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TRAFFIC SAFETY AND HUMAN CAPITAL

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Abstract

This paper documents a large educational gradient in traffic fatality rates and investigates its source. Compared to individuals with a college education, those with at most a high school diploma are more than four times as likely to die in a traffic accident, a gradient exceeding that for all-cause mortality. More educated individuals health behaviors, such as drinking or seat belt use, support this gradient. A panel analysis of data from the Fatality Analysis Reporting System indicates that this gradient is, to a small degree, causal, particularly for males, who cause most traffic accidents.

***Keywords*:** human capital; traffic safety

***JEL Codes*:** I12, I26, R41

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1. Introduction

In the beginning—that is, before the late 1960s, before traffic safety became a social problem and a potent political issue—traffic accidents in the U.S. were "regarded as accidental in almost a cosmic sense. The statistical toll of road accidents was collected and reported with an air of fatalism similar to attitudes toward earthquakes, tornadoes, or other natural disasters. At the same time, the…paradigm of responsibility began and ended with the personal fault of the parties to the accident" (Zimring, 1988).

In the late 1960s and early 1970s this began to change, as policymakers and the public realized "that the manner in which…laws are drafted and enforced can have important effects on highway deaths and injuries" (Zimring, 1988). Researchers now consider traffic safety in this light, writing dozens of papers exploring the effects of various laws and policies on accident and fatality rates.

This has become so commonplace, in fact, that it is easy to overlook other perspectives on the issue. But such perspectives can be fruitful. In this paper we examine traffic safety from a human capital perspective. The disparity in traffic fatality rates between groups with different education levels is far greater than that associated with any given law. This disparity is causal to some degree. We reveal similar variation in safety-related behaviors, and, in a dynamic panel analysis, find that increases in education at the state level indicate a reduction in fatal accidents for male drivers, ceteris paribus, but not for females. These findings contribute not only to the traffic safety literature, but also to related literatures on the health effects of education and on the socioeconomic gradient in health.

The paper proceeds as follows. We first set the stage by reviewing the three literatures to which we contribute, and then examine the relationship between education and traffic safety, using three well-known data sets. With the U.S. Vital Statistics, we document a large educational gradient in traffic fatalities. With a panel analysis of traffic fatalities, recorded in the Fatality Analysis Reporting System, we show that increases in a state's education level indicate a modest reduction in that state's traffic fatalities, ceteris paribus, and that men and women are impacted differently by these changes. Finally, with the Behavioral Risk Factor Surveillance System, we confirm a similar educational gradient in behaviors relevant to traffic safety, which also differs systematically between men and women.

2. Review of Relevant Literatures

Traffic Safety

Economic research on traffic safety became increasingly common in the 1980s, after the implementation of policies designed to reduce traffic accidents, such as seat belt laws, laws concerning drunk driving, and reduced speed limits. Examples include Lave (1985), who argued that speed limits mattered less for traffic safety than the variation in speed, and Fowles and Loeb (1989), who found that higher speed limits are associated with increased risk of accidents. Adams et al. (2012) find that higher minimum wages increase the probability of alcohol involvement in fatal accidents among teenagers. But some policies matter more than others. Freeman (2007) has shown that *per se* .08 blood alcohol content laws do not reduce fatalities, while Grant (2010) has shown a similar result for zero tolerance laws.

This research typically uses a panel of states covering a decade or more, and controls for state-level non-policy determinants of traffic fatalities, such as the unemployment rate, the number of miles driven, and population demographics. It is by now traditional to include state fixed effects and to account for time trends at the national or state level.

In parts of our analysis below we follow the methods of many of these studies, and employ many of the same controls. Our focus is not a specific policy change, however, such as laws related to speed limits or drunk driving. Rather, we are concerned about the impact that education may have on observable and unobservable driver behavior and the resulting impact on mortality rates. Policy variables take an unfamiliar role—that of controls.

Education and Health

Multiple researchers have already examined the relationship between various measures of education or education policies and measures of health. The recent survey of Lochner (2011), for example, identifies fifteen such studies within the previous five years.

The personal characteristics that influence the amount of schooling obtained, such as cognitive ability, time preference, and self-control, can also influence health directly. Most recent studies in this literature attempt to address this issue by employing instruments that exogenously influence the amount of education received, especially reforms in the number of years of mandatory education. The literature as a whole, while not unanimous, supports the notion that education causes improvements in health.

While these studies discuss a wide variety of health behaviors and health outcomes, the literature on education and mortality specifically is neither voluminous nor decisive. Lleras-Muney (2005) finds that education substantially reduces mortality, while Mazumder (2008) and Clark and Royer (2013) find a small effect in the opposite direction, and Albouy and Lequien's (2009) estimates are statistically insignificant. In contrast to these studies, two recent papers focus on the effect of college: Buckles et al. (2015), who examine how increased college attendance resulting from Vietnam era draft avoidance in the United States affected mortality, and

Lundborg, Lyttkens, and Nystedt's (2016) analysis of twins in Sweden. The first study found that college graduates are less likely to smoke than their non-college educated counterparts, and have a lower incidence of cancer and heart disease, while the second found that college graduation lengthens life by three years. However, none of these studies directly address traffic fatalities specifically or even accidental causes of death generally.

