want: Child continue school after year 9	0.936	0.245	0	1	3316
Mother want: Child try to complete upper secondary	0.743	0.437	0	1	3315
Mother want: Child leave school, start working soon	0.117	0.321	0	1	3316
Mothers rule for education: Stay home not ill is not OK	0.782	0.413	0	1	3312
Mothers rule for education: Time when to be home	0.746	0.436	0	1	3251
Mothers rule for education: Tests child on homework	0.193	0.394	0	1	3308
Mothers facilitate education: Reads child's schoolbooks	0.353	0.478	0	1	3309
Mothers facilitate education: Been to PTA in last year	0.533	0.499	0	1	3312
Index: 5 restrictions to make child invest in education	2.604	1.09	0	5	3233

3.6.2 Mechanisms testing

Sequentially, this section tests whether mothers' and children's time preferences are correlated (hypothesis 3), whether more patient mothers prefer higher educational attainment for their children (hypothesis 4), and whether mothers' and children's preferences for education are correlated (hypothesis 5). Further, it looks at the possibility that mothers who want more education for their children restrict their children's choice lists in this direction (hypothesis 6). Lastly, we combine the hypotheses together and investigate how robust the channels are. In this analysis, we investigate how the mothers' time preferences relate to restrictions of the children's choice lists and the children's preferences for schooling.

Hypothesis 3: Parents' and children's time preferences are positively correlated.

Figure 3.2: Time Preference Categorisation



Notes: Circles weighted by observations; colors show agreement/disagreement between mother/adolescent. Both are patient (less patient) in 51.6% (9.1%) of the couples, N=3478.

Figure 3.2 presents the raw data on how the N=3478 matched observations of mothers' and adolescents' answers in the time preferences question. In the majority of intergenerational pairs, 56.6%, both mothers and children are classified as patient, and 9.1% of intergenerational pairs are both classified as impatient. In 25.9% of pairs, the adolescent is classified as patient while the mother is impatient, and in 13.5% of pairs, the opposite is true. The raw data for all five answers in the time preferences question is presented in Appendix Figure 3.B.1.

Table 3.8 explores the relationship between mothers' and children's time preferences using regressions. Columns 1a and 1b present probit average marginal effects for the binary outcome of adolescents choosing the delayed reward, with and without controls. We estimate a significant relationship between intergenerational time preferences, though including additional controls in column 1b slightly reduces the magnitude of the coefficient estimate.[14] In Appendix Table 3.F.1, we show that the result is robust when we use the categorical time preference measures instead of the binary measure.

The positive relation is consistent with results shown on educational outcomes in Section 5, where the coefficient size for mothers' time preferences drops as adolescents' time preferences are added to the regressions. Our correlation results are also in line with earlier findings by Epper et al. (2020) and Chowdhury et al. (2018). However, while the coefficients are consistently positive and significant, in line with hypothesis 3, the magnitude of the estimated intergenerational correlation is rather modest. Adolescents with mothers who chose to delay the reward are, on average, 4–5 percentage points, or 5–6.5 percent (columns 1a and 1b) more likely to have delayed the reward as well.[15] Similar modest intergenerational correlations in self-reported impulsiveness measures are found by Gauly (2017). To summarise, while our results consistently depict an association between mothers' and adolescents' time preferences, there is still a lot of unique variation within individuals' time preferences for each generation.

Hypothesis 4: Parents who are more patient are more likely to prefer higher educational attainment for their children.

Hypothesis 4 is tested with mothers' time preferences and information on whether the mothers want their children to continue after elementary school, try to complete upper secondary school, or start working sooner. Results presented in Table 3.9 show that all these measures for mother educational preferences are significantly related to their time preferences. The coefficient's size for choosing the delayed reward in column 1 is in the same order of magnitude as the coefficient for the mothers' education level. In columns 2 and 3, the time preference coefficient is similar in absolute numbers to two more levels of completed education for the mother, which is measured on a seven-step scale. Overall, the results in Table 3.9 are in line with hypothesis 4, that patient parents prefer higher education for their children.[16] To our knowledge, this paper is the first to empirically investigate if there is an association between parental time preference and preferences for future schooling for their children.

[14] The estimated intergenerational correlation is basically the same if we estimate an OLS model instead of a probit model. Results are available upon request.

[15] Note that when only the variable for the mothers' time preferences is included, pseudo R-square is only 0.003 (column 1).

[16] In Appendix Table 3.F.2, we show that the results are robust when applying OLS regressions instead of probit regressions.

Table 3.8: Hypothesis 3: Mothers' and children's time preferences

	Binary Adolescent chose delayed reward Probit AME (1a)	Binary Adolescent chose delayed reward Probit AME (1b)
Mother chose delayed reward	0.051***	0.038**
	(0.015)	(0.015)
Adolescent female		-0.101***
		(0.014)
Mother's income		-0.002
		(0.001)
Father's income		0.000
		(0.000)
Mother's age at childbirth		0.001
		(0.002)
Father's age at childbirth		-0.002
		(0.002)
Mother's highest educational level		0.015***
		(0.005)
Father's highest educational level		0.009**
		(0.004)
Adolescent birth month		0.000
		(0.002)
Observations	3478	3478
Pseudo R^2	0.003	0.030
ymean	0.774	0.774

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.9: Hypothesis 4: Parents' patience and preferences for higher education for their children

	Want child to continue in school after elementary school Probit AME (1)	Want child to try to complete upper secondary school Probit AME (2)	Want child to leave school soon and start working Probit AME (3)
Mother chose delayed reward	0.027***	0.061***	-0.040***
	(0.008)	(0.015)	(0.011)
Female	0.002	0.010	-0.021*
	(0.008)	(0.014)	(0.011)
Mother's income	-0.001	0.002	-0.001
	(0.001)	(0.002)	(0.001)
Father's income	0.000	0.002***	-0.001**
	(0.000)	(0.001)	(0.001)
Mother's age at childbirth	0.002**	0.002	-0.002
	(0.001)	(0.002)	(0.001)
Father's age at childbirth	-0.000	0.003*	-0.000
	(0.001)	(0.002)	(0.001)
Mother's highest educational level	0.021***	0.028***	-0.021***
	(0.004)	(0.005)	(0.005)
Father's highest educational level	0.020***	0.041***	-0.019***
	(0.003)	(0.004)	(0.004)
Adolescent birth month	0.001	-0.001	-0.002
	(0.001)	(0.002)	(0.002)
Observations	3313	3312	3313
Pseudo R^2	0.142	0.135	0.104
ymean	0.936	0.743	0.117

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Hypothesis 5: Parents' and children's preferences for the children's educational attainment are positively correlated.

The data on mothers' preferences for education are also used to test hypothesis 5. Table 3.10 shows results on how mothers' preferences for future education in 1968 relate to whether their children wanted to continue to upper secondary school (asked in 1966) and whether they applied to upper secondary school in grade 9 (in 1969). Although the two outcome variables for the adolescents' educational preferences are very different and are measured at different points in time, Table 3.10 show highly significant and large associations between mothers' and adolescents' preferences for educational attainment in columns 1 and 2. In line with hypothesis 5, children whose mothers wanted them to continue in school were much more likely to report that they themselves want to continue in school and were also much more likely to apply to higher levels of education.[17] However, we want to note that it is not obvious that actual application is a demonstration of the individual adolescents' own preferences. The adolescents might well have been forced by their parents to apply. Other important explanatory variables in this setting are mothers' and fathers' educational attainment, which both correlate positively and consistently with the educational outcomes of their children in columns 1 and 2.

Hypothesis 6: Parents with stronger preferences for higher educational attainment of their child are also more likely to restrict their children's choice lists in this direction.

As we mentioned before, the meaning of "restricting children's choice lists" can be discussed in the setting of educational attainment. The results in Table 3.10, column 2, could potentially suggest that mothers decide for their children whether they apply to an upper secondary school. Yet, there are also other ways in which a parent can "restrict" the child. In Table 3.11, we look at two such ways. The first is that mothers can force their children to invest in their education via household rules. This is tested in Table 3.11 by looking at whether mothers with a higher preference for education are more likely to test their children on their homework, whether they have more rules for when their children should be home, and whether they are less likely to let their children stay home from school when they are not ill. Column 1 shows that mothers who want their children to continue

[17] The results are also robust when applying OLS regression instead of probit regressions, as well as when using an alternative measure for mothers' preferences for education. See Appendix Table 3.F.3 for OLS results. Regression results using the alternative preference measure "Mother wants child to try to complete upper secondary school" are available upon request.

Table 3.10: Hypothesis 5: Parents' and children's preferences for the children's educational attainment

	Adolescent wants to apply to upper secondary school (asked at age 13) Probit AME (1)	Adolescent applied to upper secondary school (end of school year 9) Probit AME (2)
Mother wants child to continue education after elementary school	0.333***	0.346***
	(0.043)	(0.034)
Female	0.009	0.021
	(0.015)	(0.015)
Mother's income	0.000	0.000
	(0.002)	(0.002)
Father's income	0.002**	0.001
	(0.001)	(0.001)
Mother's age at childbirth	0.003*	0.005***
	(0.002)	(0.002)
Father's age at childbirth	0.004**	0.003
	(0.002)	(0.002)
Mother's highest educational level	0.043***	0.046***
	(0.005)	(0.005)
Father's highest educational level	0.044***	0.042***
	(0.004)	(0.004)
Adolescent birth month	-0.003	0.000
	(0.002)	(0.002)
Observations	3270	3306
Pseudo R^2	0.190	0.201
ymean	0.499	0.632

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

with their education are significantly more likely not to allow their child to skip school without a valid excuse. Columns 2 and 3, however, show no significant relation between mothers' educational preferences and restrictions on the children's choice lists. Looking at the variables for parents' educational attainment, we see that these coefficients also display unstable results. One possible explanation could be that mothers' rule-setting and testing are driven by things other than their own preferences for education, such as their children's propensity to come home late in the evening or shirk their homework.

A second way in which parents can impose indirect restrictions on their children's future is to engage or not to engage in behaviour that facilitates their children's schooling. This is investigated using available information on whether the mothers report having been to a PTA meeting in the last year and if they read their children's schoolbooks. Columns 4 and 5 show a significant positive relationship between these two outcomes and mothers' preferences for schooling.

Using an earlier version of the Stockholm birth cohort, Björklund et al. (2010) find that variables like parents' participation in PTA meetings and whether they read their children's schoolbooks are important for explaining sibling similarities in long-term income. With the same data, Von Otter & Stenberg (2015) define parents' involvement in school activities as "social capital" and find that children of parents with higher social capital have significantly higher grades in school in year 9.

Adding all outcomes in columns 1 to 5 together and creating an index, the coefficient for mothers' educational preference is positively correlated with this index of choice list restriction, seen in Table 3.11, column 6. These results are in line with hypothesis 6.[18]

In Appendix Table 3.H.2, the List et al. (2019) adjustment procedure for multiple hypothesis testing is applied again for the outcomes selected for mechanism testing. Again, the results show that significance levels are almost unaffected by the multiplicity adjustment.

[18] All results are robust when we run OLS regressions instead of probit regressions, see Appendix Table 3.F.4.

Table 3.11: Hypothesis 6: Parents' preferences for children's educational attainment and restriction on the children's choice lists

	Rules restrictions: Probit average marginal effect		Facilitators: Probit average marginal effect			Index OLS
	(1) Stay home not ill: not OK	(2) Rules: when to be home	(3) Tests homework	(4) Reads schoolbooks	(5) Been to PTA	(6) All 5
Mother wants child to continue education after elementary school	0.077***	-0.048	-0.004	0.094***	0.177***	0.290***
	(0.028)	(0.034)	(0.029)	(0.037)	(0.036)	(0.079)
Female	-0.054***	0.008	-0.011	-0.012	0.023	-0.039
	(0.014)	(0.015)	(0.014)	(0.016)	(0.017)	(0.038)
Mother's income	-0.000	0.001	0.000	0.001	-0.000	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)
Father's income	0.000	0.000	-0.001*	-0.001*	-0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Mother's age at childbirth	0.002	-0.003	0.000	0.000	-0.003	-0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)
Father's age at childbirth	0.003*	-0.004***	-0.000	0.003*	0.001	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Mother's highest educational level	-0.021***	-0.017***	0.012***	0.032***	0.026***	0.033**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.014)
Father's highest educational level	-0.004	-0.002	-0.001	0.006	0.007	0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.011)
Adolescent birth month	0.003	0.010***	0.007***	0.011***	-0.002	0.029***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.006)
Observations	3308	3248	3308	3309	3311	3233
R^2						0.023
Pseudo R^2	0.024	0.022	0.009	0.030	0.022	
ymean	0.781	0.745	0.193	0.353	0.533	2.604

Estimates for included control variables in regression for *Missing mother's income, Missing father's income, Missing mother's education, Missing father's education,* and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Hypotheses 4, 5, and 6 combined

Lastly, to check the stability of the proposed mechanisms, we test what happens if we combine them. Adding hypotheses 4 and 5 together, we test whether more patient parents have children with stronger preferences for higher educational attainment, and adding hypotheses 4 and 6 together, we test whether more patient parents are more likely to restrict their children's choice lists to make them more highly educated.

Table 3.12, column 1, displays a weakly significant positive relationship between mothers' time preferences and children's preferences for future education, measured two years earlier. Column 2 shows that children whose mothers chose the delayed reward were 6 percentage points more likely to apply to upper secondary school, compared with their peers. This correlation is non-negligible and is a tenth of the size of the outcome mean. Yet, we cannot know whether the adolescents' applications are a sign of their educational preferences or of restrictions on their choice lists put in place by their parents. Perhaps they are both.

Continuing with Table 3.12, column 3 does not display a significant relationship between mothers' time preferences and the index of restrictions on their children's choice lists.[19]

3.7 Discussion and Conclusion

Existing research has found that being patient is associated with favourable outcomes in terms of educational investments and labour market outcomes (Golsteyn et al. 2014, Angerer et al. 2021). However, many educational investments are made early in life, which suggests a large degree of parental involvement. Hence, not only individuals' own time preferences but also their parents' time preferences could be an important piece of missing information in earlier empirical research. Indeed, in the macro model of Krusell & Smith (1998), intergenerational transmission of time preferences turns out to be crucial for wealth accumulation, which further links our results to the large body of literature on intergenerational social mobility.

Using the unique SBC data, our study is the first to investigate whether parental time preferences are associated with long-term educational outcomes for their children. Taken together, our results are mainly in line with our first hypothesis,

[19] For regressions of the mothers' time preferences on all five measures included in the index, see Appendix Table 3.F.5. The results show that while patient mothers were more likely to attend PTA meetings, at the same time they were less likely to read their children's schoolbooks. Looking at the variable for the mother's educational attainment, the coefficients are significant but inconsistent in sign and vary from positive to negative, depending on the outcome.

Table 3.12: Hypotheses 4, 5 and 6 combined: Parents' time preferences, restriction of children's educational choice lists, and children's preferences for higher education

	Adolescent wants to apply to upper secondary school (asked at age 13) Probit AME (1)	Adolescent applied to upper secondary school (end of school year 9) Probit AME (2)	Index: 5 restrictions by mothers to make children invest in education OLS (3)
Mother chose delayed reward	0.028*	0.060***	-0.009
	(0.017)	(0.016)	(0.041)
Female	0.011	0.025*	-0.039
	(0.016)	(0.015)	(0.038)
Mother's income	0.001	0.001	0.002
	(0.002)	(0.002)	(0.004)
Father's income	0.002***	0.002**	-0.001
	(0.001)	(0.001)	(0.001)
Mother's age at childbirth	0.004**	0.007***	-0.003
	(0.002)	(0.002)	(0.005)
Father's age at childbirth	0.003*	0.002	0.003
	(0.002)	(0.002)	(0.004)
Mother's highest educational level	0.046***	0.050***	0.036***
	(0.005)	(0.006)	(0.014)
Father's highest educational level	0.047***	0.046***	0.009
	(0.004)	(0.004)	(0.011)
Adolescent birth month	-0.004*	0.001	0.029***
	(0.002)	(0.002)	(0.006)
Observations	3429	3467	3233
R^2			0.019
Pseudo R^2	0.169	0.177	
ymean	0.493	0.621	2.604

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, and *Missing parents' age at birth* are not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

that adolescents with more patient mothers receive higher GPAs, choose more theoretical education, and attain higher levels of education. We find that both mothers' and adolescents' own time preferences are associated with the adolescents' future educational outcomes in terms of choice of elementary school track, GPA in 9th grade, and future completion of any post-secondary education. These results are robust to changes in how we construct the measure of mothers' time preferences, the inclusion of municipality and school headmaster fixed effects, and the inclusion of additional control variables.

With respect to GPA in upper secondary school, we estimate a marginally significant association with mothers' time preferences, though the significant association does not survive our battery of robustness checks. Furthermore, we do not estimate a significant association between mothers' time preference and school track choice in upper secondary school or upper secondary school completion. We recognise that, to some extent, it seems contradictory to estimate significant associations for outcomes at the elementary and post-secondary education levels while not estimating significant associations at the upper secondary school level. Of course, one possible explanation is that there is simply no relationship between mothers' time preferences and these educational variables at the upper secondary level. For example, 82.3% of adolescents in our sample completed upper secondary school. Thus, attaining upper secondary education might be seen as a default choice and hence not primarily related to parental time preferences. Another possibility is that there is a relationship, but it is small, and we, therefore, lack the statistical power to estimate a significant association. In Appendix C, Section 8.3, we make rough power calculations for the analysis and find that the smallest detectable effect size with this sample is 0.028. The magnitude of the coefficient estimates for mothers' time preferences in the regression on choosing a theoretical upper secondary school program and completing upper secondary school are indeed smaller than 0.028. Furthermore, with respect to GPA and choice of school track in upper secondary school, the sample size is reduced to about half as a result of missing information in the register from which the data on these outcomes are retrieved. Of course, this further reduces the statistical power. As a final comment, we also recognise that the use of several binary outcomes in combination with, for some outcomes, a rather modest sample size reduces precision and the likelihood of estimating significant associations. Hence, we welcome more research with access to larger data samples in the future to further investigate this.

Overall, our results suggest a link between mothers' time preferences and adolescents' future educational outcomes beyond the intergenerational transmission of time preferences. Adolescents' own time preferences are, in general, positive and significantly associated with their own future educational outcomes in our regression analysis. However, importantly, adding adolescents' own time preferences as a control in the regression analysis only slightly decreases the magnitude of the coefficient estimate for mothers' time preferences. Hence, parental time preferences seem to be a missing piece of information in previous research on individual time preferences and future educational outcomes.

The data we have access to allows us to also explore some of the potential mechanisms behind our results. We wish to be fully transparent that this analysis is exploitative in the sense that it does not use the theoretically optimal measures, but instead uses the best possible data available in this historical data set. Yet, this analysis helps clarify the nature of the relationship between mothers' time preferences and their children's future educational outcomes. Our results clearly suggest that patient mothers are more likely to be in favour of higher educational attainment for their adolescents. Both mothers' and adolescents' preferences for future education and discounting are also positively associated. Yet, while the coefficient estimate for intergenerational transmission of preferences for education can be considered large (0.333), the coefficient estimate for time preferences is more modest (0.038). This suggests that there is still a high degree of variation in time preferences within the mother-child dyad. Furthermore, we find that mothers with stronger preferences for higher educational attainment for their children are also more likely to restrict and/or facilitate the adolescents' educational investments in a certain direction.

Interestingly, we estimate a positive though weakly significant relationship between mothers' time preferences and their adolescents' stated preferences for future education, measured in grade 6. Considering actual applications made to upper secondary education in grade 9, the estimated relationship with mothers' time preferences is larger and highly statistically significant, though it is not obvious that the application is a demonstration of the adolescents' own preferences, since mothers may have forced the adolescents to apply. Hence, one may also interpret this result in favour of the proposed channel of directly imposing restrictions on the adolescents' educational choices. However, the additional results exploring this channel do not suggest it is a mechanism for our main results.

While our data are not detailed enough to fully distinguish between likely mechanisms, we interpret our results as suggestive evidence that mothers' time preferences influence their children's preferences for future education and that more patient mothers may restrict their children's educational choices in favour of higher educational investments.

Our results contribute to the large body of literature on intergenerational social mobility. When social mobility is low, we can expect that children of poor individuals are restricted in their life opportunities. Blanden et al. (2007) find that education variables explain large parts of stickiness in intergenerational income, and using Swedish data, Adermon et al. (2021) show large persistence in education variables within family dynasties. Fully understanding the drivers of this social immobility will take time, but in our paper, we provide some evidence of the importance of intergenerational transmission of time preferences for the persistence of long-run education outcomes. We find not only an intergenerational correlation between mothers' and adolescents' time preferences, which could influence educational investments across multiple generations. But also a positive association between mothers' time preferences and adolescents' educational outcomes beyond the intergenerational transmission of time preferences, making the family one is born into an even more important predictor of future academic success.

