Journal of Health Economics 29 (2010) 1–28

Contents lists available at ScienceDirect

Journal of Health Economics

journal homepage: www.elsevier.com/locate/econbase

Understanding differences in health behaviors by education

David M. Cutler[a], Adriana Lleras-Muney[b,*]

[a] Department of Economics, Harvard University and NBER, 1875 Cambridge Street, Cambridge, MA 02138, United States
[b] Department of Economics, UCLA and NBER, 9373 Bunche Hall, Los Angeles, CA 90025, United States

ARTICLE INFO

Article history:
Received 9 December 2008
Received in revised form 10 July 2009
Accepted 15 October 2009
Available online 31 October 2009

JEL classification:
I12
I20

Keywords:
Education
Health

ABSTRACT

Using a variety of data sets from two countries, we examine possible explanations for the relationship between education and health behaviors, known as the education gradient. We show that income, health insurance, and family background can account for about 30 percent of the gradient. Knowledge and measures of cognitive ability explain an additional 30 percent. Social networks account for another 10 percent. Our proxies for discounting, risk aversion, or the value of future do not account for any of the education gradient, and neither do personality factors such as a sense of control of oneself or over one's life.

1. Introduction

In 1990, a 25-year-old male college graduate could expect to live another 54 years. A high school dropout of the same age could expect to live 8 years fewer (Richards and Barry, 1998). This enormous difference in life expectancy by education is true for every demographic group, is persistent – if not increasing – over time (Kitagawa and Hauser, 1973; Elo and Preston, 1996; Meara et al., 2008), and is present in other countries (Marmot et al., 1984 (the U.K.); Mustard et al., 1997 (Canada); Kunst and Mackenbach, 1994 (northern European countries)).[1]

A major reason for these differences in health outcomes is differences in health behaviors.[2] In the United States, smoking rates for the better educated are one-third the rate for the less educated. Obesity rates are half as high among the better educated (with a particularly pronounced gradient among women), as is heavy drinking. Mokdad et al. (2004) estimate that nearly half of all deaths in the United States are attributable to behavioral factors, most importantly smoking, excessive weight, and heavy alcohol intake. Any theory of health differences by education thus needs to explain differences in health behaviors by education. We search for explanations in this paper.[3]

In standard economic models, people choose different consumption bundles because they face different constraints (for example, income or prices differ), because they have different beliefs about the impact of their actions, or because they have different tastes. We start by showing, as others have as well, that income and price differences do not account for all of these behavioral differences. We estimate that access to material resources, such as gyms and smoking cessation methods, can account for at most 30 percent of the education gradient in health behaviors. Price differences work the other way. Many unhealthy behaviors are costly (smoking, drinking, and overeating), and evidence suggests that the less educated are more responsive to price than the better educated. As a result, we consider primarily differences in information and in tastes.

Some of the differences by education are indeed due to differences in specific factual knowledge—we estimate that knowledge of the harms of smoking and drinking accounts for about 10 percent of the education gradient in those behaviors. However, more important than specific knowledge is how one thinks. Our most striking finding, shown using US and UK data, is that a good deal of the education effect – about 20 percent – is associated with general cognitive ability. Furthermore this seems to be driven by the fact that education raises cognition which in turn improves behavior.

* Corresponding author. Tel.: +1 310 825 3925.
E-mail addresses: dcutler@harvard.edu (D.M. Cutler), alleras@econ.ucla.edu (A. Lleras-Muney).

[1] See Cutler and Lleras-Muney (2008a,b) for additional references.

[2] Observed health behaviors however do not explain all of the differences in health status by education or other SES measures. We do not focus on this issue in this paper.

[3] Formal explanations for this phenomenon date from Grossman (1972).

0167-6296/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.jhealeco.2009.10.003

A lengthy literature suggests that education affects health because both are determined by individual taste differences, specifically in discounting, risk aversion, and the value of the future—which also affect health behaviors and thus health. Victor Fuchs (1982) was the first to test the theory empirically, finding limited support for it. We suspect that taste differences in childhood cannot explain all of the effect of schooling, since a number of studies show that exogenous variation in education influences health. For example, Lleras-Muney (2005) shows that adults affected by compulsory schooling laws when they were children are healthier than adults who left school earlier. Currie and Moretti (2003) show that women living in counties where college is more readily available have healthier babies than women living in other counties. However, education can increase the value of the future simply by raising earnings and can also change tastes.

Nevertheless, using a number of different measures of taste and health behaviors, we are unable to find a large impact of differences in discounting, value of the future, or risk aversion on the education gradient in health behaviors. Nor do we find much role for theories that stress the difficulty of translating intentions into actions, for example, that depression or lack of self-control inhibits appropriate action (Salovey et al., 1998). Such theories are uniformly unsupported in our data, with one exception: about 10 percent of the education gradient in health behaviors is a result of greater social and emotional support.

All told, we account for about two-thirds of the education gradient with information on material resources, cognition, and social interactions. However, it is worth noting that our results have several limitations. First, we lack the ability to make causal claims, especially because it is difficult to estimate models where multiple mechanisms are at play. Second, we recognize that in many cases the mechanisms we are testing require the use of proxies which can be very noisy, causing us to dismiss potentially important theories. Nevertheless we view this paper as an important systematic exploration of possible mechanisms, and as suggesting directions for future research.

The paper is structured as follows. We first discuss the data and empirical methods. The next section presents basic facts on the relation between education and health. The next two sections discuss the role of income and prices in mediating the education-behavior link. The fourth section considers other theories about why education and health might be related: the cognition theory; the future orientation theory; and the personality theory. These theories are then tested in the next three sections. We then turn to data from the U.K. The final section concludes.

2. Data and methods

In the course of our research, we use a number of different data sets. These include the National Health Interview Survey (NHIS), the National Longitudinal Survey of Youth (NLSY), the National Survey of Midlife Development in the United States (MIDUS), the Health and Retirement Study (HRS), the Survey on Smoking (SOS), and the National Childhood Development Study (NCDS) in the U.K. We use many data sets because no single source of data has information allowing us to test all the relevant theories. For the US we have restricted our attention to the whites only because our earlier work showed larger education gradients among them (Cutler and Lleras-Muney, 2008b) but the results presented here are not particularly sensitive to that choice. A lengthy data appendix discusses the surveys in more detail.

In all data sets we restrict the samples to individuals ages 25 and above (so education has been mostly completed)—but place no upper limit on age. The health behaviors we look at are self-reported. This is a limitation of our study, but we were unable to find data containing measured (rather than self-reported) behaviors to test our theories.[4] To the extent that biases in self-reporting vary across behaviors, our use of multiple health behaviors mitigates this bias. Nevertheless it is worth noting that not much is known about whether biases in reporting vary systematically by education.

To document the effect of education on health behaviors, we estimate the following regression:

$$H_i = \beta_0 + \beta_1^* Education_i + \boldsymbol{X}_i\alpha + \varepsilon_i \quad (1)$$

where H_i is a health behavior of individual i, *Education* is measured as years of schooling in the US, and as a dummy for whether the individual passed any A level examinations in the UK.[5] The basic regression controls for basic demographic characteristics (gender, age dummies and ethnicity) and all available parental background measures (which vary depending on the data we use). Ideally in this basic specification we would like to control for parent characteristics and all other variables that determine education but cannot be affected by it, such as genetic and health endowments at birth—we control for the variables that best seem to fit this criterion in each data set.[6] The education gradient is given by β_1, the coefficient on education, and measures the effect of schooling on behavior, which could be thought of as causal if our baseline controls were exhaustive. We discuss below whether the best specification of education is linear or non-linear.

In testing a particular theory we then re-estimate Eq. (1) adding a set of explanatory variables Z:

$$H_i = \alpha_0 + \alpha_1^* Education_i + \boldsymbol{X}_i\alpha + \boldsymbol{Z}_i\gamma + \varepsilon_i. \quad (2)$$

We then report, for each health measure, the percent decline in the coefficient of education from adding each set of variables, $1 - \alpha_1/\beta_1$.

Many of our health measures are binary. To allow for comparability across outcomes, we estimate all models using linear probability, but our results are not very different if we instead use a non-linear model. Thus, the coefficients are the percentage point change in the relevant outcome. Since we have many outcomes, it is helpful to summarize them in a single number. We use three methods to form a summary. First we compute the average reduction of the gradient across outcomes for those outcomes with a statistically significant gradient in the baseline specification. Of course, not all behaviors contribute equally to health outcomes. Our second summary measure weights the different behaviors by their impact on mortality. The regression model, using the 1971–1975 National Health and Nutrition Examination Survey Epidemiological Follow-up Study, is described in Appendix. For comparability reasons, the behaviors are restricted to smoking, drinking, and obesity. The summary measure is the predicted change in 10-year mortality associated with each additional year of education.[7] Finally, we report the average effect of education across outcomes using

[4] The only exception would be BMI which is measured in the NHANES and which we do not use here because it contains no proxies to test our theories.

[5] There is no straightforward way to compute years of schooling using the information that is asked of respondents in Britain. Although using a dichotomous variable makes it difficult to compare the results to those for the U.S., we preferred this measure.

[6] For example we control for parental education, under the assumption that parental education is mostly determined prior to children's education and that mothers and fathers do not make education decisions taking into account the possibility that their own education will determine their children's education as well.

[7] Since the regression is a logit, the impact of changes in the X variables is non-linear. We evaluate the derivative around the average 10-year mortality rate in the population, 10.7 percent. We hold this rate constant in all data sets, even when age and other demographics differs.

the methodology described in Kling et al. (2007), which weights outcomes equally after standardizing them.[8]

3. Education and health behaviors: the basic facts

We start by presenting some basic facts relating education and health behaviors, before discussing theories linking the two. Health behaviors are asked about in a number of surveys. Probably the most complete is the National Health Interview Survey (NHIS). In order to examine as many behaviors as possible, we use data from a number of NHIS years, 1990, 1991, 1994 and 2000.[9] We group health behaviors into eight groups: smoking, diet/exercise, alcohol use, illegal drugs, automobile safety, household safety, preventive care, and care for people with chronic diseases (diabetes or hypertension). Within each group, there are multiple measures of health behaviors. Because the NHIS surveys are large, our sample sizes are up to approximately 23,000.

Table 1 shows the health behaviors we analyze and the mean rates in the adult population. We do not remark upon each variable, but rather discuss a few in some depth. Current cigarette smoking is a central measure of poor health. Mokdad et al. (2004) estimate that cigarette smoking is the leading cause of preventable deaths in the country (accounting for 18 percent of all deaths). The first row shows that 23 percent of white adults in 2000 smoked cigarettes. The next columns relate cigarette smoking to years of education, entered linearly. We control for single year of age dummies, a dummy for females, and a dummy for Hispanic.

Each year of education is associated with a 3.0 percentage point lower probability of smoking. Put another way, a college grad is 12 percentage points less likely to smoke than a high school grad. Given that smoking is associated with 6 years shorter life expectancy (Cutler et al., 2002), this difference is immense.

Entering education linearly may not be right. One might imagine that some base level of education is important, and that additional education beyond that level would not reduce smoking. That is not correct, however. The first part of Fig. 1 shows the relationship between exact years of education and smoking: the figure reports the marginal effect of an additional year of education for each level of education, estimated using a logit model. If anything, the story is the opposite of the 'base education' hypothesis; the impact of education is greater at higher levels of education, rather than lower levels of education (although there are few observations at the lower end of the education distribution and thus these estimates are imprecise). Overall the relationship appears to be linear above 10 years of schooling for all of the outcomes in Fig. 1.

Next to smoking, obesity is the leading behavioral cause of death. While all measures of excess weight are correlated, we focus particularly on obesity (defined as a Body Mass Index or BMI equal to or greater than 30). Twenty-two percent of the population in 2000 self-reported themselves to be obese.[10] This too is negatively related to education; each year of additional schooling reduces the probability of being obese by 1.4 percent (Table 1). The shape by exact year of education is similar to that for smoking (Fig. 1). Obesity declines particularly rapidly for people with more than 12 years of education.

Heavy drinking is similarly harmful to health. We focus on the probability that the person is a heavy drinker—defined as having an average of 5 or more drinks when a person drinks. Eight percent of people are heavy drinkers. Each additional year of education lowers this by 1.8 percent. Interestingly the better educated are more likely to drink but less likely to drink heavily.

Self-reported use of illegal drugs is relatively low; only 2–8 percent of people report using such drugs in the past year. Recent use of illegal drugs is generally unrelated to education (at least for marijuana and cocaine). But better educated people report they are more likely to have ever tried these drugs. Better educated people seem better at quitting bad habits, or at controlling their consumption. This shows up in cigarette smoking as well, where the gradient in current smoking is somewhat greater than the gradient in ever smoking.

Automobile safety is positively related to education; better educated people wear seat belts much more regularly than less educated people. The mean rate of always wearing a seat belt is 69 percent; each year of education adds 3.3 percent to the rate. The analysis of seat belt use is particularly interesting. Putting on a seat belt is as close to costless as a health behavior comes. Further, knowledge of the harms of non-seat belt use is also very high. But the gradient in health behaviors is still extremely large.

Household safety is similarly related to education. Better educated people keep dangerous objects (such as handguns safe) and know what to do when something does happen (for example, they know the poison control phone number).

Better educated people engage in more preventive and risk control behaviors. Better educated women get mammograms and pap smears more regularly, better educated men and women get colorectal screening and other tests more regularly, and better educated people are more likely to get flu shots. Among those with hypertension, the better educated are more likely to have their blood pressure under control. Services involving medical care are the least clear of our education gradients to examine, since access to health care matters for receipt of these services. We thus focus more on the other behaviors. But, these data are worth remarking on because it does not appear that access to medical care is the big driver. Controlling for receipt of health insurance does not diminish these gradients to any large extent (the education coefficient on receipt of a mammogram is reduced by only 18 percent, for example, if we control for insurance in addition to age and ethnicity alone). This is consistent with the Rand Health Insurance Experiment (Newhouse, 1993); making medical care free increases use, but even when care is free, there is still significant under use. Seeing a doctor may be like wearing a seat belt; it is something that better educated people do more regularly.

Table 1 makes clear that education is associated with an enormous range of positive health behaviors, the majority of health behaviors that we explore. The average predicted 10-year mortality rate is 11 percent, shown in the last row of the table. Relative to this average, our results suggest that every year of education lowers the mortality risk by 0.3 percentage points, or 24 percent, through reduction in risky behaviors (drinking, smoking, and weight).

We have examined the education gradient in health behaviors using other data sets as well. Some of these results are presented later in the paper. In each case, there are large education differences across a variety of health behaviors and for somewhat different samples. Education differences in health behaviors are not specific to the United States. They are apparent in the U.K. as well. As documented later in the paper (Appendix Table 3), we analyze a sample of British men and women at ages 41–42. People who passed the A levels are 15 percent less likely to smoke than those who did not

[8] This methodology estimates a common education effect across outcomes, after standardizing the variables to have mean = 0 and standard deviation = 1. In each case, outcomes are redefined so that a higher outcome constitutes an improvement. Only outcomes that are defined for the entire population are included (so, for example, mammogram exam is excluded since it pertains to women only). The average effect of education is then computed as the unweighted average of the coefficient on education on each of the standardized outcomes.

[9] Later analyses use other years as well, specifically 1987 and 1992.

[10] Observed and self-reported obesity are not entirely similar. Measured obesity rates are generally 3–4 percent higher than self-reported rates (Cawley, 2004; Cawley and Burkhauser, 2006). Still, the two are highly correlated.

Table 1
Health behaviors for whites over 25 National Health Interview Survey.