Furthermore, these studies' use of instrumental variables, while justified, has real costs and uncertain benefits. Lleras-Muney (2005), Mazumder (2008), Albouy and Lequien (2009), and Clark and Royer (2013), like many studies in the education-health literature, use compulsory schooling reforms to identify the causal effect on health. As a result, "they measure improvements in health associated with lower levels of education" (Lochner, 2011, p. 231), which by now are easily surpassed by most residents of economically developed countries, and where the education-health gradient is smallest (Montez et al., 2012). Furthermore, despite an expected upward bias in ordinary least squares, Chou et al. (2010) stress that instrumental variable estimates tend to be larger than ordinary least squares estimates. Buckles et al. (2015) find no difference between their OLS and IV estimates. These findings, collectively, are reassuring for panel analyses like those below, for which no natural IV strategy is available.

In addition to these studies are several others, also reviewed in Lochner (2011), that investigate the pathways through which education might improve health. Several pathways, such as diet, smoking, and exercise, are quite important for health generally but far less relevant to traffic safety. Others are more relevant: education may reduce stress, improve decision-making, ameliorate prudence or self-control, or increase the resources available to purchase health-related inputs (such as safer automobiles). The most relevant study that speaks to these is Cutler and Lleras-Muney (2010), which finds roles for cognitive skills and resources, and which finds that education and seat belt use are positively correlated. The next most-closely related study, Ross and Wu (1995), reports similar findings.

In summary, despite large literatures on traffic safety and the effect of education on health, we know little about the relationship between education and traffic safety. The literature that does exist does not provide a convincing basis to confidently assert that such a relationship should or should not exist: existing mortality studies are too few and too contradictory in their findings, while the relevant "pathways" literature, which is even smaller, finds a role for one pathway (resources) but not for others. Furthermore, traffic safety is unique in this literature in being an accidental cause of death, which affects the (relatively) young more than the elderly, and is influenced less by physiological health behaviors such as diet than by psychological factors such as self-control. All of these reasons justify a focused investigation on the link between education and traffic safety.

3. The Association between Education and Traffic Safety

We begin by documenting the raw association between education and traffic safety, in both aggregated and disaggregated form. Individual-level associations are calculated using the U.S. Vital Statistics, while state-level associations utilize the data from the Fatality Analysis Reporting System, described below. As it turns out, the strength of the association is similar either way.

Vital Statistics

The U.S. Vital Statistics record demographic information and causes of death for every fatality in the United States and its territories. We selected all deaths in 2014 within the U.S. proper (no territories) for all individuals aged 25 and over, and retained the following demographic information: race, ethnicity, age, sex, and the highest level of education completed. The latter is broken down quite finely, into eight groups, ranging from individuals who never progressed beyond the 8th grade to those receiving doctorates. The U.S. Census Bureau publishes population estimates for each of these groups, broken down by these same demographics, so we can calculate the relative fatality risk by education, for the full population or any of the demographics selected.

Such fatality risks are presented in Table 1, relative to high school graduates, for three "underlying causes of death": motor vehicle accidents; "external causes," which include motor vehicle accidents, other accidents, homicides, and suicides, in roughly equal number; and all causes of death. We can see the educational gradient by reading down each column, as education increases, beginning with those who never attended high school and ending with those obtaining doctorate or professional degrees.

Certain patterns apply across all three causes of death. There is a sizeable education gradient throughout. The death rate of college graduates, collectively, is at most a third of high school graduates, which is in turn less than that of high school dropouts. These gradients apply, to varying degrees, across all demographic groups. At higher education levels, however, the relative mortality rates differ by gender, in ways that vary depending on the cause of death. It appears that there is something different about men and women at higher education levels, foreshadowing a theme we explore in our regressions below.

These patterns certainly apply to motor vehicle accidents in particular. The overall gradient is, with the intriguing exception of the lowest education group, larger than it is for all external causes of death and for all causes of death. High school dropouts are five times more likely to die of a motor vehicle accident than are individuals with doctorate or professional degrees.

To put these differences in context, we calculated the counterfactual mortality rate that would obtain if half of the individuals in each education group had been in the next higher group. As each group generally differs from its successor by one or two years of education, this would implied reduction in fatalities, 15%, would amount to saving roughly 4,000 lives.

The size of this gradient depends on demographic factors. It is somewhat larger for men, who perish more frequently in these accidents, than women, and applies, to a greater or lesser degree, to Hispanics, non-Hispanic whites, and blacks. But the most dramatic demographic effect, for all three sets of causes of death, occurs by age: the education gradients for individuals aged at least 55 tend to be roughly half of those for younger ages. For individuals between the ages of 25 and 34, the socioeconomic gradient is extremely strong, so that individuals with advanced education have one tenth the fatality risk of high school dropouts. For many causes of death, this gradient would have little effect upon the aggregate, because most deaths would occur at higher ages. But motor vehicle accidents are a distinct exception: most deaths in this category occur before age 45. If this effect is even slightly causal, it would be quite meaningful, especially given the modest effects of many traffic safety laws, which are often in the neighborhood of 5% or less.

In summary, the education gradient in traffic mortality is relatively large. This occurs for two reasons: 1) conditional on age, the gradient is larger than it is for other causes of death, and 2) most traffic fatalities occur at younger ages, where the gradient is larger for all causes of death.

Fatality Analysis Reporting System

The relationship we have uncovered at the micro level shows up in the aggregate as well. To illustrate, we relate state-level fatality rates, in logarithms, to a summary measure of education.