Lastly, we agree with Angerer et al. (2021) that research considering both parents' and children's time preferences and children's educational choices is an interesting avenue for future research. Hence, we hope more studies will follow that put our results under the microscope.

Appendices 3

Index

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3.A Investigating future income and earnings

With respect to future earnings and disposable income, the results are highly inconclusive and do not survive our battery of robustness checks. Hence, we do not find any clear evidence of an association between mothers' time preferences and adolescents' future earnings and disposable incomes. One possible explanation is that mothers' time preferences are more important at early ages, when the adolescents live under the same roof and have daily interactions with their mothers, and hence correlate with educational outcomes but less so with future earnings and disposable incomes in adulthood.

In Table 3.A.1, earnings and disposable incomes are presented in log form at age 27, which is the first year of observation, as well as ages 40, 50, and 60. We also present individuals' long-term earnings and long-term disposable incomes which are the averages of earnings and disposable income over the years 1990 to 2015, equivalent to average earnings over ages 37 to 62.[20] This is longer follow-up data than used by Golsteyn et al. (2014), who are only able to follow individuals up to the age of 48. The caveat with using the log form of earnings and disposable incomes is that we lose a small fraction of individuals with zero earnings or disposable income. We experience the largest loss of individuals, 15% of the sample, with respect to the earnings outcome at age 60. Zero earnings at the age of 60 might, to some extent, reflect early retirement. We conduct balance tests for the sample with positive earnings and disposable incomes and the sample with earnings and disposable income equal to zero or missing. The general conclusion is that individuals in the sample for whom earnings and income are missing or zero are less patient and have lower GPA as well as lower educational attainment.[21]

Mother's time preferences and adolescent's future earnings and income

Finding that adolescents with more patient mothers (1) receive higher grades, (2) are more likely to enrol in an elementary school program preparing for upper secondary education, and (3) are more likely to attain post-secondary education leads us to the regression analysis for our second hypothesis. Our hypothesis is that due to higher educational investments, adolescents with more patient mothers are expected to have higher lifetime earnings and incomes.

[20] Our data do not contain year-to-year information about earnings and disposable income prior to 1990. Hence, we are not able to average income and disposable earnings over a wider age span.
[21] Results are available upon request.

Table 3.A.1: Summary statistics: Outcomes

Variable	Mean	Std. Dev.	Min.	Max.	N
Earnings and income outcomes					
Earnings age 27 (log)	10.792	0.809	4.605	12.682	3255
Earnings age 40 (log)	11.876	0.983	4.605	15.744	3046
Earnings age 50 (log)	12.37	0.969	5.298	14.912	2885
Earnings age 60 (log)	12.603	1.031	4.605	15.66	2647
Long-term earnings(log)	12.206	1.078	2.446	14.548	2957
Disposable income age 27 (log)	10.79	0.787	4.605	12.687	3286
Disposable income age 40 (log)	11.846	0.609	5.298	16.394	3296
Disposable income age 50 (log)	12.163	0.676	5.298	15.989	3189
Disposable income age 60 (log)	12.509	0.737	6.908	15.995	3076
Long-term disposable income (log)	12.282	0.494	9.500	14.643	2992

In Table 3.A.2, results for mothers' time preferences are not significant when looking at adolescents' long-term future earnings (average lifetime earnings, ages 37 to 62). However, looking at adolescents' future long-term disposable income, we do find a positive and statistically significant relationship with mothers' time preferences. Yet, using the five-step categorical measures of time preferences, which include information on participants' assertiveness in their preferences, neither results with long-term future earnings nor disposable income are significant.[22] Hence, the results are not robust to changes in the construction of our time preference measure.[23]

Tables 3.A.3 and 3.A.4 show the regression results for earnings and disposable income at ages 27, 40, 50, and 60. As is evident from the results in Table 3.A.3, the relationship between mothers' time preferences and adolescents' future earnings is mixed. We estimate a positive and statistically significant relationship with earnings at ages 27 and 50. A statistically significant relationship is estimated also between mothers' time preferences and adolescents' future disposable income at the same ages, see results in Table 3.A.4.

To summarize, with respect to the second hypothesis in this paper, our results are inconclusive. We find a positive relationship between mothers' time preferences and adolescents' future earnings and disposable income at ages 27 and 50. We further estimate a positive relationship with adolescents' long-term disposable income, but as noted by Golsteyn et al. (2014), one would expect disposable income to be less correlated with the adolescents' own time preferences than their

[22] Regression results are available upon request.

[23] Further robustness checks include adding municipality and school headmaster fixed effects, as well as a set of additional control variables. In general, our results are robust to inclusion of additional control variables but not to inclusion of fixed effects. Regression results are available upon request.

earnings, and hence even less correlated with their mothers' time preferences, since disposable income includes different government transfers. Furthermore, the significant associations between mothers' time preferences earning and disposable income at ages 27 and 50, as well as long-term disposable income, are not robust to the use of the categorical measures for time preferences or inclusion of municipality or school headmaster fixed effects.

Table 3.A.2: Hypothesis 2: Time preferences, long-term earnings, and disposable income

	Long-term earnings (log) OLS (1a)	Long-term earnings (log) OLS (1b)	Long-term disp. inc. (log) OLS (2a)	Long-term disp. inc. (log) OLS (2b)
Mother chose delayed reward	-0.000	-0.007	0.046**	0.043**
	(0.040)	(0.040)	(0.018)	(0.018)
Adolescent chose delayed reward		0.187***		0.076***
		(0.053)		(0.019)
Full set of controls	Yes	Yes	Yes	Yes
Observations	2957	2957	2992	2992
R^2	0.063	0.068	0.148	0.152
ymean	12.206	12.206	12.282	12.282

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.A.3: Hypothesis 2: Time preferences and earnings at different ages

	Earnings age 27 (log) OLS (1a)	Earnings age 27 (log) OLS (1b)	Earnings age 40 (log) OLS (2a)	Earnings age 40 (log) OLS (2b)	Earnings age 50 (log) OLS (3a)	Earnings age 50 (log) OLS (3b)	Earnings age 60 (log) OLS (4a)	Earnings age 60 (log) OLS (4b)
Mother chose delayed reward	0.061*	0.058*	-0.007	-0.011	0.078**	0.075**	0.031	0.025
	(0.032)	(0.032)	(0.036)	(0.036)	(0.038)	(0.038)	(0.044)	(0.044)
Adolescent chose delayed reward		0.081**		0.105**		0.072		0.158***
		(0.035)		(0.044)		(0.044)		(0.053)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3255	3255	3046	3046	2885	2885	2647	2647
R^2	0.065	0.067	0.073	0.075	0.056	0.057	0.031	0.035
ymean	10.792	10.792	11.876	11.876	12.370	12.370	12.603	12.603

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.A.4: Hypothesis 2: Time preferences and disposable income at different ages

	Disp. inc. age 27 (log) OLS (1a)	Disp. inc. age 27 (log) OLS (1b)	Disp. inc. age 40 (log) OLS (2a)	Disp. inc. age 40 (log) OLS (2b)	Disp. inc. age 50 (log) OLS (3a)	Disp. inc. age 50 (log) OLS (3b)	Disp. inc. age 60 (log) OLS (4a)	Disp. inc. age 60 (log) OLS (4b)
Mother chose delayed reward	0.064**	0.061**	0.038*	0.035	0.072***	0.071***	0.023	0.018
	(0.030)	(0.030)	(0.022)	(0.022)	(0.026)	(0.027)	(0.028)	(0.027)
Adolescent chose delayed reward		0.065**		0.059**		0.045*		0.131***
		(0.032)		(0.025)		(0.025)		(0.031)
Full set of controls	Yes	Yes	Yes	Yes	Yes.	Yes	Yes	Yes
Observations	3286	3286	3296	3296	3189	3189	3076	3076
R^2	0.069	0.070	0.048	0.050	0.064	0.065	0.055	0.060
ymean	10.790	10.790	11.846	11.846	12.163	12.163	12.509	12.509

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

3.B Raw data from the time preference questions

Figure 3.B.1: Time Preference Categorisation (5 steps)

Comparing time preferences of mother and adolescent		**Adolescent's response**				
		Certainly immediately	Probably immediately	indifferent/ Do not know	Probably delay	Certainly delay
Mother's response	Certainly immediately	1.6%	1.5%	2.1%	7.1%	7.9%
	Probably immediately	0.5%	0.7%	1.1%	3,0%	3.6%
	indifferent/ Do not know	0.5%	0.3%	0.8%	1.8%	2.5%
	Probably delay	0.3%	0.4%	0.8%	2.8%	3.6%
	Certainly delay	3.6%	3.4%	5.1%	19.8%	25.3%

Note: N=3478 matched pairs.

3.C Power calculations

For the main analysis in the study, the underlying model is assumed to look as follows:

$$\begin{aligned} y_i = \beta_0 + \beta_1 MotherTP_i + \beta_2 AdolTP_i + \beta_3 Adol.female_i \\ + \beta_4 \mathbf{X}_i^p + \beta_5 \mathbf{D}_i^p + \beta_6 BM_i + \epsilon_i \end{aligned} \quad (3.C.1)$$

The outcome variables of interest, y_i, include variables on educational outcomes and future earnings for the adolescent i. The key variable of interest is $MotherTP_i$, which measures the mother's time preferences. This measure is binary. In addition, the model includes a series of control variables. To calculate statistical power, we need information on the effect size and on variance and covariance between the variables. The covariances between the multiple control variables and mother choosing the delayed reward are unknown. To simplify the calculations, all control variables are therefore ignored in these power calculations. The aim of the calculations is to get an idea of how small the differences in variables we can detect are between the groups of different maternal time preferences. The variable variance is calculated using the following:

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1} \quad (3.C.2)$$

where n is the sample size, $\bar{x}$ is the mean of the variable, and x_i is an observation for a particular individual. We can get the effect size d by assuming $\alpha = 0.05$, $\beta = 0.2$, and thereby $1 - \beta = 0.8$, and reorganizing a classical power calculation:

$$d = \sqrt{\frac{12.35 s^2}{n}} \quad (3.C.3)$$

This allows us to calculate the effect size we can detect with our statistical power. In the SBC, 65.1% of the 3478 mothers chose the delayed reward, giving us $s^2 = 0.227$ and the smallest detectable effect size of 0.028. This means that we are only able to detect sample sizes that are highly economically meaningful in this setting. For comparison, the sample means for completion of upper secondary or post-secondary education are 0.813 and 0.401, respectively.

In some of the regressions in this paper, the sample is reduced for different reasons. This reduces the statistical power. At a sample of n=1000 or n=2000, the smallest detectable effect size in this simplified analysis becomes 0.053 and 0.037, respectively. In the context of labour economics, a 5% increase or decrease in the likelihood of, for example, attaining an upper secondary education, which is already at 81.3% in the sample, would be considered a very large effect.

3.D Balance sample with and without information on mothers' time preferences

Table 3.D.1: Balance table: Controls

Variable	(1) Sample without mothers' time preferences	(2) Sample with mothers' time preferences	(3) Difference
Adolescent chose delayed reward	0.782	0.774	-0.008
	(0.413)	(0.418)	(0.008)
Adolescent certainly chose immediate reward	0.062	0.064	0.003
	(0.240)	(0.246)	(0.005)
Adolescent probably chose immediate reward	0.066	0.064	-0.003
	(0.249)	(0.244)	(0.005)
Adolescent indifferent immediate/delayed reward	0.090	0.098	0.008
	(0.286)	(0.297)	(0.006)
Adolescent probably chose delayed reward	0.356	0.344	-0.011
	(0.479)	(0.475)	(0.009)
Adolescent certainly chose delayed reward	0.426	0.430	0.004
	(0.495)	(0.495)	(0.010)
Adolescent female	0.502	0.474	-0.028***
	(0.500)	(0.499)	(0.010)
Adolescent birth month	6.309	6.249	-0.060
	(3.358)	(3.379)	(0.067)
Mother's income	4.472	4.569	0.097
	(6.800)	(7.498)	(0.139)
Father's income	24.598	25.736	1.138***
	(20.871)	(22.737)	(0.424)
Mother's age at childbirth	28.331	28.375	0.044
	(5.720)	(5.651)	(0.113)
Father's age at childbirth	31.186	31.207	0.021
	(6.349)	(6.323)	(0.126)
Parent with upper secondary school	0.257	0.292	0.034***
	(0.437)	(0.455)	(0.009)
Parent with university	0.084	0.118	0.034***
	(0.278)	(0.322)	(0.006)
No available info on mother's income	0.483	0.495	0.012
	(0.500)	(0.500)	(0.010)
No available info on father's income	0.151	0.146	-0.005
	(0.358)	(0.353)	(0.007)
Missing info on parents' age at childbirth	0.047	0.041	-0.006
	(0.212)	(0.199)	(0.004)
Observations	9478	3478	12,956

Table 3.D.2: Balance table: Outcomes

Variable	(1) Sample without mothers' time preferences	(2) Sample with mothers' time preferences	(3) Difference
Educational outcomes			
GPA 9th grade	3.153	3.264	0.111***
	(0.742)	(0.841)	(0.016)
GPA upper secondary school	3.296	3.439	0.143***
	(0.637)	(0.689)	(0.019)
Elementary school preparing for upper sec. school	0.540	0.555	0.016
	(0.498)	(0.497)	(0.010)
Theoretical program in upper sec. school	0.689	0.758	0.070***
	(0.463)	(0.428)	(0.013)
Upper secondary school completed	0.830	0.813	-0.016**
	(0.376)	(0.390)	(0.008)
Post-secondary education	0.376	0.401	0.025**
	(0.484)	(0.490)	(0.010)
Earnings and disposable income			
Earnings age 27 (log)	10.782	10.792	0.009
	(0.807)	(0.809)	(0.017)
Earnings age 40 (log)	11.863	11.876	0.013
	(0.931)	(0.983)	(0.020)
Earnings age 50 (log)	12.345	12.370	0.024
	(0.966)	(0.969)	(0.021)
Earnings age 60 (log)	12.589	12.603	0.013
	(0.989)	(1.031)	(0.023)
Long-term earnings(log)	12.190	12.206	0.016
	(1.026)	(1.078)	(0.022)
Disposable income age 27 (log)	10.779	10.790	0.011
	(0.786)	(0.787)	(0.016)
Disposable income age 40 (log)	11.824	11.846	0.021*
	(0.593)	(0.609)	(0.012)
Disposable income age 50 (log)	12.146	12.163	0.017
	(0.683)	(0.676)	(0.014)
Disposable income age 60 (log)	12.484	12.509	0.026
	(0.773)	(0.737)	(0.016)
Long-term disposable income (log)	12.256	12.282	0.026**
	(0.501)	(0.494)	(0.011)
Observations	9478	3478	12,956

3.E Robustness checks on education

Table 3.E.1: Hypothesis 1: Time preferences and grades, five-step measure including assertiveness

	GPA 9th grade (standardised) OLS (1a)	GPA 9th grade (standardised) OLS (1b)	GPA upper secondary school (standardised) OLS (2a)	GPA upper secondary school (standardised) OLS (2b)
Ref. Mother certainly chose immediate reward				
Mother probably chose immediate reward	-0.003	-0.005	-0.030	-0.035
	(0.067)	(0.067)	(0.095)	(0.095)
Mother indifferent immediate/delayed reward	0.005	0.013	-0.001	-0.006
	(0.074)	(0.073)	(0.123)	(0.123)
Mother probably chose delayed reward	0.175**	0.157**	0.193*	0.162
	(0.070)	(0.069)	(0.102)	(0.102)
Mother certainly chose delayed reward	0.092**	0.086*	0.082	0.066
	(0.045)	(0.044)	(0.066)	(0.066)
Ref. Adolecent certainly chose immediate reward				
Adolescent probably chose immediate reward		0.330***		0.086
		(0.085)		(0.146)
Adolescent indifferent immediate/delayed reward		0.282***		0.138
		(0.079)		(0.143)
Adolescent probably chose delayed reward		0.431***		0.331***
		(0.065)		(0.116)
Adolescents certainly chose delayed reward		0.406***		0.438***
		(0.065)		(0.116)
Full set of controls	Yes	Yes	Yes	Yes
Observations	3226	3226	1655	1655
R^2	0.195	0.206	0.103	0.118
ymean	-0.000	-0.000	-0.000	-0.000

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.2: Hypothesis 1: Time preferences and choice of school program, five-step measure including assertiveness

	Elementary school is prep. for upper secondary school Probit AME (1a)	Elementary school is prep. for upper secondary school Probit AME (1b)	Theoretical upper secondary program Probit AME (2a)	Theoretical upper secondary program Probit AME (2b)
Ref. Mother certainly chose immediate reward				
Mother probably chose immediate reward	0.031	0.029	0.060	0.060
	(0.032)	(0.032)	(0.041)	(0.041)
Mother indifferent immediate/delayed reward	0.009	0.014	0.076	0.076
	(0.037)	(0.036)	(0.050)	(0.050)
Mother probably chose delayed reward	0.105***	0.092***	0.100**	0.098**
	(0.034)	(0.034)	(0.042)	(0.042)
Mother certainly chose delayed reward	0.056**	0.052**	0.045*	0.044
	(0.022)	(0.022)	(0.027)	(0.027)
Ref. Adolescent certainly chose immediate reward				
Adolescent probably chose immediate reward		0.159***		0.081
		(0.042)		(0.059)
Adolescent indifferent immediate/delayed reward		0.089**		0.046
		(0.039)		(0.058)
Adolescent probably chose delayed reward		0.207***		0.075
		(0.032)		(0.048)
Adolescents certainly chose delayed reward		0.200***		0.075
		(0.032)		(0.048)
Full set of controls	Yes	Yes	Yes	Yes
Observations	3250	3250	1656	1656
Pseudo R^2	0.196	0.208	0.126	0.128
ymean	0.555	0.555	0.758	0.758

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.3: Hypothesis 1: Time preferences and choice of school program, OLS

	Elementary school is prep. for upper secondary school OLS (1a)	Elementary school is prep. for upper secondary school OLS (1b)	Elementary school is prep. for upper secondary school OLS (1c)	Elementary school is prep. for upper secondary school OLS (1d)	Theoretical upper secondary program OLS (2a)	Theoretical upper secondary program OLS (2b)	Theoretical upper secondary program OLS (2c)	Theoretical upper secondary program OLS (2d)
Mother chose delayed reward	0.054***	0.048***			0.026	0.025		
	(0.017)	(0.017)			(0.023)	(0.023)		
Adolescent chose delayed reward		0.127***				0.034		
		(0.018)				(0.028)		
Ref. Mother certainly chose immediate reward								
Mother probably chose immediate reward			0.032	0.029			0.060	0.060
			(0.033)	(0.032)			(0.043)	(0.043)
Mother indifferent immediate/delayed reward			0.006	0.011			0.079	0.079
			(0.038)	(0.037)			(0.052)	(0.052)
Mother probably chose delayed reward			0.106***	0.095***			0.100**	0.098**
			(0.034)	(0.034)			(0.042)	(0.042)
Mother certainly chose delayed reward			0.059***	0.054**			0.051*	0.050*
			(0.022)	(0.022)			(0.030)	(0.030)
Ref. Adolescent certainly chose immediate reward								
Adolescent probably chose immediate reward				0.160***				0.093
				(0.041)				(0.067)
Adolescent indifferent immediate/delayed reward				0.086**				0.050
				(0.036)				(0.066)
Adolescent probably chose delayed reward				0.214***				0.085
				(0.030)				(0.055)
Adolescent certainly chose delayed reward				0.206***				0.090
				(0.030)				(0.054)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3250	3250	3250	3250	1656	1656	1656	1656
R^2	0.230	0.241	0.231	0.245	0.124	0.125	0.127	0.129
ymean	0.555	0.555	0.555	0.555	0.758	0.758	0.758	0.758

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.4: Hypothesis 1: Time preferences and educational attainment, five-step measure including assertiveness

	Upper secondary school completion Probit AME (1a)	Upper secondary school completion Probit AME (1b)	Post-secondary education Probit AME (2a)	Post-secondary education Probit AME (2b)
Ref. Mother certainly chose immediate reward				
Mother probably chose immediate reward	-0.025	-0.027	0.031	0.030
	(0.026)	(0.026)	(0.032)	(0.032)
Mother indifferent immediate/delayed reward	0.019	0.020	-0.004	-0.004
	(0.030)	(0.030)	(0.038)	(0.038)
Mother probably chose delayed reward	0.010	0.007	0.088***	0.079**
	(0.029)	(0.029)	(0.033)	(0.033)
Mother certainly chose delayed reward	0.012	0.011	0.055**	0.051**
	(0.019)	(0.018)	(0.022)	(0.022)
Ref. Adolescent certainly chose immediate reward				
Adolescent probably chose immediate reward		0.113***		0.085*
		(0.033)		(0.045)
Adolescent indifferent immediate/delayed reward		0.104***		0.056
		(0.030)		(0.041)
Adolescent probably chose delayed reward		0.107***		0.138***
		(0.024)		(0.035)
Adolescents certainly chose delayed reward		0.096***		0.150***
		(0.024)		(0.034)
Full set of controls	Yes	Yes	Yes	Yes
Observations	3303	3303	3303	3303
Pseudo R^2	0.115	0.121	0.151	0.157
ymean	0.813	0.813	0.401	0.401

