Understanding Differences in Health Behaviors by Education

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 one self or over one's life.

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, Richards, and Cutler, 2008), and is present in other countries (Marmot, Shipley, and Rose, 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 (especially 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

[1] See Cutler and Lleras-Muney (2007) 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) although there was less formal discussion earlier.

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 in 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.

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 know 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 inhibits appropriate action (Salovey, Rothman, and Rodin, 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.

I. 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 . 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). 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:

$$(1) \qquad H_i = \beta_0 + \beta_1 * Education_i + \boldsymbol{X_i}\,\alpha + \varepsilon_i$$

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

Where H_i is a health behavior, *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 gender, age dummies and ethnicity. The education gradient is given by β_1, the coefficient on education. We discuss below whether the best specification of education is linear or non-linear.

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

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

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. 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 1971-75 National Health and Nutrition Examination Survey Epidemiological Follow-up Study, is described in the Appendix. For comparability reasons, the behaviors are restricted to

[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.

smoking, drinking, and obesity. The summary measure is the predicted change in 10 year mortality associated with each additional year of education.[6] Finally, we report the average effect of education across outcomes using the methodology described in Kling, Liebman, and Katz (2007), which weights outcomes equally after standardizing them.[7]

II. 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.[8] 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 death in the

[6] 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.

[7] 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 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.

country (accounting for 18 percent of all deaths). The first row shows that twenty-three percent of 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 7 years shorter life expectancy, 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 Figure 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.

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

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

population in 2000 self-reported themselves to be obese.[9] This too is negatively related to education; each year of additional schooling reduces the probability of being obese by 1.4 percent. The figure by exact year of education is similar to that for smoking. 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 to 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

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

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 behavior. Better educated women get mammograms and pap smears more regularly, better educated men and women get colorectal screening and other tests, 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). 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 that we explore. The average predicted 10 year mortality rate is 10.7 percent. Relative to this average, our results suggest that every year of education lowers the mortality risk by 0.2 percentage points 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 and persistent education differences across a variety of health behaviors.

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 (Table 7), 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 pass. Additionally those that passed A levels are 6 percent less likely to be obese, and are 3 percent less likely to be a heavy drinker.

III. 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 clear endogeneity issues with income. Current income might be low because a person is sick, rather than the reverse—although the endogeneity is less clear for behaviors (studied here) 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.[10] The mortality-weighted average is a decline of 24 percent.

The NHIS contains a number of other measures of economic status beyond 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. Straightforward theories suggest why these variables might be important. Ideally we would also like to control for parent characteristics and other determinants of education such as health while growing up, since greater parental resources may result in higher incomes and more education. The NHIS is not very rich in this dimension, but we do include a large number of background variables available from other data sets in subsequent tables.

[10] 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.

[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.

As with income, each of these variables may be endogenous. Sicker people 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 be 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 columns in Table 1 add these additional economic controls to the regressions. 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 to 30 percent of the education effect.

The NHIS does not have a measure of wealth or family background. Further, measures of income in the NHIS are underreported, as in many surveys. To consider the importance of this, we repeated our analysis using the Health and Retirement Study. The economic data in the HRS is 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. Controlling for demographics alone (the first regression column), the HRS data show similar, though in some cases smaller, gradients to the NHIS data. For example, smoking declines by 2 percentage points with each year of education, compared with 3.0 percent in the NHIS. However, the change in obesity is similar: a decline of 1.3 percent with each additional year of education in the HRS, compared to 1.4 percent in the NHIS. It is possible that the lower coefficient on smoking

reflects deaths of smokers by HRS survey ages. 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 2007 for references).

In the middle columns of the table, we include labor force status, total family income, family size, assets, major activity, region, MSA, marital status, 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 reduction in the education coefficient ranges from 11 percent for current smoking to 37 percent for obesity. The average reduction on the education effect is 36 percent, and the mortality-weighted reduction is 22 percent.

In total, therefore, we estimate that material resources account for about 20 to 30 percent of the impact of higher education on health behaviors, assuming that all our measures (including background measures) can be thought of as material resources. This matches what we find in other data set as well (see below). With the understanding that this estimate is likely too high (because of endogeneity), we conclude that there a large share of the education effect still to be explained.

IV. 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.[12] Even given health insurance, out-of-pocket costs may be 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 may be 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.[13] 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

[12] A variety of surveys show this response, including the 1987 NHIS Cancer Control Supplement.
[13] Gruber and Koszegi (2004) estimate elasticities of -1 for people without a high school degree, -.9 for high school grads, -.1 for people with some college, and -.4 for college grads. Chaloupka (1991) estimates elasticities of -.6 for people with a high school degree or less and -.15 for people with more than high school.

Agreement, the real value of cigarette taxes is now at its highest level in the post-war era. Yet over the same time period, smoking rates among the better educated fell more than in 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.

V. 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.[14] 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.

A. Specific Health Knowledge

The 1990 NHIS asks people 12 questions about the health risks of smoking and 7 questions about drinking (see the Appendix). In the smoking section, respondents were

[14] 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.

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. Overall, the typical person gets 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 college education 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 but not knowledge. The coefficients are similar to 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 education questions included, while the coefficient on 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 (see also Meara, 2001, and Kenkel, 1991).

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 don't know as much). Although we do not know whether this bias in reporting varies by education, in the case of smoking we do know that both smokers and non-smokers vastly overestimate the risks of smoking (Viscusi, 1992).

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.[15] We cannot 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 are not sufficient to explain much of the education gradient in health behavior.

B. Conceptual Thinking

The tobacco example suggests that information processing, more than (or in addition to) exposure to knowledge, may be the key to explaining education gradients in behaviors. This dovetails with other evidence in the literature showing that more educated people are better able to use complex technologies/treatments than less educated individuals. Goldman and Smith (2002), for example, 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

[15] 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.

the rhythm method is much more effective among educated women. The more educated may also be better at learning. Lleras-Muney and Lichtenberg (forthcoming) find that 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 that have an opportunity to learn. Similarly Lakdawalla and Goldman (2005) and Case, Fertig and Paxson 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.[16] 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.[17] Table 3 shows that those with a college degree or more scored much higher in the AFQT (70th percentile on average) compared to high school dropouts (15th 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.

[16] 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.
[17] The specifics of the AFQT have changed over time. Currently, it is a combination of word knowledge, paragraph comprehension, arithmetic reasoning, and mathematical knowledge.

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.

The first column of regression results shows the impact of education on behavior including only demographic controls: age, gender, and race. The impact of education on behavior is large, often times larger than the NHIS. For example, each year of education is associated with a 5.6 percent lower probability of smoking, a 1.9 percent lower chance of being obese, and a 1.5 percent lower chance of heavy drinking. The next column includes income and family background controls. There is generally a significant impact of these variables on the education gradient. Nearly half of the lower obesity among the better educated is explained by income and background, for example. The impact on other behaviors is smaller. Using the mortality weights noted above we estimate that 28 percent of the education gradient in mortality is explained with income and family background 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. ASVAB scores account for an additional 11 percent of the education gradient in smoking, 13 percent of the gradient in obesity, and 9 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).[18] 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 13 percent of the education effect.

