

**Does Watching Television Rot Your Mind?
Estimates of the Effect on Test Scores^{*}**

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Abstract: This study examines whether the number of hours of television watched by young adults is associated with performance on standardized exams and whether any such relationship is causal. Data from the National Longitudinal Survey of Youth, the High School and Beyond survey and the National Education Longitudinal Study all indicate a negative cross-sectional relationship between hours of television viewing and test scores, even after controlling for a variety of socioeconomic characteristics. However, endogeneity bias may underlie this negative relationship. Models that include individual or family fixed effects to partially control for endogeneity suggest that television viewing does not negatively affect performance on standardized exams.

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* Work on this study began while the author was affiliated with Occidental College. Any views expressed here are solely those of the author.

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1. Introduction

Television is one of the most omnipresent features of Americans' lives. The average American adult watches about 15 hours of television per week, accounting for almost one-half of free time (Robinson & Godbey, 1997). Television viewing accounts for the second largest amount of waking hours—after attending school—among U.S. children (Juster & Stafford, 1991). The substantial amount of time that most individuals spend watching television makes it important to examine its effects on society, including human capital accumulation and academic achievement. This study uses scores on standardized tests as a proxy for these variables and estimates the relationship between television viewing and test scores. The cross-sectional results here indicate that watching more television as a young adult is negatively associated with contemporaneous scores on achievement tests, but the results from individual and family fixed effects models do not indicate that watching more television has an adverse effect on test scores.

There are several reasons why watching television might affect test scores and, more generally, human capital.¹ Television viewing may displace other activities that contribute to children's human capital, such as studying, reading and participating in extracurricular activities. In addition, critics often charge that watching television shortens youths' attention spans, causing them to learn less in school and hampering their performance on exams. Alternatively, television viewing may be beneficial, exposing people to cultural events and ideas they would not otherwise encounter.

¹ It should be noted that there is substantial disagreement about whether standardized test scores are accurate measures of human capital, either innate or acquired. Critics contend that standardized tests such as the AFQT contain racial, socioeconomic and cultural biases (e.g., Maume, Cancio & Evans, 1996; Rodgers & Spriggs, 1996). Concerns about such biases in test scores are not relevant for the relationship between television viewing and test scores focused on here unless watching television affects test scores differentially across groups, such as blacks and whites. In so, then stratifying the data by race or interacting television viewing with race would control for this effect.

Television viewing also may have no causal effect on outcomes such as test scores. Instead, the number of hours of television an individual watches may merely reflect other individual characteristics that are associated with test scores, such as ability, socioeconomic status or parental involvement. A common set of factors—not all of which may be observable—may affect both television viewing and test scores. In addition, young adults who watch more television may choose to do so because they have relatively low returns to acquiring more human capital through studying or other such activities that are substitutes for watching television; heavy television watchers may have a relatively low opportunity cost of watching television. The analysis here focuses on partially controlling for these potential sources of endogeneity in the estimated relationship between test scores and television viewing by controlling for a wide variety of individual and family characteristics and by including individual and family fixed effects in regression models.

Previous findings on the relationship between television viewing and test scores are mixed. A study of math achievement test scores using data from the National Education Longitudinal Study reported a negative association between the number of hours of television watched on weekdays and test scores in panel data regressions (Aksoy & Link, 2000). However, studies using panel data from the High School and Beyond survey and the National Health Examination Survey did not find an association between the amount of television viewed and test scores, particularly after controlling for other socioeconomic factors (Gaddy, 1986; Gortmaker, Salter, Walker & Dietz, 1990). Cross-sectional studies typically find a negative relationship between television viewing and test scores (e.g., Hornik, 1981; Keith, Reimers, Fehrmann, Pottebaum & Aubey, 1986). This negative cross-sectional relationship tends to persist, particularly for reading test scores, when controlling for IQ (Morgan & Gross, 1980).

A few previous studies explicitly addressed whether endogeneity underlies the negative relationship between television viewing and test scores found by some researchers. Consistent with the hypothesis that individuals with relatively low opportunity costs of watching television spend more hours doing so, Keith et al. (1986) reported that low-ability young adults watch more television than their more able peers. In addition, they found that the estimated relationship between hours viewed and test scores declines by three-fourths when controlling for family background and other factors in cross-sectional data, suggesting that only about one-fourth of the association between television viewing and test scores is causal. Also consistent with the endogeneity hypothesis, Gortmaker et al. (1990) reported that children with lower test scores during childhood tend to watch more television during adolescence. Panel data studies, which implicitly partially control for endogeneity by including individual fixed effects, reached mixed results, as discussed above.

This study makes several contributions to our understanding of the effect of watching television on test scores. Although there is considerable research on the relationship between television viewing and test scores, most previous studies treated television viewing as exogenous and controlled for a limited set of covariates. Research that used panel data techniques to partially control for endogeneity reached conflicting results. This study uses several methods to control for endogeneity bias: controls for a wide range of observable characteristics, individual fixed effects and comparisons among siblings, including twins. Previous research has not used sibling comparisons to estimate the effect of watching television on test scores nor estimated panel data models with different data sets but the same set of covariates.