Dependent variable	Mean	*N*	Year	Demographic controls		Adding income			Adding income and other economic controls		
				Years of education (β)	Std error	Years of education (β)	Std error	Reduction in education coefficient	Years of education (β)	Std error	Reduction in education coefficient
Smoking											
Current smoker	23%	22,141	2000	−0.030	(0.001)**	−0.022	(0.001)**	26%	−0.020	(0.001)**	33%
Former smoker	26%	22,270	2000	0.004	(0.001)**	0.002	(0.001)	58%	0.001	(0.001)	79%
Ever smoked	49%	22,156	2000	−0.026	(0.001)**	−0.021	(0.001)**	20%	−0.019	(0.001)**	25%
Number cigs a day (smokers)	17.7	4,910	2000	−0.697	(0.068)**	−0.561	(0.071)**	19%	−0.444	(0.073)**	36%
Made serious attempt to quit◦	64%	7,603	1990	0.013	(0.002)**	0.011	(0.002)**	12%	0.011	(0.002)**	16%
Diet/exercise											
Body mass index (BMI)	26.7	21,401	2000	−0.190	(0.014)**	−0.159	(0.015)**	16%	−0.139	(0.016)**	27%
Underweight (bmi ≤ 18.5)	2%	21,401	2000	−0.0005	(0.0004)	−0.0001	(0.0004)	85%	0.0000	(0.0004)	98%
Overweight (bmi ≥ 25)	59%	21,401	2000	−0.014	(0.001)**	−0.014	(0.001)**	0%	−0.013	(0.001)**	12%
Obese (bmi ≥ 30)	22%	21,401	2000	−0.014	(0.001)**	−0.011	(0.001)**	18%	−0.010	(0.001)**	28%
How often eat fruit or veggies per day	1.9	22,285	2000	0.079	(0.004)**	0.067	(0.004)**	16%	0.067	(0.004)**	15%
Ever do vigorous activity	39%	22,003	2000	0.039	(0.001)**	0.032	(0.001)**	18%	0.028	(0.001)**	28%
Ever do moderate activity	53%	21,768	2000	0.037	(0.001)**	0.030	(0.001)**	17%	0.029	(0.001)**	21%
Alcohol											
Had 12+ drinks in entire life	80%	22,054	2000	0.021	(0.001)**	0.017	(0.001)**	19%	0.014	(0.001)**	33%
Drink at least once per month	47%	21,803	2000	0.033	(0.001)**	0.025	(0.001)**	24%	0.020	(0.001)**	41%
Number of days had 5+ drinks past year- drinkers	10.8	13,458	2000	−2.047	(0.157)**	−1.711	(0.167)**	16%	−1.754	(0.170)**	14%
Number of days had 5+ drinks past year- all	6.8	21,663	2000	−0.848	(0.092)**	−0.703	(0.098)**	17%	−0.763	(0.100)**	10%
Average # drinks on days drank	2.3	13,600	2000	−0.162	(0.012)**	−0.162	(0.012)**	0%	−0.144	(0.012)**	11%
Heavy drinker (average number of drinks ≥ 5)	8%	13,600	2000	−0.018	(0.001)**	−0.015	(0.001)**	12%	−0.015	(0.001)**	13%
Drove drunk past year◦	11%	17,121	1990	−0.003	(0.001)**	−0.002	(0.001)**	27%	−0.005	(0.001)**	−38%
Number of times drove drunk past year◦	93%	17,121	1990	−0.140	(0.036)**	−0.103	(0.038)**	27%	−0.119	(0.040)**	15%
Illegal drugs											
Ever used marijuana◦	48%	13,413	1991	0.015	(0.002)**	0.014	(0.002)**	9%	0.009	(0.002)**	41%
Used marijuana, past 12 months◦	8%	13,413	1991	−0.001	(0.001)	0.000	(0.001)	139%	−0.002	(0.001)**	−100%
Ever used cocaine◦	16%	13,174	1991	0.005	(0.001)**	0.005	(0.001)**	−14%	0.000	(0.001)	94%
Used cocaine, past 12 months◦	2%	13,174	1991	0.000	(0.000)	0.000	(0.001)	–	−0.001	(0.001)	–
Ever used any other illegal drug◦	22%	13,370	1991	0.003	(0.014)**	0.006	(0.002)**	−80%	0.001	(0.002)	79%
Used other illegal drug, past 12 months◦	5%	13,176	1991	−0.002	(0.001)**	0.000	(0.001)	87%	−0.002	(0.001)**	20%
Automobile safety											
Always wear seat belt◦	69%	29,993	1990	0.033	(0.001)**	0.027	(0.001)**	19%	0.026	(0.001)**	23%
Never wear seat belt◦	9%	29,993	1990	−0.014	(0.001)**	−0.011	(0.001)**	20%	−0.011	(0.001)**	22%
Household safety											
Know poison control number◦	65%	6,838	1990	0.031	(0.002)**	0.026	(0.002)**	18%	0.027	(0.002)**	15%
1 + working smoke detectors◦	80%	29,021	1990	0.019	(0.001)**	0.012	(0.001)**	36%	0.012	(0.001)**	38%
House tested for radon◦	4%	28,440	1990	0.007	(0.000)**	0.005	(0.000)**	29%	0.005	(0.000)**	25%
Home paint ever tested for lead◦	4%	9,600	1991	0.000	(0.001)	0.001	(0.001)	–	−0.001	(0.001)	–
At least 1 firearm in household	42%	14,207	1994	−0.011	(0.002)**	−0.019	(0.002)**	−73%	−0.012	(0.002)**	−9%
All firearms in household are locked (has firearms)	36%	5,268	1994	−0.005	(0.003)**	−0.008	(0.003)**	−60%	−0.007	(0.003)**	−40%
All firearms in household are unloaded (has firearms)	81%	5,262	1994	0.006	(0.002)**	0.003	(0.001)**	50%	0.004	(0.002)**	33%

Preventive care-recommended population											
Ever had mammogram-age 40+	87%	8,169	2000	0.017	(0.001)**	0.013	(0.002)**	27%	0.010	(0.002)**	40%
Had mamogram w/in past 2 years	56%	8,100	2000	0.026	(0.002)**	0.017	(0.002)**	34%	0.014	(0.002)**	45%
Ever had pap smear test	97%	11,866	2000	0.009	(0.001)**	0.009	(0.001)**	7%	0.009	(0.001)**	1%
Had pap smear w/in past years	62%	11,748	2000	0.028	(0.002)**	0.019	(0.002)**	32%	0.015	(0.002)**	46%
Ever had colorectal screening-age 40+	31%	14,302	2000	0.021	(0.001)**	0.019	(0.002)**	11%	0.018	(0.002)**	14%
Had colonoscopy w/in past years	9%	14,259	2000	0.007	(0.001)**	0.007	(0.001)**	11%	0.006	(0.001)**	17%
Ever been tested for hiv	30%	20,853	2000	0.011	(0.001)**	0.011	(0.001)**	0%	0.011	(0.001)**	2%
Had an std other than hiv/aids, past 5 years	2%	11,398	2000	0.000	(0.001)	0.001	(0.001)	–	0.000	(0.001)	–
Had flu shot past 12 months	32%	22,047	2000	0.014	(0.001)**	0.013	(0.001)**	11%	0.013	(0.001)**	11%
Ever had pneumonia vaccination	18%	21,705	2000	0.005	(0.001)**	0.006	(0.001)**	−30%	0.006	(0.001)**	−25%
Ever had hepatitis B vaccine	19%	21,118	2000	0.018	(0.001)**	0.017	(0.001)**	4%	0.017	(0.001)**	8%
Received all 3 hepatitis B shots	15%	20,848	2000	0.015	(0.001)**	0.014	(0.001)**	6%	0.014	(0.001)**	7%
Among diabetics											
Are you now taking insulin	32%	1,442	2000	−0.002	(0.004)	−0.003	(0.004)	−38%	−0.003	(0.005)	−36%
Are you now taking diabetic pills	66%	1,443	2000	−0.006	(0.004)	−0.004	(0.004)	25%	−0.004	(0.005)	40%
Blood pressure high at last reading◦	7%	28,373	1990	−0.005	(0.001)**	−0.004	(0.001)**	24%	−0.004	(0.001)**	24%
Among hypertensives											
Still have high bp◦	47%	6,899	1990	−0.012	(0.002)**	−0.010	(0.002)**	19%	−0.009	(0.002)**	25%
High bp is cured (vs. controlled)◦	26%	3,537	1990	0.000	(0.003)	−0.001	(0.003)	–	−0.002	(0.003)	–
Average reduction in education coefficient											
Unweighted (outcomes w/significant gradients at baseline)								12%			22%
Mortality weighted	11%							24%			32%

Note: Sample sizes are constant across columns. Demographic controls include a full set of dummies for age, gender, and Hispanic origin. Economic controls include family income, family size, major activity, region, MSA, marital status, and whether covered by health insurance. Outcomes marked with◦ came from waves of the NHIS that did not collect health insurance data, so health insurance is not included in these regressions. Self-reports are from questions of the form "Has a doctor ever told you that you have . . .?" Unweighted average reduction in education coefficient is calculated for all behaviors where the education effect without controls is statistically significant. NHIS weights are used in all regressions and in calculating means. ** Indicates statistically significant at the 5% level.

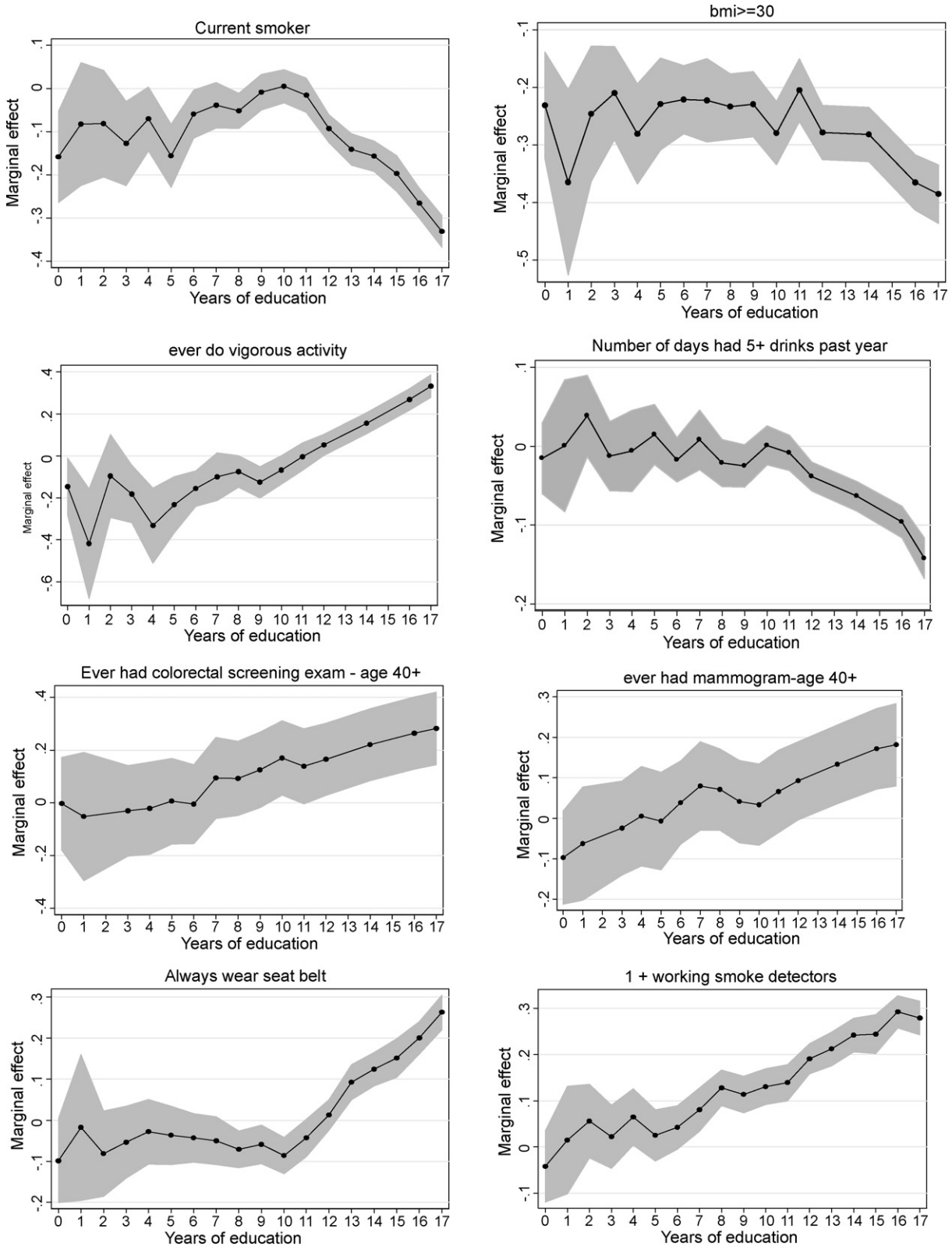

Fig. 1. Effect of education on various health behaviors, by single year of schooling. *Note*: Marginal effects from logit regressions on education, controlling for race and gender. The shaded areas are 95% confidence intervals for each coefficient. Exact years of education are not available in all surveys and were imputed as the middle of the education category. Years of education is top coded as 17.

pass. Additionally those that passed A levels are 6 percent less likely to be obese, and are 3 percent less likely to be heavy drinkers.

4. Education as command over resources

An obvious difference between better educated and less educated people is resources. Better educated people earn more than less educated people, and these differences in earnings could affect health. There are two channels for this. First, higher income allows people to purchase goods that improve health, for example, health insurance. In addition, higher income increases steady-state consumption, and thus raises the utility of living to an older age. We focus here on the impact of current income as a whole, and consider specifically the value of the future in a later section.

A number of studies suggest that both education and income are each associated with better health. Thus, it is clear that income does not account for all of the education relationship. But for our purposes, the magnitude of the covariance is important. We examine this by adding income to our basic regressions in Table 1. The NHIS asks about income in 9 categories (13 in 2000). We include dummy variables for each income bracket. There are endogeneity issues with income. Current income might be low because a person is sick, rather than the reverse—although the endogeneity problem is less clear for behaviors than for health. Nevertheless, we can interpret these variables as a sensitivity test for the potential role of income as a mediating factor.

The second columns in Table 1 report regressions including family income. Adding income accounts for some of the education effect. For example, the coefficient on years of education in the current smoking equation falls by 26 percent. The coefficient on body mass index falls by 16 percent (roughly the same as the fall in the coefficients on overweight and obese), and the coefficient on heavy drinking falls by 12 percent. The average decline (for outcomes with a significant gradient at baseline) is 12 percent. The mortality-weighted average is a decline of 24 percent. It is worth noting that our income measure includes both permanent and transitory income and further is measured with error. Thus, the reduction in education coefficients we observe might be too small.

The NHIS contains a number of other measures of economic status beyond current income, including major activity (whether individual is working, at home, in school, etc.), whether the person is covered by health insurance,[11] geographic measures (region and urban location), family size, and marital status. These variables are likely to determine permanent income and in principle can be affected by educational attainment.

As with income, each of these variables may be endogenous. Sicker people (or those with poor risky behaviors) may be more or less likely to get insurance, depending on the operation of public and private insurance markets. In each case, the coefficients on those variables may not capture the 'true effect', and furthermore, including these variables may bias the coefficient of education. Still, the results are an important sensitivity test: the results are suggestive about what the largest effect of "resources" broadly construed may be.

The last column in Table 1 adds these additional economic controls to the regressions (in addition to income). As a group, these variables do not add much beyond income. The additional reduction in the education coefficient is 7 percent in the smoking regression, 11 percent for obesity, and 1 percent for heavy drinking. All told, the effect of material resources in the NHIS accounts for 20–30 percent of the education effect.[12] The reduction of 20–30 percent may be an underestimate of the true effect, because characteristics like permanent income are measured with error, or an overstatement, because we control for variables that are themselves influenced by education.

The NHIS does not have measures of wealth or family background. Further, measures of income in the NHIS are underreported, as in many surveys. To obtain better estimates of the possible effect of resources on the education gradient (beyond background), we repeated our analysis using the Health and Retirement Study, a sample of older adults. The economic data in the HRS are generally believed to be extremely accurate and HRS has family information as well, although only four health behaviors are asked about: smoking, diet/exercise, drinking, and preventive care.

Table 2 shows the HRS results. The first column shows results controlling for demographics and a large set of socioeconomic background measures: a dummy for father alive, father's age (current or at death), dummy for mother alive, mother's age (current or at death), father's education, mother's education, religion, self-reported SES at age 16, self-reported health at age 16, and dad's occupation at age 16. The HRS data show similar gradients to the NHIS data, though in some cases they are smaller. For example, smoking declines by 2 percentage points with each year of education, compared with 3 percentage points in the NHIS. In part, this reduction results from the fact we have added more extensive background controls as thus would be expected. If we used only the same basic demographics available in the NHIS, we would still find somewhat smaller gradients in the HRS (available upon request). Lower coefficients might also be due to selective mortality: lower educated individuals die younger and thus are less likely to be in the HRS. Although we do not know the reason, our finding that education gradients are smaller for older individuals has been noted elsewhere (see Cutler and Lleras-Muney, 2008a for references).

In the middle columns of the table, we include economic controls: labor force status, total family income, family size, assets, major activity, region, MSA, and marital status. The reduction in the education coefficient ranges from 0 percent for flu shots to 25 percent for current drinking. The average reduction in the education effect is 20 percent, and the mortality-weighted reduction is 17 percent.

In total, therefore, we estimate that material resources account for about 20 percent of the impact of higher education on health behaviors, assuming that all our measures can be thought of as material resources. This matches what we find in other data sets as well (see below). With the understanding that this estimate is likely too high (because of endogeneity), we conclude that there is a large share of the education effect still to be explained.

5. Prices

Differences in prices or in response to prices are a second potential reason for education-related differences in health behaviors. This shows up most clearly in behaviors involving the medical system. In surveys, lower income people regularly report that time and money are major impediments to seeking medical care.[13] Even given health insurance, out-of-pocket costs may be

[11] Different health variables are available in different NHIS surveys, not all of which have information on health insurance. We note in the table which regressions do not have controls for health insurance.

[12] Note that since these outcomes come from different surveys we cannot compute the third overall measure of the effect of education which we report in subsequent tables.

[13] A variety of surveys show this response, including the 1987 NHIS Cancer Control Supplement.

Table 2
Health behaviors, resources, and risk aversion health and retirement study (wave 3), whites.