We calculate fatality rates by dividing traffic fatalities in each state by the total vehicle miles traveled in that state. These fatality data come from the Fatality Analysis Reporting System (FARS) of the National Highway Traffic Safety Administration (NHTSA), while the Department of Transportation (DOT) provides estimates of vehicle miles traveled within each state. We omit the District of Columbia, as we anticipate many of the District's accidents involve drivers from other states, especially Maryland and Virginia.

For our summary measure of education, we use the fraction of adults at least twenty-five years of age who have graduated from college. This measure is of general interest, identifies the key margin along which educational achievement has increased over the period of our analysis, 1980-2014, varies substantially over this time period, and corresponds well with education levels generally. Its correlation with the average years of education, for example, is about 0.9.

Our long sample period is intended to allow maximum variation in educational achievement at the state*year level. However, perfectly consistent measures of educational achievement over this period are not available. The best we could find comes from the IPUMS extracts of the

Current Population Survey (Flood et al., 2015), which interviews 50-60,000 households monthly on a rotation basis. The variable we use, the time-consistent educational status recode, "was created to maximize comparability over time for those studying educational attainment." We selected all individuals reported in the survey who were at least twenty-five years of age and recorded their educational achievement in years. We coded people with at least sixteen years of educational achievement as college graduates. We then calculated the proportion of college graduates within each state for each year, using population weights.

The top graph in Figure 1 presents a simple scatterplot between our education measure and per-mile traffic fatalities, at the state level, for the middle year of our sample period, 1997. Their association is essentially linear, suggestive of a dose-response relationship, and their correlation, nearly -0.62, is surprisingly strong. An increase in educational achievement in the state, such that the fraction of college graduates grows by five percentage points, is associated with a reduction in per mile fatalities of almost 18%. This compares quite closely to the association predicted by the Vital Statistics data, in which a comparable increase in educational achievement reduced motor vehicle fatalities by 15%.

The bottom graph in Figure 1 shows that this association also holds at a much broader level. It combines three cross-sectional plots: from 1997; from 1980, seventeen years before; and from 2014, seventeen years after. All three plots fall along the same line, whose slope is almost identical to that given above. If the cross-sectional relation between education and traffic fatalities was wholly causal, this graph would imply that virtually all of the more than halving of fatality rates over this period could be attributed to increases in educational attainment.

The within-year variation is also revealing. In 1980, both educational attainment and fatality rates are fairly tightly clustered, but as time progresses educational attainment becomes substantially more variable, and fatality rates with it. This should not be attributed only to within-state educational production: recent decades have seen substantial sorting of college graduates into coastal states (Bishop, 2008). Either way, the spatial variation in traffic fatalities has responded accordingly.

In general, then, both the Vital Statistics and the FARS data reveal a strong educational gradient in motor vehicle fatalities, which accords with the cross-sectional variation in traffic fatality rates, their decline over time, and their increased geographical dispersion.

4. **Causal Impacts**

The Vital Statistics and FARS data are useful in establishing the relationship between education and traffic fatalities, but the estimates in the previous section do not admit of a causal interpretation. In this section we use data from the FARS and the Behavioral Risk Factor Surveillance System to explore causal mechanisms and establish whether this relationship is robust in the presence of other factors which the existing literature has shown to be correlated with traffic fatalities.

Panel Estimation Method

The natural place to start is with panel regressions that relate state fatality rates to our simple statewide measure of educational attainment, the percentage of adults with a college degree. The applicable regression specification is as follows:

$$\ln(\text{fatalities per million miles travelled})_{s,t} = \alpha_s + \beta \text{COLLEGE}_{s,t} + \gamma X_{s,t} + \delta t + \phi t^2 + \varepsilon_{s,t}$$

where COLLEGE measures the proportion of that state's adults who have graduated from college, X represents a vector of control variables, t indexes time, α_s represents a full set of state fixed effects, β is the regression coefficient of primary interest, γ are the coefficients on the controls, δ and ϕ estimate a quadratic time trend, used to account for the general reduction in traffic related fatalities over the sample period, and ε is an error term. A Box-Cox analysis of the data suggests the natural log transformation of fatalities, which is also consistent with other studies of traffic fatalities, such as Anderson, Hansen and Rees (2013) and Cohen and Einav (2003). Because the error term is mildly correlated within states over time, all standard errors are computed using the Newey-West method that accounts for this autocorrelation.

It is important to clarify how β is identified. Though expressed as a fraction of the population, our education variable is at heart a stock variable, an accumulation of the flow of people that graduate from college in that state, net of the flow of migrant college graduates into and out of the state. As such, it can be expected to evolve slowly over time.

It does so, and it does so at a fairly even rate. Figure 2 presents a scatter plot that relates our education measure in 1980 to that in 2014. The strong national trend is apparent. A panel regression relating our education measure to state fixed effects and a linear national trend has an R^2 value of 0.92. Still, there is some inter-state variation in the growth rate of educational achievement. Nearly half of this comes from trends at the state level: adding these to this regression increases the R^2 value to 0.95. The remaining variance in education has a standard deviation of under two percentage points, which complicates identification given the sampling error in measuring this variable by state by year. In consequence, we computed results both with and without state trends, but focus on the former, as statistical tests and the findings themselves both support their inclusion. In these, β is identified through the deviation in annual values from the trend. Though this moderates the coefficient estimates (by amplifying the effects of errors-in-variables bias introduced through sampling error) and weakens statistical power somewhat, enough remains to draw clear conclusions.