The rest of the paper proceeds as follows. The next section further discusses the endogeneity problem faced when estimating the effect of watching television on outcomes such as test scores. The determinants of the amount of television watched by young adults and the

relationship between television viewing and test scores are then investigated using data from three large-scale surveys. The results indicate that contemporaneous test scores are negatively associated with hours of television watched in cross-sectional data, particularly for females and whites. However, panel data on individuals and comparisons among siblings do not indicate a negative relationship between test scores and television viewing, suggesting that the cross-sectional relationship is not causal.

2. Theoretical background

Since at least Becker (1965), economists have recognized that there is an opportunity cost associated with non-working uses of time. Standard economic models of time allocation posit that individuals divide their time across work and leisure activities in whatever way maximizes their utility, subject to budget constraints and time limitations. Leisure activities, such as watching television, involve both direct and indirect costs. The indirect, or opportunity, costs include income foregone by watching television instead of working. If the time an individual spends watching television could instead be spent on an activity that would lead to higher income, such as accumulating human capital, that foregone income would be an indirect cost as well.

These opportunity costs of leisure activities, such as watching television, are likely to differ across individuals. If individuals forgo acquiring human capital when watching television (instead of studying, for example), individuals with lower returns to human capital forgo less income and therefore have a lower opportunity cost of watching television. Because their indirect cost of watching television is lower, people with low returns to human capital should watch more television than individuals with higher returns to human capital. This suggests that television viewing is endogenous in human capital models—such as models of the determinants

of test scores—because the amount of television an individual watches depends on her return to human capital.

Another source of bias in conventional models of test scores and television viewing is that the number of hours of television an individual watches may depend on factors that also affect test scores. For example, parental involvement may affect how many hours of television a child watches and also influence academic achievement, including performance on standardized tests. Regressions that fail to control for such common factors would mistakenly attribute the effect of these factors on test scores to hours of television watched. The direction of this bias is negative if these factors are negatively associated with the amount of television watched but positively associated with test scores. Regressions that do not control for this source of endogeneity bias therefore overestimate any negative relationship between television viewing and test scores.

This study first examines the determinants of the amount of television watched by young adults in order to investigate whether groups generally regarded as having lower returns to human capital watch more television, on average, as young adults and whether family background and other factors that are likely to affect test scores are also associated with hours of television watched. The analysis then estimates the effect of including more control variables and fixed effects—attempts to control for endogeneity—on the estimated relationship between television viewing and test scores.

3. Data

This analysis uses three data sets to examine the relationship between television viewing and test scores: the National Longitudinal Survey of Youth 1979 (NLSY), the High School and Beyond (HSB) survey and the National Education Longitudinal Study (NELS). There are

several reasons why this study uses these surveys. Each includes test scores and a question about the number of hours of television watched by young adults.² However, the tests and the wording of the television question differ across the three studies. The HSB survey and the NELS have multiple observations on test scores and television viewing for some participants, which allows for the inclusion of individual fixed effects in order to control for time invariant, unobservable factors, such as ability. The HSB has a sample of twins while the NLSY has a sample of siblings, so unobserved family-specific effects can be controlled using these samples. The data used here from the NLSY and the HSB are from the early 1980s while the NELS data are from the late 1980s and early 1990s. Table 1 provides a summary of the data sets.

NLSY

The NLSY began in 1979 with a survey of young adults who were born between 1957 and 1964. These young adults were periodically resurveyed, first annually and then on a biannual basis. The survey design includes a nationally representative cross-sectional sample, an oversample of blacks, Hispanics and low-income whites and a military sample.³ Only individuals enrolled in high school at the time of the 1981 survey are included here in order to make the NLSY sample somewhat comparable in age to the other data sets.⁴ The NLSY sample used here has 2477 individuals who have valid test scores. This sample includes 239 families with at least two survey participants who are biological siblings.⁵

² None of the surveys asks about television program content, such as news and educational programs versus sports and sitcoms. Studies that focus on effects of program content are largely limited to young children.

³ The oversample is an additional sample of blacks, Hispanics and low-income whites added to the NLSY's nationally representative sample to ensure adequate sample sizes for those groups. The NLSY weights used here make the entire sample nationally representative.

⁴ Using a sample largely young enough to be subject to compulsory schooling laws also avoids the problem of years of educational attainment potentially affecting AFQT scores (Neal & Johnson, 1996).

⁵ Sibling sets that indicated that they are step-siblings are not included.

The NLSY contains two items that are particularly relevant for this study: a self-report of the number of hours of television watched during the week prior to the 1981 survey, and individuals' scores on a standardized test administered to participants during the summer of 1980. The television variable is a linear variable topcoded at 96 hours; the average person in the NLSY sample reported watching about 14 hours of television during the previous seven days. The standardized test is the Armed Forces Vocational Aptitude Battery (ASVAB), which consists of 10 parts. The NLSY reports individuals' scores as a percentile based on the four ASVAB parts that focus on verbal and math skills. This percentile score is commonly referred to as the AFQT, the Armed Forces Qualifying Test. This study uses the 1989 revision of the AFQT scores.

HSB

The HSB is a longitudinal study that began in 1980 with students who were then high school sophomores and seniors. An attempt was made to reinterview all individuals in 1982, and a sample was resurveyed again in 1984 and 1986. Survey participants were given a set of achievement tests in 1980, and the sophomore sample was retested in 1982 (when most were seniors). The tests include a vocabulary test, a reading test and a math test. The HSB reports individuals' test scores normalized within the samples by original grade, and the average of the normalized scores on the vocabulary, reading and math tests is used here as the primary test measure. Only sophomores are included in the main (non-twin) HSB sample used here so that two test scores, for 1980 and 1982, are available for each individual. This sample includes 14,988 individuals who were still in school in 1982.