Dependent variable	Mean	*N*	Coefficient on years of education			Reduction in education coefficient	
			Demographic and background controls	Adding economic controls	Adding risk aversion (in addition to economic controls)	Economic controls	Adding risk aversion and economic controls
Smoking							
Current smoker	21%	5036	−0.020**	−0.018**	−0.018**	10%	0%
			(0.003)	(0.003)	(0.003)		
Former smoker	41%	5036	0.000	−0.001	−0.001	N/A	N/A
			(0.003)	(0.003)	(0.003)		
Ever smoked daily	63%	5217	−0.020**	−0.018**	−0.019**	10%	−5%
			(0.002)	(0.003)	(0.003)		
Diet/exercise							
BMI	27.2	5144	−0.132**	−0.115**	−0.113**	13%	2%
			(0.031)	(0.031)	(0.031)		
Underweight	2%	5144	0.001	0.001	0.001	0%	0%
			(0.001)	(0.001)	(0.001)		
Overweight	65%	5144	−0.008**	−0.008**	−0.008**	0%	0%
			(0.003)	(0.003)	(0.003)		
Obese	24%	5144	−0.009**	−0.007**	−0.007**	22%	0%
			(0.003)	(0.002)	(0.002)		
Vigorous activity 3+ times/week	53%	5214	0.000	−0.004	−0.004	N/A	N/A
			(0.003)	(0.003)	(0.003)		
Drinking							
Current drinker	58%	5187	0.024**	0.018**	0.018**	25%	0%
			(0.003)	(0.003)	(0.003)		
Heavy drinker (ever drinks > 5 drinks–all persons)	2%	5187	−0.003**	−0.003**	−0.003**	0%	0%
			(0.001)	(0.001)	(0.001)		
Preventive care							
Got flu shot	39%	5215	0.011**	0.011**	0.012**	0%	−9%
			(0.003)	(0.003)	(0.003)		
Got mammogram (women)	73%	2864	0.025**	0.022**	0.022**	12%	0%
			(0.004)	(0.004)	(0.004)		
Got pap smear (women)	68%	2858	0.020**	0.016**	0.016**	20%	0%
			(0.004)	(0.005)	(0.005)		
Got prostate test (men)	67%	2348	0.027**	0.026**	0.026**	4%	0%
			(0.004)	(0.004)	(0.004)		
Average reduction in education coefficient							
Unweighted standardized index, excluding preventive care		4936	0.012**	0.010**	0.011**	20%	−5%
			(0.002)	(0.002)	(0.002)		
Unweighted percentages (outcomes w/significant gradients at baseline)						10%	−1%
Mortality weighted						17%	0%

Note: Sample sizes are constant across columns. Data are from wave 3 of the HRS. Demographic controls include a full set of dummies for age, gender, and Hispanic origin. Socioeconomic background measures include dummy for father alive, father's age (current or at death), dummy for mother alive, mother's age (current or at death), father's education, mother's education, religion, self-reported SES at age 16, self-reported health at age 16, dad's occupation at age 16. Economic controls include total family income, total assets, number of individuals in the household, labor force status, region, MSA, marital status. Unweighted regression results use the methodology of Kling et al. (2007). Unweighted average reduction in education coefficient is calculated for all behaviors where the education effect without controls is statistically significant. HRS weights are used in all regressions and in calculating means. Standard errors are clustered at the person level. ** Indicates statistically significant at the 5% level.

greater for the poor than for the rich—for example, their insurance might be less generous. Time prices to access care may be higher as well, if for example, travel time is higher for the less educated.

A consideration of the behaviors in Table 1 suggests that price differences are unlikely to be the major explanation, however. While interacting with medical care or joining a gym costs money, other health-promoting behaviors save money: smoking, drinking, and overeating all cost more than their health-improving alternatives. It is possible that the better educated are more responsive to price than the less educated, explaining why they smoke less and are less obese. But that would not explain the findings for other behaviors which are costly but still show a favorable education gradient: having a radon detector or a smoke detector, for example. Still other behaviors have essentially no money or time cost, but still display very strong gradients: wearing a seat belt, for example.

More detailed analysis of the cigarette example shows that consideration of prices exacerbates the education differences. A number of studies show that less educated people have *more* elastic cigarette demand than do better educated people.[14] Prices of cigarettes have increased substantially over time. Gruber (2001) shows that cigarette prices more than doubled in real terms between 1954 and 1999; counting the payments from tobacco companies to state governments enacted as part of the Master Settlement Agreement, real cigarette taxes are now at their highest level in the post-war era. Yet over the same time period, smoking

[14] Gruber and Koszegi (2004) estimate elasticities of −1 for people without a high school degree, −0.9 for high school grads, −0.1 for people with some college, and −0.4 for college grads. Chaloupka (1991) estimates elasticities of −0.6 for people with a high school degree or less and −0.15 for people with more than high school.

rates among the better educated fell more than half, and smoking rates among the less educated declined by only one-third. For these reasons, we do not attribute any of the education gradient in health behaviors to prices.[15]

6. Knowledge

The next theory we explore is that education differences in behavior result from differences in what people know. Some information is almost always learned in school (advanced mathematics, for example). Other information could be more available to educated individuals because they read more. Still other information may be freely distributed, but believed more by the better educated. Most health information is of the latter type. Everyone has access to it, but not everyone internalizes it.

The possible importance of information is demonstrated by differences in how people learn about health news. Half of people with a high school degree or less get their information from a doctor, compared to one-third of those with at least some college.[16] In contrast, 49 percent of people with some college report receiving their most useful health information from books, newspapers, or magazines, compared to 18 percent among the less educated.

6.1. Specific health knowledge

The 1990 NHIS asks people 12 questions about the health risks of smoking and 7 questions about drinking (see the Data Appendix). In the smoking section, respondents were asked whether smoking increased the chances of getting several diseases (emphysema, bladder cancer, cancer of the larynx or voice box, cancer of the esophagus, chronic bronchitis and lung cancer). For those under 45, the survey also asked respondents if smoking increased the chances of miscarriage, stillbirth, premature birth and low birth weight; and also whether they knew that smoking increases the risk of stroke for women using birth control. In the heart disease module individuals were asked if smoking increases chances of heart disease. Similarly, respondents were asked whether heavy drinking increased one's chances of getting throat cancer, cirrhosis of the liver, and cancer of the mouth. For those under 45, the survey also asked respondents if heavy drinking increased the chances of miscarriage, mental retardation, low birth weight and birth defects.

These questions are important, though they do suffer a (typical) flaw—the answer in each case is yes. Still, not everyone knows this. Table 3 shows the share of questions that the average person answered correctly, separated by education group. About three-quarters of people do not answer all questions correctly (not reported in the table). This seems low, but the answers are much better on common conditions. For example, 96 percent of people believe that smoking is related to lung cancer, and 92 percent believe it is related to heart disease. On average, individuals get 81 percent of smoking questions correct and 67 percent of drinking questions correct. There are some differences in responses by education, but often these are not that large. For example, 91 percent of high school dropouts report that smoking causes lung cancer, compared to 97 percent of those with a college degree. For heart disease, there is a bigger difference: 84 percent of high school dropouts versus 96 percent of the college educated believe smoking is related to heart disease.

Table 4 examines how important knowledge differences are for smoking and drinking. The first columns in the table show the gradient in poor behaviors associated with education when controlling for socioeconomic factors and income but not knowledge. The coefficients are roughly similar to those reported in the last specification of Table 1, although from a decade earlier.

As the next columns show, people who answer more smoking questions correctly are less likely to smoke. Indeed, answering all questions correctly eliminates smoking. Similarly, people who answer drinking questions correctly are less likely to drink heavily.

But knowledge has only a modest impact on the education gradient in smoking and little impact on the gradient in drinking. The coefficient on years of education in explaining current smoking declines by 17 percent with the knowledge questions included, while the coefficient for drinking is essentially unaffected. The average reduction is between 5 and 18 percent, depending on the metric. These results thus suggest that specific knowledge is a source, but not the major source, of differences in smoking and drinking. These results are in line with those found by Meara (2001) and interestingly with those reported by Kenkel (1991), who attempted to account for the possibility that health knowledge is endogenous.[17]

Cognitive dissonance suggests an important caveat to these findings: individuals may differ in the extent to which they report they know about what is harmful as a function of their habits (for example, smokers might report they do not know as much). In the case of smoking Viscusi (1992) suggests that both smokers and nonsmokers vastly overestimate the risks of smoking (though other studies find different results, see Schoenbaum, 1997, for example). Most importantly here, it is not known whether these biases differ by education.

One potential concern about the knowledge questions is that we do not know the extent to which the answers reflect the depth of individuals' beliefs. People may know what the correct answer is without believing it that strongly. For decades, tobacco producers sought to portray the issue of smoking and cancer as an unresolved debate, rather than a scientific fact. This might have had a greater impact on the beliefs of the less educated, for whom the methods of science are less clear.[18]

We have only a single piece of evidence along these lines. We examined self-reported questions from the Motor Vehicle Occupant Safety Survey (MVOSS), which asks people about the value of wearing a seat belt (results available upon request).[19] Respondents are asked to strongly agree, somewhat agree, somewhat disagree, or strongly disagree with two questions about seat belt use: "If I were in an accident, I would want to have my seat belt on," and "Seat belts are just as likely to harm you as help you." A claim that seat belts harm people in an accident is commonly expressed by those who oppose mandatory seat belt legislation, somewhat akin to the 'debate' about the harms of tobacco.

[15] Obesity might be an exception. Food prices have fallen over time, especially for processed foods. Still, Cutler et al. (2003) argue that falling time prices are more important than monetary costs in explaining increased obesity.

[16] These data are from the 1987 NHIS Cancer Control Supplement. The question was open ended; people were allowed to give multiple answers. We report the share of people volunteering the indicated response.

[17] Kenkel instrumented for health knowledge with variation including receipt of physician advice about lifestyle-related topics, industry and occupation dummies, and a dummy for employment in a health-related field. For smoking, years of schooling after 1964 are also included as an instrumental variable.

[18] In the General Social Survey, for example, about 15 percent of people with less than a high school degree had a "clear understanding" of scientific study, compared to nearly 50 percent of college graduates. Similarly, fewer than 10 percent of people with less than a high school degree can describe the use of a control group in a drug trial, compared to nearly one-third of college graduates. About one-third of the less educated reported "a great deal" of confidence in science, compared to over 50 percent of those with a college degree.

[19] We are grateful to Alan Block of the National Highway Traffic Safety Administration for making these data available to us.

Table 3
Explanations for health differences.

Measure (data set)	Mean by education							
	N	Mean (all)	<High school	High school	Some college	College+	Min	Max
Knowledge								
Health knowledge (NHIS)								
Smoking questions (percent correct)	30,469	81%	74%	81%	83%	86%	0	1
Drinking questions (percent correct)	30,468	67%	62%	66%	69%	70%	0	1
AFQT (NLSY, 2002 weights)	4,709	52.7	17.8	41.4	58.4	72.8	1	99
Utility function parameters								
Discounting (MIDUS)								
Life satisfaction current (0 = worst; 10 = best)	2,561	7.7	7.6	7.8	7.4	7.8	0	10
Life satisfaction future (0 = worst; 10 = best)	2,561	8.3	7.8	8.4	8.2	8.5	0	10
Plan for the future (percent agree)	2,547	43%	32%	42%	41%	50%	0	1
Risk aversion (HRS) (1 = least; 4 = most)	5,217	3.3	3.3	3.4	3.3	3.2	1	4
Discounting (SOS)								
Impulsivity index (higher values correspond to more impulsive)	556	35.6	38.7	36.1	35.2	34.8	20	54
Financial tradeoff variables								
Win $1k now vs. $1.5k in a year (percent prefer now)	561	62%	75%	71%	61%	53%	0	1
Win $20 now vs. $30 in a year (percent prefer now)	561	79%	92%	83%	78%	73%	0	1
Lose $1.5k in a year vs. $1k now (percent prefer in a year)	545	47%	53%	45%	51%	43%	0	1
Lose $30 in a year vs. $20 now (percent prefer in a year)	551	43%	53%	42%	42%	43%	0	1
Planning horizon for savings and spending (years)	564	6.93	5.47	5.29	6.57	8.62	0	20
Spent a great deal of time on financial planning (percent agree)	562	58%	45%	54%	55%	66%	0	1
Spent a great deal of time planning vacation (percent agree)	556	59%	52%	56%	60%	62%	0	1
Health discounting questions								
Extra healthy days 1 year from now equal to 20 healthy days now	351	61.2	92.4	68.8	83.5	34.8	0	365
Extra healthy days 5 years from now equal to 20 healthy days now	344	79.7	101.6	77.7	103.3	58.1	0	365
Extra healthy days 10 years from now equal to 20 healthy days now	340	94.8	105.3	92.2	112.1	80.1	0	365
Extra healthy days 20 years from now equal to 20 healthy days now	330	105.5	92.3	101.5	128.7	90.7	0	365
Personality scores								
Self-control, efficacy, depression (NLSY 2002 weights)								
Rosenberg self-esteem score (1980) (0 = min; 30 = max)	4,709	22.1	19.7	21.3	22.6	23.5	0	30
Rosenberg self-esteem score (1987) (0 = min; 30 = max)	4,709	22.8	20.1	22.1	23.3	24.2	0	30
Pearlin score of self-control (1992) (0 = min; 28 = max)	4,709	21.8	19.9	21.5	22.1	22.4	0	28
Shy at age 6 (percent extremely or somewhat)	4,709	57%	63%	61%	57%	52%	0	1
Shy as an adult (1985) (percent extremely or somewhat)	4,709	26%	35%	26%	24%	23%	0	1
Rotter scale of control over life (1979) (1 = internal; 16 = external)	4,709	8.7	9.3	9.0	8.6	8.2	1	16
Depression scale (1992) (0 = minimum; 21 = maximum)	4,709	3.7	5.0	4.1	3.5	3.1	0	21
Depression scale (1994) (0 = minimum; 21 = maximum)	4,709	3.4	4.6	3.8	3.4	2.5	0	21
Personality (MIDUS)								
Depression scale (0 = no; 7 = maximum)	2,561	0.9	1.2	0.8	0.9	0.7	0	7
Generalized anxiety disorder (0 = no; 10 = maximum)	2,561	0.2	0.5	0.2	0.2	0.1	0	10
Positive affect (1 = all of time; 5 = none of time)	2,555	3.3	3.3	3.3	3.3	3.4	1	5
Negative affect (1 = all of time; 5 = none of time)	2,553	1.6	1.8	1.6	1.6	1.5	1	5
Control (1 = lowest; 7 = highest)	2,553	2.7	2.6	2.7	2.6	2.7	0	3
Depression scale (SOS, 0 = no; 9 = maximum)	632	2.2	3.4	2.4	2.3	1.6	0	9
Socialization (MIDUS)								
Friends support (positive) scale (1 = least; 4 = most)	2,551	3.2	3.1	3.2	3.2	3.3	1	4
Friends strain (negative) scale (1 = least; 4 = most)	2,552	1.9	1.9	1.9	2.0	2.0	1	4
Family support (positive) scale (1 = least; 4 = most)	2,548	3.9	3.9	3.9	3.9	3.9	1	4
Family strain (negative) scale (1 = least; 4 = most)	2,545	2.1	2.1	2.1	2.2	2.1	1	4
Spouse/partner support (positive) scale (1 = least; 4 = most)	1,838	3.6	3.6	3.6	3.5	3.6	1	4
Spouse/partner strain (negative) scale (1 = least; 4 = most)	1,838	2.3	2.3	2.2	2.3	2.3	1	4
Social integration (3 = min; 21 = max)	2,550	13.8	12.9	13.7	13.6	14.5	3	21
Social contribution (3 = min; 21 = max)	2,550	15.2	13.1	14.4	15.4	17.2	3	21
Stress (MIDUS)								
Worrying describes you (percent agree)	2,556	53%	59%	56%	51%	48%	0	1
All stress (answered yes to 3 stress questions)	1,816	7%	7%	6%	6%	8%	0	1
Any stress (answered yes to any stress question)	1,818	47%	36%	43%	51%	54%	0	1

Weights used in all means. The appendix has specific questions and coding information.

Answers to the question about wanting a seat belt in an accident are uniformly high; 89–97 percent of people strongly or somewhat agree that they would want a seat belt on if they were in an accident. But there is still residual doubt about the value of a seat belt that is much more common among the less educated. Fifty-five percent of people with less than a high school degree strongly or somewhat agree that seat belts are just as likely to harm as help them, compared to only 17 percent of those with a college degree.[20] These patterns suggest that superficially, individuals of all education levels have received the main public health message that one should wear a seat belt, and they report as much when asked.

[20] Scientifically, it is true that it is better not to be wearing a seat belt in some accidents, but it is more helpful to wear one on the whole.

Table 4
The impact of health knowledge on health behaviors 1990 National Health Interview Survey, whites ages 25 and over.