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.5: Hypothesis 1: Time preferences and Educational attainment

	Upper secondary school completion OLS (1a)	Upper secondary school completion OLS (1b)	Upper secondary school completion OLS (1c)	Upper secondary school completion OLS (1d)	Post-secondary education OLS (2a)	Post-secondary education OLS (2b)	Post-secondary education OLS (2c)	Post-secondary education OLS (2d)
Mother chose delayed reward	0.020	0.019			0.051***	0.047***		
	(0.014)	(0.014)			(0.017)	(0.017)		
Adolescent chose delayed reward		0.034**				0.093***		
		(0.017)				(0.018)		
Ref. Mother certainly chose immediate reward								
Mother probably chose immediate reward			-0.029	-0.031			0.033	0.031
			(0.028)	(0.028)			(0.032)	(0.032)
Mother indifferent immediate/delayed reward			0.015	0.016			-0.001	-0.001
			(0.032)	(0.031)			(0.037)	(0.036)
Mother probably chose delayed reward			0.017	0.013			0.092***	0.085**
			(0.028)	(0.028)			(0.034)	(0.034)
Mother certainly chose delayed reward			0.014	0.013			0.056**	0.052**
			(0.019)	(0.019)			(0.022)	(0.022)
Ref. Adolescent certainly chose immediate reward								
Adolescent probably chose immediate reward				0.138***				0.075*
				(0.040)				(0.040)
Adolescent indifferent immediate/delayed reward				0.136***				0.046
				(0.037)				(0.035)
Adolescent probably chose delayed reward				0.138***				0.127***
				(0.032)				(0.029)
Adolescents certainly chose delayed reward				0.126***				0.139***
				(0.032)				(0.029)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3303	3303	3303	3303	3303	3303	3303	3303
R^2	0.093	0.094	0.093	0.100	0.193	0.199	0.193	0.200
ymean	0.813	0.813	0.813	0.813	0.401	0.401	0.401	0.401

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Municipality and headmaster fixed effects

Table 3.E.6: Hypothesis 1: Time preferences and grades, municipality/headmaster dummies

	GPA 9th grade (standardised) OLS (1a)	GPA 9th grade (standardised) OLS (1b)	GPA 9th grade (standardised) OLS (1c)	GPA upper secondary school (standardised) OLS (2a)	GPA upper secondary school (standardised) OLS (2b)	GPA upper secondary school (standardised) OLS (2c)
Mother chose delayed reward	0.093***	0.108***	0.108***	0.092*	0.081	0.090
	(0.035)	(0.037)	(0.038)	(0.051)	(0.054)	(0.057)
Adolescent chose delayed reward	0.200***	0.197***	0.196***	0.303***	0.290***	0.275***
	(0.038)	(0.041)	(0.042)	(0.063)	(0.066)	(0.069)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality dummies	No	Yes	No	No	Yes	No
Headmaster dummies	No	No	Yes	No	No	Yes
Observations	3226	2839	2839	1655	1514	1514
R^2	0.202	0.203	0.240	0.114	0.122	0.184
ymean	-0.000	0.036	0.036	-0.000	-0.001	-0.001

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.7: Hypothesis 1: Time preferences and grades, municipality/headmaster FE

	GPA 9th grade (standardised) OLS	GPA 9th grade (standardised) OLS	GPA 9th grade (standardised) OLS	GPA upper secondary school (standardised) OLS	GPA upper secondary school (standardised) OLS	GPA upper secondary school (standardised) OLS
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)
Mother chose delayed reward	0.093***	0.108***	0.108***	0.092*	0.081	0.090
	(0.035)	(0.036)	(0.039)	(0.051)	(0.051)	(0.059)
Adolescent chose delayed reward	0.200***	0.197***	0.196***	0.303***	0.290***	0.275***
	(0.038)	(0.042)	(0.047)	(0.063)	(0.083)	(0.067)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	Yes	No	No	Yes	No
Headmaster FE	No	No	Yes	No	No	Yes
Observations	3226	2839	2839	1655	1514	1514
R^2	0.202	0.189	0.168	0.114	0.101	0.090
ymean	-0.000	0.036	0.036	-0.000	-0.001	-0.001

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.8: Hypothesis 1: Time preferences and choice of school program, municipality/headmaster dummies

	Elementary school is prep. for upper secondary school Probit AME	Elementary school is prep. for upper secondary school Probit AME	Elementary school is prep. for upper secondary school Probit AME	Theoretical upper secondary program Probit AME	Theoretical upper secondary program Probit AME	Theoretical upper secondary program Probit AME
	(1a)	(1b)	(1c)	(2a)	(2a)	(2c)
Mother chose delayed reward	0.046***	0.049***	0.043**	0.020	0.035	0.059***
	(0.017)	(0.018)	(0.018)	(0.021)	(0.022)	(0.022)
Adolescent chose delayed reward	0.118***	0.114***	0.115***	0.029	0.015	0.012
	(0.018)	(0.019)	(0.019)	(0.025)	(0.027)	(0.027)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality dummies	No	Yes	No	No	Yes	No
Headmaster dummies	No	No	Yes	No	No	Yes
Observations	3250	2857	2855	1656	1514	1473
Pseudo R^2	0.204	0.198	0.239	0.124	0.133	0.196
ymean	0.555	0.576	0.576	0.758	0.758	0.751

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.9: Hypothesis 1: Time preferences and choice of school program, municipality/headmaster FE

	Elementary school is prep. for upper secondary school OLS (1a)	Elementary school is prep. for upper secondary school OLS (1b)	Elementary school is prep. for upper secondary school OLS (1c)	Theoretical upper secondary program OLS (2a)	Theoretical upper secondary program OLS (2b)	Theoretical upper secondary program OLS (2c)
Mother chose delayed reward	0.048***	0.052***	0.046**	0.025	0.040	0.056**
	(0.017)	(0.012)	(0.022)	(0.023)	(0.026)	(0.026)
Adolescent chose delayed reward	0.127***	0.124***	0.124***	0.034	0.019	0.011
	(0.018)	(0.016)	(0.021)	(0.028)	(0.029)	(0.029)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	Yes	No	No	Yes	No
Headmaster FE	No	No	Yes	No	No	Yes
Observations	3250	2857	2857	1656	1514	1514
R^2	0.241	0.208	0.181	0.125	0.113	0.097
ymean	0.555	0.576	0.576	0.758	0.758	0.758

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.10: Hypothesis 1: Time preferences and educational attainment, municipality/headmaster dummies

	Upper secondary school completion Probit AME (1a)	Upper secondary school completion Probit AME (1b)	Upper secondary school completion Probit AME (1c)	Post-secondary education Probit AME (2a)	Post-secondary education Probit AME (2b)	Post-secondary education Probit AME (2c)
Mother chose delayed reward	0.015	0.013	0.012	0.047***	0.057***	0.060***
	(0.014)	(0.014)	(0.014)	(0.017)	(0.019)	(0.019)
Adolescent chose delayed reward	0.030**	0.035**	0.043***	0.096***	0.087***	0.088***
	(0.015)	(0.015)	(0.015)	(0.019)	(0.021)	(0.021)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality dummies	No	Yes	No	No	Yes	No
Headmaster dummies	No	No	Yes	No	No	Yes
Observations	3303	2806	2757	3303	2806	2795
Pseudo R^2	0.115	0.125	0.163	0.156	0.148	0.178
ymean	0.813	0.841	0.841	0.401	0.426	0.426

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.11: Hypothesis 1: Time preferences and educational attainment, municipality/headmaster FE

	Upper secondary school completion OLS (1a)	Upper secondary school completion OLS (1b)	Upper secondary school completion OLS (1c)	Post-secondary education OLS (2a)	Post-secondary education OLS (2b)	Post-secondary education OLS (2c)
Mother chose delayed reward	0.019	0.017***	0.014	0.047***	0.058**	0.062***
	(0.014)	(0.006)	(0.014)	(0.017)	(0.025)	(0.019)
Adolescent chose delayed reward	0.034**	0.038**	0.044**	0.093***	0.085***	0.087***
	(0.017)	(0.016)	(0.019)	(0.018)	(0.015)	(0.020)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	No	Yes	No	No	Yes	No
Headmaster FE	No	No	Yes	No	No	Yes
Observations	3303	2806	2806	3303	2806	2806
R^2	0.094	0.082	0.077	0.199	0.167	0.145
ymean	0.813	0.841	0.841	0.401	0.426	0.426

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Additional control variables

Table 3.E.12: Hypothesis 1: Time preferences and grades

	GPA 9th grade (standardised) OLS (1a)	GPA 9th grade (standardised) OLS (1b)	GPA 9th grade (standardised) OLS (1c)	GPA 9th grade (standardised) OLS (1d)	GPA 9th grade (standardised) OLS (1e)	GPA 9th grade (standardised) OLS (1f)
Mother chose delayed reward	0.093***	0.090***	0.091***	0.086**	0.076**	0.071**
	(0.035)	(0.035)	(0.034)	(0.034)	(0.032)	(0.032)
Adolescent chose delayed reward	0.200***	0.200***	0.189***	0.200***	0.080**	0.073**
	(0.038)	(0.038)	(0.038)	(0.039)	(0.035)	(0.036)
Mother is married		0.172***				0.124**
		(0.059)				(0.052)
No. siblings			-0.095***			-0.054***
			(0.016)			(0.015)
No. books at home				0.086***		0.033*
				(0.019)		(0.018)
Cognitive ability					0.049***	0.048***
					(0.002)	(0.002)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3226	3226	3226	3082	3195	3052
R^2	0.202	0.204	0.211	0.209	0.345	0.353
ymean	-0.000	-0.000	-0.000	0.015	0.003	0.018

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.13: Hypothesis 1: Time preferences and grades

	GPA upper secondary school (standardised) OLS (1a)	GPA upper secondary school (standardised) OLS (1b)	GPA upper secondary school (standardised) OLS (1c)	GPA upper secondary school (standardised) OLS (1d)	GPA upper secondary school (standardised) OLS (1e)	GPA upper secondary school (standardised) OLS (1f)
Mother chose delayed reward	0.092*	0.091*	0.093*	0.092*	0.076	0.075
	(0.051)	(0.051)	(0.051)	(0.051)	(0.049)	(0.049)
Adolescent chose delayed reward	0.303***	0.305***	0.303***	0.307***	0.224***	0.230***
	(0.063)	(0.062)	(0.063)	(0.064)	(0.061)	(0.063)
Mother is married		0.085				0.043
		(0.094)				(0.093)
No. siblings			-0.026			-0.029
			(0.025)			(0.025)
No. books at home				0.030		0.010
				(0.031)		(0.030)
Cognitive ability					0.034***	0.034***
					(0.003)	(0.003)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1655	1655	1655	1599	1643	1588
R^2	0.114	0.115	0.115	0.114	0.170	0.171
ymean	-0.000	-0.000	-0.000	0.011	0.005	0.015

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.14: Hypothesis 1: Time preferences and choice of school program

	Elementary school is prep. for upper secondary school Probit AME (1a)	Elementary school is prep. for upper secondary school Probit AME (1b)	Elementary school is prep. for upper secondary school Probit AME (1c)	Elementary school is prep. for upper secondary school Probit AME (1d)	Elementary school is prep. for upper secondary school Probit AME (1e)	Elementary school is prep. for upper secondary school Probit AME (1f)
Mother chose delayed reward	0.046***	0.045***	0.045***	0.041**	0.037**	0.032**
	(0.017)	(0.017)	(0.017)	(0.016)	(0.015)	(0.015)
Adolescent chose delayed reward	0.118***	0.117***	0.112***	0.111***	0.067***	0.059***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)
Mother is married		0.071***				0.038
		(0.027)				(0.025)
No. siblings			-0.053***			-0.036***
			(0.007)			(0.007)
No. books at home				0.062***		0.039***
				(0.009)		(0.009)
Cognitive ability					0.018***	0.017***
					(0.001)	(0.001)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3250	3250	3250	3104	3219	3074
Pseudo R^2	0.204	0.206	0.216	0.216	0.304	0.318
ymean	0.555	0.555	0.555	0.563	0.555	0.564

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.15: Hypothesis 1: Time preferences and choice of school program

	Theoretical upper secondary program Probit AME (1a)	Theoretical upper secondary program Probit AME (1b)	Theoretical upper secondary program Probit AME (1c)	Theoretical upper secondary program Probit AME (1d)	Theoretical upper secondary program Probit AME (1e)	Theoretical upper secondary program Probit AME (1f)
Mother chose delayed reward	0.020	0.020	0.021	0.021	0.019	0.018
	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)	(0.020)
Adolescent chose delayed reward	0.029	0.030	0.028	0.026	-0.005	-0.009
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Mother is married		0.084**				0.066*
		(0.036)				(0.034)
No. siblings			-0.025**			-0.017
			(0.011)			(0.010)
No. books at home				0.033***		0.023*
				(0.013)		(0.012)
Cognitive ability					0.015***	0.014***
					(0.001)	(0.001)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1656	1656	1656	1600	1644	1589
Pseudo R^2	0.124	0.127	0.127	0.129	0.195	0.199
ymean	0.758	0.758	0.758	0.759	0.757	0.758

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.16: Hypothesis 1: Time preferences and educational attainment

	Upper secondary school completion Probit AME (1a)	Upper secondary school completion Probit AME (1b)	Upper secondary school completion Probit AME (1c)	Upper secondary school completion Probit AME (1d)	Upper secondary school completion Probit AME (1e)	Upper secondary school completion Probit AME (1f)
Mother chose delayed reward	0.015	0.015	0.013	0.012	0.013	0.011
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)
Adolescent chose delayed reward	0.030**	0.030**	0.027*	0.027*	0.007	0.005
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Mother is married		-0.011				-0.025
		(0.023)				(0.022)
No. siblings			-0.029***			-0.020***
			(0.006)			(0.006)
No. books at home				0.026***		0.013*
				(0.008)		(0.008)
Cognitive ability					0.009***	0.009***
					(0.001)	(0.001)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3303	3303	3303	3144	3274	3116
Pseudo R^2	0.115	0.115	0.123	0.118	0.165	0.171
ymean	0.813	0.813	0.813	0.820	0.813	0.820

Full set of controls includes *Adolescent female*, *Mother's income*, *Father's income*, *Mother's age at childbirth*, *Father's age at childbirth*, *Mother's highest educational level*, *Father's highest educational level*, *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.E.17: Hypothesis 1: Time preferences and educational attainment

	Post-secondary education Probit AME (1a)	Post-secondary education Probit AME (1b)	Post-secondary education Probit AME (1c)	Post-secondary education Probit AME (1d)	Post-secondary education Probit AME (1e)	Post-secondary education Probit AME (1f)
Mother chose delayed reward	0.047***	0.046***	0.046***	0.043**	0.042***	0.040**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)
Adolescent chose delayed reward	0.096***	0.096***	0.093***	0.098***	0.056***	0.057***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Mother is married		0.044				0.025
		(0.028)				(0.027)
No. siblings			-0.031***			-0.020**
			(0.008)			(0.008)
No. books at home				0.040***		0.022**
				(0.009)		(0.009)
Cognitive ability					0.014***	0.014***
					(0.001)	(0.001)
Full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3303	3303	3303	3144	3274	3116
Pseudo R^2	0.156	0.157	0.160	0.160	0.211	0.212
ymean	0.401	0.401	0.401	0.408	0.401	0.409

Full set of controls includes *Adolescent female, Mother's income, Father's income, Mother's age at childbirth, Father's age at childbirth, Mother's highest educational level, Father's highest educational level, Missing mother's income, Missing father's income, Missing mother's education, Missing father's education, Missing parents' age at birth*, and *Adolescent birth month*. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

3.F Mechanisms

Table 3.F.1: Hypothesis 3: Mothers' and children's time preferences, five-step measure including assertiveness

	Five steps adolescent time preferences (OLS) (1a)	Five steps adolescent time preferences (OLS) (1b)
Ref. Mother certainly chose immediate reward		
Mother probably chose immediate reward	0.052	0.060
	(0.081)	(0.083)
Mother indifferent immediate/delayed reward	0.049	0.076
	(0.098)	(0.099)
Mother probably chose delayed reward	0.232***	0.221***
	(0.078)	(0.081)
Mother certainly chose delayed reward	0.147***	0.125**
	(0.053)	(0.056)
Female		-0.259***
		(0.040)
Mother's income		-0.005
		(0.003)
Father's income		0.001
		(0.001)
Mother's age at childbirth		0.002
		(0.005)
Father's age at childbirth		-0.004
		(0.005)
Mother's highest educational level		0.043***
		(0.013)
Father's highest educational level		0.022**
		(0.011)
Observations	3478	3478
R^2	0.004	0.028
ymean	4.012	4.012

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month* not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.F.2: Hypothesis 4: Parents' patience and preferences for higher education for their children

	Want child to continue in school after elementary school OLS (1)	Want child to try to complete upper secondary school OLS (2)	Want child to leave school soon and start working OLS (3)
Mother chose delayed reward	0.033***	0.067***	-0.043***
	(0.010)	(0.016)	(0.012)
Female	0.004	0.015	-0.020*
	(0.008)	(0.014)	(0.011)
Mother's income	-0.001	0.001	-0.000
	(0.001)	(0.001)	(0.001)
Father's income	-0.000	0.001**	-0.000
	(0.000)	(0.000)	(0.000)
Mother's age at childbirth	0.002**	0.003	-0.002
	(0.001)	(0.002)	(0.001)
Father's age at childbirth	-0.000	0.003*	-0.000
	(0.001)	(0.002)	(0.001)
Mother's highest educational level	0.011***	0.024***	-0.015***
	(0.002)	(0.004)	(0.003)
Father's highest educational level	0.013***	0.040***	-0.017***
	(0.002)	(0.004)	(0.003)
Observations	3316	3315	3316
R^2	0.050	0.128	0.061
ymean	0.936	0.743	0.117

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month* not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.F.3: Hypothesis 5: Parents' and children's preferences for the children's educational attainment

	Adolescent wants to apply to upper secondary school (asked at age 13) OLS (1)	Adolescent applied to upper secondary school (end of school year 9) OLS (2)
Mother wants child to continue education after elementary school	0.263***	0.372***
	(0.022)	(0.025)
Female	0.009	0.024
	(0.015)	(0.015)
Mother's income	-0.000	-0.000
	(0.001)	(0.001)
Father's income	0.001**	0.000
	(0.000)	(0.000)
Mother's age at childbirth	0.004*	0.005***
	(0.002)	(0.002)
Father's age at childbirth	0.004**	0.003*
	(0.002)	(0.002)
Mother's highest educational level	0.045***	0.043***
	(0.005)	(0.005)
Father's highest educational level	0.051***	0.044***
	(0.004)	(0.004)
Observations	3270	3306
R^2	0.235	0.231
ymean	0.499	0.632

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month* not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.F.4: Hypothesis 6: Parents' preferences for children's educational attainment and restriction on the children's choice lists

	Rules restrictions: Probit average marginal effect			Facilitators: Probit average marginal effect		Index OLS
	(1) Stay home not ill: Not OK	(2) Rules: when to be home	(3) Tests child on homework	(4) schoolbooks schoolbooks	(5) Been to PTA	(6) All 5
Mother wants child to continue education after elementary school	0.079**	-0.043	-0.003	0.084***	0.175***	0.290***
	(0.031)	(0.029)	(0.028)	(0.030)	(0.034)	(0.079)
Female	-0.053***	0.009	-0.011	-0.012	0.023	-0.039
	(0.014)	(0.015)	(0.014)	(0.016)	(0.017)	(0.038)
Mother's income	-0.001	0.002	0.000	0.002	-0.000	0.003
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.004)
Father's income	0.000	0.000	-0.001**	-0.001*	-0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Mother's age at childbirth	0.001	-0.003	0.000	0.000	-0.003	-0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)
Father's age at childbirth	0.003*	-0.005**	-0.000	0.003*	0.001	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Mother's highest educational level	-0.022***	-0.017***	0.012**	0.034***	0.026***	0.033**
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.014)
Father's highest educational level	-0.004	-0.002	-0.001	0.006	0.007	0.005
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.011)
Observations	3311	3250	3308	3309	3311	3233
R^2	0.026	0.025	0.009	0.039	0.029	0.023
ymean	0.782	0.746	0.193	0.353	0.533	2.604