The HSB study included a special sample of individuals who had a twin (or triplet) in the main sample. In 1980, these twins were given the same achievement tests as the individuals in the main sample. The special sample of twins was not resurveyed later, so the twins data used

here is cross-sectional. The twins data used here include 431 sets of twins and one set of triplets.⁶

Like the NLSY, the HSB includes a question about television viewing. The HSB asked individuals how many hours of television they watched during a weekday within seven intervals. The weekday measure in the HSB survey is multiplied by seven and treated as a linear variable in this analysis to make it roughly comparable to the NLSY weekly television viewing variable.⁷ By this measure, the average person in the HSB sample watched almost 21 hours of television per week. The same question was asked in both 1980 and 1982. Average weekly hours of television were about six hours greater in 1980, when the students were sophomores, than in 1982, when most were seniors.

NELS

The NELS is a longitudinal study designed to update the HSB study with a new cohort. A sample of eighth graders was surveyed in 1988, and this sample was resurveyed at two-year intervals through 1994. Participants were given achievement tests in a variety of subjects, including reading and math, in 1988, 1990 and 1992. The NELS reports these test scores, including a composite test score for each year based on the reading and math test scores, as percentiles. This analysis uses the composite test scores as the primary measure of test scores for the NELS. The NELS sample used here includes 6255 individuals who were surveyed in 1988,

⁶ Seniors are not included in the main HSB sample (but are included in the twins sample) because the aptitude tests were not readministered to 1980 seniors in 1982. Differences between siblings who are a sophomore and a senior in 1980 are not examined here because the HSB reports test scores normed within grades, making comparisons across siblings in different grades difficult to interpret.

⁷ The seven intervals are none, less than one hour, at least one hour but less than two, two hours but less than three, etc., up to five or more hours. Intervals other than none were converted to the middle of the interval (e.g., 1.5 hours for at least one hour but less than two) and multiplied by seven. The highest interval is converted here to 5.5 hours (multiplied by seven). All results are qualitatively similar if a variable ranging from zero to six is included in the regressions instead of the weekly approximation or if other numbers are used to construct the highest value (6.5 hours, 7.5 hours, etc.). The results for the determinants of television viewing are also qualitatively similar if an ordinal probit model is used instead of the OLS model reported in Table 2.

1990 and 1992, have valid test scores each year and remained in school through 1992 (when most were seniors).⁸

The first three waves of the NELS asked about the number of television hours per day usually watched on weekdays and, separately, on weekend days during the school year. The first two survey waves had seven intervals for the television questions, and the third wave six intervals.⁹ The measure of weekly television viewing used here for each survey year is average weekday hours times five plus average weekend-day hours times two. By this measure, the average NELS respondent in the sample watched almost 19 hours of television a week. Average television watching falls by about three hours per week from 1988 to 1990, when most of the sample was high school sophomores, and by another hour from 1990 to 1992, when most were seniors. Previous studies also find a drop-off in television viewing as teens age (e.g., Searls, Mead & Ward, 1985).

A similar set of factors that are likely to affect both test scores and television watching was created from the NLSY, HSB and NELS data sets. These factors can be divided into three categories: individual characteristics, family background and other uses of time. The set of individual characteristics includes age, sex, race (black), ethnicity (Hispanic) and immigrant status.¹⁰ The set of family background characteristics is the total number of siblings, the availability of reading materials in the household (measured here as two indicator variables for no reading materials and numerous reading materials, with the in-between group as the omitted category) and parents' education (four indicator variables for whether each parent is a high

⁸ The NELS added new respondents in 1990 and 1992; these individuals are not included here. The NELS did not report a composite test score for 1992, so the average of the reading and math test score percentiles is used as the composite test score. The data used here are from the Base Year through Third Follow-Up version of the data.

⁹ The 1988 and 1990 NELS intervals are the same as the HSB intervals. The 1992 NELS has three to five hours as a single interval. As with the HSB data, the middle of the interval was used to construct the television variable.

¹⁰ The regressions do not control for educational attainment for two reasons. First, educational attainment may be endogenous in test score regressions. In addition, the distribution of educational attainment is narrow in the NLSY sample, which is limited to individuals enrolled in high school in 1981. Education does not vary in the HSB and NELS base year samples and varies in later years only because of students skipping grades or being held back.

school graduate or a college graduate).¹¹ The two measures of other uses of time are how much time individuals spend reading and doing homework.¹² Appendix Table 1 presents descriptive statistics for the main variables used in this analysis.

4. Methods

This study first estimates the determinants of the number of hours of television watched in order to examine whether individuals with lower returns to human capital—and hence individuals likely to have lower test scores—watch more television. For example, if women and minorities have lower average returns to human capital, they might watch more television, on average. Research has yielded mixed results on how returns to education vary across groups. Some studies find evidence that returns are lower for women (e.g., Kane & Rouse, 1995) while others find higher returns for women and minorities (e.g., Belman & Heywood, 1991). Other research suggests few differences in the returns to education by race and sex (e.g., Jaeger & Page, 1996). Evidence on the effect of parental education on the return to children’s education is mixed as well (Altonji & Dunn, 1996).