Dependent variable	Mean	*N*	Regression coefficients without knowledge questions	Regression coefficients with knowledge questions		
			Years of education	Years of education	Percent questions correct	Reduction in education coefficient
Smoking						
Current smoker	26%	29,929	−0.021**	−0.018**	−0.318**	17%
			(0.001)	(0.001)	(0.012)	
Former smoker	28%	29,929	0.003**	0.001	0.156**	63%
			(0.001)	(0.001)	(0.013)	
Made serious attempt to quit (smokers)	64%	7,602	0.011**	0.008**	0.24**	28%
			(0.002)	(0.002)	(0.024)	
Number cigs a day (smokers)	21.5	15,388	−0.327**	−0.327**	0.056	0%
			(0.046)	(0.047)	(0.554)	
Alcohol						
Drink at least 12 drinks per year	73%	29,869	0.010**	0.010**	−0.044**	−3%
			(0.001)	(0.001)	(0.009)	
Heavy drinker (usually drinks ≥ 5–all persons)	5%	30,222	−0.005**	−0.005**	−0.011**	1%
			(0.0005)	(0.0005)	(0.005)	
Number drinks when drinks (drank in last 2 weeks)	2.4	13,845	−0.105**	−0.103**	−0.189**	1%
			(0.006)	(0.006)	(0.049)	
Average reduction in education coefficient						
Unweighted standardized index		29,836	0.022**	0.021**		5%
			(0.001)	(0.001)		
Unweighted percentages (outcomes w/significant gradients at baseline)						18%
Mortality weighted						12%

Note: The sample is aged 25 and older. Sample sizes are constant across columns. All regressions include a full set of age dummies, gender, Hispanic origin, family income, family size, major activity, region, MSA, and marital status. The smoking questions ask whether smoking increases a person's risk for 7 diseases, for 4 pregnancy complications, and for stroke incidence while on birth control. The drinking questions ask whether alcohol increases the risk for 3 diseases and 4 pregnancy complications. Unweighted regressions use the methodology of Kling et al. (2007). ** Indicates statistical significance at the 5% level.

But uneducated individuals seem less certain of the validity of that information, and that becomes clear when the questions are asked slightly differently. Furthermore, we can "explain" a larger share of the effect of education on seat belt use when we include these alternative measures of "depth of knowledge" (results available upon request).

We cannot further examine this possibility here. We simply note that our results suggest that providing factual information alone may not be sufficient to make individuals change their behavior, and that differences in information alone are not sufficient to explain much of the education gradient in health behavior.

6.2. Conceptual thinking

The tobacco and seat belt examples suggest that information processing, more than (or in addition to) exposure to knowledge, may be the key to explaining education gradients in behaviors. Similar arguments have been made to explain why education raises earnings in the labor market. Nelson and Phelps (1966) first hypothesized that "education is especially important to those functions requiring adaptation to change" and that "the rate of return to education is greater the more technologically progressive is the economy." This was echoed by Schultz (1975), who proposed that education enhances individuals' "ability to deal with disequilibria" and Rosenzweig (1995), who argued that education improves individuals' ability to "decipher" information. All of these ideas can easily be applied in the context of health behaviors.

The existing literature provides some suggestions that cognitive ability is related to education gradients. For example, more educated people are better able to use complex technologies/treatments than less educated individuals. Goldman and Smith (2002) document that the more educated are more likely to comply with HIV and diabetes treatments, which are extremely demanding. Rosenzweig and Schultz (1989) similarly show that contraceptive success rates are identical for all women for "easy" contraception methods such as the pill, but the rhythm method is much more effective among educated women. The more educated appear to be better at learning. Lichtenberg and Lleras-Muney (2005) find that, controlling for insurance, the more educated are more likely to use drugs more recently approved by the FDA, but this is only true for individuals who repeatedly purchase drugs for a given condition, so for those who have an opportunity to learn. Similarly Goldman and Lakdawalla (2005) and Case et al. (2005) find that the health gradient is larger for chronic diseases, where learning is possible, than for acute diseases.

To examine the possibility that cognitive ability lies behind the education gradient in behavior, we turn to measures of general cognition.[21] The NLSY administered the Armed Services Vocational Aptitude Battery (ASVAB) to all participants in 1979. The ASVAB is the basis for the Armed Forces Qualification Test (AFQT) but it contains many more dimensions than are scored in the AFQT. We include the test results for all 10 subjects, namely science, arithmetic, mathematical reasoning, word knowledge, paragraph comprehension, coding speed, numeric operations speed, auto and shop information, mechanical competence, and electronic information.[22] Table 3 shows that those with a college degree or more scored much higher in the AFQT

[21] There is debate in the literature about whether these tests are IQ tests or not. For our purposes, this is not relevant. We term them measures of cognition as a general descriptor.

[22] The specifics of the AFQT have changed over time. Currently, it is a combination of word knowledge, paragraph comprehension, arithmetic reasoning, and mathematical knowledge.

Table 5
The impact of cognitive ability and personality on education gradients National Longitudinal Survey of Youth 1979, whites.

Measure	Mean	*N*	Year	Coefficient on years of education				Reduction in education coefficient		
				Demographic and family background controls	Economics controls	Addition to economic and family background controls		Economic controls	Addition to income and family background	
						ASVAB scores	Personality scales		ASVAB scores	Personality scales
Smoking										
Current smoker	27%	5052	1998	−0.049**	−0.047**	−0.039**	−0.045**	5%	15%	4%
				(0.003)	(0.003)	(0.003)	(0.003)			
Former smoker	21%	5053	1998	0.0028	0.0027	0.0003	0.0014	3%	86%	49%
				(0.003)	(0.003)	(0.003)	(0.003)			
Diet/exercise										
BMI	27.53	4548	2002	−0.197**	−0.169**	−0.126**	−0.156**	14%	22%	7%
				(0.039)	(0.040)	(0.046)	(0.040)			
Underweight	1%	4548	2002	−0.00106	−0.00067	−0.00087	−0.00094	37%	−19%	−25%
				(0.0008)	(0.0008)	(0.0009)	(0.0008)			
Overweight	64%	4548	2002	−0.014**	−0.013**	−0.006	−0.013**	4%	51%	1%
				(0.003)	(0.003)	(0.004)	(0.003)			
Obese	27%	4548	2002	−0.016**	−0.014**	−0.012**	−0.013**	17%	9%	3%
				(0.003)	(0.003)	(0.004)	(0.003)			
Vigorous exercise	42%	3730	1998	0.032**	0.030**	0.029**	0.024**	8%	1%	17%
				(0.004)	(0.004)	(0.005)	(0.004)			
Light exercise	79%	3729	1998	0.019**	0.017**	0.010**	0.013**	8%	38%	21%
				(0.004)	(0.003)	(0.004)	(0.003)			
Alcohol										
Current drinker	60%	4704	2002	0.016**	0.010**	−0.001	0.006*	40%	64%	24%
				(0.003)	(0.003)	(0.004)	(0.003)			
Heavy drinker (mean # of drinks ≥ 5–all population)	8%	4704	2002	−0.011**	−0.009**	−0.008**	−0.009**	16%	10%	−2%
				(0.002)	(0.002)	(0.002)	(0.002)			
Frequency of heavy drinking past month (drinkers only)	97%	2751	2002	−0.141**	−0.132**	−0.106**	−0.126**	7%	18%	4%
				(0.019)	(0.019)	(0.023)	(0.020)			
Number of drinks (drinkers only)	264%	2746	2002	−0.154**	−0.134**	−0.087**	−0.125**	13%	30%	6%
				(0.016)	(0.016)	(0.019)	(0.017)			
Illegal drugs										
Never tried pot	34%	5036	1998	0.002	0.002	0.008**	0.003	−3%	−339%	−68%
				(0.003)	(0.003)	(0.003)	(0.003)			
# times smoked pot in life > 50	26%	5036	1998	−0.014**	−0.014**	−0.017**	−0.014**	3%	−27%	−4%
				(0.003)	(0.003)	(0.003)	(0.003)			
Never tried cocaine	73%	5048	1998	0.000	0.000	0.007**	0.000	123%	1906%	117%
				(0.003)	(0.003)	(0.003)	(0.003)			
# times used cocaine in life > 50	7%	5048	1998	−0.006**	−0.005**	−0.008**	−0.006**	13%	−67%	−17%
				(0.002)	(0.002)	(0.002)	(0.002)			
Preventive care use										
Regular doctor visit last year	57%	4709	2002	0.005**	0.003	0.007	0.002	36%	−57%	35%
				(0.003)	(0.003)	(0.003)	(0.003)			
OBGYN visit last year	58%	2424	2002	0.027**	0.021**	0.023**	0.021**	22%	−9%	−1%
				(0.004)	(0.005)	(0.006)	(0.005)			
Other										
Read food labels	46%	4709	2002	0.035**	0.034**	0.020**	0.031**	1%	40%	10%
				(0.003)	(0.003)	(0.004)	(0.003)			

Average reduction in education coefficient									
Unweighted standardized index, excluding OBGYN visits, 2002	2002		0.033**	0.028**	0.020**	0.026**	14%	27%	7%
			(0.003)	(0.003)	(0.004)	(0.003)			
Unweighted standardized index, 1998		1998	0.021**	0.020**	0.018**	0.018**	4%	10%	13%
			(0.003)	(0.003)	(0.004)	(0.003)			
Unweighted percentages (outcomes w/significant gradients at baseline)							14%	9%	7%
Unweighted percentages, excluding illegal drugs (outcomes w/significant gradients at baseline)							15%	18%	10%
Mortality weighted							12%	15%	4%

Reading food labels is an indicator for whether the person always or often reads nutritional labels when buying food for the first time. Frequency of heavy drinking reports the number of times in the last month that the respondent had 6 or more drinks in a single occasion. Demographic controls include a full set of dummies for age, and gender. Economic controls include family income, family size, region, MSA, marital status. Background controls include whether respondent is American, whether mom is America, whether dad is American, family income in 1979, mother's education, father's education, whether lived with dad in 1979, whether the person had tried marijuana by 1979, whether the person had damaged property by 1979, whether the person had fought in school by 1979, and whether the person had been charged with a crime by 1980 and height. Personality scores include the Rosen self-esteem score in 1980 and 1987, the Pearlin score of self-control in 1992, the Rotter scale of control over one's life in 1979, whether the person considered themselves shy at age 6 and as an adult (in 1985), and history of depression (the CESD, measured in 1992 and 1994). Sample contains individuals with no missing education or AFQT. Indicator variables for missing controls are included whenever any other control is missing. Unweighted regressions use the methodology in Kling et al. (2007). NLSY weights are used in all regressions and in calculating means. ** Indicates statistical significance at the 5% level.

(73rd percentile on average) compared to high school dropouts (18th percentile).

Table 5 shows the relation between education, ASVAB scores, and a variety of health behaviors (smoking, diet, exercise, alcohol consumption, illegal drug use and preventive care). We use behaviors from relatively recent survey years, 1998 or 2002. The respondents thus range in age from the mid-30s to the mid-40s. Mean rates of favorable and poor health behaviors are shown in the first column; these percentages are close to those for the NHIS, particularly when restricted to the same ages.

We first document education gradients and the effects of economic resources in this sample. The first column shows the impact of education on behavior including only demographic and family background controls. The impact of education on behavior is large, often times larger than the NHIS. For example, each year of education is associated with a 4.9 percent lower probability of smoking and a 1.6 percent lower chance of being obese. The next column includes economic resources. There is generally a significant impact of these variables on the education gradient. Using the mortality weights noted above we estimate that 12 percent of the education gradient in mortality is explained with economic controls (alternative averages yield similar results).

The third column includes the individual ASVAB scores, in addition to the income and family background. The additional impact of these controls is substantial, though it varies by outcome. ASVAB scores account for an additional 15 percent of the education gradient in smoking, 9 percent of the gradient in obesity, and 10 percent of the gradient in heavy drinking. The overall average reduction varies depending on whether the illegal drug use variable is included or not. Including test scores exacerbates the education gradients in illegal drug use. It is not clear why this is the case, and is not true with the British data (discussed below).[23] We also find that adding cognition increases the education gradient in preventive care. The reduction is about 20 percent without those variables but near zero (or negative) with those variables. Using the mortality weights, ASVAB scores explain 15 percent of the education effect. A central concern about these results is causality: is cognitive ability affected by education, or does cognitive ability lead people to become more educated? We return to this in Section 10.

While the estimates differ across specifications, our overall summary is that together knowledge and cognition account for 5–30 percent of the education gradient in behaviors, although cognition measures tend to increase education gradients in illegal drug use and preventive care, a puzzle which we do not resolve here.

7. Utility function characteristics: discount rates, risk aversion and the value of the future

The most common economic explanation for different behaviors is tastes. In our framework, tastes take the form of differences in discount rates, the value of the future, or risk aversion. The source of differences in utility functions is not clear. Education may lead people to have lower discount rates (Becker and Mulligan, 1997): for example, if education raises future income, individuals have an incentive to invest in lowering their discount rate. Education may also lead people be more risk averse. Alternatively, education may itself be the product of differences in utility functions (Fuchs, 1982), which may be distributed randomly, may be inherited, or may be a product of the early childhood environment.

[23] We have explored this in other data sets, as we are able. The British Cohort Study (BCS) is similar to the National Child Development Study; it surveys everyone born in England, Scotland, and Wales in one week in 1970. Measures of test scores in the BCS do not exacerbate the education gradient in illegal drug use.

Some preliminary evidence suggests that differences in utility functions cannot be the primary explanation for differences in health behaviors. Were the difference in health behaviors driven by fixed aspects of individuals, we would expect that health behaviors would be highly correlated across individuals: people who care about their health would maximize longevity in all ways. However, while almost all health behaviors are related to education, these behaviors are not particularly highly correlated at the individual level. Cutler and Glaeser (2005) show that the correlation between different health behaviors is generally about 0.1. Still, we can investigate this hypothesis more directly.

We start first with the value of the future. Probably the best measures of discounting and of the value of the future come from the National Survey of Midlife Development in the United States, or MIDUS, a sample of people aged 25–74 in the mid-1990s.[24] MIDUS has several measures of the value of the future. In an overall summary question about future expectations, individuals are asked "Looking ahead ten years into the future, what do you expect your life overall will be like at that time?".[25] The same question is asked about current situation, which we include as well. There are some questions that can be used as proxies for discount rates. Individuals were asked whether they agreed with the following statement: "I live one day at a time and don't really think about the future." We code those who strongly disagree as being able to plan for the future. Theory suggests that that people with higher future utilities or who are able to plan will invest more in health, and possibly that there will be an interaction between the two (those who value the future and are good at planning will invest even more in health).

Table 3 shows summary measures of these variables by education. High school dropouts are indeed less future oriented than those with more than a college degree, but there appears to be no difference between high school graduates and those with some college only. The more educated are equally satisfied with their current life as the least educated, and those with some college report the lowest current satisfaction. The relationship between education and future satisfaction is also not linear, being the highest among the college educated, followed by high school graduates, those with some college and high school dropouts[26]. Although these satisfaction measures are not very highly correlated with education, Fig. 2 shows that the ratio of future to current satisfaction is monotonically increasing in education—the more educated value the future more *relative* to the present.

MIDUS asks about some measures of health, though not as many as dedicated health surveys. It includes smoking and weight, though not alcohol consumption. Questions are also asked about general health behavior, illegal drug use, and receipt of preventive care.

Table 6 shows results from the MIDUS survey. The first columns report means of the independent variables. Where we can compare, the means are close to the NHIS. Using just demographic and family background measures as controls (the first column of regression coefficients) the education coefficients are also similar, if anything slightly larger. Each year of education reduces smoking by 3.5 percent and obesity by 1.6 percent.

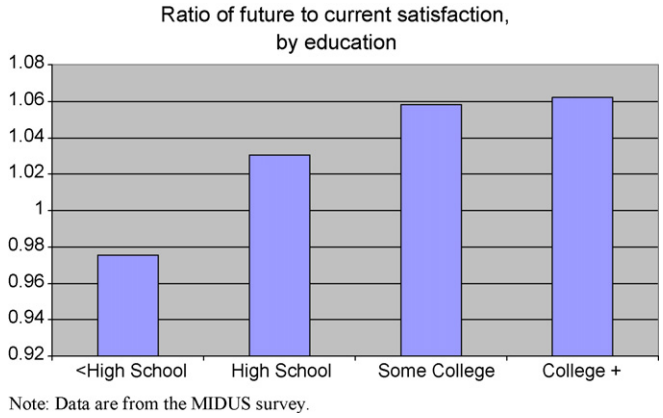

Fig. 2. Ratio of future to current satisfaction, by education. *Note*: Data are from the MIDUS survey.

The next columns show the impact of including economic resources. The impact is somewhat lower than the NHIS and NLSY. On average, 11 percent of education differences in behavior are attributable to economic resources.

The next column includes measures of current and future life satisfaction, the ability to plan for the future, and the interaction of planning and future life satisfaction, in addition to economic resources.[27] There is no significant impact of these variables on education gradients. Indeed, in some cases the addition of these variables actually increases the effect of education. For the major outcomes we consider, smoking and obesity, the changes are 2 percent or less.

The measures of discount rates in the MIDUS are not ideal. Indeed, it is not entirely clear that there is a single measure of discounting that applies to all settings. To investigate whether there is variation in the appropriate measure, we use data from the Survey on Smoking (SOS), a sample of 663 individuals between 50 and 70 years of age.[28] The SOS asks a variety of discounting questions (discussed below). The drawback of the SOS is the sample size and lack of many health questions (in addition to the fact that the sample is not nationally representative). For these reasons, we can only relate education to two outcomes—current smoker and obesity.

Table 7 shows the basic gradients in smoking and obesity in this sample. Education significantly lowers the likelihood of smoking and of being obese. Controlling for income (a dummy is used for each income category) lowers the smoking gradient by 9 percent and the obesity gradient by 21 percent.