These results raise several questions. One is whether some components of cognition matter more than others. In other work (Cutler and Lleras-Muney 2008) we find that math, verbal, and speed test scores seem to matter equally, with vocational scores mattering much less. The impact of these variables is not through memory, however. In the HRS, cognitive memory measures do not appear to account for any of the education gradient, nor do vocabulary and spelling test scores at age 16 in the British Cohort Survey (results available upon request).[19] Rather, the tests seem to matter as a indicator of higher level processing.

An important concern about these results is causality: is cognitive ability affected by education, or does cognitive ability lead people to become more educated? Hansen, Heckman and Mullen (2004) report that one year of schooling increases AFQT scores between 2 and 4 percentage points. Our results suggest then that those with more education behave better because education raises cognition, but we cannot provide any evidence here that the cognitive performance is causally related to education. We leave that to future work.

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[18] 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.

[19] Goldman and Smith (2002) find similar results. They report that among diabetics in the HRS, all of the effect of education on the probability that they adhere to their treatment can be accounted for by controlling for the WAIS score, a measure of higher level reasoning. The memory test did not affect the education gradient.

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

VI. 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.

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.[20] 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?"[21] The same question is asked about current situation, which we include as well. There are some questions that can also 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 that strongly disagree as being able to plan for the future. Thheory 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

[20] MIDUS was conducted in 1995-96 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 3,000 observations in MIDUS, although for certain outcomes the sample is considerably smaller.

[21] 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.

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. Although these satisfaction measures are not very highly correlated with education, Figure 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. The list of health measures is shown in table 6. 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 demographics 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 4.3 percent and obesity by 1.6 percent. In this sample, education is not always statistically significant, but the sample sizes are small.

The next columns show the impact of including measures of economic and family background. The impact of economic and family background are similar to the NHIS and NLSY. On average, about one-quarter of education differences in behavior are attributable to economic and demographic controls.

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.[22] 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.

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 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 to 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 or some college 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

[22] 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.

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.[23]

The measures of discount rates and risk aversion in the MIDUS and HRS 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.[24] 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 8 percent and the obesity gradient by 22 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 are very inpatient (64% prefer $1000 now than $1500 in a year), and more so when the stakes are small (80% prefer $20 now than $30 in a year). When the questions refer to losing amounts, individuals are very inpatient, but less than for gains. More importantly,

[23] 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.

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 answers to these discounting questions as regressors increases the coefficient on education for both outcomes.

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% but has no impact in the obesity regression.

The third measure of discounting is the answer 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. 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.

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

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 5 percent.

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 14 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 14 percent for smoking and 6 percent for obesity. All told, we attribute very little of the education gradient in health behaviors to utility function characteristics.

VII. 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. This parallels Rosenzweig and Schultz’s (1998)

results on the success of contraceptive use. Many of these aspects of education were stressed by 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.[25] 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

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

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. The addition of personality variables reduces the effect of education by at most 5 percent. The impacts on exercise and preventive care are among the largest effects; personality scores account for about 20 percent of the gradient in these behaviors. But they actually increase the gradient in illegal drug use measures and have minimal effects on smoking, drinking, and obesity. The average reduction in the education coefficient is 2 to 5 percent.

Some authors have posited that stress, depression, and anxiety are the mediating factor in behavioral changes (Salovey, Rothman, and Rodin, 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. 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; as in the NLSY, the overall change is essentially zero.[26]

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. Family and friends can also be sources of information or reinforcement about behaviors. They might also pick up other aspects of the environment. Whatever the explanation, we analyze how they are related to the education gradient in behaviors.

The final column of table 6 shows the impact of social integration on education gradients in behaviors. There is a modest impact of these social integration measures. The coefficient on current smoking falls by 5 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 5 to 17 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 small part of the gradient, perhaps as much as 8 percent, though it is not clearly entirely why they

[26] 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 2. 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.

matter. The caveat to our results is that the measures of personality are self-reported. Still, such measures are not a significant part of the education gradient in behaviors.[27]

VIII. 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 6,500 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.

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

The first set of regression results relates behaviors to demographic controls only. As noted above, the gradients are relatively similar in the U.S. and the U.K. Passing the A levels is associated with a 15 percent lower probability of smoking and a 6 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).

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 and father's education. Because these were taken 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 next column shows the impact of adding these income and background 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 37 percent, and the impact of education on obesity falls by 35 percent. The average is between 36 and 39 percent, depending on the measure used. This degree of explanatory power is somewhat greater than in the U.S., likely reflecting the more extensive and better measured background controls in the NCDS.

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 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 36 percent and the impact on obesity by 11 percent. The share of the education effect that is attributable to cognitive ability ranges between 9 and 35 percent.

The pattern of the cognitive test scores suggests that education is causally related to behaviors, rather than the reverse. Of the three tests (age 7, age 11, and age 16), essentially all of the education gradient in behaviors is accounted for by test performance at age 16, and test performance at age 11 accounts for more than test performance at age 7 (results available upon request).

The NCDS has measures of current and expected future life satisfaction (each is a scale from 1-10 where 10 is the highest; see the 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 to 2 percent, roughly the same as in the U.S.

The NCDS also has 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 3 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. The next column of the table presents the results from adding these measures. Social measures have a moderate impact on the education gradient in behaviors, reducing the coefficient by about 10 percent (in comparison to the 5 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 40 percent using the weighted measure and less with the unweighted ones. Along with the 36 percent of the education gradient that is attributable to economic and background factors, we can account for up to 77 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.

IX. 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 and gender, 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 9 summarizes our quantitative results. Resources are an important first factor. Income, health insurance, socio-economic background and the like account for 10 to 40 percent of the education gradient in behavior; a consensus estimate is perhaps 30 percent.

Our most surprising result is that education seems to influence cognitive ability, and cognitive ability in turn leads to healthier 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 more. We estimate that cognitive ability is about as important as resources in accounting for health behaviors (12-35 percent); a guess is about 20 percent.

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 measures of these taste parameters are not great, butnone 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 interaction accounts for about 5 to 10 percent of the education gradient in behavior.

All told, our different theories account for 60 to 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.

References

Robert B. Barsky, F. Thomas Juster, Miles S. Kimball and Matthew D. Shapiro, "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study." *Quarterly Journal of Economics*, Vol. 112, No. 2, In Memory of Amos Tversky (1937-1996) (May, 1997), pp. 537-579

Becker, Gary S & Mulligan, Casey B, 1997. "The Endogenous Determination of Time Preference," *Quarterly Journal of Economics*, vol. 112(3), pages 729-58, August.

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

Case, Anne, Darren Lubotsky, and Christina Paxson, "Economic Status and Health in Childhood: The Origins of the Gradient," *American Economic Review*, 2002, 92(5):1308-1334.

Cawley, John, "The Impact of Obesity on Wages", *Journal of Human Resources*, 2004, 34(2), 451-474.

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

Chaloupka, Frank, "Rational Addictive Behavior and Cigarette Smoking," *The Journal of Political Economy*, Vol. 99, No. 4. (Aug., 1991), pp. 722-742.

Currie, Janet, and Enrico Moretti, "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings," *Quarterly Journal of Economics*, 2003, 118(4):1495-1532.

Cutler, David M., and Edward Glaeser, "What Explains Differences in Smoking, Drinking, and Other Health Related Behaviors?," *American Economic Review*, 95(2), May 2005, 238-242.