The regression model for the number of hours of television watched is

$$\begin{aligned} \text{Hours of TV}_{it} = & \alpha + \beta \text{Individual Characteristics}_{it} + \gamma \text{Family Background}_{it} \\ & + \delta \text{Other Uses of Time}_{it} + \tau T_{it} + \varepsilon_{it}, \end{aligned} \tag{1}$$

¹¹ For the NLSY sample, no reading materials is defined as the household not having a subscription to a newspaper, not having a subscription to a magazine and not having a library card when the respondent was 14 years old, and numerous reading material as having all three. For the HSB and NELS samples, no reading materials is defined as the household not receiving a newspaper and the household not having more than 50 books at the time of the survey, and numerous reading materials is defined as having both. Indicator variables for mother's education and father's education not reported are included in the regressions.

¹² For the NLSY data, these variables are scaled as hours per week. The HSB survey has ordinal response intervals for time spent reading for pleasure (four intervals, ranging from rarely or never to every day or almost every day) and on homework (seven intervals), which are used here as linear variables. The NELS has six (eight) response intervals for the reading (homework) question in 1988 and eight (nine) in 1990 and 1992, which are collapsed into the same six (eight) intervals as in 1988.

where i indexes individuals and t indexes survey years. The vector T is survey year fixed effects and is included when the model is estimated using data from the HSB or NELS, which contain two and three observations per individual, respectively. The individual characteristics, family background and other uses of time vectors contain the variables discussed above. Not all of the variables vary over time in the panel data; sex and race are time-invariant, for example, while other uses of time may change across panels.

The basic regression model for test scores is

$$\begin{aligned} \text{Test Score}_{it} = & \alpha + \nu \text{Hours of TV}_{it} + \beta \text{Individual Characteristics}_{it} \\ & + \gamma \text{Family Background}_{it} + \delta \text{Other Uses of Time}_{it} + \tau T_{it} + \varepsilon_{it}, \end{aligned} \quad (2)$$

where test scores are normalized to a sample mean of zero and standard deviation of one.¹³ The estimated coefficients therefore give the relationship between a change in a covariate—such as watching an additional hour of television per week—and the change in test scores relative to the standard deviation. All of the test score regressions contain the measure of television viewing, which is the variable of interest. All regressions using the HSB and NELS data also include survey year fixed effects. Because the HSB and NELS surveys were administered to multiple students at the same school, some specifications using those data also include school fixed effects to control for school-level factors that may influence test scores. The other variables are added consecutively to the regression in order to examine how the coefficient of the television variable changes as the regression controls for other factors that affect both television viewing and test scores. As discussed above, not controlling for common factors is likely to negatively bias the television coefficient, so it should become more positive as the regression includes controls for individual characteristics, family background and other uses of time.

¹³ The test scores are not corrected for age; instead, age is included directly in the regressions. The results are similar if the test scores are first regressed on age and then the normalized residuals are used as the dependent variable.

Another way to partially control for endogeneity besides adding more control variables is to include individual or family fixed effects. The individual fixed effects control for unobservable time-invariant individual characteristics that influence test scores and may also be associated with television viewing, such as ability. The individual fixed effects regressions, which are estimated using the HSB and NELS panel data, give the relationship between changes in test scores and changes in television viewing over time. The family fixed effects control for unobservable factors that are common across siblings, such as parental characteristics. The siblings and twins regressions with family fixed effects, which are estimated using NLSY and HSB cross-sectional data, respectively, give the relationship between differences in test scores and differences in television viewing across siblings.

The basic regression model for the fixed effects models of test scores is

$$\text{Test Score}_{ift} = \alpha + \nu \text{Hours of TV}_{ift} + \sigma \text{FE}_{if} + \tau T_{it} + \varepsilon_{ift}, \quad (3)$$

where i indexes individuals, f indexes families and t indexes survey years. The family subscript applies to the family fixed effects regressions and the time subscript applies to the individual fixed effects regressions; none of the data sets used here has multiple observations on siblings over time. The fixed effects regressions do not include the controls for individual characteristics, family background or other uses of time because there is relatively little or no variation over time or within families in those variables.

All regressions are estimated using ordinary least squares (OLS). Separate regressions are estimated for each data set. The cross-sectional test score regressions are estimated separately by sex and by racial/ethnic group as well as for the entire samples to investigate whether the relationship between test scores and television viewing differs across groups; Chow tests indicate that the coefficients are jointly statistically different between males and females and between whites and blacks, so separate regressions are estimated instead of merely including

interaction terms between television viewing and sex and race/ethnicity in a single regression. Whites and non-black, non-Hispanic others are pooled as a racial/ethnic group because the NLSY does not clearly distinguish between these groups. Standard errors are White-corrected for heteroscedasticity and clustered on the individual (on the family in the family fixed effects regressions). The NLSY data are weighted using the 1981 survey weights. The HSB and NELS data are weighted using the panel data test weights, which account for attrition and failure to take the tests.

Methodological issues

The main methodological question that arises from the OLS and fixed effects approaches used here to partially control for the endogeneity of television viewing in models of test scores is, why not use instrumental variables or simultaneous equations methods instead? Identification in these alternate methods requires a variable that affects television viewing but does not also influence test scores (and vice versa for the simultaneous equations approach). There is no such obvious variable in the data. Geographic variation in television viewing is a possibility—perhaps because differences in average temperatures or in time zones affect television viewing—but geographic variation at the MSA, county or state level accounts for little of the variation in television viewing across individuals in the NLSY. In addition, geographic variation in access to cable television or in the number of broadcast channels was not significantly associated with geographic variation in hours of television watched for the NLSY sample. Thus, although instrumental variables or simultaneous equations models would be a better way to control for endogeneity, it is not possible to identify those models with these data sets.