The vector X includes several control variables that could confound the link between education and traffic safety, focusing on variables that other researchers have used and found meaningful in explaining the variation in traffic fatalities across states. We compiled 70+ mile per hour speed limit law data from a variety of sources, including the NHTSA's *Summary of State Speed Laws* (various editions); where gaps in the NHTSA's publications left the year of a state's speed limit change ambiguous we searched for the state's law to determine the year. Fowles and Loeb (1989) and McCarthy (2005) show connections between driving speeds, speed limits and safety. We include information on seat belt laws available from the Insurance Institute for Highway Safety; see Cohen and Einav (2003) for a discussion of seat belt laws. In addition, the DOT estimates the number of miles traveled on rural roads and we use this to control for the percentage of miles traveled on rural roads (Dang, 2008). Finally, controls for administrative license revocation laws (McArthur and Kraus, 1999) are included. This is the only major drunk driving law with a statistically negative effect in our estimates.[1]

The Census Bureau also provides estimates of the number of people in different age groupings, from which we calculated the percentage of each state's population between 25 and 44 years of age, and that 45 years of age or older, with drivers under 25 as the omitted category. Age demographics like these have been used previously by Eisenberg (2003) and Freeman (2007). As different measures of economic activity we took the state unemployment rates from the Bureau of Labor Statistics (BLS) and the state level per capita income from the Current Population Survey. Unemployment rates are a common explanatory variable in the literature on traffic fatalities (see for example Ruhm (1996), Dee (2001), and Eisenberg (2003)) while per capita income and GDP have also been shown to have explanatory power (see results in Adams et al. (2012) and Eisenberg (2003)).

Table 2 shows summary statistics and correlations for these variables. The correlations between fatalities, the age structure of the population, education, and income are substantial. These correlations, serial correlation in the error term, and the inclusion of state trends in many specifications will complicate efforts to precisely disentangle the effects of each independent variable on fatalities. Accordingly, we conduct the one-sided hypothesis tests that are strictly supported by theory and past evidence of the effect of education on health, which leads us to expect $\beta < 0$. This alternative is tested against the null that β is non-negative.

Results: Fatality Analysis Reporting System

As a baseline, the initial columns of Table 3 report the β estimates from regressions that reproduce the results of the previous section in coefficient form. The first includes only COLLEGE, omitting all fixed effects, trends, and controls from the specification above. This

[1] The effects of laws aimed at youth, such as lower drinking ages, are reliably insignificant in traffic safety studies that do not focus on that age group (see, for example, Eisenberg (2003)). In addition, several specifications below exclude accidents involving drivers under 25.

estimate, -5.1 (standard error 0.1) implies that a one percentage point increase in COLLEGE is associated with a 5% reduction in fatality rates.[2] The coefficient changes dramatically when state fixed effects and trend variables are added, to -.27 (0.21). It changes further, to -.41 (.18), when we add the other covariates, and then to -.19 (.16) when adding state*trend interactions. While each of these three estimates takes the expected sign, traditional significance levels are achieved only for the model that includes state fixed effects and covariates but not state trends. The signs of the estimated coefficients on the other covariates are all consistent with previous studies and our expectations.

We provide results using alternative measures of educational achievement in Panel A of Table 4. When we use average years of schooling as the explanatory variable, in the last column of the table, we find an insignificant coefficient estimate of -.02 (.02). But significance returns when we use the proportion of high school graduates, with an estimated coefficient of -.35 (.18). Including both the proportion of college and high school graduates yields a coefficient estimate for the proportion of high school graduates that is of similar magnitude and again statistically significant, while the estimate for college graduates decreases noticeably in magnitude and statistical significance. These results suggest that achieving certain educational levels or thresholds may be particularly important for traffic safety, and that the lower threshold—high school graduation—is more important than the upper threshold, graduating from college.

Overall, the estimates are consistently negative, sometimes significant, and small though not trivial. A sizeable five percentage point increase in the percentage of college and high school graduates implies a two percent decrease in fatal accidents. Our findings indicate that much, though not all, of the strong relationship observed in Figure 1 is an artifact of a general trend in education and traffic fatalities and, to a lesser degree, the effects of observed covariates.

Given the mixed statistical significance of these coefficients, we consider whether a different look at the data may clarify the picture. Thus we examine fatalities among *drivers* aged 25 to 65, reducing potentially extraneous variation in the number of fatalities in the accident and focusing on drivers who are likely to have completed their education. We further homogenize the set of drivers considered by excluding those over 65, noting that aging impacts driving in negative ways.[3]

In Panel B of Table 4 we show results from regressions where the dependent variable is the log of fatalities among drivers aged 25-65 per million vehicle miles. The educational measures we use here are the same as in Panel A, though we restrict our key explanatory variables to the population aged 25-65. As in Panel A, the coefficient estimates are negative with similar magnitudes but the statistical significance is uniformly weaker.

[2] This is somewhat larger than the effect noted earlier, which was only for 1997.

[3] See the National Institutes of Health webpage https://nihseniorhealth.gov/olderdrivers/howagingaffectsdriving/01.html.

In order to explore this further, we break down the analysis by gender. There are several reasons for doing so. We observed gender differences in the education gradients calculated from the Vital Statistics in Table 1a. Heckman (2008) and others have documented that growth in schooling has been far greater among women than men. Schooling's effect on traffic safety could also differ across the genders: males, who are more accident-prone than females, could have more to gain. Finally, a similar breakdown can be found in some other studies in this literature (e.g., Lundborg, Lyttkens, and Nystedt, 2016).