Cutler, David M., and Adriana Lleras-Muney, "Education and Health: Evaluating Theories and Evidence," forthcoming in James S. House, Robert F. Schoeni, George A. Kaplan, and Harold Pollack, eds., *The Health Effects of Social and Economic Policy*, New York: Russell Sage Foundation, 2007.

Cutler, David .M. and Adriana Lleras-Muney (2008), "Understanding differences in health behaviors by education" Mimeo, Princeton University.

Elo, Irma T., and Samuel H. Preston, "Educational differentials in mortality: United States, 1979-85", *Social Science and Medicine*, 1996, 42(1): 47-57.

Fuchs, Victor R., "Time Preference and Health: An Exploratory Study", in Victor R. Fuchs, ed., *Economic Aspects of Health*, Chicago: University of Chicago Press, 1982.

Goldman, Dana P. & Darius Lakdawalla, 2005. "A Theory of Health Disparities and Medical Technology," *Contributions to Economic Analysis & Policy*, Berkeley Electronic Press, vol. 4(1), pages 1395-1395.

Goldman, Dana P., and James P. Smith, "Can patient self-management help explain the SES health gradient?" Proceedings of the National Academy of Science (2002), vol 99, no. 16, 10929-10934.

Grossman, Michael, "On the Concept of Health Capital and the Demand for Health." *Journal of Political Economy*, 1972, 80(2):223-255.

Gruber, Jonathan, "Tobacco At the Crossroads: The Past and Future of Smoking Regulation in the United States", *Journal of Economic Perspectives* 15 (2001), 193-212.

Gruber, Jonathan and Botond Koszegi, "Tax incidence when individuals are time-inconsistent: the case of cigarette excise taxes" *Journal of Public Economics* 88 (2004) 1959–1987

Hall, Robert, and Chad Jones, "The Value of Life and the Rise in Health Spending", NBER Working Paper No. 10737, September 2004.

Hansen, T. Karsten, James J. Heckman and Kathleen J. Mullen, "The effect of schooling and ability on achievement test scores," *Journal of Econometrics* (2004) 121: 39-98.

Kenkel, Donald S, 1991. "Health Behavior, Health Knowledge, and Schooling," *Journal of Political Economy*, vol. 99(2), 287-305, April.

Khwaja, Ahmed, Dan Silverman and Frank Sloan, "Time Preference, time discounting and smoking decisions," *Journal of Health Economics* 26 (2007) 927-949.

Kitagawa, Evelynn M., and Philip M. Hauser, *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*, 1973, Cambridge, MA: Harvard University Press.

Kling, Jeffrey, Jeffrey B Liebman, Lawrence F Katz (2007), "Experimental Analysis of Neighborhood Effects," *Econometrica* 75 (1), 83–119.

Kunst AE, Mackenbach JP "The size of mortality differences associated with educational level in nine industrialized countries" *American Journal of Public Health* 1994, 84:932-7.

Lichtenberg, Frank and Adriana Lleras-Muney, "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, forthcoming

Lleras-Muney, Adriana, "The Relationship Between Education and Adult Mortality in the U.S.," *Review of Economic Studies*, 2005, 72(1):189-221.

Marmot Michael G, Martin J. Shipley, and Geoffrey Rose, "Inequalities in death--specific explanations of a general pattern?" *Lancet*. 1984 May 5;1(8384):1003–1006.

Marmot, Michael, "The Influence of Income on Health: Views of An Epidemiologist," *Health Affairs*, 2002, 21(2): 31-46.

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

Meara, Ellen R., Seth Richards and David M. Cutler, "The Gap Gets Bigger: Changes In Mortality And Life Expectancy, By Education, 1981–2000", *Health Affairs*, 27(2), 2008, 350-360.

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

Mokdad, Ali H., James S. Marks, Donna F. Stroup, and Julie L. Gerberding, "Actual Causes of Death in the United States, 2000", *JAMA*, 2004, 291(10):1238-45.

Mustard, Cameron A., Shelley Derksen, Jean-Marie Berthelot, Leslie L. Roos, and Michael C. Wolfson, "Age Specific education and income gradient in morbidity and mortality in a Canadian province," *Social Science and Medicine*, 1997, 45(3): 383-397.

Richards, Hugh, and Ronald Barry, "U.S. Life Tables for 1990 by Sex, Race, and Education", *Journal of Forensic Economics*, 1998, 11(1):9-26.

Rosenzweig, Mark R & Schultz, T Paul, 1989. "Schooling, Information and Nonmarket Productivity: Contraceptive Use and Its Effectiveness," International Economic Review, Department of Economics, University of Pennsylvania and Osaka University Institute of Social and Economic Research Association, vol. 30(2), pages 457-77, May.

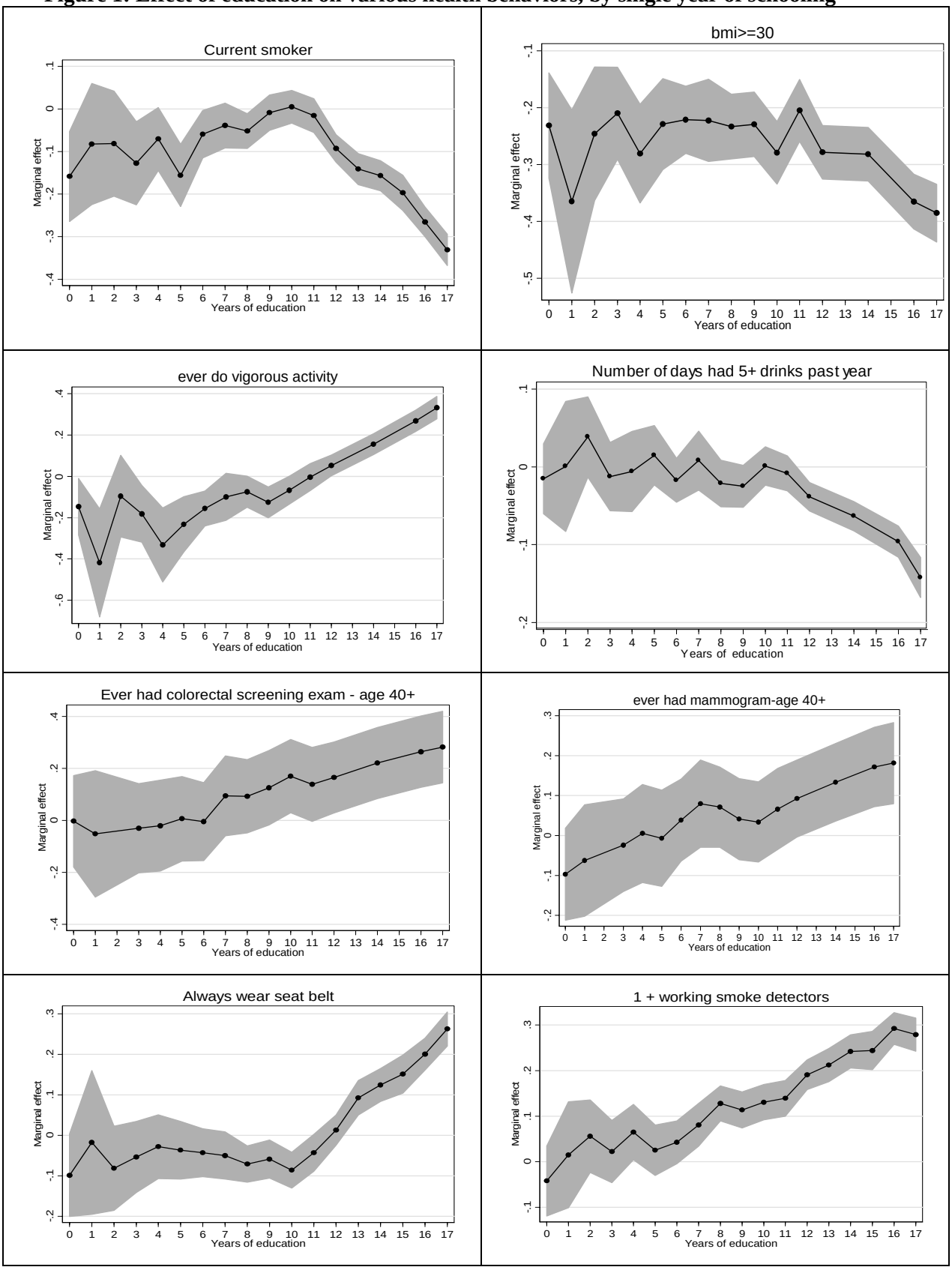
Salovey, Peter, Alexander J. Rothman, and Judith Rodin, "Health Behavior" in Daniel T. Gilbert, Susan T. Fiske and Gardner Lindzey, *Handbook of Social Psychology, Volume II*, New York, Oxford University Press, 1998.