5. Results

Hours of television

The regressions examining the determinants of the number of hours of television watched are shown in Table 2. Television viewing tends to decrease with age among young adults, although the result is significant only in the HSB data. Controlling for other factors, women in the HSB and NELS data report watching fewer hours than men whereas the opposite result holds in the NLSY data. Blacks and Hispanics watch more television than whites and other races/ethnicities, with the exception of Hispanics in the NLSY data. Reported hours of television watched are negatively associated with the number of siblings in all three data sets.

Some results suggest that factors that affect human capital accumulation are also related to television viewing. Parents' educational attainment is negatively associated with how much television young adults watch. In addition, young adults living in homes with numerous reading materials watch fewer hours of television in the HSB and NELS results than do young adults in a home with some reading materials. Television viewing appears to be a substitute for time spent doing homework in all three data sets; the HSB data also indicate that young adults who spend more time reading for leisure spend less time watching television. These findings are generally consistent with the hypothesis that young adults trade off acquiring human capital and watching television. However, given the mixed findings in the literature on heterogeneity in returns to education, it is difficult to clearly conclude from these results whether individuals with lower returns to human capital, on average, watch less television.

Test scores

Table 3 presents the cross-sectional results for the relationship between test scores and hours of television watched. The results indicate that young adults who watch more hours of

television have significantly lower test scores, but the estimates are small in magnitude and—consistent with endogeneity bias—become smaller as more controls are added. In regressions that pool sexes and racial/ethnic groups and include only the measure of television viewing, an additional hour of television per week is associated with a decline in test scores of about 0.01 to 0.02 standard deviations (column 1, specification A). Controlling for age, sex, race/ethnicity and immigrant status reduces these already small estimates by about 15-30 percent (specification B). Adding controls for the number of siblings, parents' education and availability of reading materials further reduces the estimates (specification C). Adding measures of the amount of time spent doing homework and reading has little effect on the estimates (specification D), as does including school fixed effects in the HSB and NELS data (specification E). Controlling for all these factors, the estimates indicate that an additional hour of television viewing is associated with a decline in test scores of about 0.003 to 0.01 standard deviations, estimates that are statistically significant but miniscule.

The relationship between test scores and most other factors is considerably larger than the estimates for television viewing. Appendix Table 2 reports the estimated coefficients for some of the other variables included in specification D of Table 2, column 1. Controlling for other factors, blacks' average test scores are about 0.4 to 0.7 standard deviations lower than whites and other races/ethnicities, and Hispanics' test scores 0.3 to 0.6 standard deviations lower. Having an additional sibling is associated with a decline in test scores of about 0.02 to 0.04 standard deviations, more than twice as large as the estimates for an additional hour of television per week. Young adults who spend more time reading or doing homework have significantly higher test scores. The magnitude of the estimates for these variables in the NLSY data can be directly compared with the television coefficients because all are measured in hours per week; young adults who spend an additional hour reading per week have test scores about 0.01 standard

deviations above the mean while young adults who do an additional hour of homework have test scores 0.02 standard deviations higher, compared with 0.003 standard deviations lower for young adults who watch an additional hour of television per week.

The relationship between television viewing and test scores varies somewhat across sexes and across racial/ethnic groups. The estimates tend to be smaller in magnitude for men than for women, particularly in the NELS data. The estimates are also smaller for blacks and Hispanics than for whites and other groups; most of the results fail to indicate a significant negative relationship for blacks and Hispanics. Interestingly, at all ages, males and minorities tend to watch more television than females and whites (Searls, Mead & Ward, 1985). The results are therefore consistent with the hypothesis that groups that experience more detrimental effects of television on human capital watch less of it, on average.

The estimates may also differ by socioeconomic status. Some previous studies argue that the relationship between television viewing and test scores is more negative among students from relatively socioeconomically advantaged backgrounds (Fetler, 1984; Morgan, 1982; Searls, Mead & Ward, 1985) while others conclude that estimates do not differ by socioeconomic status (Gortmaker et al., 1990; Gaddy, 1986). These studies typically use parental occupation as a proxy for socioeconomic status. In results not shown in the tables, the estimated coefficients of the television variable are about 40 percent larger among young adults in the NLSY and HSB whose fathers are in professional occupations than among those with fathers in non-professional occupations. However, the NELS results do not differ significantly by father's occupational status.

The above results assume that the relationship between television and test scores is linear, but some previous studies suggest that any effect may be nonlinear. For example, Williams, Haertel, Haertel & Walberg (1982) conclude that hours of television watched is positively related

to test scores for up to 10 hours a week but the relationship is negative thereafter. In regressions not shown here, including a quadratic term for hours of television watched had little effect on the results. Including a spline for television viewing over 10 hours per week also did not change most of the results, suggesting that the relationship—if any—is linear. The only exception was among blacks in the NLSY, among whom heavy viewers had higher test scores than less intensive viewers, controlling for other factors. The results are robust to dropping individuals who reported not watching any television (which ranged from 1-5 percent of the samples).