We calculate educational attainment separately for women and men, by state by year, and relate it to gender-specific measures of traffic safety: driver fatalities, as before. This removes females killed in cars driven by males, and vice versa, and should provide a cleaner measure of cause and effect. As we noted above, the number of fatalities given a severe accident contains noise stemming from the number of passengers in the car and the number of cars involved.

Table 5, Panel A shows regression results where the dependent variable is the natural log of the number of male drivers aged 25-65 per million miles travelled killed in traffic accidents. The regressions parallel those in Table 4, Panel B. In contrast with those results, however, here the estimated coefficients for the proportion of male college graduates, the proportion of male high school graduates, and males' average years of schooling are statistically significant at the .05 level. The estimated coefficient on the proportion of high school graduates, -.48 (.22), is somewhat larger than its college graduate counterpart -.35 (.19), a relationship maintained when the two measures are included in the regression together. Panel B presents analogous results for females. Here the findings are much less auspicious, with coefficient estimates of unexpected sign and generally low significance.

In summary, increases in education rates benefit male drivers, who cause most accidents, but not female drivers, for whom the coefficient estimates are sometimes positive. It is possible that more educated women do more driving, supplanting some of the driving done by males. We cannot check for this directly, however, as we do not have miles driven by gender, just total miles driven per state per year. However, behavioral factors are also at work, as we now show.

Mechanisms: Behavioral Risk Factor Surveillance System

To explore behavioral mechanisms, we turn from the FARS and Vital Statistics to data from the Centers for Disease Control and Prevention (CDC), whose annual Behavioral Risk Factor Surveillance System (BRFSS) queries US residents concerning their health and safety related attitudes and practices. During some years from 1991-2010 the CDC asked questions about education and driving related practices.

These surveys record the respondent's self-reported level of education, in the following categories: 1) kindergarten or less, 2) through 8th grade, 3) through 11th grade, 4) GED or high school graduate, 5) some college, and 6) college graduate. In addition, survey participants also answered questions about their frequency of safety belt use, including whether they "always" use a safety belt when riding or driving in a car. They also reported the number of times they had driven in the past month after having had too much to drink.[4]

We conducted a series of regressions to estimate the relationship between these behaviors and two education measures: an indicator for being a college graduate, and the scale used by the CDC, treated as an ordinal scale. In these regressions we used various demographic indicators, the respondent's age and the year as covariates. These results are in Table 6.

The explanatory power of these regressions is low, with R^2 values under .07, but the statistical significance of the estimated coefficients on the education variables is high, with *p*-values below 0.01. They indicate that college graduates are more likely to wear seat belts, as found by Cutler and Lleras-Muney (2010) using a different data set, and have fewer occurrences of driving after drinking.

The results also confirm a difference between men and women. Men are less likely to wear a seatbelt and more likely to drive after drinking. However, the estimated coefficients on the interaction term between gender and educational achievement suggest that education has more impact on men's behaviors than it does on women's. The signs on the remaining covariates are also intuitively plausible.

These results suggest that the mechanisms through which we observe the gradient in the Vital Statistics data include increased seat belt use and decreased drunk driving.

5. **Conclusion**

The educational gradient in traffic safety is substantial: greater even than it is for all-cause mortality. Our estimates, however, suggest only a small portion of this is causal—perhaps one-tenth of the raw, unadjusted relationship. Panel point estimates indicate that an increase in a state's education level, such that its high school and college graduation rate both rise by five percentage points, will reduce its traffic fatalities by about two percentage points. Education matters, though it is not the dominant factor.

This relationship appears to be gender-specific, holding for men but not for women. One mechanism driving these results are driving behaviors, including seat belt use and driving after

[4] In some years the question was worded as "past month" and in other years it was worded as "last 30 days."

drinking. More educated people are less likely to exhibit unsafe behaviors, and more likely to exhibit safe ones; this holds especially for men.

The data and statistical precision available have not permitted us to investigate all aspects of the relationship between education and traffic safety. Several important questions remain unanswered. These include the following. Does education impact traffic safety via other behavioral mechanisms, such as driving at safer speeds? Are other non-behavioral factors at play, such as the type of cars driven by more educated individuals? To what extent do the safer driving benefits of college graduation spill over to non-graduates? And do migration or the selection of individuals into higher education play a role in generating these results? We hope such questions can be addressed in future research.

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Table 1. Relative Fatality Rates, Standardized to Those of High School Graduates, 2014 U.S. Vital Statistics, Ages 25+.