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month* not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.F.5: Hypotheses 4 and 6 combined: Parents' time preferences and restriction of children's educational choice lists: All five outcomes

	Rules restrictions: Probit average marginal effect			Facilitators: Probit average marginal effect	
	(1) ill: not OK Stay home not	(2) Rules: when to be home	(3) Tests child on homework	(4) Reads child's schoolbooks	(5) Been to PTA
Mother chose delayed reward	0.005	-0.025	-0.010	-0.037**	0.053***
	(0.015)	(0.016)	(0.015)	(0.017)	(0.018)
Female	-0.053***	0.007	-0.011	-0.012	0.025
	(0.014)	(0.015)	(0.014)	(0.016)	(0.017)
Mother's income	-0.000	0.002	0.000	0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Father's income	0.000	0.000	-0.001*	-0.001*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mother's age at childbirth	0.002	-0.003	0.000	0.000	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Father's age at childbirth	0.003*	-0.005***	-0.000	0.003*	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mother's highest educational level	-0.020***	-0.017***	0.012***	0.034***	0.027***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Father's highest educational level	-0.003	-0.002	-0.001	0.007	0.009*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Observations	3309	3249	3308	3309	3312
Pseudo R^2	0.022	0.022	0.009	0.029	0.018
ymean	0.782	0.745	0.193	0.353	0.533

Estimates for included control variables in regression for *Missing mother's income*, *Missing father's income*, *Missing mother's education*, *Missing father's education*, *Missing parents' age at birth*, and *Adolescent birth month* not shown in table to conserve space. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

3.G Unobservable Selection Oster (2019)

Table 3.G.1: Finding the $\widetilde{\delta}$ that makes "Choosing the delayed" $\beta = 0$ at different R_{max} using Oster (2019)

	(1) Baseline effect (std. error) [R^2]	(2) Controlled effect (std. error) [R^2]	(3) $\widetilde{\delta}$ for $\beta = 0$ given $R_{max} = 1.3\widetilde{R_2}$	(4) $\widetilde{\delta}$ for $\beta = 0$ given $R_{max} = 2\widetilde{R_2}$
GPA 9th grade	0.1786	0.1020	3.413	1.049
	(0.0364) [0.007]	(0.0349) [0.195]		
GPA upper secondary school	0.1525	0.1044	5.223	1.642
	(0.0518) [0.005]	(0.0513) [0.102]		
Elementary school preparing for upper secondary school	0.0988	0.0540	3.127	0.960
	(0.0184) [0.009]	(0.0171) [0.230]		
Theoretical program in upper secondary school	0.0432	0.0262	4.123	1.258
	(0.0231) [0.002]	(0.0225) [0.124]		
Upper secondary school completed	0.0467	0.0201	2.051	0.624
	(0.0146) [0.003]	(0.0144) [0.093]		
Any tertiary education	0.0920	0.0507	3.126	0.962
	(0.0176) [0.008]	(0.0170) [0.193]		

Notes: $\widetilde{R_2}$ is the R^2 value in the corresponding model with controls included. Exogenous variables controlled for in column 2 are adolescent's gender and month of birth, mother's and father's age at childbirth, income and education, as well as binary indicators for missing information on mother's and father's characteristics. Robust standard errors are applied.

Table 3.G.2: Bias-adjusted β for "Mothers choosing the delayed reward"

	(1) Baseline effect (std. error) [R^2]	(2) Controlled effect (std. error) [R^2]	(3) Bias-adjusted β $R_{max} = 1.3\widetilde{R_2}$	(4) Bias-adjusted β $R_{max} = 2\widetilde{R_2}$
Panel A: $\delta = 1$				
GPA 9th grade	0.1786	0.1020	$0.0751^{\triangledown}$	$0.0054^{\triangledown}$
	(0.0364) [0.007]	(0.0349) [0.195]		
GPA upper secondary school	0.1525	0.1044	$0.0876^{\triangledown}$	$0.0450^{\triangledown}$
	(0.0518) [0.005]	(0.0513) [0.102]		
Elementary school preparing for upper secondary school	0.0988	0.0540	$0.0383^{\triangledown}$	$-0.0025^{\triangledown}$
	(0.0184) [0.009]	(0.0171) [0.230]		
Theoretical program in upper secondary school	0.0432	0.0262	$0.0204^{\triangledown}$	$-0.0059^{\triangledown}$
	(0.0231) [0.002]	(0.0225) [0.124]		
Upper secondary school completed	0.0467	0.0201	$0.0107^{\triangledown}$	$-0.0136^{\triangledown}$
	(0.0146) [0.003]	(0.0144) [0.093]		
Any tertiary education	0.0920	0.0507	$0.0360^{\triangledown}$	$-0.0023^{\triangledown}$
	(0.0176) [0.008]	(0.0170) [0.193]		
Panel B: $\delta = 2$				
GPA 9th grade	0.1786	0.1020	$0.0461^{\triangledown}$	$-0.1213^{\triangledown}$
	(0.0364) [0.007]	(0.0349) [0.195]		
GPA upper secondary school	0.1525	0.1044	$0.0698^{\triangledown}$	$-0.0285^{\triangledown}$
	(0.0518) [0.005]	(0.0513) [0.102]		
Elementary school preparing for upper secondary school	0.0988	0.0540	$0.0213^{\triangledown}$	$-0.0773^{\triangledown}$
	(0.0184) [0.009]	(0.0171) [0.230]		
Theoretical program in upper secondary school	0.0432	0.0262	$0.0144^{\triangledown}$	$-0.0189^{\triangledown}$
	(0.0231) [0.002]	(0.0225) [0.124]		
Upper secondary school completed	0.0467	0.0201	$0.0006^{\triangledown}$	$-0.0595^{\triangledown}$
	(0.0146) [0.003]	(0.0144) [0.093]		
Any tertiary education	0.0920	0.0507	$0.0201^{\triangledown}$	$-0.0740^{\triangledown}$
	(0.0176) [0.008]	(0.0170) [0.193]		

Notes: $\widetilde{R_2}$ is the R^2 value in the corresponding model with controls included. $^{\triangledown}$ Indicates that multiple solutions are generated. The solution that minimises the squared difference to the estimated treatment effect in the controlled regression is selected, as suggested by Oster (2019). Exogenous variables controlled for in column 2 are adolescent's gender and month of birth, mother's and father's age at childbirth, income and education, as well as binary indicators for missing information on mother's and father's characteristics. Robust standard errors are applied.

3.H Adjust for multiple hypothesis testing

Table 3.H.1: Multiple main outcomes, unadjusted and adjusted p-values

Outcome	Diff. in mean	p-values unadjusted	p-values Multiplicity adjusted List et al. (2019)
GPA 9th grade	0.179	0.0003***	0.0003***
GPA upper secondary school	0.152	0.0027***	0.0050***
Elementary school preparing for upper sec. school	0.099	0.0003***	0.0003***
Theoretical program in upper sec. school	0.043	0.0567*	0.0567*
Upper secondary school completed	0.047	0.0010***	0.0023***
Any tertiary education	0.092	0.0003***	0.0003***

Notes: The comparison groups are the mothers who chose the delayed reward or who chose the early reward/were indifferent.

Table 3.H.2: Multiple outcomes for education and mechanisms, unadjusted and adjusted p-values

Outcome	Diff. in mean	p-values unadjusted	p-values Multiplicity adjusted List et al. (2019)
Adolescent chose delayed reward	0.052	0.0010***	0.0017***
Adolescent want: Apply upper secondary school	0.073	0.0003***	0.0003***
Adolescent applied upper secondary school (at year 9)	0.112	0.0003***	0.0003***
Mother want: Child continue school after year 9	0.039	0.0007***	0.0013***
Mother want: Child try to complete upper secondary	0.086	0.0003***	0.0003***
Mother want: Child leave school, start working soon	0.051	0.0003***	0.0003***
Index: 5 restrictions to make child invest in education	0.005	0.895	0.895

Notes: The comparison groups are the mothers who chose the delayed reward or who chose the early reward/were indifferent.

Chapter 4

The highly educated live longer. The role of time preference, cognitive ability, and educational plans.

Abstract

Using Swedish data on a cohort born in 1953, interviewed in 1966 (age 13), and followed with register data until 2018 (age 65), this study shows that one more year of schooling predicts a 17% lower risk of early mortality. Addressing concerns of potential selection bias, the mortality inequality by educational attainment persists when extensive controls are included in the regression. Adding information on background health, gender, socioeconomic variables, as well as adolescents' early educational plans, cognitive ability, and time preferences only results in a 2-percentage point change in the mortality risk by years of education. Even when adolescents' applications to upper secondary school and year 6 and 9 grades are controlled for, completion of upper secondary and university education remain strong predictors of future health. Yet, the study also finds that the measure of future health matters for the stability of the results.

Ethics Approval has been obtained from the Swedish Ethical Review Authority Dnr: 2020-02068.

4.1 Introduction

In Sweden, a welfare state where education and healthcare are tax funded, average life expectancy is still higher for people with longer education (Statistics Sweden 2021b). A strong correlation between education and health is also established internationally (Grossman 2015), and evidence from the U.S. shows that the mortality by education gap is clearly visible also during the COVID pandemic (Case & Deaton 2021). Yet, as a policymaker, it is important to understand whether more education actually leads to better health. This is still an active puzzle for researchers to solve, as historical reforms that increased compulsory schooling have not robustly improved the health of the treated cohorts (for an overview see Galama et al. 2018).[1] Selection could be one potential explanation for the differences between correlation and casual results, and Grossman (2015) lists time preference and cognitive abilities as potential "hard-to-measure variables" that could affect both individuals' selection into education and future health outcomes. Time preferences, for example, serve as a predictor of both future educational attainment (Golsteyn et al. 2014) and early mortality (Norrgren 2021). If patient individuals are more likely to educate themselves and invest in their health, then omitted variables like time preferences could be suspected to explain why correlational and causal papers differ on the relationship between education and health.

Fuchs (1982) was the first to suggest that time preferences could be an omitted variable in this setting, and Van der Pol (2011) and Fuchs (1982) tried to study the phenomenon using cross-sectional data on education and self-assessed health. While the results of Fuchs are mixed, Van der Pol (2011) finds that the time preference variable reduces the education coefficient by 5–9%. Yet to my knowledge, no one has had access to long-run objective health measures to investigate how including individual time preferences affects the predictive power of education.

Looking at other important variables, Conti & Heckman (2010) find that adding controls for family background and cognitive, non-cognitive, and health endowments reduces the relationship between education and self-reported health by about half. Yet, Lager et al. (2009) find that adding individuals' IQ reduces the correlation between attained education and early mortality for men, but increases

[1]While historical reform papers have great advantages, they are often criticized for their lack of flexibility and external validity, making them harder to rely on for policymakers. Heckman & Urzúa (2010), for example, discuss how researchers working with the instrumental variable approach often gain precision in the method by asking narrower questions. Correlational methods are better in this regard, as they are more flexible. Instead of merely studying the effects of increasing the lowest levels of compulsory schooling, they allow us, for example, to study participants at all levels of education. Using long follow-up data in this setting can also reduce issues with potential reverse causality.

it for women. How health inequality by educational attainment is affected by selection on cognitive ability/IQ is therefore not clear from the current literature.

This paper has access to unique data on cognitive ability and time preferences gathered from a cohort of 13-year-olds (N=12,118), in Stockholm, Sweden, in 1966, combined with register data on mortality until 2018. Eight percent of this sample passed away in ages 40–65, and this paper confirms a strong correlation between attained education and mortality in this age span. Compared with individuals without upper secondary education, the paper shows that having a university level or upper secondary education as the highest completed level predicts a 68% and 42% lower risk of early mortality, respectively. Using a different educational measure, the results show that one more year of schooling predicts a 17% lower risk of mortality. However, this paper does not find large signs of selection effects when adding controls on either of these educational measures. Mortality risk by years of education only changes by 2 percentage points when adding an extensive list of controls to the regression. These controls include information on the adolescents' background health, gender, socioeconomic factors, cognitive ability, time preferences, and early educational plans. The latter measure is unique for the investigated dataset and captures adolescents' educational aspirations at age 13.

To really challenge the results, a second set of analyses are performed to further reduce potential biases from selection into schooling. In addition to the control variables already described, information on the adolescents' applications to upper secondary school (in Sweden students apply to get into specific schools and fields of study) and grades in 6^{th} and 9^{th} grade are added. This analysis could be seen as a way to over-control for variables that also measure educational attainment to some degree, as grades could be seen as a qualitative measure of how much schooling the child has acquired. Yet, even when using all controls, university- and upper secondary-educated people still have a 52% and a 25% lower risk of early mortality, respectively, compared with participants without upper secondary education. Having one more year of schooling is still associated with a 12% lower risk of dying before age 65.[2]

To test the stability of the results, a participant's total number of hospitalizations is used as a second measure of health. Using this outcome, which has potential issues with self-selection into hospital care, the changes in the education coefficients when adding controls are larger. For the number of years of education measure, the coefficient decreases by 20% when adding the controls for cognitive

[2]This is a drop in mortality hazard by only 5 percentage points (29%), compared with the regression without any controls at all.

ability, time preferences, educational plans, background health, gender, and socioeconomics. Adding additional controls for grades and upper secondary school applications reduces this educational coefficient by 64%, compared with its original size without any controls.[3] This reduction is twice as large as the reduction seen in the mortality regression when the same controls are added.

This analysis teaches us three things:

1. The relationship between education and longevity is very strong, even when adding extensive controls.
2. Although early educational plans, cognitive ability, and time preference can be important variables for health outcomes, this study finds little evidence that these variables are the missing piece in the puzzle of education and health.
3. The measure of health matters. Using an all-cause hospitalization measure, where participants' selection into medical care can play a role, the results between education and future health are not as stable as when all-cause mortality is used as the health measure. This is an important finding for future research to be aware of and potentially explore further. In particularly since self-reported health measures, common in this field, could suffer from similar bias.

4.2 Literature

Through multiple studies in health economics, a strong correlation between education and health has been established (Grossman 2015). This is explained in theoretical modelling by assuming that educated people obtain more health from a given unit of medical care and that they are better at selecting health-improving treatments. Educated people are also assumed to have a higher health market productivity and could therefore have a higher demand for health, which enables them to participate more in the job market (Grossman 2006; Galama & Van Kippersluis 2019). However, studies using historical reforms that increase compulsory schooling find mixed or no causal effects of increased education on health in the treated cohorts (see, e.g., results by Van Kippersluis et al. 2011; Clark & Royer 2013; Meghir et al. 2018). Galama et al. (2018)'s literature review of educational reform studies shows that there is no evidence of education impacting women's mortality. For men, the evidence is mixed.

[3] A similar pattern of coefficient reduction is found when instead using the participants' total number of diagnoses as the outcome health measure

This great disparity between correlational and causal results remains a puzzle for researchers to solve. Fischer et al. (2021) address this by focusing on limitations in the causal historical institutional approach. Doing so, they find that more schooling actually had positive health effects, once changes in academic track and peer groups are controlled for. Yet, studies investigating the causal effect of education on health using historical reforms are often criticized for their lack of external validity in other settings. Heckman & Urzúa (2010) argue that the instrumental variable approach focuses not on well-formulated economic problems, but on questions that are possible for the model to answer. In the context of this paper, reforms that increase the lowest mandatory level of education can, for example, not be used to study the relationship between health and higher levels of education. Papers using historical reform changes can also not be used to capture effects from having attained more education relative to others.

A different way to look at the relationship between education and health is to use data from identical twins whose genetic and environmental factors are the same, while their obtained schooling might differ. The method requires large sample sizes since twins often have the same educational level. Lundborg (2013) finds that 67% of twin pairs in their sample (347 pairs of identical twins) report the same level of education. In a literature review of the relationship between education and health, Grossman (2015) shows that results using twin study design are mixed and also points out that the twin studies cannot answer the question of why identical twins would obtain different amounts of schooling. In addition, as the twin method controls for all socioeconomic and genetic variance at the same time, this approach cannot be used to understand which separate mechanisms cause the selection bias.

Another approach to understanding the education and health relationship could be to focus on earlier limitations in the correlational strategies, specifically trying to control for various variables that we think could drive selection. Fuchs (1982) was the first to argue that time preferences could be a driver in this context and potentially explain the correlations found between individual schooling and health outcomes. On page 95, Fuchs writes about health-improving behaviors:

> "From an economic point of view many of these behaviours have a common characteristic – they involve trade-offs between current costs and future benefits. The costs may be purely psychic, such as the loss of pleasure from passing up a rich dessert or a cigarette. They may involve time, such as jogging, or they may involve other costs including financial and nonfinancial resources. The expected benefits

> typically take the form of reductions in the probability of morbidity and mortality from one or more diseases sometime in the future."

Fuchs argues that time preferences could explain the education-health correlation in two not mutually exclusive ways. Firstly, patient individuals with a low discount rate could be expected to invest more in both schooling and activities improving their health. This is what I in this paper call the *omitted variable hypothesis*. Secondly, more schooling might in itself affect time preferences and generate more patient individuals, which could, in turn, alter choices between current cost and future health. Let's call this channel *school-induced patience*.

In the empirical part of his paper, Fuchs (1982) uses a U.S. sample of 319 adult participants, split on gender. Time preferences are measured with six hypothetical questions asking participants to choose between, e.g., US$ 750 now or US$ 1,250 in one year, varying the amounts and time periods. In the male sample, education is no longer significant at the 5% level when time preferences are added. For women, the educational coefficient on health remains significant and is reduced by 8% in size when time preference information is added to the regression.

Van der Pol (2011) studies 1,863 Dutch 16–89-year-old participants who were asked, "In general, would you say your health is: Excellent, Good, Fair, Not so good, Poor?", and finds that adding time preferences, measured by six questions with hypothetical incentives, reduces the coefficient size between education and this self-reported general health measure by 5–9%, depending on what other controls are already included. Van der Pol (2011) does not have access to data on participants' cognitive ability or their parents' education, but controls for other things such as participants' gender, age, and household income. Yet, after adding all controls, the coefficient for education remains significant and sizeable.

While not being able to test for this in their available data, Van der Pol (2011) argues that cognitive ability is another potentially important variable that could affect education and health. Looking at this, Lager et al. (2009) study a Swedish sample of 593 women and 740 men, who around the age of 10 were interviewed in year 1938, i.e., right before the Second World War. Using long term educational and health data, and controlling already for father's educational level, the paper finds that including information on IQ reduces the correlation between attained education and early mortality (before age 75) for men, but increases the same correlation for women.[4]

[4] Lager et al. (2009) find that early IQ had a protective effect on early mortality for men. Surprisingly, however, for women, having a high IQ (being in the highest quartile) was associated with a higher mortality risk later in life. This positive mortality-IQ relation for women is not a common finding and a review of the literature by Calvin et al. (2011) shows that the negative intelligence-mortality association is similar for men and women in other earlier research.

Studying similar issues, Conti & Heckman (2010) use a British cohort study of 7,397 individuals born in 1970, who completed cognitive tests in 1980 and were asked about their self-reported health in year 2000 (age 30). Splitting their sample on gender, the paper decomposes observed differences in self-reported health by education. It then claims that half or less than half of the difference in health by education is due to direct treatment effects, while the rest can be attributed to selection effects. Besides cognitive ability, Conti & Heckman (2010) include data on non-cognitive ability, socioeconomics factors, as well as weight, height, and head circumference data as controls.

Conti & Heckman (2010), Fuchs (1982), and Van der Pol (2011) all use self-reported health measures. It is possible that the subjective nature of these measures impacts the stability of the education-health relation when controls are included. This could be a problem if both education and control variables influence the way participants answer self-reported health questions, independently of their actual health. The analysis in the present paper is therefore an improvement in this regard, as the available data on early mortality is an objective health measure. Further, using cross-sectional data, Fuchs (1982) and Van der Pol (2011) cannot distinguish between the "school-induced patience" channel (that more schooling would increase patience) and the "omitted variable hypothesis" (that patience increases both education and health investments) as potential mechanisms of how time preferences could affect the correlation between education and health. The unique longitudinal Stockholm Birth Cohort enables me to address this better, as time preferences are measured yearly for a group of adolescents all born in the same year with the same access to schooling. The longitudinal nature of the data also makes it possible to separate health background from future health outcomes. This is important as it allows me to better test whether the explanatory variables (like education and time preferences) drive participants' health rather than the reverse causality.