The results in Table 3 are for composite test scores based on math and English exams. The results are generally similar if the regressions are estimated using specific test scores instead of the composite scores. Math, reading comprehension and vocabulary test scores tend to be significantly negatively associated with hours of television watched for the full sample, males, females and whites in each data set but generally not for blacks and Hispanics.

Regressions estimating the relationship between time spent doing homework and hours spent watching television suggest that television viewing may displace homework for some groups. Regressions similar to the test scores regressions were estimated, with time spent reading and time spent doing homework as the dependent variables. In results not shown here, the amount of time spent on homework is significantly negatively related to television viewing for women and whites/others—the groups with the strongest relationship between television viewing and test scores—in all three data sets. This suggests that watching more television may lower test scores by displacing homework. Time spent reading for pleasure is generally not related to time spent watching for television.

Fixed effects estimates

Whereas most of the cross-sectional results indicate a negative relationship between test scores and television scores, the fixed effects estimates suggest that television viewing does not affect test scores. As indicated by the simple correlations reported in the last two rows of Table 4, television viewing is highly correlated within individuals over time and among siblings at a point in time, as are test scores. However, the regression results in the first row of Table 4 indicate that changes in individuals' test scores over time are not related to changes in television viewing in the HSB and the NELS. Similarly, differences in test scores across siblings in the NLSY and across twins in the HSB are not significantly related to differences in television viewing. Scores on specific tests are not negatively related to television viewing in the fixed effects estimates; time spent watching television is also not significantly associated with time spent doing homework and time spent reading (not shown).

There are several possible interpretations of the insignificant relationship between television viewing and test scores in the individual and family fixed effect estimates. The difference between the cross-sectional and fixed effects estimates may indicate that factors that are time-invariant within individuals or common across siblings and that are not controlled for in the cross-sectional regressions underlie the negative estimates in the cross-sectional results. If so, then the fixed effects estimates correctly indicate that there is not a causal relationship between hours of television watched and test scores.

Alternatively, measurement error may underlie much of the changes in individuals' responses and the differences between siblings' reports of hours of television watched.¹⁴ For example, although about one-third of twins in the HSB report the same interval for the number of

¹⁴ Self-reports of time spent watching television are positively correlated with time diary measures (Price, Ritchie, Roberts & Lieberman, 1986), but the extent of measurement error in self-reports is unknown.

hours usually watched on a weekday, almost another one-third indicate that they watch at least two hours more (or less) per weekday than their twin. In the NELS, about one-quarter of respondents report changes in hours of television watched per week in excess of 10 hours—a substantial change relative to the sample mean of less than 19 hours per week—across survey waves. However, excluding siblings sets or individuals with large differences (in excess of 10 hours per week) yields estimates similar to those shown in Table 4, suggesting that measurement error does not underlie the difference between the cross-sectional and fixed effects results.

Another possible reconciliation between the cross-sectional and fixed effects estimates is that the negative effect on test scores occurs as a result of watching television at younger ages. If young adults who are heavy television viewers were also heavy television viewers as children, then the cross-sectional estimates might reflect a detrimental effect of heavy television viewing at younger ages that carries over to test scores during later adolescence and adulthood. If the effect occurs at younger ages and persists, then changes in television viewing at older ages might have little impact on test scores.

It is possible that levels of television viewing are related to changes in test scores even though changes in television viewing are not. In other words, individuals who watch more television when younger may experience less improvement in test scores over time. However, if the change in test scores is regressed on weekly television viewing in the base year of the HSB and the NELS, the results are either insignificant or positive (not shown). Regressing the change in test scores in the NELS on the amount of television viewing reported in the previous wave also yields a positive result, even when controlling for other factors. These results provide no evidence that eighth graders of high school sophomores who watch more television experience declines in test scores over time relative to their peers who watch less television.

6. Conclusion

Everything from the decline in hours worked among U.S. males (Juster & Stafford, 1991) to the decline in average SAT scores (Wirtz et al., 1977) has been attributed, in part, to a sectoral increase in hours spent watching television. This study's examination of the relationship between television viewing and test scores suggests that such concerns may be misplaced. In cross-sectional data on young adults from the 1980s and early 1990s, test scores on vocabulary, reading and math tests are negatively associated with contemporaneous reports of hours of television watched. However, the magnitude of the estimates is small, particularly in comparison with the effects of time spent reading and time spent doing homework. The estimated effect of television becomes smaller when controlling for other factors, such as parental education. Further, comparisons across siblings, including twins, at a point in time and within individuals over time do not indicate a negative relationship between test scores and television viewing. Similarly, time spent doing homework is negatively associated with time watching television in cross-sections but not in fixed effects estimates. Changes in time spent watching television as a young adult therefore do not appear to adversely affect test scores. Instead, endogeneity likely underlies the negative relationship between test scores and television viewing reported in several previous studies.

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Table 1
Summary of Samples from Data Sets

	NLSY	HSB	NELS
Number of individuals	2,477	14,988	6,255
Type of data	Cross-section	Panel	Panel
Time period	1981	1980, 1982	1988, 1990, 1992
Age of respondents	16-19	13-22	12-20
Sibling structure	239 sibling pairs	432 twin pairs	None
Test scores	AFQT	Vocabulary, reading, math	Reading, math
TV variable	Hours per week	Hours per weekday	Hours per weekday, weekend day
Categorical or linear	Linear	Categorical (7)	Categorical (6 or 7)

Notes: The number of observations is the number of individuals from each data set included in the samples used here, not the total number available in the raw data. One of the pairs of twins in the HSB consists of three triplets. The twins data in the HSB are a cross-section in 1980.