(a) Motor Vehicle Accidents

Highest Level of Education Completed	*All*	*Male*	*Female*	*Age 25-34*	*Age 35-54*	*Age 55+*	*Non-Hispanic White*	*Black*	*Hispanic (of any race)*
≤ 8th Grade	1.03	1.00	1.08	0.84	0.93	1.21	1.28	0.85	1.24
H.S. Dropout	1.24	1.23	1.22	1.25	1.39	1.06	1.50	1.15	1.00
GED, H.S. diploma	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Some College	0.63	0.63	0.70	0.59	0.61	0.66	0.62	0.58	0.73
Associates	0.50	0.49	0.61	0.41	0.44	0.63	0.50	0.46	0.47
Bachelor's	0.31	0.28	0.41	0.18	0.23	0.54	0.31	0.32	0.38
Master's	0.27	0.24	0.37	0.13	0.16	0.47	0.28	0.21	0.19
Doctorate	0.25	0.21	0.30	0.13	0.15	0.40	0.25	0.25	0.37

(b) All External Causes

Highest Level of Education Completed	*All*	*Male*	*Female*	*Age 25-34*	*Age 35-54*	*Age 55+*	*Non-Hispanic White*	*Black*	*Hispanic (of any race)*
≤ 8th grade	0.95	0.91	1.01	0.68	0.68	1.14	1.60	0.95	1.06
H.S. Dropout	1.24	1.26	1.15	1.34	1.41	1.07	1.51	1.37	1.07
GED, H.S. Diploma	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Some College	0.61	0.63	0.61	0.60	0.60	0.64	0.60	0.54	0.68
Associates	0.48	0.48	0.53	0.38	0.42	0.61	0.47	0.42	0.49
Bachelor's	0.34	0.35	0.34	0.18	0.25	0.56	0.34	0.26	0.35
Master's	0.28	0.30	0.28	0.11	0.19	0.46	0.28	0.22	0.28
Doctorate	0.33	0.33	0.24	0.11	0.19	0.50	0.32	0.23	0.41

(c) All Causes

Highest Level of Education Completed	*All*	*Male*	*Female*	*Age 25-34*	*Age 35-54*	*Age 55+*	*Non-Hispanic White*	*Black*	*Hispanic (of any race)*
≤ 8th Grade	1.59	1.60	1.58	0.83	0.82	1.45	2.76	2.61	1.95
H.S. Dropout	1.08	1.13	1.03	1.29	1.36	1.12	1.37	1.29	0.82
GED, H.S. Diploma	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Some College	0.51	0.60	0.43	0.60	0.59	0.56	0.49	0.49	0.59
Associates	0.42	0.46	0.38	0.40	0.44	0.53	0.39	0.49	0.53
Bachelor's	0.35	0.43	0.27	0.20	0.27	0.48	0.32	0.34	0.47
Master's	0.33	0.44	0.24	0.14	0.20	0.39	0.30	0.38	0.45
Doctorate	0.36	0.49	0.18	0.12	0.18	0.38	0.33	0.39	0.79

Table 2. Summary Statistics. (N = 1750)															
			Correlations, with bolded entries statistically significant at $p \leq .01$.												
	Mean	*St. Dev.*	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) ln(Fatalities / Million VMT)	-4.054	0.398	**-0.79**	**-0.73**	**-0.78**	**0.18**	**0.38**	**0.46**	**0.27**	**-0.62**	**-0.79**	**-0.38**	**-0.26**	**-0.36**	**-0.77**
(2) Proportion College Grads	0.236	0.062		**0.75**	**0.88**	**-0.21**	**-0.43**	**-0.47**	**-0.2**	**0.47**	**0.84**	**0.35**	**0.27**	**0.31**	**0.68**
(3) Proportion High School Grads	0.833	0.074			**0.96**	**-0.35**	**-0.5**	**-0.16**	**-0.28**	**0.51**	**0.71**	**0.28**	**0.41**	**0.45**	**0.76**
(4) Mean Years Schooling	12.81	0.659				**-0.31**	**-0.52**	**-0.28**	**-0.26**	**0.52**	**0.79**	**0.31**	**0.38**	**0.42**	**0.77**
(5) Unemployment Rate	0.060	0.021					**0.51**	**-0.1**	**-0.09**	**-0.08**	**-0.26**	**0.07**	**-0.13**	**-0.17**	**-0.15**
(6) Proportion of Pop in Poverty	0.130	0.038						**0.22**	**-0.18**	-0.05	**-0.51**	**0.1**	**0.08**	**-0.09**	**-0.09**
(7) Proportion of VMT Rural	0.467	0.176							**-0.14**	**-0.12**	**-0.54**	**-0.28**	0.01	0.01	**-0.21**
(8) Proportion of Pop 25 to 44	0.291	0.027								**-0.74**	**-0.16**	**-0.24**	**-0.44**	**-0.11**	**-0.57**
(9) Proportion of Pop 45+	0.345	0.049									**0.54**	**0.35**	**0.39**	**0.22**	**0.79**
(10) Real Personal Income (deflated using the CPI)	156.94	32.65										**0.37**	**0.23**	**0.27**	**0.69**
(11) Primary Seat Belt Law	0.285	0.451											**0.22**	**0.21**	**0.47**
(12) Maximum Speed Limit ≥ 70	0.333	0.471												**0.28**	**0.6**
(13) Administrative License Revocation	0.632	0.482													**0.45**
(14) Year (time trend)	1997	10.10													--