Sapolsky Robert M. "Neuroendocrinology of the stress-response," In Becker JB, Breedlove SM, Crews D, editors, *Behavioral Endocrinology*. Cambridge: The MIT Press. 1993, 287-324

Sapolsky, Robert, *Why Zebras don't get Ulcers: a guide to stress, stress-related disorders and coping*, New York, NY: WH Freeman Publishers, 1998.

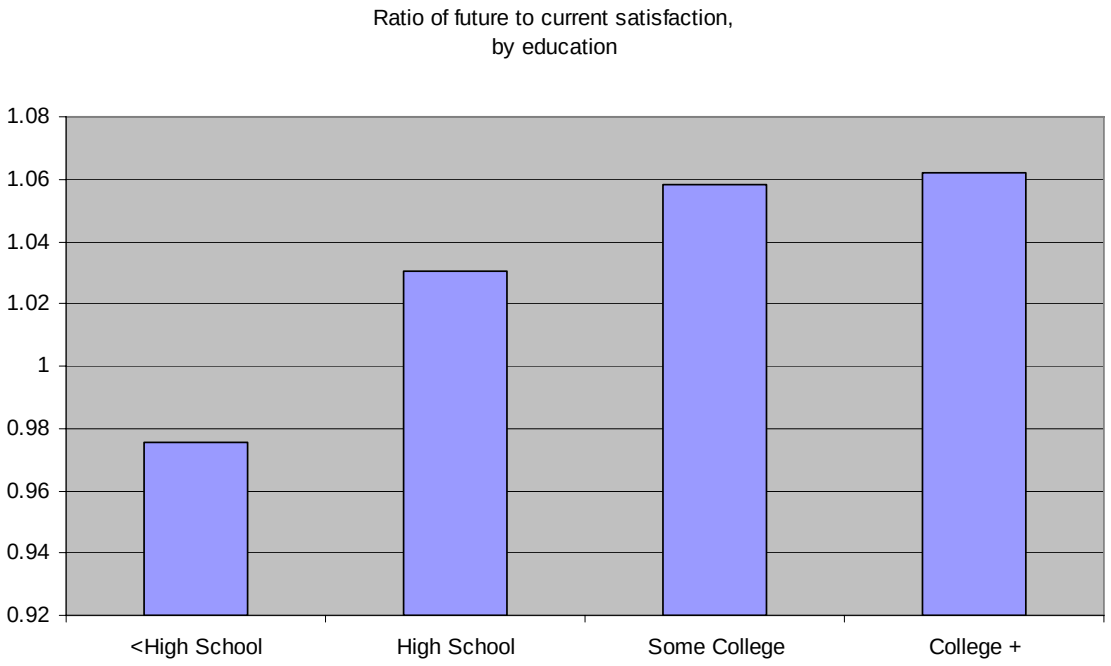
Viscusi, W. Kip, *Fatal Tradeoffs: Public and Private Responsibilities for Risk*, New York: Oxford University Press, 1992.

Figure 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.

Figure 2:



Note: Data are from the MIDUS survey.

Table 1: Health Behaviors for Whites over 25
National Health Interview Survey

				Demographic Controls			Adding Income				Adding Economic Controls			
Dependent Variable	Mean	Obs	Year	Years of Education	std error		Years of Education	std error		Reduction in Education Coefficient	Years of Education	std error		Reduction in Education Coefficient
Smoking														
Current smoker	23%	22141	2000	-0.030	(0.001)	**	-0.022	(0.001)	**	26%	-0.020	(0.001)	**	33%
Former smoker	26%	22270	2000	0.004	(0.001)	**	0.002	(0.001)		58%	0.001	(0.001)		79%
Ever smoked	49%	22156	2000	-0.026	(0.001)	**	-0.021	(0.001)	**	20%	-0.019	(0.001)	**	25%
Number cigs a day (smokers)	17.7	4910	2000	-0.697	(0.068)	**	-0.561	(0.071)	**	19%	-0.444	(0.073)	**	36%
Made serious attempt to quit °	64%	7603	1990	0.013	(0.002)	**	0.011	(0.002)	**	12%	0.011	(0.002)	**	16%
Diet/Exercise														
Body mass index (BMI)	26.7	21401	2000	-0.190	(0.014)	**	-0.159	(0.015)	**	16%	-0.139	(0.016)	**	27%
Underweight (bmi<=18.5)	2%	21401	2000	-0.0005	(0.0004)		-0.0001	(0.0004)		85%	0.0000	(0.0004)		98%
Overweight (bmi>=25)	59%	21401	2000	-0.014	(0.001)	**	-0.014	(0.001)	**	0%	-0.013	(0.001)	**	12%
Obese (bmi>=30)	22%	21401	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	22285	2000	0.079	(0.004)	**	0.067	(0.004)	**	16%	0.067	(0.004)	**	15%
Ever do vigorous activity	39%	22003	2000	0.039	(0.001)	**	0.032	(0.001)	**	18%	0.028	(0.001)	**	28%
Ever do moderate activity	53%	21768	2000	0.037	(0.001)	**	0.030	(0.001)	**	17%	0.029	(0.001)	**	21%
Alcohol														
Had 12+ drinks in entire life	80%	22054	2000	0.021	(0.001)	**	0.017	(0.001)	**	19%	0.014	(0.001)	**	33%
Drink at least once per month	47%	21803	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	13458	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	21663	2000	-0.848	(0.092)	**	-0.703	(0.098)	**	17%	-0.763	(0.100)	**	10%
Average # drinks on days drank	2.3	13600	2000	-0.162	(0.012)	**	-0.162	(0.012)	**	0%	-0.144	(0.012)	**	11%
Heavy drinker (average number of drinks>=5)	8%	13600	2000	-0.018	(0.001)	**	-0.015	(0.001)	**	12%	-0.015	(0.001)	**	13%
Drove drunk past year °	11%	17121	1990	-0.003	(0.001)	**	-0.002	(0.001)	**	27%	-0.005	(0.001)	**	-38%
Number of times drove drunk past year °	93%	17121	1990	-0.140	(0.036)	**	-0.103	(0.038)	**	27%	-0.119	(0.040)	**	15%
Illegal Drugs														
Ever used marijuana °	48%	13413	1991	0.015	(0.002)	**	0.014	(0.002)	**	9%	0.009	(0.002)	**	41%
Used marijuana, past 12 months °	8%	13413	1991	-0.001	(0.001)		0.000	(0.001)		139%	-0.002	(0.001)	**	-100%
Ever used cocaine °	16%	13174	1991	0.005	(0.001)	**	0.005	(0.001)	**	-14%	0.000	(0.001)		94%
Used cocaine, past 12 months °	2%	13174	1991	0.000	(0.000)		0.000	(0.001)		---	-0.001	(0.001)		---
Ever used any other illegal drug °	22%	13370	1991	0.003	(0.014)	**	0.006	(0.002)	**	-80%	0.001	(0.002)		79%
Used other illegal drug, past 12 months °	5%	13176	1991	-0.002	(0.001)	**	0.000	(0.001)		87%	-0.002	(0.001)	**	20%
Automobile Safety														
Always wear seat belt °	69%	29993	1990	0.033	(0.001)	**	0.027	(0.001)	**	19%	0.026	(0.001)	**	23%
Never wear seat belt °	9%	29993	1990	-0.014	(0.001)	**	-0.011	(0.001)	**	20%	-0.011	(0.001)	**	22%