Table 2
Determinants of Number of Hours of Television Watched per Week

	NLSY	HSB	NELS
<u>Individual characteristics</u>			
Age	-.547 (.382)	-.299† (.155)	-.256 (.200)
Female	1.279* (.552)	-.462* (.191)	-.860** (.241)
Black	1.414† (.736)	5.173** (.329)	6.690** (.462)
Hispanic	-1.396† (.793)	.846** (.307)	1.695** (.507)
Foreign born	-.057 (1.298)	.042 (.525)	-.429 (.583)
<u>Family background</u>			
Number of siblings	-.221† (.113)	-.159** (.057)	-.202* (.086)
No reading materials at home	-.535 (1.009)	.510 (.465)	1.098 (.734)
Numerous reading materials at home	-.742 (.608)	-.460* (.214)	-.578† (.306)
Mother graduated high school	-.665 (.672)	-1.198** (.295)	-.885† (.488)
Mother graduated college	-3.676** (1.024)	-2.819** (.404)	-1.950** (.569)
Father graduated high school	-1.651* (.689)	-.773** (.287)	-.833† (.490)
Father graduated college	-3.795** (.993)	-3.569** (.364)	-2.861** (.543)
<u>Other uses of time</u>			
Time spent reading	-.016 (.026)	-.666** (.080)	-.044 (.073)
Time spent on homework	-.111** (.041)	-.314** (.065)	-.408** (.069)
Adjusted R ²	.035	.125	.102
Number of observations	2,477	29,976	18,765

** p < .01; * p < .05; † p < .10

Notes: The dependent variable is number of hours of television watched per week for the NLSY sample, the number of hours watched on a weekday times seven for the HSB sample and the number of weekday hours times five plus the number of weekend day hours times two for the NELS sample. Regressions also include indicator variables for mother's education and father's education not reported and a constant. The HSB and NELS regressions include an observation from each survey for each individual and have year fixed effects for the survey waves. Observations are weighted using survey weights, and standard errors (in parentheses) are White-corrected for heteroscedasticity and clustered on the individual.

Table 3
Relationship between Hours of Television Watched and Test Scores, Cross-sectional Estimates

	All	Male	Female	Black	Hispanic	White/Other
<u>NLSY: AFQT score</u>						
A. TV only	-.010** (.001)	-.007** (.002)	-.012** (.002)	.002 (.002)	-.004 (.003)	-.014** (.002)
B. A + individual characteristics	-.007** (.001)	-.007** (.002)	-.008** (.002)	.002 (.002)	-.005 (.003)	-.014** (.002)
C. B + family background	-.003** (.001)	-.002 (.002)	-.005** (.001)	.002 (.002)	-.002 (.003)	-.007** (.002)
D. C + other uses of time	-.003* (.001)	-.002 (.002)	-.004** (.002)	.003† (.002)	-.001 (.003)	-.006** (.002)
Number of observations	2,477	1,309	1,168	719	415	1343
<u>HSB: Composite test score</u>						
A. TV only	-.019** (.001)	-.018** (.001)	-.020** (.001)	-.006* (.002)	-.008** (.002)	-.017** (.001)
B. A + individual characteristics	-.015** (.001)	-.015** (.001)	-.016** (.001)	-.006** (.002)	-.009** (.002)	-.017** (.001)
C. B + family background	-.011** (.001)	-.011** (.001)	-.012** (.001)	-.005** (.002)	-.006** (.002)	-.012** (.001)
D. C + other uses of time	-.009* (.001)	-.009** (.001)	-.009** (.001)	-.004** (.002)	-.006** (.002)	-.010** (.001)
E. D + school fixed effects	-.008* (.001)	-.007** (.001)	-.008** (.001)	-.003* (.002)	-.003† (.001)	-.009** (.001)
Number of observations	29,976	13,548	16,428	2,792	4,134	23,050
<u>NELS: Composite test score</u>						
A. TV only	-.019** (.001)	-.017** (.002)	-.022** (.002)	-.007† (.004)	-.010* (.005)	-.018** (.002)
B. A + individual characteristics	-.016** (.001)	-.013** (.002)	-.019** (.002)	-.007† (.004)	-.012* (.005)	-.018** (.002)
C. B + family background	-.011** (.001)	-.009** (.002)	-.013** (.002)	-.006† (.004)	-.008† (.005)	-.012** (.001)
D. C + other uses of time	-.010* (.001)	-.008** (.002)	-.012** (.001)	-.005 (.004)	-.006 (.004)	-.011** (.001)
E. D + school fixed effects	-.009* (.001)	-.006** (.002)	-.011** (.001)	-.002 (.004)	.000 (.003)	-.008** (.001)
Number of observations	18,765	8,871	9,894	1,275	1,707	15,783

** p < .01; * p < .05; † p < .10

Notes: The dependent variable is normalized test scores. Shown are estimated coefficients of the number of hours of television watched per week (weekday hours times seven for the HSB sample and weekday hours times five plus weekend day hours times two for the NELS sample). Regressions include a constant and other variables as indicated (see text and Appendix Table 1 for details); HSB and NELS regressions also include year fixed effects for the survey waves. Observations are weighted using survey weights, and standard errors (in parentheses) are White-corrected for heteroscedasticity and clustered on the individual. "White/Other" is non-black, non-Hispanic individuals.