Table 3. Dependent Variable=LN(fatalities/million vehicle miles)								
Independent Variable	(I)	SE	(II)	SE	(III)	SE	(IV)	SE
Intercept	-2.855**	0.028	-3.205**	0.034	-4.238**	0.508	-5.125**	0.637
Proportion of 25+ Year Olds Graduated College	-5.057**	0.112	-0.269	0.205	-0.414*	0.179	-0.195	0.164
Unemployment Rate					-1.519**	0.231	-1.608**	0.196
Proportion of Population in Poverty					-0.740**	0.166	-0.448**	0.147
Proportion of Vehicle Miles That Are Rural					-0.006	0.133	-0.254	0.135
Proportion of Population That Is Aged 25 to 44					-2.285**	0.416	-1.963**	0.515
Proportion of Population at least 45 Years Old					-0.879	0.456	0.938	0.788
Real Personal Income (logs)					0.493**	0.093	0.550**	0.094
Primary Seat Belt Law					-0.008	0.011	-0.034**	0.009
Speed Limit ≥ 70 mph					0.053**	0.010	0.044**	0.011
Administrative License Revocation					-0.041**	0.011	-0.023*	0.011
Time Trend			-0.043**	0.001	-0.052**	0.003	-0.054**	0.004
$Trend^2$ /1000			0.399**	0.040	0.413**	0.059	0.333**	0.052
State Fixed Effects	NO		YES		YES		YES	
Linear State Trends	NO		NO		NO		YES	
R^2	0.625		0.913		0.934		0.954	
Data cover all 50 U.S. from 1980-2014, n=1750, Newey-West standard errors are below * indicates p-value <=.05, ** indicates p-value <=.01.								

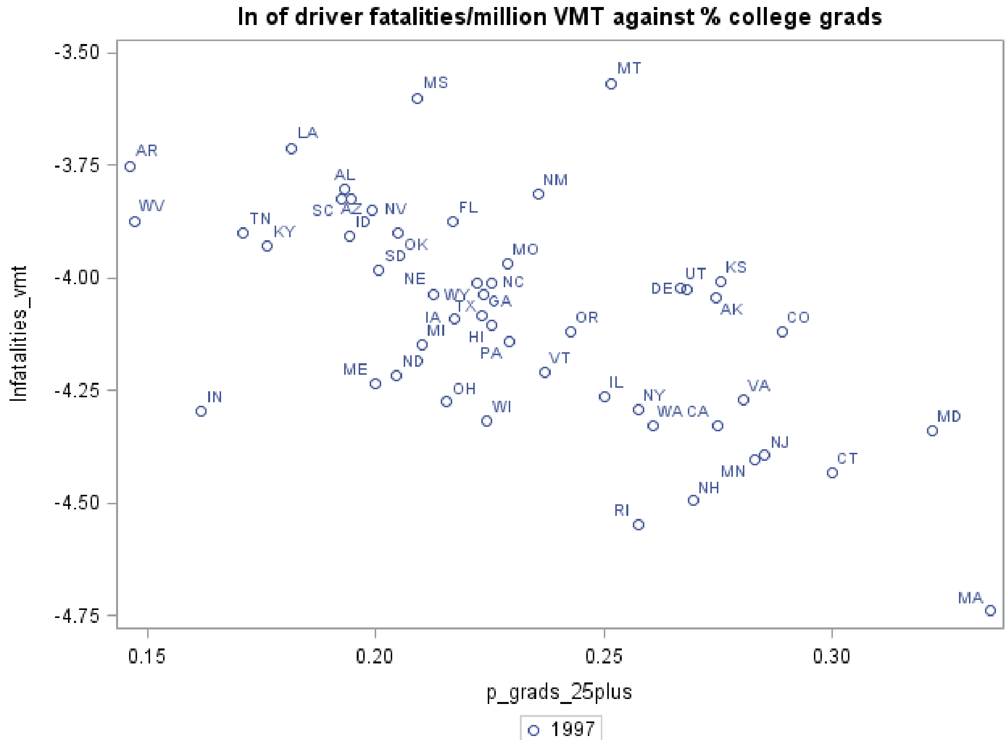
Table 4. Examining Alternative Measures of Education.								
Panel A Dependent Variable=LN(fatalities/million vehicle miles)								
Independent Variable	(I)	SE	(II)	SE	(III)	SE	(IV)	SE
Proportion of 25+ Year Olds Graduated College	-.195	.163			-.099	.171		
Proportion 19+ Year Olds Graduated High School			-0.353*	0.179	-.320*	.188		
Average Years Schooling (25+ Year Olds)							-0.017	0.022
All Other Covariates	YES		YES		YES		YES	
State Fixed Effects	YES		YES		YES		YES	
State*Trend	YES		YES		YES		YES	
R^2	0.954		0.954		.954		0.953	
Panel B Dependent Variable=LN((.5+ fatalities of drivers aged 25-65)/million vehicle miles)								
Independent Variable	(I)	SE	(II)	SE	(III)	SE	(IV)	SE
Proportion of 25-65 Year Olds Graduated College	-.137	0.210			-.037	.220		
Proportion 25-65 Year Olds Graduated High School			-.358	.242	-.344	.254		
Average Years Schooling (25-65 Year Olds)							-.021	.028
All Other Covariates	YES		YES		YES		YES	
State Fixed Effects	YES		YES		YES		YES	
State*Trend	YES		YES		YES		YES	
R^2	.898		.899		.899		.898	
Data cover all 50 U.S. from 1980-2014, n=1750, with Newey-West standard errors. * indicates p-value <=.05, ** indicates p-value <=.01, in one-sided tests of the null that the coefficient estimate is non-negative.								