Table 1 (continued)

				Demographic Controls			Adding Income				Adding Economic Controls			
Dependent Variable	Mean	Obs	Year	Years of Education	std error		Years of Education	std error		Reduction in Education Coefficient	Years of Education	std error		Reduction in Education Coefficient
Household Safety														
Know poison control number °	65%	6838	1990	0.031	(0.002)	**	0.026	(0.002)	**	18%	0.027	(0.002)	**	15%
1 + working smoke detectors °	80%	29021	1990	0.019	(0.001)	**	0.012	(0.001)	**	36%	0.012	(0.001)	**	38%
House tested for radon °	4%	28440	1990	0.007	(0.000)	**	0.005	(0.000)	**	29%	0.005	(0.000)	**	25%
Home paint ever tested for lead °	4%	9600	1991	0.000	(0.001)		0.001	(0.001)		---	-0.001	(0.001)		---
At least 1 firearm in household	42%	14207	1994	-0.011	(0.002)	**	-0.019	(0.002)	**	-73%	-0.012	(0.002)	**	-9%
All firearms in household are locked (has firearms)	36%	5268	1994	-0.005	(0.003)	**	-0.008	(0.003)	**	-60%	-0.007	(0.003)	**	-40%
All firearms in household are unloaded (has firearms)	81%	5262	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%	8169	2000	0.017	(0.001)	**	0.013	(0.002)	**	27%	0.010	(0.002)	**	40%
Had mamogram w/in past 2 yrs	56%	8100	2000	0.026	(0.002)	**	0.017	(0.002)	**	34%	0.014	(0.002)	**	45%
Ever had pap smear test	97%	11866	2000	0.009	(0.001)	**	0.009	(0.001)	**	7%	0.009	(0.001)	**	1%
Had pap smear w/in past yr	62%	11748	2000	0.028	(0.002)	**	0.019	(0.002)	**	32%	0.015	(0.002)	**	46%
Ever had colorectal screening-age 40+	31%	14302	2000	0.021	(0.001)	**	0.019	(0.002)	**	11%	0.018	(0.002)	**	14%
Had colonoscopy w/in past yr	9%	14259	2000	0.007	(0.001)	**	0.007	(0.001)	**	11%	0.006	(0.001)	**	17%
Ever been tested for hiv	30%	20853	2000	0.011	(0.001)	**	0.011	(0.001)	**	0%	0.011	(0.001)	**	2%
Had an std other than hiv/aids, past 5 y	2%	11398	2000	0.000	(0.001)		0.001	(0.001)		---	0.000	(0.001)		---
Had flu shot past 12 mo	32%	22047	2000	0.014	(0.001)	**	0.013	(0.001)	**	11%	0.013	(0.001)	**	11%
Ever had pneumonia vaccination	18%	21705	2000	0.005	(0.001)	**	0.006	(0.001)	**	-30%	0.006	(0.001)	**	-25%
Ever had hepatitis b vaccine	19%	21118	2000	0.018	(0.001)	**	0.017	(0.001)	**	4%	0.017	(0.001)	**	8%
Received all 3 hepatitis B shots	15%	20848	2000	0.015	(0.001)	**	0.014	(0.001)	**	6%	0.014	(0.001)	**	7%
Among Diabetics														
Are you now taking insulin	32%	1442	2000	-0.002	(0.004)		-0.003	(0.004)		-38%	-0.003	(0.005)		-36%
Are you now taking diabetic pills	66%	1443	2000	-0.006	(0.004)		-0.004	(0.004)		25%	-0.004	(0.005)		40%
Blood pressure high at last reading °	7%	28373	1990	-0.005	(0.001)	**	-0.004	(0.001)	**	24%	-0.004	(0.001)	**	24%
Among hypertensives														
Still have high bp °	47%	6899	1990	-0.012	(0.002)	**	-0.010	(0.002)	**	19%	-0.009	(0.002)	**	25%
High bp is cured (vs controlled) °	26%	3537	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										24%				32%

Notes: 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% (10%) level.

Table 2: Health Behaviors, Resources, and Risk Aversion
Health and Retirement Study (wave 3)

			Coefficient on Years of Education			Reduction in Education Coefficient	
Dependent Variable	Mean	Obs	Demographic Controls	Adding Economic and Background Controls	Adding Risk Aversion	Economic and Background Controls	Adding Risk Aversion
Smoking							
Current smoker	21%	5036	-0.020**	-0.019**	-0.018**	9%	-1%
			(0.002)	(0.003)	(0.003)		
Former smoker	41%	5036	0.005*	-0.001	-0.001	124%	-1%
			(0.003)	(0.003)	(0.003)		
Ever smoked daily	63%	5217	-0.015**	-0.018**	-0.019**	-24%	-1%
			(0.002)	(0.003)	(0.003)		
Diet/Exercise							
BMI	27.2	5144	-0.192**	-0.115**	-0.113**	40%	1%
			(0.026)	(0.031)	(0.031)		
Underweight	2%	5144	0.001	0.001	0.001	-20%	0%
			(0.001)	(0.001)	(0.001)		
Overweight	65%	5144	-0.013**	-0.008**	-0.008**	43%	0%
			(0.002)	(0.003)	(0.003)		
Obese	24%	5144	-0.014**	-0.007**	-0.007**	47%	2%
			(0.002)	(0.002)	(0.002)		
Vigorous activity 3+ times/week	53%	5214	0.003	-0.004	-0.004	245%	-8%
			(0.003)	(0.003)	(0.003)		
Drinking							
Current drinker	58%	5187	0.036**	0.018**	0.018**	50%	1%
			(0.003)	(0.003)	(0.003)		
Heavy drinker (ever drinks>5 drinks--all persons)	2%	5187	-0.003**	-0.003**	-0.003**	-4%	-3%
			(0.001)	(0.001)	(0.001)		
Preventive Care							
Got flu shot	39%	5215	0.014**	0.011**	0.012**	15%	-1%
			(0.002)	(0.003)	(0.003)		
Got mammogram (women)	73%	2864	0.031**	0.022**	0.022**	30%	0%
			(0.003)	(0.004)	(0.004)		
Got pap smear (women)	68%	2858	0.030**	0.016**	0.016**	46%	0%
			(0.003)	(0.005)	(0.005)		
Got prostate test (men)	67%	2348	0.029**	0.026**	0.026**	13%	-1%
			(0.003)	(0.004)	(0.004)		
Average Reduction in Education Coefficient							
Unweighted, excluding preventive care		4936	0.014**	0.010**	0.011**	24%	-1%
			(0.020)	(0.002)	(0.002)		
Unweighted percentages (outcomes w/significant gradients at baseline)						30%	0%
Mortality weighted						26%	0%