Table 4
Relationship between Hours of Television Watched and Test Scores, Individual and Family Fixed Effects Estimates

	Individual HSB	Individual NELS	Siblings NLSY	Twins HSB
TV	.001 (.001)	.0001 (.0008)	-.002 (.005)	-.001 (.005)
Individual fixed effects	Yes	Yes	No	No
Family fixed effects	No	No	Yes	Yes
Year fixed effects	Yes	Yes	No	No
Number of observations	29,976	18,765	490	865
Correlation in television viewing	.431	.527	.200	.445
Correlation in test scores	.871	.884	.571	.695

** p < .01; * p < .05; † p < .10

Notes: The dependent variable is normalized test scores. Shown are estimated coefficients of the number of hours of television watched per week (weekday hours times seven for the HSB samples) and simple correlations among siblings at a point in time or within individuals over time. All regressions include fixed effects as indicated and a constant. Observations are weighted using survey weights, and standard errors (in parentheses) are White-corrected for heteroscedasticity and clustered on the individual in columns 1-2 and on the family in columns 3-4.

Appendix Table 1
Descriptive Statistics

	NLSY		HSB		NELS
	All	Siblings	All	Twins	
Hours of television per week	14.07 (13.09)	12.22 (12.39)	20.53 (12.02)	23.20 (11.97)	18.53 (9.79)
Non-normalized test score	36.02 (26.74)	30.04 (24.74)	52.45 (8.56)	49.21 (8.64)	54.20 (8.83)
Age	16.88 (.74)	16.98 (.83)	16.51 (1.20)	16.36 (1.18)	15.51 (1.71)
Female	.42 (.49)	.40 (.49)	.54 (.50)	.56 (.50)	.51 (.50)
Black	.29 (.46)	.39 (.49)	.08 (.28)	.12 (.32)	.07 (.26)
Hispanic	.16 (.37)	.17 (.38)	.10 (.30)	.07 (.25)	.07 (.26)
Foreign born	.06 (.23)	.07 (.25)	.04 (.19)	.04 (.20)	.04 (.20)
Number of siblings	3.62 (2.52)	4.54 (2.70)	2.78 (1.68)	3.88 (2.32)	2.11 (1.46)
No reading materials at home	.09 (.29)	.11 (.31)	.04 (.20)	.05 (.22)	.03 (.16)
Numerous reading materials at home	.40 (.49)	.37 (.48)	.73 (.44)	.67 (.47)	.73 (.44)
Mother graduated high school (and not college)	.48 (.50)	.42 (.49)	.58 (.49)	.58 (.49)	.55 (.50)
Mother graduated college	.07 (.26)	.07 (.26)	.13 (.34)	.10 (.30)	.26 (.44)
Father graduated high school (and not college)	.39 (.49)	.39 (.49)	.41 (.49)	.37 (.48)	.47 (.50)
Father graduated college	.12 (.32)	.10 (.30)	.19 (.40)	.20 (.40)	.32 (.46)
Time spent reading	5.11 (8.30)	4.95 (7.93)	2.38 (1.13)	2.20 (1.14)	2.01 (1.53)
Time spent on homework	5.61 (6.06)	5.31 (5.52)	4.73 (1.41)	4.53 (1.36)	4.01 (1.61)
Number of observations	2,477	490	29,976	865	18,765

Notes: Shown are weighted means (standard deviations) for the main variables included in the regressions. The NLSY sample includes individuals enrolled in high school at the time of the 1981 survey and who had valid AFQT scores. The HSB sample includes high school sophomores in 1980 who were also in school and surveyed in 1982 and who had two valid test scores. The NELS sample includes eighth graders in 1988 who were also in school and surveyed in 1990 and 1992 and who had three valid test scores.

Appendix Table 2
Estimated Coefficients of Other Variables in Test Score Regressions

	NLSY	HSB	NELS
Age	.045* (.022)	-.147** (.012)	-.204** (.023)
Female	-.058† (.032)	-.283** (.015)	-.025 (.028)
Black	-.739** (.039)	-.661** (.026)	-.408** (.051)
Hispanic	-.293** (.050)	-.576** (.024)	-.335** (.053)
Foreign born	-.149* (.074)	-.055 (.048)	.195** (.056)
Number of siblings	-.026** (.007)	-.044** (.004)	-.022* (.010)
No reading materials at home	-.127* (.050)	-.101** (.033)	-.063 (.120)
Numerous reading materials at home	.287** (.039)	.124** (.017)	-.039 (.035)
Mother completed high school	.201** (.041)	.169** (.023)	.251** (.047)
Mother completed college	.487** (.081)	.372** (.032)	.487** (.061)
Father completed high school	.195** (.042)	.154** (.023)	.218** (.046)
Father completed college	.606** (.069)	.448** (.030)	.507** (.061)
Time spent reading	.009** (.002)	.172** (.006)	.102** (.008)
Time spent on homework	.021** (.003)	.129** (.005)	.104** (.007)
Adjusted R ²	.398	.340	.232
Number of observations	2,477	29,976	18,765

** p < .01; * p < .05; † p < .10

Notes: Shown are estimated coefficients of some of the other variables included in the regressions shown in column 1 of Table 3 (all observations, specification D). Regressions also include two dummy variables for mother's education and father's education not reported.