Table 5. Gender Breakdowns.								
Panel A Dependent Variable=LN((.5+ fatalities of *male* drivers aged 25-65)/million vehicle miles)								
Independent Variable	(I)	SE	(II)	SE	(III)	SE	(IV)	SE
Proportion of Males Aged 25-65 Graduated College	-0.353*	0.189			-.243	.198		
Proportion of Males Aged 25-65 Graduated High School			-.480*	.221	-.391*	.232		
Average Years Schooling, Males Aged 25-65							-.054*	.0245
All Other Covariates	YES		YES		YES		YES	
State Fixed Effects	YES		YES		YES		YES	
State*Trend	YES		YES		YES		YES	
R^2	.879		.879		.879		.879	
Panel B Dependent Variable=LN((.5+ fatalities of *female* drivers aged 25-65)/million vehicle miles)								
Independent Variable	(I)	SE	(II)	SE	(III)	SE	(IV)	SE
Proportion of Females Aged 25-65 Graduated College	0.515	0.300			.508	.312		
Proportion of Females Aged 25-65 Graduated High School			.189	.342	.036	.355		
Average Years Schooling, Females Aged 25-65							.062	.043
All Other Covariates	YES		YES		YES		YES	
State Fixed Effects	YES		YES		YES		YES	
State*Trend	YES		YES		YES		YES	
R^2	.745		.744		.745		.745	

Data cover all 50 U.S. states from 1980-2014, n=1750, with Newey-West standard errors. * indicates p-value <=.05, ** indicates p-value <=.01, in one-sided tests of the null that the coefficient estimate is non-negative. In Alaska in 1987 no female drivers were killed. To include this observation we add .5 to the driver fatalities; for consistency between our different regressions we did this in all cases for drivers.

Table 6. Estimated Regression Coefficients with BRFSS Data (years 1991-2010)						
	Dependent Variable					
Independent variable	always wears seatbelt (logit)	always wears seatbelt (logit)	seatbelt frequency (OLS)	seatbelt frequency (OLS)	drink and drive frequency (OLS)	drink and drive frequency (OLS)
Education Level		0.14**		0.11**		-0.01**
College Graduate	0.23**		0.21**		0.00	
ln(Age)	0.11**	0.16**	0.09**	0.14**	-0.11**	-0.11**
White	1.4**	1.38**	-0.02**	-0.05**	-0.02**	-0.02**
Black	1.33**	1.30**	0.00	-0.01*	-0.03**	-0.03**
Male	-0.25**	-0.38**	-0.31**	-0.41**	0.13**	0.17**
Male*Education Level		.03**		.03**		-.01**
Male*College Graduate	0.10**		0.10**		-.06**	
Married	0.11**	0.10**	0.16**	0.15**	-0.09**	-0.09**
Time Trend	-0.46**	-0.46**	0.04**	0.04**	0.01**	0.00**
Time Trend Squared	0.03**	0.03**	-0.00**	-0.00**	-0.00**	-0.00**
$\mathbf{R^2}$ in all cases is less than .07. * indicates p-value <=.05, ** indicates p-value <=.01.						

Figure 1. Cross-Sectional Relationship between Education and Per Mile Fatalities for the 50 U.S. States (indicated by postal code). Top: 1997. Bottom: 1980, 1997, 2014.



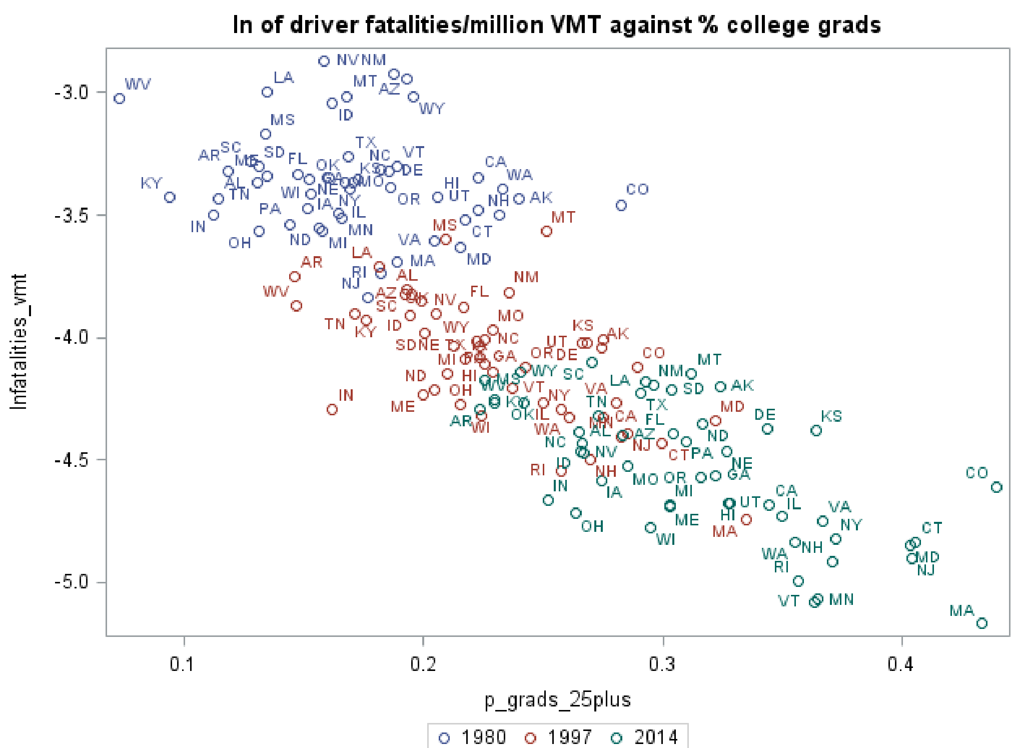


Figure 2. Scatterplot of Educational Attainment at the Beginning and End of the Sample Period.