Notes: 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. Economic controls include total family income, total assets, number of individuals in the household, labor force status, region, MSA, marital status. 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. 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% (10%) level.

Table 3: Explanations for Health Differences

Measure (Data set)	Obs	All	Education <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)	7,396	47.9	15.3	37.1	53.0	69.6	1	99
Basic language and orientation questions correct (0-4) (SOS)	663	3.8	3.7	3.8	3.8	3.9	0	4
Numerical ability (count backwards, compute interest, use percentages) (SOS	663	3.8	2.7	3.5	3.9	4.2	0	5
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
Risk Aversion (SOS) (1=least; 4=most)	395	3.2	3.7	3.4	3.1	3.1	1	4
Discounting (SOS)								
Impulsivity Index (higher values correspond to more impulsive)	649	35.6	38.4	36.2	35.3	34.8	20	54
Financial tradeoff variables								
Win $1k now vs. $1.5k in a year (percent prefer now)	655	64%	76%	70%	64%	57%	0	1
Win $20 now vs. $30 in a year (percent prefer now)	654	80%	91%	82%	80%	75%	0	1
Lose $1.5k in a year vs. $1k now (percent prefer in a year)	633	51%	52%	50%	55%	46%	0	1
Lose $30 in a year vs. $20 now (percent prefer in a year)	640	45%	50%	46%	42%	46%	0	1
Planning horizon for savings and spending (years)	663	6.59	5.02	5.04	6.53	8.11	0	20
Spent a great deal of time on financial planning (percent agree)	657	58%	49%	55%	53%	66%	0	1
Spent a great deal of time planning vacation (percent agree)	651	59%	50%	55%	59%	64%	0	1
Health discounting questions								
Extra healthy days 1 year from now equal to 20 healthy days now	431	68.3	110.6	82.6	82.9	43.1	0	365
Extra healthy days 5 year from now equal to 20 healthy days now	395	83.8	133.2	81.7	98.9	64.7	0	365
Extra healthy days 10 year from now equal to 20 healthy days now	390	99.6	136.4	99.3	107.3	87.5	0	365
Extra healthy days 20 year from now equal to 20 healthy days now	378	110.3	112.8	110.9	123.4	99.1	0	365
Personality Scores								
Self control, efficacy, depression (NLSY)								
Rosenberg self-esteem score (1980) (0=min; 30=max)	7,396	21.9	19.3	21.2	22.6	23.5	0	30
Rosenberg self-esteem score (1987) (0=min; 30=max)	7,396	22.7	19.9	22.0	23.3	24.2	0	30
Pearlin score of self control (1992) (0=min; 28=max)	7,396	21.6	19.8	21.3	22.1	22.4	0	28
Rotter scale of control over life (1979) (1=internal; 16=external)	7,396	8.8	9.4	9.0	8.7	8.3	1	16
Shy at age 6 (percent extremely or somewhat)	7,396	59%	64%	62%	58%	53%	0	1
Shy as an adult (1985) (percent extremely or somewhat)	7,396	27%	37%	27%	25%	23%	0	1
Depression scale (1992) (0=minimum; 21=maximum)	7,396	3.9	5.2	4.2	3.7	3.1	0	21
Depression scale (1994) (0=minimum; 21=maximum)	7,396	3.5	4.8	3.8	3.5	2.6	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.

Table 4: The Impact of Health Knowledge on Health Behaviors
1990 National Health Interview Survey

			Without Knowledge Questions	With Knowledge Questions		
Dependent Variable	Mean	Obs	Years of Education	Years of Education	Percent Questions Correct	Reduction in Education Coefficient
Smoking						
Current smoker	26%	29929	-0.021**	-0.018**	-0.318**	17%
			(0.001)	(0.001)	(0.012)	
Former smoker	28%	29929	0.003**	0.001	0.156**	63%
			(0.001)	(0.001)	(0.013)	
Made serious attempt to quit (smokers)	64%	7602	0.011**	0.008**	0.24**	28%
			(0.002)	(0.002)	(0.024)	
Number cigs a day (smokers)	21.5	15388	-0.327**	-0.327**	0.056	0%
			(0.046)	(0.047)	(0.554)	
Alcohol						
Drink at least 12 drinks per year	73%	29869	0.010**	0.010**	-0.044**	-3%
			(0.001)	(0.001)	(0.009)	
Heavy drinker (usually drinks>=5--all persons)	5%	30222	-0.005**	-0.005**	-0.011**	1%
			(0.0005)	(0.0005)	(0.005)	
Number drinks when drinks (drank in last two weeks)	2.4	13845	-0.105**	-0.103**	-0.189**	1%
			(0.006)	(0.006)	(0.049)	
Average Reduction in Education Coefficient						
Unweighted		29836	0.022**	0.021**		5%
			(0.001)	(0.001)		
Unweighted percentages (outcomes w/significant gradients at baseline)						18%
Mortality weighted						12%

Notes: 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% (10%) level.

Table 5: The Impact of General Knowledge and Personality on Education Gradients
National Longitudinal Survey of Youth, 1979