We then look at the effect of adding various financial discounting measures. For our first measure of financial discounting, we use responses to 4 questions of the form "would you rather win (lose) $$x$ now or $$y$ a year from now?" The mean responses to these questions by education level are reported in Table 3. On average, individuals

[24] MIDUS was conducted in 1995–1996 as part of a MacArthur Foundation Aging Network. Within the 25–74-year-old population, it is representative of the population as a whole, although the survey was on paper and was very long. Hence, response rates at the top and bottom of the income spectrum were relatively low (MIDMAC, 1999). There are about 3000 observations in MIDUS, although for certain outcomes the sample is considerably smaller.

[25] Individuals were also asked to evaluate what various aspects of their lives might be like in the future, in several dimensions (health, willingness to learn, energy, caring, wisdom, knowledge, work, finances, relationship with others, marriage, sex and relationship with children). We investigated whether results differed when using these more detailed questions, but found essentially no difference, in terms of the education gradient. Similarly, there are other possible proxies for how future oriented individuals are. The results are not affected by the choice of proxy.

[26] These results could be explained if, relative to those who attended but did not complete college, high school graduates are better decision makers. Means from other data sets for example for AFQT do not suggest that this is the case, however.

[27] We estimated different versions of these regressions, using dummy variables for each category and making use of more detailed questions about current and future satisfaction that were asked in the survey (respondents ranked their overall life satisfaction but also their satisfaction with their health, finances, relationships, etc.). The results from these alternative estimations were nearly identical to the ones presented here.

[28] We are grateful to Frank Sloan for providing us these data. See Khwaja et al. (2007) for a description.

Table 6
Discounting and the value of the future National Survey of Midlife Development in the United States, whites, 1995–1996.

Dependent variable	Mean	*N*	Coefficient on years of education					Reduction in education coefficient			
			Basic demographics and family background	Economic controls	Addition to income and family background			Economic controls	Addition to income and family background		
					Current and future life satisfaction and future planning	Personality	Social integration		Current and future life satisfaction and future planning	Personality	Social integration
Smoking											
Current smoker	25%	2545	−0.035**	−0.032**	−0.032**	−0.032**	−0.029**	9%	1%	−1%	9%
			(0.005)	(0.005)	(0.005)	(0.005)	(0.005)				
Former smoker	29%	2546	−0.009*	−0.008	−0.008	−0.006	−0.008	12%	−2%	18%	−2%
			(0.005)	(0.005)	(0.005)	(0.005)	(0.005)				
Average # of cigs per day	26.1	1372	−1.013**	−0.955**	−0.949**	−0.955**	−0.945**	6%	1%	0%	1%
			(0.240)	(0.245)	(0.244)	(0.254)	(0.267)				
Ever tried to quit smoking (if smoker)	83%	585	−0.006	−0.004	−0.005	−0.006	−0.004	31%	−11%	−26%	3%
			(0.011)	(0.012)	(0.012)	(0.012)	(0.012)				
Diet/exercise											
BMI	26.5	2440	−0.148**	−0.101*	−0.097	−0.100	−0.080	32%	3%	1%	14%
			(0.059)	(0.059)	(0.059)	(0.059)	(0.062)				
Underweight	3%	2440	0.00022	0.0027*	0.0028*	0.003**	0.003	−13%	−4%	4%	0%
			(0.0015)	(0.0016)	(0.0016)	(0.0015)	(0.0017)				
Overweight	56%	2440	−0.009	−0.004	−0.003	−0.004	−0.002	56%	5%	−6%	24%
			(0.006)	(0.006)	(0.006)	(0.006)	(0.006)				
Obese	21%	2440	−0.016**	−0.013**	−0.012**	−0.013**	−0.012**	18%	3%	2%	3%
			(0.005)	(0.005)	(0.005)	(0.005)	(0.005)				
# of times per month engages in vigorous exercise	5.9	2546	0.164**	0.114**	0.103*	0.113**	0.072**	30%	7%	1%	26%
			(0.055)	(0.057)	(0.056)	(0.057)	(0.060)				
Lose 10 lbs due to lifestyle	22%	2466	−0.012**	−0.011**	−0.012**	−0.012**	−0.012**	10%	−4%	−5%	−3%
			(0.005)	(0.005)	(0.005)	(0.005)	(0.005)				
Illegal drugs											
Used cocaine, past 12 months	1%	2538	−0.001	−0.002*	−0.002*	−0.003*	−0.002	−77%	−8%	−23%	0%
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)				
Used marijuana, past 12 months	6%	2536	0.000	−0.002	−0.003	−0.003	−0.003	−2100%	200%	−500%	−300%
			(0.003)	(0.003)	(0.003)	(0.003)	(0.003)				
Other illegal drug used, past 12 months	10%	2524	−0.004	−0.003	−0.004	−0.001	−0.001	26%	8%	37%	47%
			(0.003)	(0.003)	(0.003)	(0.003)	(0.003)				
Preventive care											
Take vitamin at least few times per week	48%	2546	0.024**	0.022**	0.022**	0.022**	0.020**	7%	1%	−1%	10%
			(0.006)	(0.006)	(0.006)	(0.006)	(0.006)				
Had blood pressure test, past 12 months	67%	2516	0.006	0.003	0.004	0.002	0.003	46%	−9%	14%	−9%
			(0.005)	(0.006)	(0.006)	(0.006)	(0.006)				

Table 6 (*Continued*)

Dependent variable	Mean	*N*	Coefficient on years of education					Reduction in education coefficient			
			Basic demographics and family background	Economic controls	Addition to income and family background			Economic controls	Addition to income and family background		
					Current and future life satisfaction and future planning	Personality	Social integration		Current and future life satisfaction and future planning	Personality	Social integration
Doctor visit, past 12 months	69%	2496	0.011** (0.005)	0.009* (0.005)	0.009* (0.005)	0.009 (0.005)	0.010 (0.005)	15%	3%	−2%	−3%
General behavior											
Work hard to stay healthy (1–7 scale, 1 is better)	2.4	2546	0.014 (0.015)	0.011 (0.015)	0.015 (0.015)	0.009 (0.015)	0.032** (0.015)	20%	−27%	16%	−149%
Effort put on health (0–10 scale, 10 is better)	7.1	2546	−0.008 (0.023)	−0.007 (0.024)	−0.014 (0.024)	−0.003 (0.024)	−0.034 (0.025)	17%	−103%	41%	−355%
Average											
Unweighted standardized index		2279	0.018** (0.004)	0.015** (0.004)	0.014** (0.004)	0.015** (0.004)	0.012** (0.004)	14%	8%	1%	22%
Unweighted percentages (outcomes w/significant gradients at baseline)								18%	1%	1%	7%
Mortality weighted								11%	1%	1%	7%

Note: Basic regressions include controls for age and gender. Economic measures include family size, family income, family income missing, major activity, marital status, and region. Family background measures include self-reported health status at age 16, whether born in the US, whether speak English at home, dad born in the US, dad's employment status at age 16, dad's education, dummy for dad alive at time of survey and dad's health status if alive, head of the household when was 16, mom's employment status at age 16, mom's education, mom alive at time of survey and mom health status if alive, whether family was on welfare while growing up, whether family was better off than other while growing up. Personality measures include a depression scale, a generalized anxiety scale, a scale on sense of control, a positive affect scale and a negative affect scale and dummy variables whenever each scale is missing. Social integration measures include a scale of social integration, the scale of social contribution, a scale on positive relations with spouse, a scale on negative relations with spouse, a scale of positive relations with friends, a scale on negative relations with friends, and dummy variables whenever each scale is missing. Effort put into health: individuals were asked to rate from 0 to 10 "How much thought and effort do you put into your health these days?", were 10 is the highest. Work hard to stay healthy: individuals were asked how strongly they agreed with the statement "I work hard at trying to stay healthy" & 1 is coded as strongly agree. MIDUS weights are used in all regressions and in calculating means. Unweighted regressions use the methodology of Kling et al. (2007). Mortality weights assume no difference in drinking. **(*) Indicates statistical significance at the 5% (10%) level.

Table 7
Effect of discounting and other measures survey of smoking, whites.

Outcome	Coefficient on years of education							
	Demographics	Adding income	Adding alternative measures of discounting, in addition to income					
			Winning and losing questions	Planning horizon	Time spent on financial planning	Time spent planning vacation	Impulsivity index	Health discounting
Current smoker (mean = .38)	−0.0309*** [0.0079]	−0.0280*** [0.0086]	−0.0298*** [0.0087]	−0.0265*** [0.0087]	−0.0280*** [0.0087]	−0.0276*** [0.0087]	−0.0270*** [0.0087]	−0.0256*** [0.0088]
% of base explained		9%	−6%	5%	0%	1%	3%	8%
Obese (mean = .32)	−0.0248*** [0.0075]	−0.0197** [0.0082]	−0.0197** [0.0083]	−0.0202** [0.0083]	−0.0182** [0.0083]	−0.0200** [0.0082]	−0.0183** [0.0083]	−0.0216** [0.0084]
% of base explained		21%	0%	−2%	6%	−1%	6%	−8%

Note: The sample size is 558 in all regressions. Demographic controls include dummies for male, married, Hispanic and age. Income is a series of dummy variables.
** (***) Indicates statistical significance at 5% (1%) level.

are very impatient (64% prefer $1000 now to $1500 in a year), and more so when the stakes are small (80% prefer $20 now to $30 in a year). When the questions refer to losing amounts, individuals are very impatient, but less than for gains. More importantly, for all the questions, more educated individuals are on average more patient (with the exception of the last question) as predicted by Fuchs. However, Table 7 shows that adding these discounting questions as regressors increases the magnitude of the coefficient on education for smoking and has no effect on obesity.

A second measure of discounting is the planning horizon that people use. Respondents were asked "in planning your savings and spending, which of the following time periods is most important to you and your family? (choices are "the next few months, the next year, the next few years, the next 5–10 years, longer than 10 years"). The answers were converted into numbers using the middle of the category. Table 3 shows that more educated individuals have longer planning horizons. Controlling for this measure lowers the coefficient on education in the smoking regression by 5 percent but increases the coefficient of education in the obesity regression.

The third set of measures of discounting are based on answers to the questions "I spent a great deal of time on financial planning" and "I spent a great deal of time planning vacations". More educated individuals are more likely to report that they agree than less educated individuals (Table 3) although the differences are small, especially for vacations. Adding the answers to these questions (a dummy for each possible answer: strongly agree, agree, agree somewhat, disagree somewhat, disagree, or disagree strongly or missing) has very little impact on our two measures of health.

Discounting may also take the form of impulsivity and lack of self-control, as suggested by Ross and Mirowsky (1999). More impulsive individuals may be less able to undertake actions with current costs but future gains, even if they know what is in their long-term interest. Individuals were asked a series of 14 questions, such as "I make hasty decisions", "I do things on impulse that I later regret", etc. Answers ranged from "disagree strongly" to "agree strongly". We score the questions on a 1–5 scale and sum them, with an index that ranges from 14 (not impulsive) to 70 (greater impulsivity). High school dropouts are more impulsive than college graduates (Table 3). Adding the impulsivity index lowers the coefficient on education, but only by 3 percent for smoking and 6 percent for obesity.

It is possible that individuals discount health differently from money. A subset of the respondents was asked questions about time preferences for health: "20 extra days in perfect health this year would be just as good as? extra days in perfect health *X* years from now", where *X* was 1, 5, 10 and 20. As with financial discounting, the more educated are more patient, and the differences are greater for tradeoffs in the near future. Adding these questions to our regression lowers the coefficient on education by about 8 percent for smoking but increases the effect of education on obesity by 8 percent.

Even included together, the impact of these variables is not substantial. When all the discount measures are included, the coefficient on education falls by about 8 percent for smoking and 1 percent for obesity.

Neither MIDUS nor NHIS have measures of risk aversion. To investigate the role of risk aversion we use data from the Health and Retirement Survey (HRS). The HRS in 2002 asked hypothetical questions that allow for categorization of individuals into 4 risk aversion categories (Barsky et al., 1997). Respondents are first asked if they would risk taking a new job, given that family income is guaranteed now. The new job offers a chance to increase income but also carries the risk of loss of income. If the respondent says he/she would take the risk, the same scenario is presented, but with riskier odds. Risk aversion is scored on a 1–4 basis, from least to most risk averse (see the Appendix). Table 3 shows that education is not monotonically related to risk aversion; those with a high school degree are the most risk averse. This already suggests risk aversion is not a very promising factor in accounting for the education gradient.

More formal models are presented in Table 2. The addition of the risk aversion categories, shown in the last column of regressions, has virtually no impact on the education coefficient. The overall impact is within 1 percent. Indeed, the categories for risk aversion are not very consistently related to health behaviors. It may be that this measure of risk aversion is not ideal, but we do not have a way of testing this.[29]

All told, we attribute very little of the education gradient in health behaviors to utility function characteristics.

8. Translating intentions into actions

Even when people know what they want to do, translating intensions into actions may be easier for the better educated. We noted above the example of smoking: the better educated are more successful at quitting smoking than the less educated, not because they try to quit more frequently or use different methods, but because they are more successful when they do try.[30] This parallels Rosenzweig and Schultz (1989) results on the success of contraceptive use. Many of these aspects of education were stressed by

[29] We also estimated models where we included seat belt use as an explanatory variable as a proxy for discount rates or risk aversion. The results are very similar to those reported here.
[30] These results are from tabulations of the 2000 NHIS.

Grossman (1972); in his formulation, education allows inputs to be combined more productively.

One reason this might be the case is time constraints. The daily hassles of life (cooking, errands, children, etc.) may involve more intensive effort by the less educated, and hence leave them less time for health planning or the mental energy to devote to behavioral change. To test this theory, we looked at behaviors before and after retirement.[31] If time constraints are a major issue, behavioral differences by education ought to decline after retirement, when leisure time increases. Results from the HRS (not shown) suggest this is not the case, however. The behavior of the more and the less educated does not change differentially after retirement, and in some cases the gradient increases.

Beyond time constraints, it may be that individuals differ in their psychological capacity to make behavioral changes. In many psychological theories, individuals need to be 'ready' to change, and feel able to do so. Depression or other psychological distress may hinder behavioral changes. Similarly, social integration and reinforcement may be helpful.

The NLSY asks a battery of questions about personality traits and sense of control. These include two self-esteem scores (the Rosenberg self-esteem score, measured in 1980 and 1987), a score about one's self-control (the Pearlin score, measured in 1992), a score about a sense of control over one's life (the Rotter scale, measured in 1979), depression (the CES-D, administered in 1992 and 1994), and two indicators for whether the person is shy (one at age 6 and one in 1985). The Appendix discusses the questionnaires in more detail. Table 3 shows the mean of these variables by education. In general, there are differences in these measures across education groups, particularly in depression scales.

Table 5 shows the impact of adding the personality scales in the NLSY (in addition to economic resources). The impacts on exercise and regular doctor visits are among the largest effects (17–35 percent). But personality measures actually increase the gradient in illegal drug use measures and have minimal effects on smoking, drinking, and obesity. Thus average reduction in the education coefficient is 4 percent using the mortality weights (though a bit larger – as much as 13 percent – using other measures). This table suggests personality might matter for some outcomes. We explore this issues further with other data sets.

Some authors have posited that stress, depression, and anxiety are the mediating factor in behavioral changes (Salovey et al., 1998). Individuals suffering from these conditions may not think their future will be very good or may not be able mentally to make behavioral changes. We have already included some of these measures in the previous NLSY analysis. But we have additional measures in other data sets. The MIDUS survey has several measures of whether individuals are under stress and whether they worry a lot. Table 3 shows that the less educated are under more stress than the better educated, but that extreme stress (answering yes to all three questions about stress) is relatively constant across education groups. This survey also contains a depression scale, an anxiety scale, a scale for sense of control, a scale for positive affect, and a scale for negative affect (the appendix shows how these are constructed). Table 6 shows that controlling for all of these measures (personality and stress) has no significant effect on the education gradients (again with a few exceptions); the overall change is essentially zero.[32]

Beyond individual attributes, we consider measures of social integration. The MIDUS asks a variety of questions about social integration, including scales for social ties, social contributions, positive and negative relations with spouse, and positive and negative relations with friends (see the appendix). These social measures pick up a number of different traits. Some part reflects individual personality—some individuals are more social than others. These measures also represent resources. Family and friends can be sources of information or reinforcement about behaviors. They can provide help in times of need or alternatively be the source of one's troubles. They might also pick up other aspects of the environment such as the ability to meet other people easily. The questions in the MIDUS survey attempt to capture the extent of an individual's social connections and the quality of these connections, both of which might matter. Interestingly many of these variables do not show steep education gradients, except for the extent to which individuals feel they are socially integrated and that they contribute to society (Table 3).

The final column of Table 6 shows the impact of social integration on education gradients in behaviors in the MIDUS. There is a modest impact of these social integration measures. The coefficient on current smoking falls by 9 percent when social integration measures are added, and the coefficient on obesity falls by 3 percent. The average effect, shown in the last rows of the table, is 7–22 percent.

Overall we find that the vast bulk of personality measures relating to sense of control, stress, and psychological impairment account for very little of the education gradient. On the other hand our measures of social integration do account for a part of the gradient, though it is not entirely clear why they matter.[33]

9. Evidence from the United Kingdom

Our results to this point have focused on the United States. As noted earlier, education gradients are pervasive in the developed (and developing) world. Analyzing data from other countries can help determine if the results in the United States carry over in other settings.