4.3 Data

With the aim to answer the question "Why do some get on better in life than others?", sociologist researchers' at Stockholm University started an ambitious data collection project in the 1960s, aiming to gather data from almost all individuals born in 1953 in the Greater Stockholm area. In 1966, the participants, aged 12–13, performed cognitive tests and answered questions about their preferences, interests, and friends (Stenberg 2018). The dataset was unidentified in 1986 but matched back again by Stenberg & Vågerö (2006). Today, the newest version of the Stockholm Birth Cohort dataset, matched by Almquist et al. (2020), contains information about educational plans, cognitive ability, and time preference for 12,118 adolescents who were in school in the spring of 1966, and for whom I have follow-up data on educational completion, medical diagnoses, and mortality up to year 2018.

4.3.1 Education

Table 4.1 presents descriptive statistics of the original data collection and follow-up studies. The sample is restricted to only include individuals who were alive in 1992 (age 40), when their educational attainment was measured.[5] At that point, the mean participant had 12.3 years of education.[6] In the sample, 38% have a university-level degree, while 44% have some form of upper secondary school degree (2–4 years) as their highest attained level of education.[7]

4.3.2 Health

Mortality is chosen as the main measure of health in this paper, as it is both an objective and a highly relevant measure. The individuals' total number of hospitalizations is used as a secondary health measure to investigate the stability of the results. This healthcare utilization measure is also a relevant measure of health, but must be treated with some caution as it may be biased by self-selection into healthcare treatment, i.e., people can have different propensities to seek medical care even if their health status is the same. It is also important to remember that a person who survives longer, and has better health in this sense, may accumulate more hospitalizations over time, compared with someone who passes away early. The Stockholm Birth Cohort is followed with hospital data to year 2016 (age 63) and mortality data to year 2018 (age 65). Between the ages of 40 and 65, 8% of the participants passed away. The hospitalization data starts in 1973 in Stockholm, but nationwide hospitalization registers are unavailable until 1983. The sample used in hospitalization regressions is therefore restricted to exclude participants

[5]Table B3 in the appendix provides robustness results with education measured at age 37 and 45, in 1990 and 1997.

[6]Attained education is recorded in seven levels and years of education is assigned as follows: 7 for old primary school, 9 for new primary school, 11 for short upper secondary school, 12 for long upper secondary school, 14 for short and 15.5 for long university-level education, and 19 for education at doctoral level. This is the same assignment as Hjalmarsson et al. (2015) use for similar Swedish educational data.

[7]In this paper, all post-upper secondary education is thought of as "university level". This means that university college education (Swedish: Högskola), is included in this educational level.

who did not live in the Stockholm region 1973–1983.[8] In this restricted sample, the average person is hospitalized six times (including childbirth).

4.3.3 Time Preferences

In the original data collection at the schools in 1966, the students answered the question "*If you had to choose between SEK 100 now or SEK 1,000 in five years, which would you choose?*" Despite being asked over 60 years ago, the question is remarkably similar to contemporary time preference questions. As an example, one of the hypothetical measures used in the worldwide data collection by Falk et al. (2018) is "*Would you rather receive 100 Euro today or 153.8 Euro in 12 months?*"[9] Both the Stockholm Birth Cohort (SBC) and the Falk et al. (2018) measures use hypothetical incentives, and concerning time preference, research does not find systematic differences between measures using real and hypothetical monetary rewards (see, e.g., Matusiewicz et al. 2013; Brañas-Garza et al. 2020).

Table 4.2 shows the distribution of adolescents' answers in the SBC. Golsteyn et al. (2014) and Norrgren (2021) use a binary version of this variable when working with the SBC, categorizing individuals who probably or certainly would choose SEK 1,000 in 5 years as patient. This binary version is the preferred measure, also in the present paper, but the 5-step version is used in robustness regressions. The advantage of the binary categorization, rather than the original 5-step measure, is that other things than time preferences, such as assertiveness in the decision, can drive whether someone chooses the alternatives "probably" or "certainly" in the 5-step measure. Most of the adolescents (78%) in the sample can be thought of as patient using the binary definition (see Table 4.1), and combining the binary time preference measure with register data, Golsteyn et al. (2014) find that it can help predict the adolescents' future economic status and education. In addition, Norrgren (2021) finds that it predicts long-run health outcomes, such as early mortality and number of lifetime hospitalizations.

[8]The sample in the hospitalization regressions is restricted to include only participants who had their addresses in the Stockholm region in years 1971, 1975, and 1978–1983 when this data is available. To test the importance of this restriction, I run the regression on my other health measure, mortality, both with and without this restriction. Results in Table B3 in the Appendix shows that the mortality inequality by education is highly robust in both samples.

[9]Falk et al. (2016) show in a German student sample that the correlation between a time preferences measure constructed from 25 hypothetical questions like this one and measurements from a monetary incentivized time preference experiment is 0.5826^{***}. The hypothetical and incentivized experiments took place one week apart with the same students. The incentivized time preference experiment had a price list design and one of each participant's choices was randomly selected to be paid out.

Table 4.1: Descriptive statistics.

	Mean	Standard deviation	Min	Max	Sample size
Years of attained education by age 40	12.3	2.370	7	19	12,118
Upper Secondarily education by age 40	0.442	0.497	0	1	12,118
University education by age 40	0.384	0.486	0	1	12,118
Death by 65	0.078	0.268	0	1	12,118
Number of hospitalizations	5.631	9.668	0	293	9,529
Adolescent's time preferences at 13	0.779	0.415	0	1	12,118
Cognitive ability at 13	22.74	7.12	0	39	12,118
Education plans at 13 - *Plan to attend upper secondary school, question year 6*	0.469	0.499	0	1	12,118
Grades year 6	3.245	0.693	1	5	11,967
Grades year 9	3.184	0.768	1	5	11,317
Apply to upper secondary school – *First round of application, school year 9*	0.629	0.483	0	1	12,097
Female	0.495	0.500	0	1	12,118
Adolescent's month of birth	6.294	3.365	1	12	12,118
Year in school at survey	5.952	0.305	4	9	12,118
Father's age at childbirth	31.22	6.367	16	75	12,118
Mother's age at childbirth	28.39	5.725	15	48	12,118
Parent upper secondarily school	0.163	0.369	0	1	12,118
Parent university	0.087	0.282	0	1	12,118
Fathers total net income in 1963	24.82	20.92	0	444	12,118
Mothers total net income in 1963	4.457	6.864	0	115	12,118
Father died before age 65	0.161	0.367	0	1	12,118
Mother died before age 65	0.093	0.29	0	1	12,118
Absence from school	41.54	45.07	0	625	12,118

The sample is restricted to only include individuals who were alive in 1993, i.e., at age 40. Attained education is recorded in seven levels and years of education is assigned as follows: 7 for old primary school, 9 for new primary school, 11 for short upper secondary school, 12 for long upper secondary school, 14 for short and 15.5 for long university level education, and 19 for education at doctoral level. This is the same procedure as Hjalmarsson et al. (2015) use when working with similar Swedish data. Adolescents' time preferences are measured with the question *If you had to choose between SEK 100 now or SEK 1,000 in five years, what would you choose?* The answers were: Certainly SEK 100 now (1), Probably SEK 100 now (2), Cannot choose (3), Probably SEK 1,000 in five years (4), and Certainly SEK 1,000 in five years (5). Absence from school measures all registered absence hours with a valid excuse that the adolescent had in the spring semester of the 6th year of elementary school. For 14.8% of fathers and 48.6% of mothers, the tax office does not have information on income, and 3.6% of the participants have missing information on at least one of their parents' age at childbirth. Missing information on income is interpreted as zero income and missing information on parental age is substituted with the variable mean. In both cases, the missing information is controlled for with dummies in the regressions.

Table 4.2: Adolescents' time preferences

If you had to choose between SEK 100 now or SEK 1,000 in five years, what would you choose?

	Frequency	Percent
Certainly SEK 100 now	745	6.15
Probably SEK 100 now	801	6.61
Cannot choose	1,132	9.34
Probably SEK 1,000 in five years	4,280	35.32
Certainly SEK 1,000 in five years	5,160	42.58
Total	12,118	100

SEK 1,100 (US$ 110) now or SEK 11,000 (US$1,100) in five years, expressed in rounded numbers in year 2019 price level.

4.3.4 Cognitive Ability

Figure 1 presents an example of a spatial intelligence test question, available in the rich Stockholm Birth Cohort data. The correct answer in Figure 4.1 is c, and the adolescents were asked 40 similar questions. Table 4.1 shows that the number of correct answers varied between 0 and 39, with a sample mean of 23. Härnqvist (1967) created the questions to test adolescents' non-verbal cognitive ability. The questions have been used before as a measure of fluid intelligence (see Golsteyn et al. 2014) and its design is similar to the Raven progressive matrices test, which measures abstract reasoning and general human intelligence.

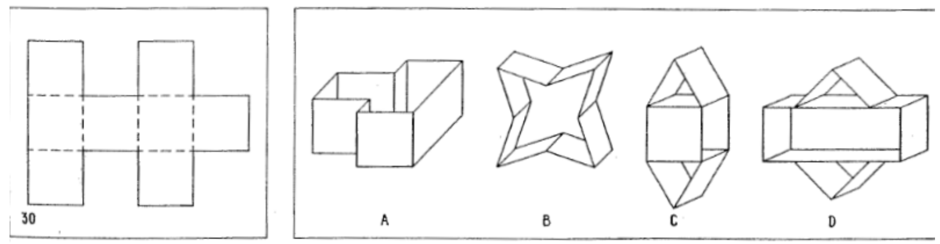

Figure 4.1: Example from the Härnqvist (1967) cognitive ability test.

4.3.5 Educational Plans

The aim of using the information on time preferences and cognitive ability in this paper is to control for variables that potentially affect both health outcomes and selection into education. Yet, the Stockholm Birth Cohort data contain further information that can be used more directly to control for such selection effects. In 1966, the participants age 12–13 were asked: "Are you going to apply to upper secondary school later on?" Answers to this self-reported question were provided anonymously, i.e., without pressure from parents to make "the right choice." The question can therefore be viewed as adolescents' own preferences for future schooling. Table 4.1 shows that in the sample, 47% of the adolescents answered yes to the question at this age.

4.3.6 Further Controls for Selection into Schooling

While the main focus of this paper is to see whether the correlation between educational attainment and future health remains when adding information on self-reported educational plans, cognitive ability, and time preferences, additional analysis is carried out to further control for selection into schooling.

In the 1960s in Sweden, education at upper secondary level could be 2, 3, or 4 years in duration, and the different academic majors that could be selected varied in terms of both subjects studied and their theoretical and vocational nature. Admissions to upper secondary school were based on grades in 9th grade and the schools and majors specified in the students' applications. Table 4.1 shows that in their first opportunity to apply in their ninth school year, 63% of the sample applied to an upper secondary level program. Students who were rejected, who changed their mind about their preferred major, or who did not apply in the first round could apply again in subsequent years.

The Stockholm Birth Cohort also contains information on participants' grades in 6th and 9th grade. Grades were assigned on a scale from 1 to 5, where 1 was the lowest and 5 the highest. In 6th grade, all participants took the same courses and Table 4.1 reports their average grades in Swedish, mathematics, English, divinity, social science, history, geography, science, music, drawing, and handicrafts. In 9th grade, students could be in different majors taking different courses, and Table 4.1 contains data on average grades for all subjects that the students studied, except for physical education.

While grades and applications are determinants of whether someone gets into future education in Sweden, one could argue that adding this information to regressions is to "over-control" for education, as grades also measure how much schooling an adolescent has already acquired. Due to the risk of over-controlling, variables concerning grades and school applications are added gradually in the regressions so that the reader can make their own judgement on the validity of the results.

4.3.7 Background Controls

Almost half of the sample are women and focusing on socioeconomics, Table 4.1 shows that 16% of the participants have upper secondary school as their highest attained level of education among their parents. In 8% of families, at least one parent has studied at university level. The mothers and fathers were on average 28 and 31 years old, respectively, when they had their child. Missing information on income is interpreted as zero income, while missing information on parental age when the child was born is substituted with the variable mean. In both cases, the missing information is controlled for with dummies in the regressions. The included socioeconomic controls are comparable to those used in Conti & Heckman (2010), but more extensive than the controls that Fuchs (1982), Lager et al. (2009), and Van der Pol (2011) have access to. None of these three latter papers have access to data on for example parental income.

Following the participants' parents over time, 16% of the fathers and 9% of the mothers die before age 65.[10] This measure of parental mortality, combined with data on the adolescents' absence from school, is used to control for the adolescents' health background. The students in this sample had on average 42 hours of absence from school with a valid cause (for example sickness) in the spring semester of 6th grade. The cognitive ability papers by Conti & Heckman (2010) and Lager et al. (2009) have long-run data and while the latter does not control for health background, Conti & Heckman (2010) do so in a sense by using available weight, height, and head circumference data. In contrast, the cross-sectional time preferences papers by Fuchs (1982) and Van der Pol (2011) cannot separate health background from future health outcomes.

Conti & Heckman (2010) use additional measures of noncognitive ability.[11] In my paper, I do not have access to similar measures, but this seems like less of a concern given Conti & Heckman (2010)'s results, which show that noncognitive skills have a 0.54 correlation with participants' cognitive endowments. Adding controls for cognitive ability to my health by education regression is therefore likely to also soak up some selection effects based on noncognitive skills.

[10]This could be an underestimation, as this is older register data. The data might not include all individuals who died abroad.

[11]The added noncognitive skills in Conti & Heckman (2010) are measures of locus of control, perseverance, cooperativeness, completeness, attentiveness, and persistence.

4.4 Empirical Strategy

The aim of this paper is to analyze various relevant, but often omitted variables in regressions of education on health. But first, I will try to replicate earlier findings of a strong relationship between education and health. I will do this using survival models (Kaplan and Meier, 1958; Cox, 1972) when studying mortality, and OLS when looking at hospitalization data.[12] The advantage of survival models when studying mortality is that they use information on both *whether* and if so *when* a person dies. In the Cox model, the outcome $h_{1i}(t)$ is the mortality hazard (risk of mortality) for individual i at time t, and $h_0(t)$ is the baseline risk at that time point:

$$h_{1i}(t) = h_0(t)exp(\gamma(Education_i) + \boldsymbol{\rho_x x_i}) \tag{4.1}$$

$Education_i$ is individual i's educational level, measured using the participant's number of years of education. However, it is not certain that the education-health relation is linear in the number of attained schooling years, and in additional regressions, education is instead measured using two binary variables of attained university and upper secondary education.

In the Cox model, a hazard rate equal to 1 is interpreted as a factor having "no effect" on the mortality hazard. A variable estimate smaller than 1 indicates a smaller risk of dying at any point in time in the investigated period. This means that we expect a $\gamma < 1$ if we think that people with higher education live longer.[13]

In equation (4.1) $\boldsymbol{x_i}$ is a vector of controls. In the baseline model, this vector is empty, but it is quickly filled in the following regressions with information on health background, socioeconomic factors, and gender. By stepwise also adding controls for early educational plans, cognitive ability, time preference, grades, and upper secondary applications, the aim of this analysis is to see whether the educational coefficient γ changes compared with the baseline model. If we think that, for example, time preferences drive both selection into higher education and better health, we expect the hazard rate γ to move closer to 1, i.e., that the relationship between education and mortality decreases, once time preferences are accounted for.

[12]For robustness, data on early mortality is analyzed in the appendix using Probit average marginal effects. Further, hospitalization data is analyzed using either the Poisson models or by excluding individuals with high numbers of hospitalizations (more than 50 or 100). Separate robustness regressions are also made where the outcome is a binary variable of being a high user of hospital care (more than 10 hospitalizations).

[13]The Cox model assumes that the hazard rate for our explanatory variable is constant over the investigated period, which is age 40–65 in the present study. The constant hazard assumption is tested in Appendix E.

4.5 Results

Figure 4.2 graphically shows the relationship between education and survival rates before age 65 using Kaplan-Meier survival estimates. The differences in mortality by education are striking. In this age span, mortality is almost three times higher among participants without upper secondary education compared to those with a university degree. The results in the figure confirm earlier findings of a strong correlation between educational attainment and health, discussed in Grossman (2015).[14]

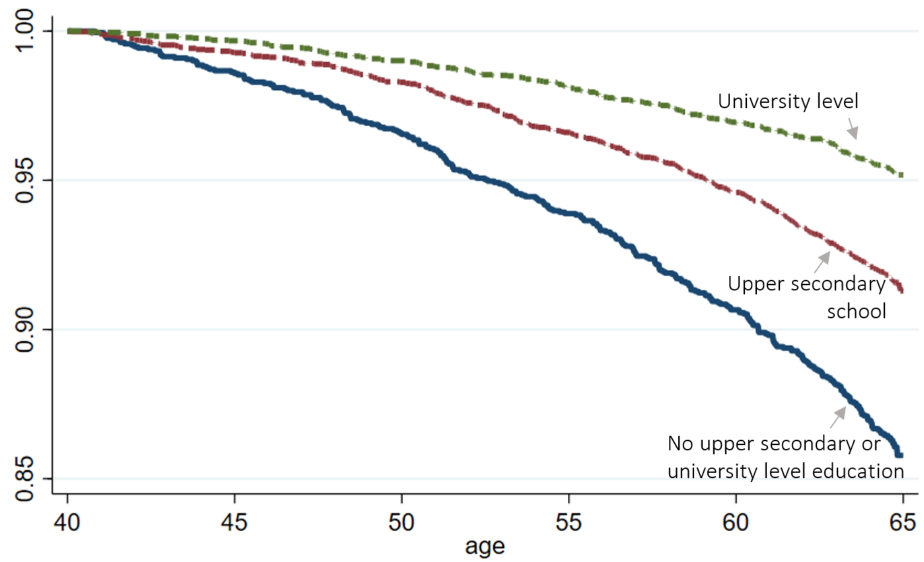

Figure 4.2: Kaplan-Meier survival estimates for individuals with different levels of education.

The following section investigates how the coefficient of education on future health is affected when adding control variables to the regression. Table 4.3 shows the mortality risk by education, with and without controls. It does so using a Cox survival model where the presented coefficients are mortality hazard (risk of mortality) for individual i, compared with the baseline risk. Remember, a hazard rate equal to 1 in this model is interpreted as "no effect" and a variable estimate smaller (greater) than 1 indicates a smaller (greater) risk of dying.[15] Table 4.3,

[14]Appendix C shows that the results are robust using a subsample of participants who do not have upper secondary- or university-educated parents. However, for the subsample with educated parents, average educational attainment is higher and the gap in mortality by education is even starker.

[15]Tests in Appendix E shows no clear signs of violations of the Cox model assumption that the hazard rate of education should be constant over the investigated period.

column 1, confirms earlier findings, i.e., that educational attainment is a strong predictor of future health. One more year of education is associated with a 17% lower risk of mortality at any point in time in the investigated period (ages 40–65). The results remain strong using binary measures for education (bottom of Table 4.3). Compared with peers with less education, university-educated people and people with upper secondary school as their highest level of education have a 68% and a 42% lower mortality risk, respectively. Columns b and c show that these education coefficients are rather stable when adding controls for health background, gender, and socioeconomic factors to the models.

Next, early educational plans, cognitive ability, and time preferences are added as controls. In Appendix G, Table G1 presents the raw predictive power of these variables on mortality (all coefficients are significant at the 1% level). With Cox coefficients in parentheses, Table G1 shows that planning to attend upper secondary school (0.71), having a one-point higher score on the 40-point cognitive ability test (0.97), and choosing the delayed reward (0.82) are all protectors against early mortality. Golsteyn et al. (2014) and Norrgren (2021) also find that cognitive ability and time preferences are predictors of early mortality in the Stockholm Birth Cohort. Yet, Table 4.3 does not show much evidence that adding any of these variables to the regressions would greatly alter the relationship between attained education and death by age 65. In Table 4.3, columns d (upper and lower), the participants' education plans (when asked about it at age 12 to 13) are not significantly related to early mortality and do not alter the education coefficients. In columns e and f, coefficients for cognitive ability and time preferences are interesting to look at in themselves, but adding this information does not cause much change in the educational coefficients either. In other words, I find no evidence here that early educational plans, cognitive ability, and time preference would be the missing pieces in the puzzle of education and future health. Adding all controls in Table 4.3 changes the years of education hazard rate by 0.02: one more year of education is now associated with a 15% instead of a 17% lower mortality risk. The hazard rates for upper secondary school and university-level education change by 0.07 and 0.06, respectively. The largest changes in the education coefficients in this bottom part of the table come from adding socioeconomic factors and gender.

To summarize the results so far, the correlation between education and future health remains strong and significant, even when adding information on adolescents' preferences regarding delayed rewards, future schooling plans, and cognitive ability. Still, most adolescents were in 6th grade when the data for these control variables were collected. At this point, they had three more years to make

Table 4.3: Education and early death.
Sample alive at age 40, education from 1993. Cox model, hazard rate.