				Effect of Education on Behaviors				Reduction in Education Coefficient		
						Addition to Income and Family Background			Addition to Income and Family Background	
Measure	Mean	Obs	Year	Demographic Controls	Income and Family Background	ASVAB Scores	Personality Scales	Income and Family Background	ASVAB Scores	Personality Scales
Smoking										
Current Smoker	27%	7918	1998	-0.056**	-0.045**	-0.038**	-0.044**	21%	11%	2%
				(0.002)	(0.002)	(0.003)	(0.002)			
Former smoker	47%	7920	1998	0.000	-0.001	-0.002	-0.001	-1100%	-2217%	-533%
				(0.002)	(0.002)	(0.003)	(0.002)			
Diet/Exercise										
BMI	27.8	7137	2002	-0.248**	-0.122**	-0.084**	-0.111**	51%	15%	4%
				(0.027)	(0.033)	(0.038)	(0.034)			
Underweight	1%	7137	2002	-0.0005	-0.0007	-0.0007	-0.0009	-35%	9%	-33%
				(0.0005)	(0.0006)	(0.0007)	(0.0006)			
Overweight	66%	7137	2002	-0.016**	-0.009**	-0.004	-0.008**	44%	27%	3%
				(0.002)	(0.003)	(0.003)	(0.003)			
Obese	29%	7137	2002	-0.019**	-0.011**	-0.008**	-0.010**	43%	13%	2%
				(0.002)	(0.003)	(0.003)	(0.003)			
Vigorous exercise	41%	6050	1998	0.038**	0.028**	0.027**	0.023**	27%	3%	12%
				(0.003)	(0.003)	(0.004)	(0.003)			
Light exercise	77%	6051	1998	0.026**	0.018**	0.011**	0.014**	30%	29%	15%
				(0.002)	(0.003)	(0.003)	(0.003)			
Alcohol										
Current drinker	58%	7389	2002	0.025**	0.009**	-0.002	0.006**	63%	46%	14%
				(0.002)	(0.003)	(0.003)	(0.003)			
Heavy drinker (mean # of drinks>=5--all population)	8%	7389	2002	-0.014**	-0.009**	-0.009**	-0.009**	33%	0%	0%
				(0.001)	(0.002)	(0.002)	(0.002)			
Frequency of heavy drinking past month (drinkers only)	1.0	3983	2002	-0.170**	-0.121**	-0.105**	-0.112**	29%	9%	5%
				(0.014)	(0.016)	(0.019)	(0.017)			
Number of drinks (drinkers only)	2.7	3973	2002	-0.207**	-0.131**	-0.096**	-0.120**	37%	17%	5%
				(0.012)	(0.014)	(0.017)	(0.015)			
Illegal Drugs										
Never tried pot	35%	7897	1998	0.009**	0.006**	0.013**	0.007**	31%	-76%	-8%
				(0.002)	(0.003)	(0.003)	(0.002)			
# times smoked pot in life>50	26%	7897	1998	-0.016**	-0.013**	-0.019**	-0.014**	18%	-34%	-2%
				(0.002)	(0.002)	(0.003)	(0.002)			
Never tried cocaine	74%	7926	1998	0.001	0.002	0.009**	0.002	-22%	-507%	-12%
				(0.002)	(0.002)	(0.003)	(0.003)			
# times used cocaine in life>50	6%	7926	1998	-0.007**	-0.005**	-0.008**	-0.006**	23%	-51%	-9%
				(0.001)	(0.001)	(0.002)	(0.001)			
Preventive Care Use										
Regular doctor visit last year	60%	7381	2002	0.005**	0.003	0.009**	0.001	47%	-114%	32%
				(0.002)	(0.003)	(0.003)	(0.003)			
OBGYN visit last year	58%	3814	2002	0.032**	0.022**	0.024**	0.022**	29%	-6%	2%
				(0.003)	(0.004)	(0.004)	(0.004)			
Other										
Read food labels	45%	7396	2002	0.049**	0.033**	0.022**	0.029**	17%	28%	10%
				(0.002)	(0.003)	(0.003)	(0.003)			
Average Reduction in Education Coefficient										
Unweighted, excluding preventive care, 2002		7132	2002	0.040**	0.025**	0.018**	0.023**	37%	17%	7%
				(0.002)	(0.003)	(0.003)	(0.003)			
Unweighted, 1998		5901	1998	0.044**	0.033**	0.037**	0.032**	27%	-9%	2%
				(0.003)	(0.003)	(0.004)	(0.004)			
Unweighted percentages (outcomes w/significant gradients at baseline)								34%	-6%	5%
Mortality weighted								28%	13%	3%

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, gender, and white. Income and family background controls include family income, family size, region, MSA, marital status, and socioeconomic background (whether respondent is american, whether mom is america,whether dad is american familiy 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 a

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% (10%) level.

Table 6: Discounting and the Value of the Future
National Survey of Midlife Development in the United States, 1995-1996

			Coefficient on Years of Education					Reduction in Education Coefficient			
					Addition to Income and Family Background				Addition to Income and Family Background		
Dependent Variable	Mean	Obs	Basic Demographics	Economic and background	Current and Future Life Satisfaction and Future Planning	Personality	Social integration	Economic and Background	Current and Future Life Satisfaction and Future Planning	Personality	Social integration
Smoking											
Current smoker	25%	2545	-0.043**	-0.032**	-0.032**	-0.032**	-0.029**	25%	0%	-1%	8%
			(0.004)	(0.005)	(0.005)	(0.005)	(0.005)				
Former smoker	29%	2546	-0.004	-0.008	-0.008	-0.006	-0.008	-76%	-6%	36%	-6%
			(0.004)	(0.005)	(0.005)	(0.005)	(0.005)				
Average # of cigs per day	26.1	1372	-1.119**	-0.955**	-0.949**	-0.955**	-0.945**	15%	1%	0%	1%
			(0.212)	(0.245)	(0.244)	(0.254)	(0.267)				
Ever tried to quit smoking (if smoker)	83%	585	-0.008	-0.004	-0.005	-0.006	-0.004	48%	-9%	-20%	2%
			(0.010)	(0.012)	(0.012)	(0.012)	(0.012)				
Diet/Exercise											
BMI	26.5	2440	-0.174**	-0.101*	-0.097	-0.100	-0.080	42%	2%	1%	12%
			(0.052)	(0.059)	(0.059)	(0.059)	(0.062)				
Underweight	3%	2440	0.00022	0.0027*	0.0028*	0.003**	0.003	-1131%	-72%	5%	-3%
			(0.0014)	(0.0016)	(0.0016)	(0.0015)	(0.0017)				
Overweight	56%	2440	-0.011**	-0.004	-0.003	-0.004	-0.002	66%	3%	-5%	19%
			(0.005)	(0.006)	(0.006)	(0.006)	(0.006)				
Obese	21%	2440	-0.016**	-0.013**	-0.012**	-0.013**	-0.012**	22%	2%	1%	3%
			(0.004)	(0.005)	(0.005)	(0.005)	(0.005)				
# of times per month engages in vigorous exercise	5.9	2546	0.211**	0.114**	0.103*	0.113**	0.072**	46%	5%	1%	20%
			(0.050)	(0.057)	(0.056)	(0.057)	(0.060)				
Lose 10 lbs due to lifestyle	22%	2466	-0.007	-0.011**	-0.012**	-0.012**	-0.012**	-53%	-7%	-8%	-6%
			(0.004)	(0.005)	(0.005)	(0.005)	(0.005)				
Illegal Drugs											
Used cocaine, past 12 months	1%	2538	-0.002	-0.002*	-0.002*	-0.003*	-0.002	-44%	-5%	-15%	-1%
			(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	-1241%	92%	-370%	-217%
			(0.002)	(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	28%	5%	34%	45%
			(0.003)	(0.003)	(0.003)	(0.003)	(0.003)				
Preventive Care											
Take vitamin at least few times per week	48%	2546	0.025**	0.022**	0.022**	0.022'**	0.020**	12%	1%	-1%	9%
			(0.005)	(0.006)	(0.006)	(0.006)	(0.006)				
Had blood pressure test, past 12 months	67%	2516	0.004	0.003	0.004	0.002	0.003	28%	-13%	18%	-12%
			(0.005)	(0.006)	(0.006)	(0.006)	(0.006)				
Doctor visit, past 12 months	69%	2496	0.011**	0.009*	0.009*	0.009	0.010	19%	2%	-2%	-3%
			(0.004)	(0.005)	(0.005)	(0.005)	(0.005)				
General Behavior											
Work hard to stay healthy (1-7 scale, 1 is better)	2.4	2546	0.001	0.011	0.015	0.009	0.032**	-1026%	-380%	228%	-2111%
			(0.013)	(0.015)	(0.015)	(0.015)	(0.015)				
Effort put on health (0-10 scale, 10 is better)	7.1	2546	-0.008	-0.007	-0.014	-0.003	-0.034	14%	-106%	43%	-367%
			(0.020)	(0.024)	(0.024)	(0.024)	(0.025)				
Average											
Unweighted		2279	0.022**	0.015**	0.014**	0.015**	0.012**	30%	6%	0%	17%
			(0.003)	(0.004)	(0.004)	(0.004)	(0.004)				
Unweighted percentages (outcomes w/significant gradients at baseline)								27%	2%	-1%	8%
Mortality weighted								25%	1%	1%	5%

Note: Basic regressions include controls for age, 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, 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, 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.