Data from the National Child Development Study (NCDS) in the United Kingdom are available to address these issues. The NCDS is a study of everyone born in a given week in Great Britain in 1958. We use data from the 6th interview wave, conducted in 1999–2000, when the participants were 41–42 years old. Nearly 6500 people are surveyed. Years of schooling is a less meaningful measure in the U.K. than it is in the U.S. We form a dichotomous variable for whether the person passed the A levels, roughly equivalent to a college degree in the U.S.

The NCDS contains a number of health measures, detailed in the first column of Table 8. The four biggest risk factors are all asked about: smoking, drinking, diet/exercise, and illegal drug use. On many measures, people in the U.K. are comparable to the U.S. Smoking rates are similar, though a bit higher in the U.K., while obesity rates are somewhat lower. Because of its longitudinal nature, the NCDS has a large set of income and background controls. These include height at age 15, birth weight, SES of father at birth, age 7, 11, and 16, marital status of mother at birth, mother's and father's birthplace, own birthplace, and mother's

[31] One could alternatively consider time diaries, but the reporting of these is notoriously incomplete.

[32] The NHIS also contains information about depression and anxiety in 2000. We examined how these variables affect the education gradient for behaviors measured that year. Results from these regressions are in Appendix Table 2A. The addition of these controls has a small effect of the education coefficient. The average across all outcomes is a reduction of 1 percent, and the mortality weighted average is 4 percent.

[33] Our regressions control for income, which may be endogenous, but the qualitative results are unaffected by this choice. Appendix Table 4A reports the NLSY results without income controls. The results are very similar to those in Table 5.

Table 8
Effect of test scores on the education gradient in the UK National Child Development Study (Wave 6).

Behavior	Mean	*N*	Coefficient on passing A level							Percent of education coefficient explained by					
			Demographics and background	Economic controls	Addition to income and background controls					Economic controls	Addition to income and background controls				
					Cognitive ability	Current and future satisfaction	Personality	Social integration	All factors		Cognitive ability	Current and future satisfaction	Personality	Social integration	Adding all factors
Smoking															
Current smoker	29%	6499	−0.119**	−0.094**	−0.040**	−0.092**	−0.091**	−0.077**	−0.033**	21%	45%	2%	3%	14%	51%
			(0.013)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)						
Former smoker	25%	6493	−0.023*	−0.020	−0.013	−0.022	−0.019	−0.028*	−0.020	13%	30%	−9%	4%	−35%	0%
			(0.013)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)						
Quit smoking (ever smoked only)	46%	3492	0.100**	0.084**	0.043*	0.080**	0.083**	0.062**	0.031	16%	41%	4%	1%	22%	53%
			(0.021)	(0.022)	(0.024)	(0.022)	(0.022)	(0.023)	(0.024)						
Number of cigarettes smoked	17.0	1599	−1.556**	−1.400**	−1.391**	−1.562**	−1.417**	−1.106**	−1.118*	10%	1%	−10%	−1%	19%	14%
			(0.586)	(0.613)	(0.657)	(0.610)	(0.604)	(0.630)	(0.668)						
Diet/exercise															
BMI	25.8	6303	−0.641**	−0.751**	−0.664**	−0.733**	−0.723**	−0.638**	−0.572**	−17%	14%	3%	4%	18%	28%
			(0.133)	(0.144)	(0.158)	(0.145)	(0.145)	(0.149)	(0.161)						
Underweight	1%	6303	0.004	0.005	0.006*	0.005*	0.005	0.005	0.005	−25%	−25%	0%	0%	0%	0%
			(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)						
Overweight	52%	6303	−0.073**	−0.079**	−0.081**	−0.079**	−0.075**	−0.068**	−0.068**	−10%	−1%	1%	7%	16%	16%
			(0.015)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.018)						
Obese	15%	6303	−0.039**	−0.040**	−0.033**	−0.040**	−0.039**	−0.032**	−0.03**	−3%	18%	0%	3%	21%	26%
			(0.011)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.013)						
Exercise regularly	75%	6498	0.091**	0.063**	0.046**	0.064**	0.062**	0.052**	0.044**	31%	19%	−1%	1%	12%	21%
			(0.013)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)						
Eat fruit every day	53%	6505	0.107**	0.098**	0.086**	0.101**	0.096**	0.075**	0.076**	8%	11%	−3%	2%	21%	21%
			(0.014)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.017)						
Eat vegetables every day	17%	6505	0.025**	0.010	0.030**	0.016	0.011	0.003	0.026**	60%	−80%	−24%	−4%	28%	−72%
			(0.011)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.013)						
Drinking															
Drinker	95%	6499	0.010*	0.005	−0.004	0.003	0.004	0.007	−0.001	50%	90%	20%	10%	−20%	60%
			(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)						
Heavy drinker	12%	6499	−0.027**	−0.016	−0.02*	−0.014	−0.015	−0.005	−0.009	41%	−15%	7%	4%	41%	26%
			(0.009)	(0.010)	(0.011)	(0.010)	[0.010]	(0.010)	(0.011)						
Number of drinks in week	19.5	5008	−3.394**	−2.348**	−2.044**	−2.224**	−2.174**	−1.381*	−1.136	31%	9%	4%	5%	28%	36%
			(0.716)	(0.775)	(0.850)	(0.777)	(0.776)	(0.784)	(0.848)						
Illegal drugs															
Illegal drugs in last 12 months	8%	6446	0.003	0.007	0.007	0.007	0.006	0.005	0.004	−133%	0%	0%	0%	67%	100%
			(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)						
Ever tried illegal drugs	33%	6446	0.072**	0.066**	0.048**	0.062**	0.069**	0.052**	0.038**	8%	25%	6%	−4%	19%	39%
			(0.013)	(0.014)	(0.015)	(0.014)	(0.014)	(0.015)	(0.015)						
Average															
Unweighted standardized index		6505	0.070**	0.058**	0.046**	0.059**	0.055**	0.49**	0.044**	17%	17%	−2%	4%	12%	20%
			(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)						

Table 8 (*Continued*)

Behavior	Mean	*N*	Coefficient on passing A level							Percent of education coefficient explained by					
			Demographics and background	Economic controls	Addition to income and background controls					Economic controls	Addition to income and background controls				
					Cognitive ability	Current and future satisfaction	Personality	Social integration	All factors		Cognitive ability	Current and future satisfaction	Personality	Social integration	Adding all factors
Unweighted percentages (outcomes w/significant gradients at baseline)										19%	15%	0%	2%	15%	23%
Mortality weighted										24%	44%	2%	2%	15%	48%

Note: The sample is people who took cognitive tests at all ages. Demographic controls include age, sex, race, and ethnic dummies. Parental and background measures include height at age 16, birth weight, SES of dad at birth age 7, age 11 and age 16, marital status of mom at birth, mother and father's age at birth, mother and father's birthplace, own birthplace, and mom and dad's education. Economic controls include family income, family size, region or residence, employment status, marital status and current SES. Three cognitive tests are included: at age 7 (math and drawing), age 11 (reading, math, verbal, non-verbal, and drawing), and age 16 (math and reading comprehension). Current life satisfaction is measured by a 10 point scale on a question of how good life has turn out so far. Future life satisfaction is a 10 scale measure on a question on where you expect to be in 10 years. Personality measures include 3 measures of efficacy based on answers to three questions (never get what I want out of life, usually have control over my life, can run my life how I want), the GHQ12 score (designed to measure short-term changes in mental health including depression, anxiety, social dysfunction and somatic symptoms), and the malaise score (psychiatric morbidity index ranging from 1 to 12). Social integration measures include: parents alive, see parents, frequency eat together as with family, frequency visit relatives with family, frequency go out together as family, frequency spend holidays together as family, frequency go out alone or with friends, frequency attends religious service. Missing variables were included as zeros, with dummies identifying missing data. Health outcomes are measured at wave 6. Unweighted regressions use the methodology of Kling et al. (2007).

**(*) Indicates statistical significance at the 5% (10%) level.

and father's education. Because these were collected during earlier waves, they are less likely to be misreported than in surveys such as the HRS, which asks respondents about these measures retrospectively.

The first set of regression results relates behaviors to demographic and background controls only. As in the US, more education is associated with better health behaviors in the U.K. (though our measures of education are not quite comparable). Passing the A levels is associated with a 12 percent lower probability of smoking and a 4 percent lower probability of being obese. As in the U.S. more educated individuals are more likely to drink (1 percent), but less likely to be heavy drinkers (3 percent). The next column shows the impact of adding economic controls. As in the U.S., these controls have a significant impact on the education gradient in behaviors. The impact of education on current smoking falls by 21 percent, but the impact of education on weight measures increases. The average reduction is between 17 and 24 percent, depending on the measure used. This degree of explanatory power is somewhat greater than in the U.S. but not much.

The NCDS has a number of tests of cognitive ability. Cognitive tests were administered at age 7 (math and drawing), age 11 (reading, math, verbal, non-verbal, and drawing), and age 16 (math and reading comprehension). The next column of the table includes the results of all these cognitive tests. As in the U.S., scores on cognitive tests predict a significant part of the education gradient. Controlling for cognitive ability reduces the impact of education on current smoking by 45 percent and the impact on obesity by 18 percent. The share of the education effect that is attributable to cognitive ability ranges between 15 and 44 percent.

The NCDS has measures of current and expected future life satisfaction (each is a scale from 1–10 where 10 is the highest; see appendix), although there are no measures of discount rates. The next column shows that life satisfaction does not affect the education gradient. The average decline is 1–2 percent, roughly the same as in the U.S.

The NCDS also has several personality measures. There are three measures of self-efficacy: whether the respondent gets what they want out of life, how much control they have over life, and whether they can run their life how they want. These variables are most related to the self-esteem and self-control measures in the NLSY. The survey also contains two scales that measure mental health and stress: the Malaise index and the General Health Questionnaire (GHQ12). The impact of adding these variables is shown in the next column of the table. Relative to economic and background controls only, personality controls have a negligible impact on the education gradient in behaviors. The overall effect is about 2 percent change in any of the average measures.

Finally, the NCDS has a variety of measures of social integration: whether the respondent's parents are alive, whether the respondent sees their parents, and whether they frequently eat together as a family, visit relatives, go out as a family, spend holidays as a family, go out alone or with friends, and attend religious services. These differ in nature from those in the MIDUS: they capture frequency of interactions, but not their quality. The next column of the table presents the results from adding these measures. Again we find that social measures have an impact on the education gradient in behaviors, reducing the coefficient by about 15 percent (in comparison to the 7 percent in the U.S.).

The final column of the table shows the combined impact of cognitive ability, future valuation, personality factors, and social integration on the education gradient in behavior. The cumulative impact is 48 percent using the weighted measure and less with the unweighted ones. Along with the 24 percent of the education gradient that is attributable to economic and background factors,

Table 9
The effect of test scores on the education gradient National Longitudinal Survey of Youth 1979, whites.

Measure	*N*	Coefficient on years of education				Reduction of education coefficient in addition to income and family background	
		Demographic family background controls	Economic controls	Addition of income and family background		Adding early IQ	Adding early and late IQ
				Add early IQ	ASVAB Scores and early IQ		
Smoking							
Current smoker	1007	−0.056**	−0.056**	−0.057**	−0.048**	−2%	14%
		[0.006]	[0.006]	[0.007]	[0.007]		
Former smoker	1007	0.00981	0.011	0.009	0.009	28%	28%
		[0.006]	[0.006]	[0.007]	[0.008]		
Diet/exercise							
BMI	924	−0.182**	−0.099	−0.120	−0.035	−12%	35%
		[0.090]	[0.094]	[0.101]	[0.113]		
Underweight	924	−0.001	−0.000	0.001	0.002	109%	136%
		[0.002]	[0.002]	[0.002]	[0.002]		
Overweight	924	−0.008**	−0.003	−0.005	−0.001	−24%	29%
		[0.007]	[0.008]	[0.008]	[0.009]		
Obese	924	−0.015**	−0.008	−0.008	−0.002	3%	39%
		[0.007]	[0.007]	[0.008]	[0.009]		
Vigorous exercise	707	0.020**	0.017	0.016	0.009	3%	40%
		[0.010]	[0.010]	[0.010]	[0.012]		
Light exercise	707	0.008	0.007	0.009	0.008	−33%	−14%
		[0.008]	[0.008]	[0.009]	[0.009]		
Alcohol							
Current drinker	947	0.010	0.006	0.002	−0.004	36%	100%
		[0.007]	[0.008]	[0.008]	[0.009]		
Heavy drinker (mean # of drinks ≥ 5–all population)	947	−0.015**	−0.013**	−0.013**	−0.011**	−5%	10%
		[0.004]	[0.004]	[0.004]	[0.005]		
Frequency of heavy drinking past month (drinkers only)	587	−0.20**	−0.187**	−0.153**	−0.134**	17%	27%
		[0.044]	[0.046]	[0.050]	[0.056]		
Number of drinks (drinkers only)	583	−0.180**	−0.151**	−0.143**	−0.104**	5%	26%
		[0.035]	[0.036]	[0.038]	[0.044]		
Preventive care use							
Regular doctor visit last year	947	0.001	0.000	0.010	0.023	−774%	−1671%
		[0.008]	[0.008]	[0.009]	[0.010]		
OBGYN visit last year	487	0.017	0.00637	0.009	0.007	−17%	−4%
		[0.011]	[0.012]	[0.012]	[0.014]		
Other							
Read food labels	947	0.031**	0.032**	0.025**	0.020**	25%	42%
		[0.008]	[0.008]	[0.009]	[0.010]		
Average reduction in education coefficient							
Unweighted standardized index, excluding OBGYN visits, 2002		0.030**	0.021**	0.020**	0.015*	2%	21%
		[0.007]	[0.007]	[0.007]	[0.008]		
Unweighted standardized index, 1998		0.029**	0.030**	0.034**	0.027**	−13%	8%
		[0.007]	[0.007]	[0.008]	[0.009]		
Unweighted percentages (outcomes w/significant gradients at baseline)						1%	32%
Mortality weighted						3%	24%

Sample is identical to sample in Table 5 but is further restricted to those who have a early IQ test score. Reading food labels is an indicator for whether the person always or often reads nutritional labels when buying food for the first time. Frequency of heavy drinking reports the number of times in the last month that the respondent had 6 or more drinks in a single occasion. Demographic controls include a full set of dummies for age, and gender. Economic controls include family income, family size, region, MSA, marital status. Background controls include whether respondent is American, whether mom is American, whether dad is American, family income in 1979, mother's education, father's education, whether lived with dad in 1979, whether the person had tried marijuana by 1979, whether the person had damaged property by 1979, whether the person had fought in school by 1979, and whether the person had been charged with a crime by 1980 and height. When early IQ is controlled for, we also include dummies for the year in which the test was taken, the type of test it was and indicators for whether this information is missing. Sample contains individuals with no missing education or AFQT. Indicator variables for missing controls are included whenever any other control is missing.
**(*) Indicates statistical significance at the 5% (10%) level.

Table 10
Effect of test scores on the education gradient in the UK National Child Development Study (Wave 6).

Behavior	Coefficient on passing A levels				Reduction in coefficient on passing A levels		
	Income and background	Addition to income and background controls			Age 7	Age 11 (relative to age 7)	Age 11 and age 16 (relative to age 7)
		Test age 7	Tests age 7 and 11	Tests age 7, 11 and 16			
Smoking							
Current smoker	−0.094***	−0.094***	−0.073***	−0.040***	0%	22%	57%
	[0.014]	[0.014]	[0.015]	[0.015]			
Former smoker	−0.02	−0.027*	−0.026*	−0.013	−35%	4%	52%
	[0.014]	[0.014]	[0.015]	[0.015]			
Quit smoking (ever smoked only)	0.084***	0.078***	0.060**	0.043*	7%	23%	45%
	[0.022]	[0.023]	[0.024]	[0.024]			
Number of cigarettes smoked	−1.400**	−1.465**	−1.503**	−1.391**	−5%	−3%	5%
	[0.613]	[0.621]	[0.644]	[0.657]			
Diet/exercise							
BMI	−0.751***	−0.690***	−0.614***	−0.664***	8%	11%	4%
	[0.144]	[0.147]	[0.154]	[0.158]			
Underweight	0.005	0.006*	0.006	0.006*	−20%	0%	0%
	[0.003]	[0.003]	[0.003]	[0.004]			
Overweight	−0.080***	−0.080***	−0.077***	−0.081***	0%	4%	−1%
	[0.016]	[0.016]	[0.017]	[0.017]			
Obese	−0.040***	−0.034***	−0.029**	−0.033***	15%	15%	3%
	[0.012]	[0.012]	[0.012]	[0.013]			
Exercise regularly	0.063***	0.061***	0.054***	0.046***	3%	11%	25%
	[0.014]	[0.014]	[0.015]	[0.015]			
Eat fruit every day	0.098***	0.095***	0.096***	0.086***	3%	−1%	9%
	[0.016]	[0.016]	[0.017]	[0.017]			
Eat vegetables every day	0.01	0.014	0.024*	0.030**	−40%	−71%	−114%
	[0.012]	[0.012]	[0.013]	[0.013]			
Drinking							
Drinker	0.005	0.003	−0.001	−0.004	40%	133%	233%
	[0.007]	[0.007]	[0.007]	[0.007]			
Heavy drinker	−0.016	−0.024**	−0.026**	−0.020*	−50%	−8%	17%
	[0.010]	[0.010]	[0.011]	[0.011]			
Number of drinks in week	−2.348***	−2.916***	−2.633***	−2.044**	−24%	10%	30%
	[0.775]	[0.787]	[0.829]	[0.850]			
Illegal drugs							
Illegal drugs in last 12 months	0.007	0.002	−0.001	0.007	71%	150%	−250%
	[0.008]	[0.008]	[0.009]	[0.009]			
Ever tried illegal drugs	0.066***	0.048***	0.021	0.048***	27%	56%	0%
	[0.014]	[0.014]	[0.015]	[0.015]			
Average							
Unweighted standardized index	0.058**	0.060**	0.059**	0.046**	−3%	0%	23%
	(0.009)	(0.009)	(0.010)	(0.010)			
Unweighted percentages (outcomes w/significant gradients at baseline)					−3%	14%	22%
Mortality weighted					1%	23%	45%

Note: The sample includes only individuals who took cognitive tests at all ages. Demographic and income controls include age, sex, race, and ethnic dummies, family income, family size, region or residence, employment status, marital status and current SES. Parental and background measures include height at age 16, birth weight, SES of dad at birth age 7, age 11 and age 16, marital status of mom at birth, mother and father's age at birth, mother and father's birthplace, own birthplace, and mom and dad's education. Three cognitive sets of tests are included: at age 7 (math and drawing), age 11 (reading, math, verbal, non-verbal, and drawing), and age 16 (math and reading comprehension). Unweighted regressions use the methodology of Kling et al. (2007).
* indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

we can account for up to 72 percent of the education gradient in health behaviors. Overall these results from the U.K. are remarkably similar to those from the U.S. data.