	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	0.83***	0.84***	0.84***	0.84***	0.85***	0.85***
	(0.012)	(0.013)	(0.014)	(0.014)	(0.015)	(0.015)
Adolescents:						
Education plans				1.03	1.07	1.07
				(0.078)	(0.082)	(0.082)
Cognitive Ability					0.98***	0.98***
					(0.0047)	(0.0047)
Time preferences						0.87*
						(0.066)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	0.58***	0.60***	0.63***	0.63***	0.65***	0.65***
	(0.044)	(0.045)	(0.049)	(0.049)	(0.051)	(0.051)
University level	0.32***	0.33***	0.36***	0.36***	0.38***	0.38***
	(0.029)	(0.030)	(0.035)	(0.036)	(0.039)	(0.039)
Adolescents:						
Education plans				0.99	1.03	1.04
				(0.075)	(0.078)	(0.079)
Cognitive ability					0.98***	0.98***
					(0.0047)	(0.0047)
Time preferences						0.87*
						(0.066)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,118	12,118	12,118	12,118	12,118	12,118

The sample is restricted to only include individuals alive in 1993 (age 40). Socioeconomic/gender controls include month of birth, sex, years of education, parents' age when their child was born, fathers and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

the decision of whether or not to apply for upper secondary education. To further control for selection into higher education, this paper continues by adding additional controls of actual secondary school applications and grades. With Cox coefficients in parentheses, Table G1 in the Appendix shows that grades in 6th grade (0.63) and 9th grade (0.66), as well as applications to upper secondary school (0.53), are all associated with a lower mortality risk before age 65. These raw predictions are all statistically significant at the 1% level.

Using these additional controls, columns d and e of Table 4.4 also show that applications and grades in 9th grade are strongly and significantly related to early mortality: those with higher grades and who applied to upper secondary school in the first round are less likely to die before age 65. Comparing the first and the last columns in Table 4.4, adding all the control variables changes the years-of-education hazard rate by 0.05 and the upper secondary school and university level hazard rates by 0.17 and 0.16, respectively. These are larger differences, but the prediction power of educational attainment on future mortality remains substantial and highly significant.[16] This suggests that other mechanisms than selection on the included variables drive the large remaining relationship between education and future health.

4.5.1 Results with an Alternative Measure for Health

Tables 4.5 and 4.6 replicate the regressions for attained education on health using the participant's total number of hospitalizations as the health outcome, instead of early mortality. The results are presented using OLS and readers are reminded that these coefficients are not to be interpreted as the earlier presented Cox hazard rates. Instead, the larger the OLS coefficients are in absolute terms, the greater the predictive power of education on health. With the outcome mean of 5.63 hospitalizations, Table 4.5 column 2a shows that university educated and upper secondary educated have 2.33 and 0.65 fewer hospitalizations, respectively, compared with participants without upper secondary education. However, adding controls reduces the coefficient sizes in absolute terms. In column 2f, the upper secondary education coefficient is no longer statistically significant, and the coef-

[16]The results are robust when education is measured in other years; see Appendix B. Appendix C shows that the mortality difference by education relation is stronger for participants with more educated parents. However, when the control variables are added, the mortality-education relation is decreased in a similar pattern for the subsamples with/without educated parents, as for the full sample. Appendix D shows that the results are robust when adding controls for number of siblings, number of older/younger brothers/sisters, municipality fixed effects, or school fixed effects. This suggests that the controls in the main regressions already capture socioeconomic variance that might otherwise have biased the results. Appendix H presents results using Probit average marginal effects. Tables H1–H2 show that the mortality by education relation is robust, highly significant, yet slightly reduced in size when using this alternative statistical model.

Table 4.4: Education and early death.
Sample alive at age 40, education from 1993. Cox model, hazard rate.

	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	0.83***	0.85***	0.85***	0.88***	0.86***	0.88***
	(0.012)	(0.015)	(0.016)	(0.018)	(0.016)	(0.018)
Adolescents:						
Grades year 6			0.92	1.10		1.12
			(0.060)	(0.088)		(0.090)
Grades year 9				0.81***		0.82***
				(0.052)		(0.054)
Apply to upper secondary school					0.77***	0.85*
					(0.063)	(0.079)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	0.58***	0.65***	0.65***	0.74***	0.68***	0.75***
	(0.044)	(0.051)	(0.052)	(0.065)	(0.055)	(0.067)
University level	0.32***	0.38***	0.39***	0.47***	0.42***	0.48***
	(0.029)	(0.039)	(0.042)	(0.055)	(0.045)	(0.058)
Adolescents:						
Grades year 6			0.90*	1.09		1.11
			(0.059)	(0.087)		(0.090)
Grades year 9				0.79***		0.81***
				(0.051)		(0.053)
Apply to upper secondary school					0.76***	0.85*
					(0.062)	(0.079)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,118	12,118	11,967	11,220	12,097	11,211

The sample is restricted to only include individuals alive in 1993 (age 40). Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

ficient for university education is now -1.88. Looking at columns 1a–1f in the top section of the table, the relationship between years of education and the participants' total number of hospitalizations is reduced by 20% in absolute terms when controls for health background, gender, socioeconomics, early educational plans, cognitive ability, and time preferences are added.[17]

In columns 1c–1e and 2c–2e of Table 4.6, the education coefficients are reduced further when more selection controls are added. While the variable for upper secondary education is statistically insignificant, the relationship between university education and participants' total number of hospitalizations is reduced in absolute terms by 68% once all controls are added. A similar pattern is seen in the years-of-education measure.

Table B1 in the Appendix presents the raw data on mortality and healthcare utilization by education. It shows that mortality by education differences is larger than differences in healthcare utilization by education.[18] Comparing regressions on mortality, which is the main outcome of this paper (Tables 4.3–4.4), with regressions where the total number of hospitalizations is the outcome (Tables 4.5–4.6), the reductions in the education coefficients when adding controls are larger in the latter analysis. This difference is not caused by the differences in samples (see Table C3 in the Appendix), and the hospitalization results are robust when participants' total number of diagnoses is instead used as the outcome (Tables A2–A3).[19] We cannot rule out that the measures of mortality and healthcare utilization each capture different aspects of health, which could be affected differently by educational attainment and the other controls. Still, while mortality is an objective measure of health, participants number of diagnoses and hospitalizations are driven by both health and participants propensity to seek medical treatment. The participant also has to be alive in order to continue accumulating hospitalization. These selection aspects of the healthcare utilization measures

[17]Replacing the binary time preference measure with a 5-step measure that includes information on the participants' assertiveness in their decision does not alter the results for educational attainment in Table 4.5 column 1f (not shown).

[18]Splitting the data on gender, Table B1 also shows that men in this age group die at a higher rate than women, but have fewer hospitalizations. One reason for this inconsistency in the different health measures could be childbirth, which is very likely to increase the average hospitalization rates for women. Another potential explaining factor could be gender differences in the propensity to seek medical care, given a certain health status.

[19]Poisson regressions in Tables F3–F4 show that the coefficient pattern of education is robust to the choice of statistical model. Appendix F also shows that restricting the sample to exclude individuals with high numbers of hospitalizations (more than 50 or 100) reduces the sample means and coefficients sizes (Table F2), but the pattern for the education coefficients when including controls is otherwise robust. In Tables F5 and F6, the outcome is a binary variable of being a high user of hospital care. The results show that participants with higher education are less likely to have more than 10 hospitalizations.

could potentially explain why these results are less robust, compared with the regressions using mortality as the health outcome.

4.6 Discussion

Despite a large literature, the link between education and health is not fully understood (Case & Deaton 2021). Studies investigating the causal effect of education on health using historical reforms have obvious advantages. Yet, due to the context-specific aspects of natural and randomized experiments, Deaton (2010) argues that such research is unlikely to help policymakers unless they also can explain *why* a treatment works or does not work. Studies using other methods could therefore be of value, if they are able to say something about the mechanisms at play.

This paper looks at why correlational and causal studies differ in the estimated relationship between education and health, focusing on certain specific selection mechanisms. Using the unique Stockholm Birth Cohort data, it replicates earlier correlational findings and shows a strong relationship between education and early mortality.[20] The paper then finds that this relation is highly robust. Adding health background, socioeconomic factors, measures of time preferences, cognitive ability, and early educational plans only changes the years-of-education coefficient by 2-percentage points. In other words, while these variables can be important in themselves, this paper finds little evidence that they are the missing piece in the puzzle of education and health.

Adding additional gateway factors into education, such as grades and applications, has a larger effect on the predictive power of education on early mortality. Nevertheless, the differences in mortality between individuals with different levels of education remain significant and large. With all controls included, university-educated people and people with upper secondary education still have a 52% and 25% lower likelihood of early mortality before age 65, respectively, compared with participants with less education.

The main outcome of this paper is early mortality, which is both a relevant and an objective measure of health. Yet, comparing regressions on mortality (Tables 4.3–4.4) with regressions using hospitalizations as the outcome (Tables 4.5–4.6) shows that the results of this paper are unstable when changing the measure of health. Regressions using participants' total number of hospitalizations, rather than their mortality, display larger changes in the education coefficient when con-

[20]Multiple studies have observed this inequality in mortality before. See, e.g., studies by Pappas et al. (1993), Lager et al. (2009), Bound et al. (2014), and Grossman (2015). For more Swedish data on life expectancy by level of education, see Statistics Sweden (2021b).

Table 4.5: Education and hospitalizations. OLS coefficients.
Sample living in Stockholm 1971, 1975, 1978–1983. Education from 1993.

VARIABLES	Number of Hosp. (1a)	Number of Hosp. (1b)	Number of Hosp. (1c)	Number of Hosp. (1d)	Number of Hosp. (1e)	Number of Hosp. (1f)
Years of education	-0.44***	-0.41***	-0.39***	-0.39***	-0.36***	-0.35***
	(0.036)	(0.036)	(0.041)	(0.047)	(0.047)	(0.047)
Adolescents:						
Education plans				0.079	0.20	0.22
				(0.24)	(0.24)	(0.24)
Cognitive Ability					-0.068***	-0.066***
					(0.014)	(0.014)
Time preferences						-0.43
						(0.26)
Constant	8.50***	7.63***	16.9***	17.1***	16.8***	17.0***
	(0.29)	(0.30)	(3.37)	(3.43)	(3.43)	(3.46)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.011	0.016	0.035	0.035	0.037	0.038
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary School	-0.65**	-0.51*	-0.66**	-0.65**	-0.55*	-0.54
	(0.30)	(0.31)	(0.32)	(0.33)	(0.33)	(0.33)
University level	-2.33***	-2.13***	-2.13***	-2.12***	-1.90***	-1.88***
	(0.27)	(0.27)	(0.30)	(0.33)	(0.33)	(0.33)
Adolescents:						
Education plans				-0.034	0.10	0.12
				(0.24)	(0.24)	(0.24)
Cognitive Ability					-0.071***	-0.069***
					(0.014)	(0.014)
Time preferences						-0.44*
						(0.26)
Constant	6.77***	5.91***	16.2***	16.1***	16.0***	16.2***
	(0.25)	(0.28)	(3.35)	(3.41)	(3.41)	(3.43)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.009	0.014	0.034	0.034	0.037	0.037
Outcome mean	5.63	5.63	5.63	5.63	5.63	5.63
Observations	9,529	9,529	9,529	9,529	9,529	9,529

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is number of hospitalizations 1973–2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4.6: Education and hospitalizations. OLS coefficients.
Sample living in Stockholm 1971, 1975, 1978–1983. Education from 1993.

VARIABLES	Number of Hosp. (1a)	Number of Hosp. (1b)	Number of Hosp. (1c)	Number of Hosp. (1d)	Number of Hosp. (1e)	Number of Hosp. (1f)
Years of education	-0.44***	-0.35***	-0.28***	-0.18***	-0.28***	-0.16***
	(0.036)	(0.047)	(0.051)	(0.049)	(0.052)	(0.051)
Adolescents:						
Grades year 6			-0.88***	-0.096		-0.022
			(0.20)	(0.23)		(0.23)
Grades year 9				-0.95***		-0.89***
				(0.23)		(0.24)
Apply to upper secondary school					-1.27***	-0.58**
					(0.26)	(0.27)
Constant	8.50***	17.0***	20.3***	15.5***	17.6***	14.9***
	(0.29)	(3.46)	(3.62)	(3.69)	(3.50)	(3.75)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.011	0.038	0.039	0.040	0.040	0.040
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary School	-0.65**	-0.54	-0.39	-0.14	-0.21	-0.027
	(0.30)	(0.33)	(0.33)	(0.32)	(0.35)	(0.33)
University level	-2.33***	-1.88***	-1.47***	-0.89***	-1.35***	-0.74**
	(0.27)	(0.33)	(0.35)	(0.33)	(0.37)	(0.35)
Adolescents:						
Grades year 6			-0.95***	-0.11		-0.027
			(0.20)	(0.23)		(0.23)
Grades year 9				-0.99***		-0.92***
				(0.22)		(0.23)
Apply to upper secondary school					-1.37***	-0.61**
					(0.27)	(0.28)
Constant	6.77***	16.2***	18.1***	14.1***	15.2***	13.5***
	(0.25)	(3.43)	(3.61)	(3.68)	(3.44)	(3.72)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.009	0.037	0.039	0.040	0.040	0.040
Outcome mean	5.63	5.63	5.64	5.40	5.63	5.40
Observations	9,529	9,529	9,427	9,052	9,516	9,046

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is number of hospitalizations 1973–2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

trols are added. Why is this? One potential explanation is that the hospitalization data could, for multiple reasons, be a biased measure of health. Firstly, looking at Swedish women who die from breast cancer, Palme & Simeonova (2015) show that participants with higher socioeconomic status live longer between the initial diagnosis and the time of death.[21] This is relevant for my study, as a higher survival period for a given diagnosis means that participants have more time during which they can make hospital visits. In the SBC data, I clearly see that participants with lower levels of education are more likely to die before age 65. This very bad health outcome excludes them from further observations in the hospitalization data and makes them look healthier when using this measure. Secondly, in contrast to the objective mortality measure, healthcare utilization in hospitals can also be driven by factors such as physical proximity to a hospital or preference for treatment. If educational attainment, cognitive ability, grades, and socioeconomic status are related to each other and, for some reason, increase the likelihood of seeking medical care for a given condition, then this could bias the result when using participants total number of hospitalizations as the outcome. Still, more empirical work is needed to confirm the relationship between the explanatory variables included here and participants' propensity to seek medical care.

The finding that the stability of the relationship between health and education depends on the used health measure could be of great value. Based on this finding, I hope that future research looks further into and think carefully about which health measure they use. Specifically, many earlier papers that study "hard-to-measure" variables (such as time preferences or cognitive ability) in the context of education and health use self-reported measures of individuals' health status. Future studies are needed in order to understand how the use of self-report methods could affect studies in this field.

Using reliable data and a full set of controls, the results from this paper (Table 4.4) show that completion of secondary school (and university-level education) remains a large and strongly significant predictor of early mortality, even when socioeconomics, "hard-to-measure" variables, and entry conditions for secondary school (grades and secondary school application) are controlled for. To dig deeper into this, Table I2 in the Appendix estimates that the effect from unobservable variables has to be at least 5.7 times larger than the effect from all controls already included, in order for the relationship between years of education and death by

[21] Palme & Simeonova (2015) deduce from this that women with higher socioeconomic status are more likely to receive an early diagnosis or/and better medical treatment.

age 65 to disappear.[22] In other words, while I have included a lot of controls for selection into schooling, much more is needed to take down the relationship between education and early mortality. This large estimation value suggests that other mechanisms, rather than pure selection, will have to be explored in order to solve the puzzle of why correlational and causal studies differ in their results on the relationship between education and health.

The people in the participants studied in this paper were born in 1953, and 17.4% of them did not by age 40 have any upper secondary or university level education. What will happen with the result of this paper in the future when we start to study cohorts born later? Will the mortality inequality by education continue to be this large? We cannot know for sure, but Bound et al. (2014) draws some conclusions on this after studying the relationship between education and mortality, looking at differences between cohorts. Considering the dramatic rise in educational attainment in the United States, Bound et al. (2014) argue that the changes in educational decomposition of the population could result in a more adversely selected group of individuals with low levels of education. Being able to understand and control for selection into education might therefore be even more important in the future when looking at these coming cohorts. Lastly, when policymakers create reforms of the educational system on all its levels, they cannot only base their decisions on results of historical reforms that increased the lowest level of mandatory education. Nor can these historical reform estimations be used to capture the effects of having higher levels of education compared to others. Studying and improving correlational models that are more flexible in nature is therefore of great value in this field. Using data on all levels of education, this paper shows that the well-documented inequality in health by education is unlikely to be caused by selection only. Other mechanisms will have to be explored to explain why the highly educated live longer.

[22] The statistical procedure is described in Oster (2019) and I use $R_{max} = 1.3\widetilde{R_2}$, as suggested in her paper. Table I2 also shows Oster (2019) analysis results using a more conservative $R_{max} = 2\widetilde{R_2}$ and Table I1 presents adjusted beta values for different levels of R_{max} and $\widetilde{\delta}$. In this analysis, $\widetilde{\delta}$ is the relative importance of unobservable controls, compared to the already included observables. The included observables here are background health, socioeconomic factors, time preferences, cognitive ability, early educational plans, grades year 6, grades year 9 and applications to upper secondary school.

Appendices 4

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A. Regressions on number of diagnoses
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4.A Regressions on number of diagnoses

Table A1. Descriptive statistics.

	Mean	Standard deviation	Min	Max	Sample size
Number of diagnoses	10.12	23.25	0	1097	9,529

Sample is restricted to only include individuals alive in 1993 (age 40)

Table A2. Education and diagnoses. OLS coefficients.
Education data from 1993. Sample living in Stockholm 1971, 1975, 1978–1983.

	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.93***	-0.87***	-0.80***	-0.81***	-0.74***	-0.73***
	(0.083)	(0.083)	(0.095)	(0.10)	(0.10)	(0.10)
Adolescents:						
Education plans				0.050	0.27	0.31
				(0.52)	(0.52)	(0.53)
Cognitive ability					-0.12***	-0.12***
					(0.030)	(0.030)
Time preferences						-0.97
						(0.60)
Constant	21.5***	19.4***	41.9***	41.9***	41.1***	41.5***
	(1.14)	(1.14)	(8.72)	(8.76)	(8.78)	(8.76)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.009	0.012	0.018	0.018	0.019	0.020
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-1.54**	-1.26*	-1.22	-1.20	-1.00	-0.99
	(0.70)	(0.71)	(0.79)	(0.80)	(0.80)	(0.80)
University level	-5.17***	-4.77***	-4.44***	-4.38***	-3.99***	-3.94***
	(0.59)	(0.61)	(0.71)	(0.76)	(0.77)	(0.76)
Adolescents:						
Education plans				-0.15	0.098	0.14
				(0.52)	(0.52)	(0.53)
Cognitive ability					-0.13***	-0.13***
					(0.030)	(0.030)
Time preferences						-0.98*
						(0.59)
Constant	12.7***	11.0***	35.5***	35.3***	35.0***	35.5***
	(0.55)	(0.64)	(8.70)	(8.73)	(8.73)	(8.70)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.008	0.011	0.018	0.018	0.019	0.019
Outcome mean	10.1	10.1	10.1	10.1	10.1	10.1
Observations	9,529	9,529	9,529	9,529	9,529	9,529

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is number of diagnoses 1973–2016. The data contain full information on diagnoses in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A3. Education and diagnoses. OLS coefficients.
Sample living in Stockholm 1971, 1975, 1978-1983. Education data from 1993.