Table 7: Effect of discounting and other measures
Survey of Smoking

			Alternative Measures of Discounting					
Outcome	Demographics	Adding income	Winning and losing questions	Planning horizon	Time spent on financial planing	Time spent planning vacation	Impulsivity index	Health discounting
Current smoker	-.0278**	-.0255**	-.0271**	-.0241**	-.0253**	-.0245**	-.0240**	-.0236**
(mean=.38)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
% of base explained		8%	-6%	5%	1%	4%	5%	7%
Obese	-.0217**	-.0168*	-.0178*	-.0169*	-.0158*	-.0175*	-.0156*	-.0199*
(mean=.32)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
% of base explained		23%	-5%	0%	5%	-3%	6%	-14%

Note: The sample size is 652 in all regressions. Demogrpahic contorls include dummies for male, married, hispanic, race and age. Income is a series of dummy variables. * significant at 5%; ** significant at 1%

Table 8: Effect of Test Scores on the Education Gradient in the UK National Child Development Study (Wave 6)

			Coefficient on Passing A Level							Percent of Education Coefficient Explained By					
					Addition to Income and Background Controls						Addition to Income and Background Controls				
Behavior	Mean	N	Demographics	Income and Background	Cognitive Ability	Current and future satisfaction	Personality	Social Integration	All Factors	Income and Background	Cognitive Ability	Current and future satisfaction	Personality	Social Integration	Adding All factors
Smoking															
Current smoker	29%	6499	-0.150**	-0.095**	-0.040**	-0.092**	-0.091**	-0.077**	-0.033**	37%	36%	1%	2%	11%	40%
			(0.012)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)						
Former smoker	25%	6493	0.002	-0.020	-0.013	-0.022	-0.019	-0.028*	-0.020	1100%	-350%	100%	-50%	400%	-50%
			(0.012)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)						
Quit smoking (ever smoked only)	46%	3492	0.149**	0.084**	0.043*	0.080**	0.083**	0.062**	0.031	44%	28%	3%	1%	15%	34%
			(0.019)	(0.022)	(0.024)	(0.022)	(0.022)	(0.023)	(0.024)						
Number of cigarettes smoked	17.0	1599	-2.386**	-1.400**	-1.391**	-1.562**	-1.417**	-1.106**	-1.118*	41%	0%	-7%	-1%	12%	6%
			(0.536)	(0.613)	(0.657)	(0.610)	(0.604)	(0.630)	(0.668)						
Diet/Exercise															
BMI	25.8	6303	-1.052**	-0.751**	-0.664**	-0.733**	-0.723**	-0.638**	-0.572**	29%	8%	2%	3%	11%	17%
			(0.122)	(0.144)	(0.158)	(0.145)	(0.145)	(0.149)	(0.161)						
Underweight	1%	6303	0.005*	0.005	0.006*	0.005*	0.005	0.005	0.005	0%	-20%	0%	0%	0%	0%
			(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)						
Overweight	52%	6303	-0.107**	-0.079**	-0.081**	-0.079**	-0.075**	-0.068**	-0.068**	25%	-1%	1%	5%	11%	11%
			(0.013)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.018)						
Obese	15%	6303	-0.062**	-0.040**	-0.033**	-0.040**	-0.039**	-0.032**	-0.03**	35%	11%	0%	2%	13%	16%
			(0.010)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.013)						
Exercise regularly	75%	6498	0.117**	0.063**	0.046**	0.064**	0.062**	0.052**	0.044**	46%	15%	-1%	1%	9%	17%
			(0.012)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)						
Eat fruit every day	53%	6505	0.139**	0.098**	0.086**	0.101**	0.096**	0.075**	0.076**	29%	9%	-2%	1%	17%	17%
			(0.013)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.017)						
Eat vegetables every day	17%	6505	0.038**	0.010	0.030**	0.016	0.011	0.003	0.026**	74%	-53%	-16%	-3%	18%	-42%
			(0.010)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.013)						
Drinking															
Drinker	95%	6499	0.012**	0.005	-0.004	0.003	0.004	0.007	-0.001	58%	75%	17%	8%	-17%	50%
			(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)						
Heavy drinker	12%	6499	-0.033**	-0.016	-0.02*	-0.014	-0.015	-0.005	-0.009	52%	-12%	6%	3%	33%	18%
			(0.008)	(0.010)	(0.011)	(0.010)	[0.010]	(0.010)	(0.011)						
Number of drinks in week	19.5	5008	-3.987**	-2.348**	-2.044**	-2.224**	-2.174**	-1.381*	-1.136	41%	8%	3%	4%	24%	29%
			(0.649)	(0.775)	(0.850)	(0.777)	(0.776)	(0.784)	(0.848)						
Illegal Drugs															
Illegal drugs in last 12 months	8%	6446	0.006	0.007	0.007	0.007	0.006	0.005	0.004	-17%	0%	0%	0%	33%	67%
			(0.007)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)						
Ever tried illegal drugs	33%	6446	0.109**	0.066**	0.048**	0.062**	0.069**	0.052**	0.038**	39%	17%	4%	-3%	13%	26%
			(0.012)	(0.014)	(0.015)	(0.014)	(0.014)	(0.015)	(0.015)						
Average															
Unweighted		6505	0.091**	0.058**	0.031**	0.059**	0.048**	0.046**	0.044**	36%	13%	-1%	3%	9%	16%
			(0.008)	(0.009)	(0.012)	(0.009)	(0.010)	(0.010)	(0.010)						
Unweighted percentages (outcomes w/significant gradients at baseline)										39%	9%	1%	2%	12%	17%
Mortality weighted										39%	35%	2%	2%	13%	39%

Note: The sample is people that 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 age16, 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 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 as 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 1-12).

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.

Table 9: Share of Education Gradient Explainable by Different Factors

	Explanatory Power					
Factor	NHIS	HRS	NLSY	MIDUS	NCDS	Approximate Summary
Economic and background	24%	26%	28%	25%	39%	30%
Additional reduction when add:						
Specific knowledge	12%	NA	NA	NA	NA	12%
Cognitive ability	NA	NA	13%	NA	35%	20%
Tastes	---	0%	NA	1%	2%	0%
Personality	4%	NA	3%	1%	2%	0%
Social integration	---	NA	NA	5%	13%	10%

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