10. Education and cognition: further results

One of our most interesting results is that a non-trivial share of the education gradient in health behaviors can be accounted for by cognition measures. Previous literature has considered whether the relationship between education and health (rather than health behaviors) is mediated by cognition, and finds mixed results. Most notably, Auld and Sidhu (2005) find that including test scores has a large effect on the education gradient in self-reported health status, whereas Grossman (1975) finds that it does not.

Causality is a central issue in this debate. It may be that education leads to greater intelligence (by this we mean better decision making abilities), and that intelligence matters for outcomes—we term this the learning channel. An equally plausible hypothesis is that people who are more intelligent go on to more education, and education matters for outcomes. Alternatively, there may be some third factor that influences both education and cognitive ability and also determines health behaviors. Of course these mechanisms are not mutually exclusive. To trace out these pathways one would need to estimate causal effects of education and cognition on health (or health behaviors), as well

Table 11
Health behaviors, education and cognition HRS Wave 1 (1992), whites.

Behavior	Mean	Coefficient on years of education					Reduction in education coefficient			
		Basic demographic and background controls	Include objective cognitive ability measures	Include subjective cognitive ability measures	Include objective memory measures	Include all cognitive measures	Objective cognitive ability	Subjective cognitive ability	Memory measures	All cognitive measures
Smoking										
Currently smokes	25%	−0.025***	−0.018***	−0.021***	−0.025***	−0.016***	28%	16%	0%	36%
		[0.003]	[0.003]	[0.003]	[0.003]	[0.003]				
Ever smoker	64%	−0.022***	−0.019***	−0.022***	−0.022***	−0.019***	14%	0%	0%	14%
		[0.003]	[0.003]	[0.003]	[0.003]	[0.003]				
Diet/exercise										
BMI	26.74	−0.158***	−0.128***	−0.149***	−0.151***	−0.120***	19%	6%	4%	24%
		[0.030]	[0.034]	[0.033]	[0.031]	[0.035]				
Underweight	1%	0.000	0.000	0.000	0.000	0.001	N/A	N/A	N/A	N/A
		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]				
Overweight	60%	−0.012***	−0.009***	−0.014***	−0.011***	−0.010***	25%	−17%	8%	17%
		[0.003]	[0.003]	[0.003]	[0.003]	[0.003]				
Obese	21%	−0.009***	−0.008***	−0.008***	−0.009***	−0.006**	11%	11%	0%	33%
		[0.003]	[0.003]	[0.003]	[0.003]	[0.003]				
Vigorous exercise	26%	0.026***	0.023***	0.022***	0.025***	0.020***	12%	15%	4%	23%
		[0.003]	[0.003]	[0.003]	[0.003]	[0.003]				
Alcohol										
Drinks	67%	0.028***	0.022***	0.021***	0.025***	0.017***	21%	25%	11%	39%
		[0.003]	[0.003]	[0.003]	[0.003]	[0.003]				
Heavy drinker (+ than 3 drink a day)	5%	−0.005***	−0.003*	−0.002	−0.004**	−0.002	40%	60%	20%	60%
		[0.002]	[0.002]	[0.002]	[0.002]	[0.002]				
Average reduction in education coefficient										
Unweighted percentages (outcomes w/significant gradients at baseline)							21%	15%	6%	31%
Mortality weighted							22%	20%	3%	39%

Data: Wave 1 HRS (1992). Objective cognitive ability measures include WAIS score and interviewer report of whether the respondent understood the survey questions. Subjective cognitive ability measures include whether the person reports having problems using a computer, using a calculator, reading maps, or using a microwave after reading instructions. Memory measures include word recall (immediate and after 10 min) and interviewer report of whether the respondent had any difficulty remembering questions. Demographic controls include gender, ethnicity dummies (6), birth year dummies, mother's education, father's education, marital status dummies, region of residence dummies and a dummy for whether the respondent was born in the US. Sample: dropped individuals with missing education, race, birth year, mother's education, father's education. Also dropped individuals with any cognitive measure missing. $N = 5488$. Survey weights used in calculating means and in regressions. Robust standard errors in brackets.
* indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

Table 12
Share of education gradient explainable by different factors.

Factor	Explanatory power					
	NHIS	HRS	NLSY	MIDUS	NCDS	Approximate summary
Economic resources	32%	17%	12%	11%	24%	20%
Additional reduction when add:						
Specific knowledge	12%	NA	NA	NA	NA	12%
Cognitive ability	NA	NA	15%	NA	44%	30%
Tastes	NA	0%	NA	1%	2%	1%
Personality	4%	NA	4%	1%	2%	3%
Social integration	NA	NA	NA	7%	15%	11%

Note: Based on the results in the previous tables. The table reports mortality weighted reductions (see text for explanation).

as causal effects of cognition on education and vice-versa. The studies that we know of cannot establish all of these, nor can we.[34]

In this section we focus instead on whether there is any evidence for the learning channel: the idea that education is causally related to health because of its impact on cognition. Some previous work supports this idea. For example, several studies point out that education seems to have a causal effect on health (as discussed in Section 1). In addition, other studies find evidence that schooling (causally) increases AFQT (or other measures of cognition). For example, Hansen et al. (2004) find that that 1-year of schooling increases AFQT scores between 2 and 4 percentage points (see also Neal and Johnson, 1996, and Winship and Korenman, 1997). Similarly, Behrman et al. (2008) estimate that schooling as well as pre- and post-schooling experiences influence adult cognition. Finally note that cognition is associated with better health and health behaviors (Gottfredson and Deary, 2004), although we know of no causal evidence.

We can present some additional, albeit imperfect, evidence that is consistent with the learning channel using our data sets. In particular, both the NLSY and the NCDS have test scores taken at different ages. A finding that cognitive ability at later ages is more important in mediating the education effect would suggest that education influences later life cognitive ability, which in turn explains differences in health behavior. If cognitive behavior at younger ages were more important, in contrast, it would suggest that early cognitive ability influences education and health behaviors.

Table 9 presents the results using a small subsample of the NLSY for which early test score measures are available.[35] For most outcomes the effect of including late IQ is much larger than that of early IQ. Overall, late IQ (controlling for early IQ) reduces the effect of education by 8–32 percent, whereas controlling for early IQ alone has no effect on average.

We can repeat this exercise using the British data as well, which has test scores for all individuals in the sample at ages 7, 11 and 16. These data are better suited for this exercise because of the larger sample, the fact that all individuals were administered the same test and that the tests are available at 3 different ages rather than 2. Table 10 shows the results. The pattern of the cognitive test scores again suggests that education is causally related to behaviors, rather than the reverse. Adding cognitive test scores at age 7 often increases education gradients and on average has no effect. Conditional on test scores at age 7 and background measures, adding test scores at age 11 reduces the effect of schooling on average by 14–23 percent. But together test performance at age 11 and 16 reduce the coefficient on A levels by 22–45 percent relative to its size when income, background and test performance at age 7 are accounted for. To the extent that performance in these test reflects learning in school, the results suggests that what is learned from age 7 to 11, and then from age 11 to 16 accounts for a significant portion of the education gradient.

Finally we examine the types of cognitive abilities that appear to "explain" the effect of education on behaviors. Using the 1992 HRS we investigated how different commonly used measures of cognition among adults and the elderly affect the education gradient in behaviors.[36] Table 11 shows the results. We find that indicators of higher level processing (such as scores on the WAIS test[37] or self-reports of one's ability to read a map, follow instructions or use computers) reduce the education gradient, whereas memory measures (the ability to recall a list of words, for example) do not appear to account for any of the education gradient.[38]

Similarly we also found that vocabulary and spelling test scores at age 16 in the British Cohort Survey (results available upon request) did not impact education gradients, while math scores did. In the NLSY, most components of the ASVAB test scores (math, science, verbal, speed, or vocational) account for about an equal reduction in the education gradient, but the effects are quite heterogeneous depending on the outcome of interest (results available upon request). Overall it would appear that measures of abstract thinking, rather than memory-based or knowledge-based questions, are more important in explaining the education gradient.

11. Conclusion

Using a variety of data sets in two countries, we examine the relation between education and health behaviors. Education gradients in health behaviors are large; controlling for age, gender, and parental background, better educated people are less likely to smoke, less likely to be obese, less likely to be heavy drinkers, more likely to drive safely and live in a safe house, and more likely to use preventive care. Given the similarity across so many different behaviors, we focus on broad explanations for health behaviors, rather than explanations specific to any particular behavior.

With a number of different theories, we are able to account for a good share of the education gradient. Table 12 summarizes our quantitative results. Resources are an important first factor. Income, health insurance, and other economic indicators account for 11–32 percent of the education gradient in behavior; a consensus estimate is perhaps 20 percent.

Our most surprising result is that education seems to influence cognitive ability, and cognitive ability in turn leads to healthier

[34] Some papers have also explored interactions between education and IQ, see for example Elias (2004) or Auld and Sidhu (2005). A structural approach to the production of education and health, that includes the possibility that education and IQ are produced jointly, could be used to make some progress on the relationship between education, IQ and health. But these models depend on functional forms and are difficult to estimate.

[35] We follow Winship and Korenman (1997) and control for the type of test and the year that the test was taken when early IQ measures are included. We omit results for ever tried illegal drug use, since the education gradients increase when IQ is included in these regressions.

[36] We use a different HRS sample because it has a large set of cognitive measures for a large sample. Thus slightly different controls and dependent variables are used.

[37] The WAIS test score assesses higher level abstract reasoning. Each respondent is given seven pairs of words and asked to describe the way in which the items are alike.

[38] Other studies report similar results among diabetics in the HRS. Sloan and Ayyagari (2008) find that cognition mediates some of the effect of education on self-reported health status among diabetics. Goldman and Smith (2002) report that all of the effect of education on the probability that diabetics adhere to their treatment can be accounted for by controlling for the WAIS score, the same measure of higher level reasoning we use here. The memory test did not affect the education gradient.

behaviors. As best we can tell, the impact of cognitive ability is not so much what one knows, but how one processes information. Everyone 'knows' that smoking is bad and seat belts are useful, but the better educated may understand it better. We estimate that cognitive ability is about as important as resources in accounting for health behaviors; a guess is about 30 percent. Specific knowledge by contrast accounts for about 12 percent of the gradient.

Many economic theories stress the role of tastes in accounting for behavioral differences: better educated people will have lower discount rates or risk aversion than the less educated. Our proxies for these taste parameters are possibly measured with error, though we attempted to obtain the best measures available. Nevertheless none of our proxies for discounting, risk aversion, or the value of future explain any of the education gradient in health behaviors.

The theory that is most difficult to test is the translation theory: more and less educated people each want to improve health behaviors, but carrying out these intentions is difficult. Our data do not support the hypothesis that self-esteem, sense of control, stress, depression, or anxiety are important mediating factors in the education gradient. But the social environment does appear to be somewhat healthier for the better educated. In both the U.S. and U.K., the degree of social integration accounts for about 11 percent of the education gradient in behavior.

All told, our different theories account for 60–80 percent of the education gradient. This is a very high share, given the magnitude of these effects and the persistent inability of previous research to make sense of these gradients. The explanation for the remaining one-quarter to one-third of the education gradient is a topic for future research. Our results suggest several possible candidates. First, measurement error in the various proxies we use may explain why in some data sets some mechanisms matter more than in others—in the data sets where income and background are better measured, they account for a larger share of the gradient, and the same is true for cognition. However, regardless of how many different proxies for personality or discounting we had, we did not find these mattered.

Another possibility is that there are important peer effects. The existence of peer effects cannot explain why educated groups adopt better behaviors than uneducated groups to begin with, but peer effects can magnify the effects of education. Finally we did not explore the possibility of interactions between our different mechanisms. It is possible that cognition matters only when individuals have knowledge, or that income matters less (or more) for those who are well-integrated in society.

Table A1
Logistic equation for 10-year mortality, NHANES I.

Independent variable	Coefficient	Std error
Black	0.489	(0.124)**
Other race	−1.409	(0.901)
Married	−0.427	(0.115)**
Smoking		
Current smoker	0.753	(0.114)**
Former smoker	0.209	(0.131)
Drinking		
Heavy drinker	0.040	(0.161)
Light drinker	−0.299	(0.113)**
Weight		
Underweight	0.864	(0.226)**
Overweight	−0.231	(0.113)**
Obese	0.624	(0.139)**
N	6647	

Note: The equation includes 10-year age–sex dummy variables, which are not reported.
** Indicates significance at the 5% level.

Acknowledgements

We are grateful to Lisa Vura-Weiss, Tom Vogl and Rebecca Lowry for excellent research assistance, to Frank Sloan for generously sharing the Survey on Smoking data with us, to Chris Winship and Alan Block for help with data and programs, and the National Institutes on Aging for research support. This work greatly benefited from comments from Michael Grossman, Joe Newhouse and the seminar participants at Princeton, the NBER, Duke and Harvard.

Appendix A.

See Tables A1–A4.

Table A2
The impact of education, depression, and anxiety on health behaviors National Health Interview Survey 2000, whites.

Dependent variable	*N*	Demographics and economic controls		Depression and anxiety scales		Percent reduction
		Years of education (β)	Std error	Years of education (β)	Std error	
Smoking						
Current smoker	22,204	−0.022	(0.001)**	−0.021	(0.001)**	4%
Former smoker	22,204	0.001	(0.001)**	0.001	(0.001)**	10%
Ever smoked	22,219	−0.020	(0.001)**	−0.020	(0.001)**	4%
Number cigs a day (smokers)	49,28	−0.455	(0.072)**	−0.437	(0.071)**	4%
Diet/exercise						
BMI	21,463	−0.132	(0.015)**	−0.125	(0.015)**	6%
Underweight	21,463	0.000	(0.000)	0.000	(0.000)	47%
Overweight	21,463	−0.012	(0.001)**	−0.012	(0.001)**	3%
Obese	21,463	−0.009	(0.001)**	−0.009	(0.001)**	7%
Ever do vigorous activity	22,065	0.029	(0.001)**	0.029	(0.001)**	1%
Ever do moderate activity	21,830	0.029	(0.001)**	0.029	(0.001)**	2%
How often eat fruits/vegetables in 1 day	22,350	0.067	(0.004)**	0.064	(0.004)**	4%
Alcohol						
Drink at least once per month	21,864	0.019	(0.001)**	0.019	(0.001)**	2%
Abstains from drinking	22,051	−0.014	(0.001)**	−0.014	(0.001)**	−1%
Ever had more than 12 drinks in 1 year	22,109	0.016	(0.001)**	0.016	(0.001)**	1%
Had 12+ drinks in entire life	22,116	0.014	(0.001)**	0.014	(0.001)**	−1%

Table A2 (*Continued*)

Dependent variable	*N*	Demographics and economic controls		Depression and anxiety scales		Percent reduction
		Years of education (β)	Std error	Years of education (β)	Std error	
Number drinks when drinks (drinkers)	13,633	−0.149	(0.012)**	−0.143	(0.011)**	4%
Heavy drinker (average number of drinks ≥ 5)	22,350	−0.029	(0.001)**	−0.028	(0.001)**	2%
Number of days had 5+ drinks in past year (all)	21,724	−0.826	(0.099)**	−0.788	(0.099)**	5%
Number of days had 5+ drinks in past year	13,491	−1.871	(0.169)**	−1.797	(0.169)**	4%
Preventive care use						
Ever had a mammogram	8,191	0.011	(0.002)**	0.012	(0.002)**	−4%
Had mammogram past 2 years	8,121	0.016	(0.002)**	0.015	(0.002)**	4%
Ever had a pap smear	11,893	0.010	(0.001)**	0.010	(0.001)**	−2%
Had pap smear in last year	11,772	0.017	(0.002)**	0.017	(0.002)**	1%
Ever had colorectal screening	14,341	0.019	(0.002)**	0.020	(0.001)**	−5%
Had colorectal screening in last year	14,297	0.006	(0.001)**	0.007	(0.001)**	−5%
Ever had HIV test	20,908	0.011	(0.001)**	0.012	(0.001)**	−7%
Had flu shot in last year	22,109	0.014	(0.001)**	0.014	(0.001)**	−2%
Ever had pneumonia vaccine	21,764	0.006	(0.001)**	0.007	(0.001)**	−6%
Ever had Hepatitis B vaccine	21,174	0.017	(0.001)**	0.017	(0.001)**	−1%
Had all 3 Hepatitis B vaccines	20,903	0.014	(0.001)**	0.014	(0.001)**	0%
Average effect						
Outcomes, not including gender-, smoker-, or drinker-specific questions	18,225	0.023	(0.001)**	0.022	(0.001)**	1%
Average % reduction (significant outcomes)						3%
Mortality weighted						4%

Note: Sample sizes are constant across columns. All regressions include a full set of age dummies, gender, Hispanic status, marital status dummies, income, family size, labor force status, region dummies and urban status. *Note*: Number of drinks when drinks in this table is on a different scale than in Table 3.
** Indicates significance at the 5% level.