	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses	Number of Diagnoses
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.93***	-0.73***	-0.56***	-0.35***	-0.56***	-0.30**
	(0.083)	(0.10)	(0.11)	(0.11)	(0.12)	(0.12)
Adolescents:						
Grades year 6			-2.05***	-0.31		-0.12
			(0.48)	(0.54)		(0.56)
Grades year 9				-2.19***		-2.02***
				(0.50)		(0.50)
Apply to upper secondary school					-3.01***	-1.55**
					(0.62)	(0.68)
Constant	21.5***	41.5***	44.2***	35.6***	38.1***	33.8***
	(1.14)	(8.76)	(9.08)	(9.99)	(8.66)	(9.82)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.009	0.020	0.021	0.020	0.022	0.021
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-1.54**	-0.99	-0.66	-0.21	-0.23	0.076
	(0.70)	(0.80)	(0.80)	(0.79)	(0.86)	(0.85)
University level	-5.17***	-3.94***	-3.01***	-1.91**	-2.70***	-1.51*
	(0.59)	(0.76)	(0.78)	(0.76)	(0.87)	(0.83)
Adolescents:						
Grades year 6			-2.16***	-0.32		-0.11
			(0.47)	(0.55)		(0.57)
Grades year 9				-2.24***		-2.07***
				(0.49)		(0.49)
Apply to upper secondary school					-3.19***	-1.61**
					(0.64)	(0.71)
Constant	12.7***	35.5***	39.8***	32.5***	33.3***	31.1***
	(0.55)	(8.70)	(9.03)	(9.90)	(8.60)	(9.71)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.008	0.019	0.021	0.021	0.022	0.021
Outcome mean	10.1	10.1	10.1	9.64	10.1	9.64
Observations	9,529	9,529	9,427	9,052	9,516	9,046

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is number of diagnoses 1973–2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.B Education variable: descriptive statistics and measured in other years

Table B1. Descriptive statistics: Health by education

	N mortality data	Number of deaths	Mortality in %	N hosp. data	Average hosp.	Average diagnoses
No upper secondary/ university education	2108	290	14%	1734	6.77	12.69
Upper sec. education	5359	442	8%	4349	6.12	11.15
University education	4651	215	5%	3446	4.44	7.52
Female sub-sample						
No upper secondary/ university education	840	102	12%	657	8.19	14.2
Upper sec. education	2735	169	6%	2181	7.26	11.91
University education	2427	112	5%	1739	5.91	9.61
Male sub-sample						
No upper secondary/ university education	1268	188	15%	1077	5.9	11.78
Upper sec. education	2624	273	10%	2168	4.98	10.39
University education	2224	103	5%	1707	2.95	5.39

The table only includes participants who were living in the year education was measured. "Hosp." is short for hospitalizations, and data on average numbers of hospitalizations and diagnoses is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983.

Table B2. Descriptive Statistics: Education measured in different years

	Mean	Standard deviation	Min	Max	Sample size
Years of education by age 40	12.296	2.370	7	19	12,118
Years of education by age 37	12.225	2.363	7	19	12,107
Years of education by age 48	12.366	2.383	7	19	11,929
Upper secondary education by age 40	0.442	0.497	0	1	12,118
Upper secondary education by age 37	0.442	0.497	0	1	12,107
Upper secondary education by age 48	0.437	0.496	0	1	11,929
University education by age 40	0.384	0.486	0	1	12,118
University education by age 37	0.374	0.484	0	1	12,107
University education by age 48	0.397	0.489	0	1	11,929

The table only includes participants who were living in the year education was measured. Attained education is recorded using 7 levels and years of education is assigned as follows: 7 for old primary school, 9 for new primary school, 11 for short upper secondary school, 12 for long upper secondary school, 14 for short and 15.5 for long university level education, and 19 for education at doctoral level.

Table B3. Education and early death. Cox model, hazard rate. Sample alive at age 37 and 45, Education from 1990 and 1998.

	Sample alive at age 37			*Sample alive at age 45*		
	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	0.83***	0.85***	0.88***	0.84***	0.85***	0.88***
	(0.012)	(0.015)	(0.018)	(0.013)	(0.015)	(0.019)
Adolescents:						
Time preference, education plans, cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	0.60***	0.67***	0.75***	0.64***	0.71***	0.81**
	(0.045)	(0.051)	(0.066)	(0.052)	(0.059)	(0.078)
University level	0.33***	0.39***	0.48***	0.33***	0.38***	0.48***
	(0.029)	(0.040)	(0.058)	(0.032)	(0.042)	(0.061)
Adolescents:						
Time preference, education plans, Cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
Observations	12,107	12,107	11,200	11,929	11,929	11,048

The sample is restricted to only include individuals who were alive in 1990 (age 37) or who were alive in 1998 (age 45), which is also the year when attained education is measured. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

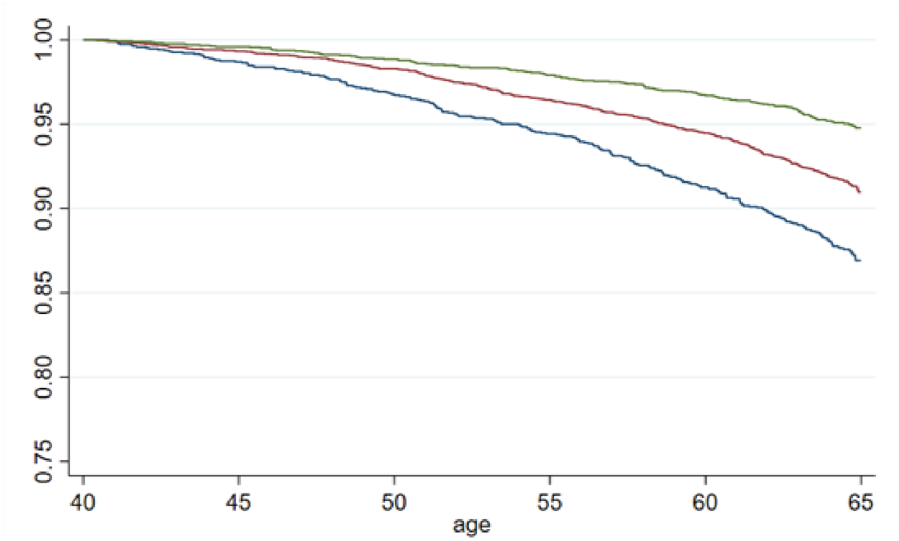
4.C Other samples - restricted or split on education

Table C1. Adolescents' educational attainment, split on parental education

	No upper secondary or university education	Upper secondary education	University level	Total
Participants whose parents do not have upper secondary or university education	185 (6%)	913 (30%)	1,926 (64%)	3,027
Participants whose parent(s) have upper secondary or university education	1920 (21%)	4,446 (49%)	2,725 (30%)	9,091

Adolescents' educational attainment is measured at age 40.

Sample: those whose parents **do not** have
upper secondary or university education n= 9,091



Sample: those whose parent(s) **do** have
upper secondary or university education n= 3,027

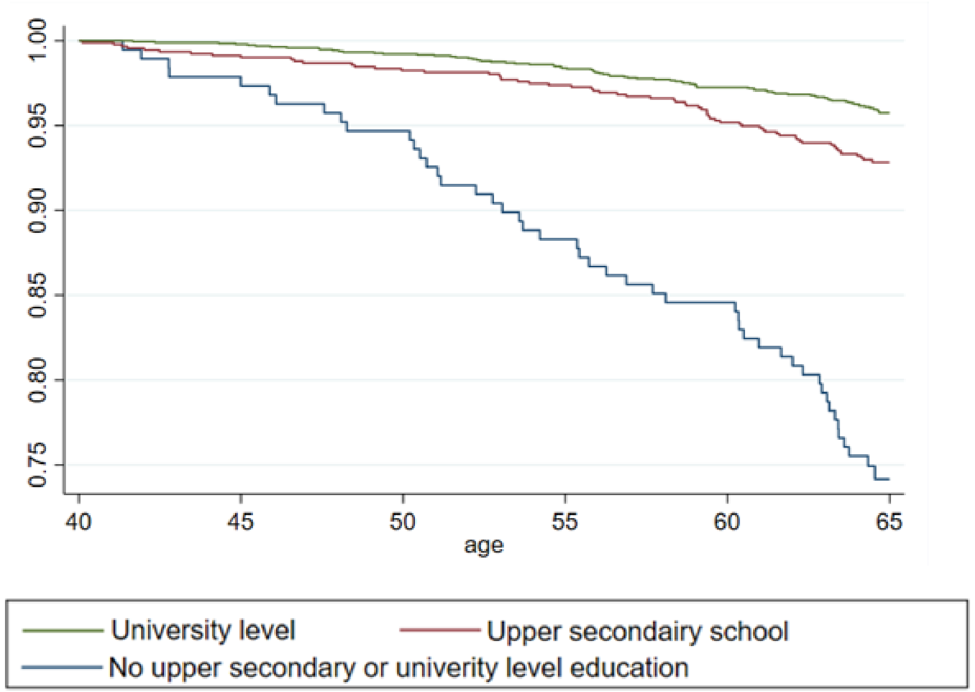


Figure C1. Kaplan-Meier survival estimates for individuals with different educational levels, split on parental education

Table C2. Education and early death.
Sample split on parent education. Cox model, hazard rate.

	Sample: Not educated parents			*Sample: Educated parents*		
	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	0.85***	0.88***	0.91***	0.75***	0.76***	0.81***
	(0.015)	(0.017)	(0.021)	(0.024)	(0.027)	(0.036)
Adolescents:						
Time preference, education plans, cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	0.66***	0.74***	0.83*	0.25***	0.26***	0.29***
	(0.054)	(0.063)	(0.080)	(0.047)	(0.051)	(0.059)
University level	0.38***	0.46***	0.56***	0.14***	0.15***	0.17***
	(0.041)	(0.054)	(0.075)	(0.026)	(0.031)	(0.038)
Adolescents:						
Time preference, education plans, cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
Observations	9,091	9,091	8,372	3,027	3,027	2,839

The sample is split on whether the participants' parents have/do not have upper secondary or university education. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table C3 shows the same regressions on mortality as Tables 4.3 and 4.4, but using the restricted sample used when looking at total number of hospitalizations in Tables 4.5 and 4.6.

Table C3. Education and early death. Cox model, hazard rate. Comparing the main sample and the restricted sample.

	Sample: Same as main results			*Sample: live in Stockholm 71-83*		
	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	0.83***	0.85***	0.88***	0.84***	0.85***	0.89***
	(0.012)	(0.015)	(0.018)	(0.014)	(0.017)	(0.020)
Adolescents:						
Time preference, education plans, cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	0.58***	0.65***	0.75***	0.57***	0.64***	0.73***
	(0.044)	(0.051)	(0.067)	(0.047)	(0.055)	(0.072)
University level	0.32***	0.38***	0.48***	0.34***	0.40***	0.50***
	(0.029)	(0.039)	(0.058)	(0.034)	(0.045)	(0.067)
Adolescents:						
Time preference, education plans, cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
Observations	12,118	12,118	11,211	9,529	9,529	9,046

The sample in "Sample: live in Stockholm 71-83" is the same as in the regressions in Tables 5 and 6 on hospitalizations, as the hospitalization data is available only for the Stockholm region (not nationally) before 1983. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.D Including additional controls

Table D1. Descriptive Statistics.

	Mean	Standard deviation	Min	Max	Sample size
Number of siblings	1.765	1.319	0	17	12,112
Number of older sisters	0.431	0.696	0	10	12,112
Number of younger sisters	0.419	0.68	0	6	12,112
Number of older brothers	0.468	0.726	0	13	12,112
Number of younger brothers	0.435	0.681	0	5	12,112

Only individuals alive in 1993 (age 40)

Table D2. Education and early death. Additional controls. Cox model, hazard rate.

VARIABLES	Death by 65 (1a)	Death by 65 (1b)	Death by 65 (1c)	Death by 65 (1d)	Death by 65 (1e)
Years of education	0.88***	0.88***	0.88***	0.88***	0.88***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Adolescents:					
Number of siblings		0.96			
		(0.027)			
Number of older sisters			0.95		
			(0.051)		
Number of younger sisters			0.99		
			(0.055)		
Number of older brothers			0.93		
			(0.049)		
Number of younger brothers			0.95		
			(0.053)		
School fixed effects				Inc.	
Municipality fixed effects					Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)
Upper secondary school	0.75***	0.75***	0.75***	0.75***	0.75***
	(0.067)	(0.067)	(0.067)	(0.067)	(0.067)
University level	0.48***	0.48***	0.48***	0.49***	0.48***
Adolescents:	(0.058)	(0.058)	(0.058)	(0.060)	(0.058)
Number of siblings		0.96			
		(0.027)			
Number of older sisters			0.95		
			(0.051)		
Number of younger sisters			0.99		
			(0.055)		
Number of older brothers			0.93		
			(0.049)		
Number of younger brothers			0.95		
			(0.053)		
School fixed effects				Inc.	
Municipality fixed effects					Inc.
Time preference, education plans, cog. ability controls	Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender	Inc.	Inc.	Inc.	Inc.	Inc.
Health background	Inc.	Inc.	Inc.	Inc.	Inc.
Grades year 6 & 9, applied upper secondary school	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	11,211	11,206	11,206	11,211	11,211

Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table D3. Education and hospitalizations. Additional controls. OLS coefficients.

VARIABLES	Number of Hosp. (1a)	Number of Hosp. (1b)	Number of Hosp. (1c)	Number of Hosp. (1d)	Number of Hosp. (1e)
Years of education	-0.16***	-0.16***	-0.16***	-0.14***	-0.15***
	(0.051)	(0.051)	(0.051)	(0.052)	(0.051)
Number of siblings		0.069			
		(0.071)			
Number of older sisters			0.080		
			(0.16)		
Number of younger sisters			0.16		
			(0.15)		
Number of older brothers			0.20		
			(0.15)		
Number of younger brothers			-0.18		
			(0.13)		
Constant	14.9***	14.7***	15.0***	14.0***	13.7***
	(3.75)	(3.75)	(3.86)	(3.34)	(3.32)
School fixed effects				Inc.	
Municipality fixed effects					Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)
Upper secondary school	-0.027	-0.020	-0.018	0.0098	-0.016
	(0.33)	(0.33)	(0.33)	(0.34)	(0.33)
University level	-0.74**	-0.74**	-0.74**	-0.65*	-0.70**
	(0.35)	(0.35)	(0.35)	(0.36)	(0.35)
Number of siblings		0.071			
		(0.071)			
Number of older sisters			0.082		
			(0.16)		
Number of younger sisters			0.16		
			(0.15)		
Number of older brothers			0.20		
			(0.15)		
Number of younger brothers			-0.18		
			(0.13)		
Constant	13.5***	13.4***	13.7***	12.8***	12.4***
	(3.72)	(3.72)	(3.83)	(3.32)	(3.29)
School fixed effects				Inc.	
Municipality fixed effects					Inc.
Time preference, education plans, cog. ability controls	Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender	Inc.	Inc.	Inc.	Inc.	Inc.
Health background	Inc.	Inc.	Inc.	Inc.	Inc.
Grades year 6 & 9, applied upper secondary school	Inc.	Inc.	Inc.	Inc.	Inc.
Observations	9,046	9,043	9,043	9,046	9,046

Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.E Test of Cox Assumptions

Table E1, Test of proportional-hazards assumption using Schoenfeld residuals

	Rho	Chi2	Prob>chi2
Participants' education:			
7-step education measure	0.02911	1.03	0.3094
Upper secondary school	0.01851	0.38	0.5367
University level	0.01571	0.27	0.6001

This table presents a test of whether the log hazard ratio function is constant over time. The null hypothesis in this test is a zero slope. The proportional-hazards assumption does not hold if this null hypothesis is rejected.

Looking at university-educated participants and participants without upper secondary education separately, Figure E1 shows no indication of proportional-hazards assumption violations. This conclusion is drawn based on the closeness of plots using Kaplan-Meier-observed survival curves and Cox predictive curves. Using Schoenfeld residuals in Table E1 gives the same results, meaning no indication of violation of the proportional-hazards assumption. The log-log plots in Figure E2 are roughly parallel. Yet, there are issues with this in the beginning of the series (mortalities close to age 40) that is not in line with the proportional-hazards assumption. This problem is likely to be caused by the continuous-time data and the low number of individuals who die early, generating noise.

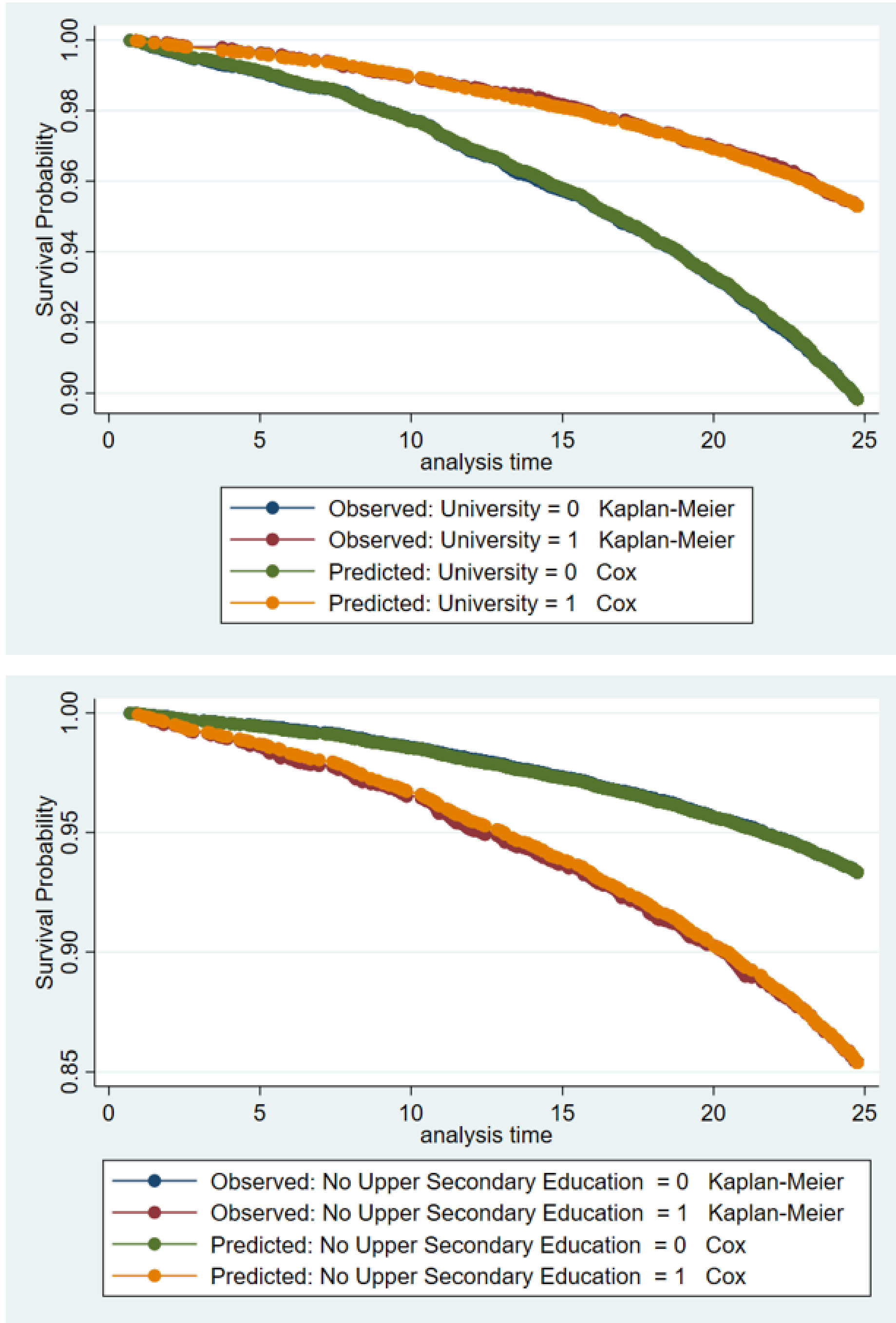


Figure E1. Plots of Kaplan–Meier observed survival curves and predictive curves using Cox.

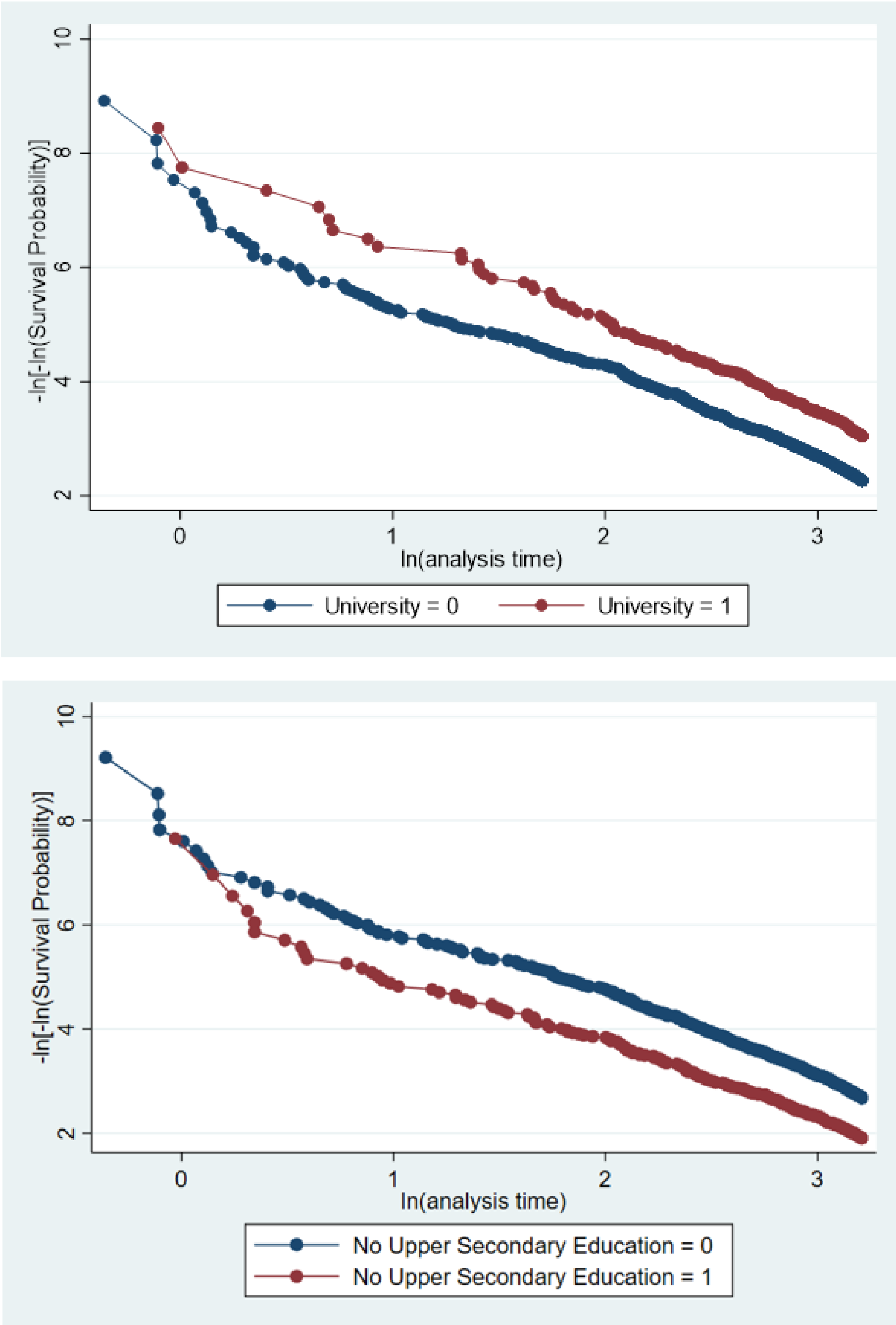


Figure E2. Log-log plots of survival.