Table A3
Explanations for health differences in the NCDS. Summary statistics by education level.

Variable	Did not pass A levels		Passed A levels		Min	Max
	N	Mean	*N*	Mean		
Cognitive measures						
Age 7						
Math (arithmetic)	7128	4.78	2973	6.39	0	10
Drawing (Draw-a-man test)	7017	23.14	2913	26.29	0	53
Age 11						
Reading comprehension	6892	14.59	2909	20.90	0	35
Math	6892	14.28	2907	25.21	0	40
Verbal	6893	20.46	2908	28.91	0	40
Non-verbal	6893	19.67	2908	26.29	0	40
Drawing (copying designs)	6881	8.23	2901	8.83	0	12
Age 16						
Reading comprehension	5963	23.86	2639	30.54	0	35
Math	5930	10.72	2636	19.01	0	31
Life satisfaction						
Current (0 = min; 10 = max)	7927	7.23	3337	7.43	0	10
In 10 years (0 = min; 10 = max)	7906	8.03	3332	8.11	0	10
Personality scales						
Efficacy 1 (never get what I want out of life = 1)	7904	0.26	3328	0.15	0	1
Efficacy 2 (usually have control over my life = 1)	7916	0.87	3334	0.94	0	1
Efficacy 3 (can run my life how I want = 1)	7916	0.94	3331	0.96	0	1
Malaise index (1 = healthy; 24 = unhealthy)	7920	3.86	3336	2.96	0	24
GHQ12 (1 = low stress; 12 = high stress)	7927	1.83	3338	1.88	0	12
Socialization						
Mother is alive (percent)	7692	0.76	3280	0.82	0	1
Frequency sees mother (0 = every day, 4 = never)	6169	1.67	2756	2.08	0	4
Father is alive (percent)	7756	0.57	3305	0.64	0	1
Frequency sees father (0 = every day, 4 = never)	4580	1.85	2141	2.23	0	4
Frequency eat together as a family (1 = daily, 5 = never)	5090	2.18	2197	2.12	1	5
Frequency go out together as a family (1 = daily, 5 = never)	5126	2.65	2254	2.17	1	5
Frequency visit relatives as a family (1 = daily, 5 = never)	5177	2.11	2274	2.14	1	5
Frequency go on holiday as a family (1 = weekly, 5 = never)	5106	3.83	2260	3.50	1	5
Frequency go out alone or with friends (1 = weekly, 4 = never)	6328	2.24	2719	2.16	1	4
Frequency attends religious services (1 = weekly, 4 = never)	6900	3.54	2580	3.04	1	4

Table A4
National Longitudinal Survey of Youth results without income (compared to Table 5), whites.

Measure	Coefficient on years of education				Reduction in education coefficient		
	Family background and demographic controls	Addition to family background			Addition to family background and demographic controls		
		Current income	ASVAB scores	Personality scales	Income	ASVAB scores	Personality scales
Smoking							
Current smoker	−0.049**	−0.047**	−0.041**	−0.046	5%	17%	6%
	(0.003)	(0.003)	(0.003)	(0.003)			
Former smoker	0.0028	0.0027	0.00003	0.001	3%	99%	60%
	(0.003)	(0.003)	(0.003)	(0.003)			
Diet/exercise							
BMI	−0.197**	−0.169**	−0.148**	−0.175**	14%	25%	11%
	(0.039)	(0.040)	(0.050)	(0.040)			
Underweight	−0.00106	−0.00067	−0.001	−0.001	37%	−4%	−21%
	(0.0008)	(0.0008)	(0.0009)	(0.0008)			
Overweight	−0.014**	−0.013**	−0.007*	−0.013**	4%	52%	2%
	(0.003)	(0.003)	(0.004)	(0.003)			
Obese	−0.016**	−0.014**	−0.014**	−0.015**	17%	13%	7%
	(0.003)	(0.003)	(0.004)	(0.003)			
Vigorous exercise	0.032**	0.030**	0.033**	0.026**	8%	−1%	19%
	(0.004)	(0.004)	(0.004)	(0.004)			
Light exercise	0.019**	0.017**	0.012**	0.014**	8%	38%	25%
	(0.004)	(0.003)	(0.004)	(0.003)			
Alcohol							
Current drinker	0.016**	0.010**	0.004	0.011**	40%	75%	33%
	(0.003)	(0.003)	(0.004)	(0.003)			
Heavy drinker (mean # of drinks ≥ 5–all population)	−0.011**	−0.009**	−0.009**	−0.011**	16%	15%	1%
	(0.002)	(0.002)	(0.002)	(0.002)			
Frequency of heavy drinking past month (drinkers only)	−0.141**	−0.132**	−0.113**	−0.132**	7%	20%	6%
	(0.019)	(0.019)	(0.022)	(0.019)			
Number of drinks (drinkers only)	−0.154**	−0.134**	−0.103**	−0.139**	13%	33%	9%
	(0.016)	(0.016)	(0.019)	(0.016)			
Illegal drugs							
Never tried pot	0.002	0.002	0.008**	0.003	−3%	−374%	−81%
	(0.003)	(0.003)	(0.003)	(0.003)			
# times smoked pot in life >50	−0.014**	−0.014**	−0.017**	−0.014**	3%	−26%	−3%
	(0.003)	(0.003)	(0.003)	(0.003)			
Never tried cocaine	0.000	0.000	0.006*	0.000	123%	1751%	97%
	(0.003)	(0.003)	(0.003)	(0.003)			
# times used cocaine in life >50	−0.006**	−0.005**	−0.009**	−0.006**	13%	−61%	−14%
	(0.002)	(0.002)	(0.002)	(0.002)			
Preventive care use							
Regular doctor visit last year	0.005**	0.003	0.008*	0.003	36%	−45%	48%
	(0.003)	(0.003)	(0.004)	(0.003)			
OBGYN visit last year	0.027**	0.021**	0.028**	0.026**	22%	−4%	1%
	(0.004)	(0.005)	(0.005)	(0.005)			
Other							
Read food labels	0.035**	0.034**	0.02041**	0.031**	1%	41%	11%
	(0.003)	(0.003)	(0.004)	(0.003)			

Reading food labels is an indicator for whether the person always or often reads nutritional labels when buying food for the first time. Frequency of heavy drinking reports the number of times in the last month that the respondent had 6 or more drinks in a single occasion. Demographic controls include a full set of dummies for age and gender. Family background controls include family size, region, MSA, marital status, and socioeconomic background (whether respondent is American, whether mom is America, whether dad is American, family income in 1979, mother's education, father's education, whether lived with dad in 1979, whether the person had tried marijuana by 1979, whether the person had damaged property by 1979, whether the person had fought in school by 1979, and whether the person had been charged with a crime by 1980 and height). Personality scores include the Rosen self-esteem score in 1980 and 1987, the Pearlin score of self-control in 1992, the Rotter scale of control over one's life in 1979, whether the person considered themselves shy at age 6 and as an adult (in 1985), and history of depression (the CESD, measured in 1992 and 1994). Sample contains individuals with no missing education or AFQT. Indicator variables for missing controls are included whenever any other control is missing.
** Indicates significance at the 5% level.

Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the version, at doi:10.1016/j.jhealeco.2009.10.003.

References

Auld, M.C., Sidhu, N., 2005. Schooling, cognitive ability and health. Health Economics 14, 1019–1034.

Barsky, R.B., Thomas Juster, F., Kimball, M.S., Shapiro, M.D., 1997. Preference parameters and behavioral heterogeneity: an experimental approach in the health and retirement study. Quarterly Journal of Economics 112 (May (2)), 537–579, In Memory of Amos Tversky (1937–1996).

Becker, G.S., Mulligan, C.B., 1997. The endogenous determination of time preference. Quarterly Journal of Economics 112 (August (3)), 729–758.

Behrman, J.R., Hoddinott, J., Maluccio, J.A., Soler-Hampejsek, E., Behrman, E.L., Martorell, R., Ramírez-Zea, M., Stein, A.D., 2008. What Determines Adult Cognitive Skills? Impacts of Pre-Schooling Schooling and Post-Schooling Experiences in Guatemala. University of Pennsylvania, Mimeo.

Case, A., Fertig, A., Paxson, C., 2005. The lasting impact of childhood health and circumstance. Journal of Health Economics 24, 365–389.

Cawley, J., 2004. The impact of obesity on wages. Journal of Human Resources 34 (2), 451–474.

Cawley, J., Burkhauser, R.V., 2006. "Beyond BMI: The Value of More Accurate Measures of Fatness and Obesity in Social Science Research", NBER Working Paper No. 12291, June.

Chaloupka, F., 1991. Rational addictive behavior and cigarette smoking. The Journal of Political Economy 99 (August (4)), 722–742.

Currie, J., Moretti, E., 2003. Mother's education and the intergenerational transmission of human capital: evidence from college openings. Quarterly Journal of Economics 118 (4), 1495–1532.

Cutler, D.M., Gruber, J., Hartman, R., Beth Landrum, M., Newhouse, J.P., Rosenthal, M., 2002. The economic impacts of the tobacco settlement. Journal of Policy Analysis and Management 21 (1), 1–19, Winter.

Cutler, D.M., Glaeser, E., 2005. What explains differences in smoking, drinking, and other health related behaviors? American Economic Review 95 (May (2)), 238–242.

Cutler, D.M, Glaeser, E., Shapiro, J., 2003. Why have Americans become more obese? Journal of Economic Perspectives 17 (3), 93–118, Summer.

Cutler, D.M., Lleras-Muney, A., 2008a. Education and health: evaluating theories and evidence. In: James, S.H., Schoeni, R.F., Kaplan, G.A., Pollack, H. (Eds.), Making Americans Healthier: Social and Economic Policy as Health Policy. Russell Sage Foundation, New York.

Cutler, D.M., Lleras-Muney, A., 2008b. Understanding Differences in Health Behaviors by Education. Princeton University, Mimeo.

Elias, J.J., 2004. The Effects of Ability and Family Background on Non-Monetary Returns to Education. Ph.D. dissertation, University of Chicago.

Elo, I.T., Preston, S.H., 1996. Educational differentials in mortality: United States 1979–85. Social Science and Medicine 42 (1), 47–57.

Fuchs, V.R., 1982. Time preference and health: an exploratory study. In: Fuchs, V.R. (Ed.), Economic Aspects of Health. University of Chicago Press, Chicago.

Goldman, D.P., Lakdawalla, D.N., 2005. A theory of health disparities and medical technology, Contributions to Economic Analysis & Policy 4 (1). Article 8. Available at: http://www.bepress.com/bejeap/contributions/vol4/iss1/art8.

Goldman, D.P., Smith, J.P., 2002. Can patient self-management help explain the SES health gradient? Proceedings of the National Academy of Science 99 (16), 10929–10934.

Gottfredson, L.S., Deary, I.J., 2004. Intelligence predicts health and longevity, but why? Current Directions in Psychological Science 13 (1), 1–4.

Grossman, M., 1972. On the concept of health capital and the demand for health. Journal of Political Economy 80 (2), 223–255.

Grossman, M., 1975. The correlation between health and schooling. In: Terleckyj, N.E. (Ed.), Household Production and Consumption. Studies in Income and Wealth, Volume 40, by the Conference on Research in Income and Wealth. Columbia University Press for the National Bureau of Economic Research, New York, pp. 147–211.

Gruber, J., 2001. Tobacco at the crossroads: the past and future of smoking regulation in the United States. Journal of Economic Perspectives 15, 193–212.

Gruber, J., Koszegi, B., 2004. Tax incidence when individuals are time-inconsistent: the case of cigarette excise taxes. Journal of Public Economics 88, 1959–1987.

Hansen, T.K., Heckman, J.J., Mullen, K.J., 2004. The effect of schooling and ability on achievement test scores. Journal of Econometrics 121, 39–98.

Kenkel, D.S., 1991. Health behavior, health knowledge, and schooling. Journal of Political Economy 99 (April (2)), 287–305.

Khwaja, A, Silverman, D., Sloan, F., 2007. Time preference, time discounting and smoking decisions. Journal of Health Economics 26, 927–949.

Kitagawa, E.M., Hauser, P.M., 1973. Differential Mortality in the United States: A Study in Socioeconomic Epidemiology. Harvard University Press, Cambridge, MA.

Kling, J., Liebman, J.B., Katz, L.F., 2007. Experimental analysis of neighborhood effects. Econometrica 75 (1), 83–119.

Kunst, A.E., Mackenbach, J.P., 1994. The size of mortality differences associated with educational level in nine industrialized countries. American Journal of Public Health 84, 932–937.

Lichtenberg, F., Lleras-Muney, A., 2005. The effect of education on medical technology adoption: are the more educated more likely to use new drugs? Special issue of the *Annales d'Economie et Statistique* in memory of Zvi Griliches, No 78/80.

Lleras-Muney, A., 2005. The relationship between education and adult mortality in the U.S. Review of Economic Studies 72 (1), 189–221.

Marmot, M.G., Shipley, M.J., Rose, G., 1984. Inequalities in death—specific explanations of a general pattern? Lancet 1 (May (8384)), 1003–1006.

Meara, E., 2001. "Why is Health related to Socio-economic status?" NBER Working Paper No. w8231, April.

Meara, E.R., Richards, S., Cutler, D.M., 2008. The gap gets bigger: changes in mortality and life expectancy, by education, 1981–2000. Health Affairs 27 (2), 350–360.

MIDMAC, 1999. Methodology of the National Survey of Midlife Development in the United States (MIDUS). The John D. and Catherine T. MacArthur Foundation.

Mokdad, A.H., Marks, J.S., Stroup, D.F., Gerberding, J.L., 2004. Actual causes of death in the United States 2000. Journal of American Medical Association 291 (10), 1238–1245.

Mustard, C.A., Derksen, S., Berthelot, J.-M., Roos, L.L., Wolfson, M.C., 1997. Age specific education and income gradient in morbidity and mortality in a Canadian province. Social Science and Medicine 45 (3), 383–397.

Neal, D., Johnson, W.R., 1996. The role of premarket factors in black–white wage differences. Journal of Political Economy 104 (5), 869–895.

Nelson, R., Phelps, E., 1966. Investment in humans, technological diffusion, and economic growth. American Economic Review 56 (1/2), 65–75.

Newhouse, J.P, 1993. And the Insurance Experiment Group Free for All: Lessons from the Rand Health Insurance Experiment. Harvard University Press, Cambridge, MA.

Richards, H., Barry, R., 1998. U.S. life tables for 1990 by sex, race, and education. Journal of Forensic Economics 11 (1), 9–26.

Rosenzweig, M.R., Schultz, T.P., 1989. Schooling, information and nonmarket productivity: contraceptive use and its effectiveness. International Economic Review 30 (May (2)), 457–477.

Rosenzweig, M.R., 1995. Why are there returns to schooling? American Economic Review 85 (May (2)), 153–158.

Ross, C.E., Mirowsky, J., 1999. Refining the association between education and health. Demography 36, 445–460.

Salovey, P., Rothman, A.J., Rodin, J., 1998. Health behavior. In: Gilbert, D.T., Fiske, S.T., Lindzey, G. (Eds.), Handbook of Social Psychology, vol. II. Oxford University Press, New York.

Schoenbaum, M., 1997. Do smokers understand the mortality effects of smoking? Evidence from the health and retirement survey. American Journal of Public Health 87 (5), 755–759.

Schultz, T.W., 1975. The value of the ability to deal with disequilibria. Journal of Economic Literature 13 (3), 827–846.

Sloan, F., Ayyagari, P., 2008. Education and Health: A Peak Inside the Black Box. Duke University, Mimeo.

Viscusi, W.K., 1992. Fatal Tradeoffs: Public and Private Responsibilities for Risk. Oxford University Press, New York.

Winship, C., Korenman, S., 1997. Does staying in school make you smarter? The effect of Education on IQ in *The Bell Curve*. In: Devlin, B., Fienberg, S.E., Resknick, D.P., Roeder, K. (Eds.), Intelligence, Genes and Success: Scientists respond to The Bell Curve. Springer–Verlag, New York, pp. 215–234.