4.F Number of hospitalizations with other samples and models

Table F1. Descriptive Statistics.

	Mean	Standard deviation	Min	Max	Sample size
Number of hospitalizations (full sample)	5.631	9.668	0	293	9,529
Number of hospitalizations (if < 100)	5.433	7.812	0	99	9,516
Number of hospitalizations (if < 50)	5.079	6.201	0	49	9,461
Number of hospitalizations > 10 (binary)	0.307	0.461	0	1	9,529

Sample is restricted to only include participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). Number of hospitalizations is measured from 1973 to 2016. The data contain full information on hospitalizations in the Stockholm area and national wide in 1973 and 1983, respectively. Number of hospitalizations (if < 100) or (if < 50) exclude participants with very high numbers of diagnoses. The binary measure for 10 < hospitalizations categorizes participants into high or low hospital users, depending on whether they have more than 10 hospitalizations in the investigated period.

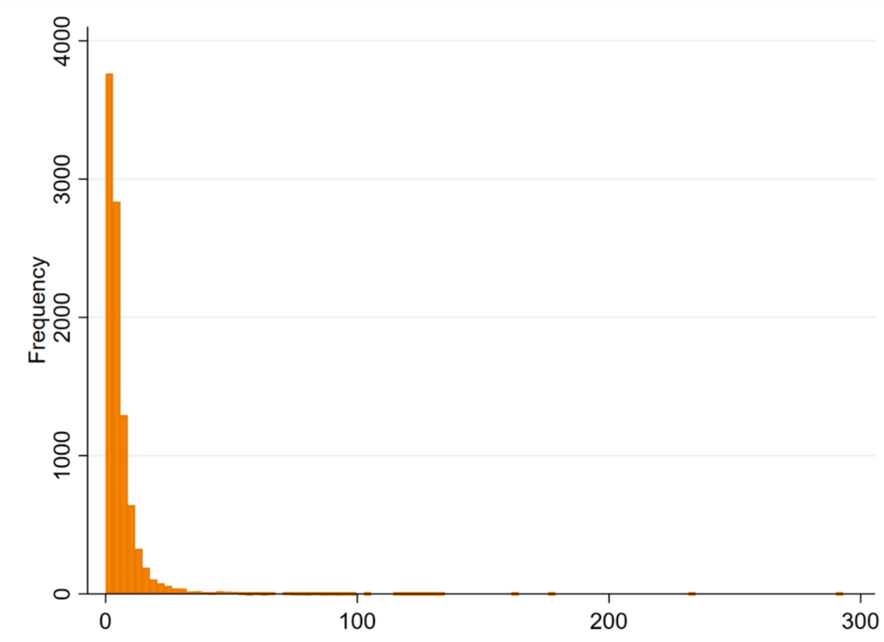


Figure F1. Total number of hospital visits per person 1973–2016
The X-axis is the number of hospitalizations and the Y-axis is the number of person in the sample who have this corresponding number of hospitalizations.
The large majority of participants have between 0 and 5 hospitalizations.

Table F2. Education and hospitalizations.
Sample restricted on number of hospitalizations. OLS.

	Sample with no. of hosp. <100			*Sample with no. of hosp. <50*		
	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.41***	-0.34***	-0.17***	-0.32***	-0.26***	-0.13***
	(0.033)	(0.044)	(0.047)	(0.026)	(0.031)	(0.035)
Adolescents:						
Time preference, education plans, cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-0.88***	-0.86***	-0.40	-0.70***	-0.72***	-0.36*
	(0.26)	(0.28)	(0.27)	(0.20)	(0.21)	(0.22)
University level	-2.23***	-1.91***	-0.90***	-1.76***	-1.48***	-0.71***
	(0.25)	(0.31)	(0.32)	(0.19)	(0.22)	(0.24)
Adolescents:						
Time preference, education plans, cog. ability controls		Inc.	Inc.		Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.		Inc.	Inc.
Health background		Inc.	Inc.		Inc.	Inc.
Grades year 6 & 9, applied upper secondary school			Inc.			Inc.
Observations	9,516	9,516	9,035	9,461	9,461	8,993
Outcome mean	5.43	5.43	5.22	5.08	5.08	4.94

Sample is restricted to exclude individuals with extreme number of hospitalizations and to only include participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is number of hospitalizations from 1973 to 2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table F3. Education and hospitalizations. Poisson coefficients.
Sample living in Stockholm 1971, 1975, and 1978–1983. Education from 1993.

	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.081***	-0.075***	-0.073***	-0.074***	-0.068***	-0.067***
	(0.0063)	(0.0063)	(0.0076)	(0.0085)	(0.0086)	(0.0086)
Adolescents:						
Education plans				0.016	0.038	0.041
				(0.043)	(0.043)	(0.044)
Cognitive Ability					-0.012***	-0.012***
					(0.0024)	(0.0024)
Time preferences						-0.066
						(0.042)
Constant	2.70***	2.51***	3.99***	4.01***	3.91***	3.94***
	(0.080)	(0.084)	(0.49)	(0.51)	(0.51)	(0.51)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-0.10**	-0.076	-0.10**	-0.10**	-0.084	-0.084
	(0.046)	(0.047)	(0.051)	(0.051)	(0.051)	(0.051)
University level	-0.42***	-0.39***	-0.39***	-0.38***	-0.35***	-0.34***
	(0.043)	(0.044)	(0.051)	(0.056)	(0.056)	(0.056)
Adolescents:						
Education plans				-0.0055	0.020	0.023
				(0.043)	(0.043)	(0.044)
Cognitive ability					-0.012***	-0.012***
					(0.0024)	(0.0024)
Time preferences						-0.067
						(0.042)
Constant	1.91***	1.77***	3.43***	3.42***	3.37***	3.40***
	(0.036)	(0.043)	(0.50)	(0.51)	(0.51)	(0.51)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	5.63	5.63	5.63	5.63	5.63	5.63
Observations	9,529	9,529	9,529	9,529	9,529	9,529

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is number of hospitalizations 1973–2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table F4. Education and hospitalizations. Poisson coefficients.
Sample living in Stockholm 1971, 1975, and 1978–1983. Education from 1993.

	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.081***	-0.067***	-0.054***	-0.037***	-0.054***	-0.035***
	(0.0063)	(0.0086)	(0.0093)	(0.0094)	(0.0095)	(0.0097)
Adolescents:						
Grades year 6			-0.15***	-0.021		-0.0091
			(0.036)	(0.042)		(0.041)
Grades year 9				-0.17***		-0.16***
				(0.040)		(0.041)
Apply to upper secondary school					-0.21***	-0.089*
					(0.044)	(0.048)
Constant	2.70***	2.51***	4.09***	3.47***	3.69***	3.37***
	(0.080)	(0.084)	(0.52)	(0.61)	(0.52)	(0.62)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary School	-0.10**	-0.084	-0.058	-0.021	-0.033	-0.0055
	(0.046)	(0.051)	(0.052)	(0.052)	(0.053)	(0.054)
University level	-0.42***	-0.34***	-0.27***	-0.18***	-0.26***	-0.16***
	(0.043)	(0.056)	(0.059)	(0.057)	(0.062)	(0.060)
Adolescents:						
Grades year 6			-0.17***	-0.024		-0.010
			(0.035)	(0.043)		(0.042)
Grades year 9				-0.18***		-0.17***
				(0.039)		(0.040)
Apply to upper secondary school					-0.23***	-0.098**
					(0.044)	(0.048)
Constant	1.91***	3.40***	3.68***	3.17***	3.23***	3.08***
	(0.036)	(0.51)	(0.52)	(0.61)	(0.51)	(0.61)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
Outcome mean	5.63	5.63	5.64	5.40	5.63	5.40
Observations	9,529	9,529	9,427	9,052	9,516	9,046

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is number of hospitalizations 1973–2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table F5. Education and having more than 10 hospitalizations. OLS coefficients. Sample living in Stockholm 1971, 1975, and 1978–1983. Education from 1993.

	Hosp >10	Hosp >10	Hosp >10	Hosp >10	Hosp >10	Hosp >10
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.016***	-0.015***	-0.015***	-0.015***	-0.014***	-0.014***
	(0.0014)	(0.0014)	(0.0016)	(0.0017)	(0.0017)	(0.0017)
Adolescents:						
Education plans				-0.00080	0.0026	0.0028
				(0.0077)	(0.0078)	(0.0078)
Cognitive ability					-0.0019***	-0.0019***
					(0.00051)	(0.00051)
Time preferences						-0.0033
						(0.0084)
Constant	0.32***	0.29***	0.43***	0.43***	0.42***	0.42***
	(0.018)	(0.019)	(0.077)	(0.079)	(0.079)	(0.079)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.013	0.017	0.027	0.027	0.029	0.029
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-0.041***	-0.037***	-0.041***	-0.041***	-0.038***	-0.038***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
University level	-0.093***	-0.087***	-0.086***	-0.084***	-0.078***	-0.078***
	(0.010)	(0.010)	(0.011)	(0.012)	(0.012)	(0.012)
Adolescents:						
Education plans				-0.0058	-0.0018	-0.0016
				(0.0076)	(0.0077)	(0.0077)
Cognitive ability					-0.0020***	-0.0020***
					(0.00051)	(0.00051)
Time preferences						-0.0038
						(0.0084)
Constant	0.18***	0.15***	0.32***	0.32***	0.31***	0.31***
	(0.0091)	(0.010)	(0.078)	(0.079)	(0.079)	(0.079)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.011	0.015	0.026	0.026	0.027	0.027
Outcome mean	0.12	0.12	0.12	0.12	0.12	0.12
Observations	9,529	9,529	9,529	9,529	9,529	9,529

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is a binary variable of having more than 10 hospitalizations 1973–2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table F6. Education and having more than 10 hospitalizations. OLS coefficients. Sample living in Stockholm 1971, 1975, and 1978–1983. Education from 1993.

	Hosp >10	Hosp >10	Hosp >10	Hosp >10	Hosp >10	Hosp >10
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.016***	-0.014***	-0.011***	-0.0080***	-0.011***	-0.0074***
	(0.0014)	(0.0017)	(0.0018)	(0.0019)	(0.0018)	(0.0019)
Adolescents:						
Grades year 6			-0.032***	-0.011		-0.0086
			(0.0070)	(0.0082)		(0.0082)
Grades year 9				-0.025***		-0.023***
				(0.0068)		(0.0069)
Apply to upper secondary school					-0.041***	-0.019**
					(0.0092)	(0.0095)
Constant	0.32***	0.42***	0.44***	0.35***	0.37***	0.33***
	(0.018)	(0.079)	(0.081)	(0.084)	(0.079)	(0.084)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.013	0.029	0.030	0.028	0.031	0.028
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-0.041***	-0.038***	-0.031***	-0.022**	-0.027**	-0.019*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
University level	-0.093***	-0.078***	-0.061***	-0.044***	-0.061***	-0.040***
	(0.010)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Adolescents:						
Grades year 6			-0.035***	-0.012		-0.0097
			(0.0069)	(0.0082)		(0.0082)
Grades year 9				-0.026***		-0.024***
				(0.0067)		(0.0068)
Apply to upper secondary school					-0.043***	-0.019*
					(0.0093)	(0.0097)
Constant	0.18***	0.31***	0.36***	0.30***	0.28***	0.28***
	(0.0091)	(0.079)	(0.081)	(0.085)	(0.078)	(0.085)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
R-square	0.011	0.027	0.030	0.027	0.030	0.028
Outcome mean	0.12	0.12	0.12	0.12	0.12	0.12
Observations	9,529	9,529	9,427	9,052	9,516	9,046

Sample is restricted to include only participants who lived in the Stockholm region in 1971, 1975, and 1978–1983 and who were alive in 1993 (age 40). The outcome variable is a binary variable of having more than 10 hospitalizations 1973–2016. The data contain full information on hospitalizations in the Stockholm area and nationwide in 1973 and 1983, respectively. Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

4.G The raw predictive power of "hard to measure" control variables

Table G1. Education and early death.
Sample alive at age 40. Education from 1993. Cox model, hazard rate.

	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Adolescents:						
Education plans	0.71***					
	(0.047)					
Cognitive ability		0.97***				
		(0.0043)				
Time preferences			0.82***			
			(0.061)			
Grades year 6				0.63***		
				(0.031)		
Grades year 9					0.66***	
					(0.030)	
Apply to upper secondary school						0.53***
						(0.035)
Observations	12,118	12,118	12,118	11,967	11,317	12,097

The sample is restricted to only include individuals who were alive in 1993 (age 40). Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table G2. Education and hospitalizations. OLS coefficients.
Sample living in Stockholm 1971, 1975, and 1978–1983. Education from 1993.

	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.	Number of Hosp.
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Adolescents:						
Education plans	-1.02***					
	(0.20)					
Cognitive ability		-0.13***				
		(0.013)				
Time preferences			-1.09***			
			(0.27)			
Grades year 6				-1.32***		
				(0.16)		
Grades year 9					-1.37***	
					(0.14)	
Apply to upper secondary school						-2.20***
						(0.22)
Constant	6.10***	8.56***	6.48***	9.88***	9.73***	7.04***
	(0.14)	(0.35)	(0.25)	(0.55)	(0.51)	(0.20)
R-square	0.003	0.009	0.002	0.009	0.013	0.012
Outcome mean	5.63	5.63	5.63	5.64	5.40	5.63
Observations	9,529	9,529	9,529	9,427	9,125	9,516

The sample is restricted to only include individuals who were alive in 1993 (age 40). Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.H Regressions on mortality using Probit average marginal effects

Table H1. Education and early death.
Sample alive at age 40. Education from 1993. Probit average marginal effects.

	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.014***	-0.013***	-0.012***	-0.013***	-0.012***	-0.012***
Adolescents:	(0.0011)	(0.0011)	(0.0012)	(0.0013)	(0.0013)	(0.0013)
Education plans				0.0029	0.0052	0.0056
				(0.0055)	(0.0056)	(0.0056)
Cognitive ability					-0.0013***	-0.0012***
					(0.00036)	(0.00036)
Time preferences						-0.0098*
						(0.0057)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-0.042***	-0.040***	-0.036***	-0.036***	-0.034***	-0.034***
	(0.0060)	(0.0060)	(0.0061)	(0.0062)	(0.0062)	(0.0062)
University level	-0.084***	-0.081***	-0.075***	-0.075***	-0.071***	-0.070***
Adolescents:	(0.0068)	(0.0068)	(0.0072)	(0.0075)	(0.0076)	(0.0076)
Education plans				-0.00037	0.0023	0.0027
				(0.0055)	(0.0056)	(0.0056)
Cognitive ability					-0.0013***	-0.0013***
					(0.00036)	(0.00036)
Time preferences						-0.0099*
						(0.0057)
Socioeconomics, gender			Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,118	12,118	12,118	12,118	12,118	12,118

The sample is restricted to only include individuals who were alive in 1993 (age 40). Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table H2. Education and early death.
Sample alive at age 40. Education from 1993. Probit average marginal effects.

	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65	Death by 65
VARIABLES	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Years of education	-0.014***	-0.012***	-0.011***	-0.0090***	-0.011***	-0.0086***
Adolescents:	(0.0011)	(0.0013)	(0.0013)	(0.0014)	(0.0013)	(0.0014)
Grades year 6			-0.0053	0.0072		0.0087
			(0.0049)	(0.0056)		(0.0057)
Grades year 9				-0.015***		-0.013***
				(0.0046)		(0.0046)
Apply to upper secondary school					-0.020***	-0.012*
					(0.0060)	(0.0064)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)
Upper secondary school	-0.042***	-0.034***	-0.033***	-0.023***	-0.030***	-0.022***
	(0.0060)	(0.0062)	(0.0062)	(0.0065)	(0.0063)	(0.0066)
University level	-0.084***	-0.070***	-0.068***	-0.052***	-0.063***	-0.050***
Adolescents:	(0.0068)	(0.0076)	(0.0079)	(0.0082)	(0.0079)	(0.0084)
Grades year 6			-0.0073	0.0063		0.0078
			(0.0048)	(0.0056)		(0.0057)
Grades year 9				-0.016***		-0.015***
				(0.0045)		(0.0045)
Apply to upper secondary school					-0.020***	-0.012*
					(0.0061)	(0.0065)
Time preference, education plans, cog. ability controls		Inc.	Inc.	Inc.	Inc.	Inc.
Socioeconomics, gender		Inc.	Inc.	Inc.	Inc.	Inc.
Health background		Inc.	Inc.	Inc.	Inc.	Inc.
Observations	12,118	12,118	11,967	11,220	12,097	11,211

The sample is restricted to only include individuals who were alive in 1993 (age 40). Socioeconomic/gender controls include month of birth, sex, year of school, parents' age when their child was born, father's and mother's total income, and information on university and upper secondary schooling for the parent with the highest level of education. It also includes dummy variables for missing observations of parents' income and their age when their child was born. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.I Unobservable Selection (Oster 2019)

Table I1. Bias adjusted β for "Years of education"

	(1) Baseline effect (Std. error) [R^2]	(2) Controlled effect (Std. error) [R^2]	(3) Bias adjusted β $R_{max} = 1.3\ \widetilde{R_2}$	(4) Bias adjusted β $R_{max} = 2\ \widetilde{R_2}$
Panel A δ=0.5				
Death by 65	-0.0114	-0.0083	-0.0063	-0.0002
	(0.0010) [0.011]	(0.0014) [0.018]		
Hospitalizations	-0.3764	-0.1594	-0.0875	0.1229
	(0.0412) [0.009]	(0.0533) [0.040]		
Panel B δ=1				
Death by 65	-0.0114	-0.0083	-0.0032†	-0.0204†
	(0.0010) [0.011]	(0.0014) [0.018]		
Hospitalizations	-0.3764	-0.1594	0.0035†	0.7109†
	(0.0412) [0.009]	(0.0533) [0.040]		

Due to limitations in the Oster (2019) procedure, all estimations (including the binary mortality outcome) are made using OLS. $\widetilde{R_2}$ is the R^2 value in the corresponding model with controls included. †Multiple solutions are generated. The solution that minimizes the squared difference to the estimated treatment effect in the controlled regression is selected, as suggested by Oster (2019).

Table I2. Finding the $\tilde{\delta}$ that makes "Years of education" β =0 at different R_{max}

	(1) Baseline effect (Std. error) [R^2]	(2) Controlled effect (Std. error) [R^2]	(3) $\tilde{\delta}$ for β=0 given $R_{max} = 1.3\ \widetilde{R_2}$	(4) $\tilde{\delta}$ for β=0 given $R_{max} = 2\ \widetilde{R_2}$
Death by 65	-0.0114	-0.0083	5.66	1.72
	(0.0010) [0.011]	(0.0014) [0.018]		
Hospitalizations	-0.3764	-0.1594	1.43	0.44
	(0.0412) [0.009]	(0.0533) [0.040]		

Due to limitations in the Oster (2019) procedure, all estimations (including the binary mortality outcome) are made using OLS. $\widetilde{R_2}$ is the R^2 value in the corresponding model with controls included.

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