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This is a post-peer-review, pre-copyedit version of an article published in:

Journal of Human Resources

The definitive publisher-authenticated and formatted version:

Hernæs, Øystein M., Simen Markussen, Knut Røed, 2018, Television, Cognitive Ability, and High School Completion, Journal of Human Resources, Forthcoming, DOI: 10.3368/jhr.54.2.0316.7819R1.

is available at:

https://doi.org/10.3368/jhr.54.2.0316.7819R1

Television, Cognitive Ability, and High School Completion*

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September 2017

Abstract

We exploit supply-driven heterogeneity in the expansion of cable television across Norwegian municipalities to identify developmental effects of commercial television exposure during childhood. We find that higher exposure to commercial television reduces cognitive ability and high school graduation rates for boys. The effects appear to be driven by consumption of light television entertainment crowding out more cognitively stimulating activities. Point estimates suggest that the effects are most negative for boys from more educated families. We find no effect on high school completion for girls, pointing to the growth of non-educational media as a factor in the widening educational gender gap.

Keywords: Human capital, Media, Education gender gap

JEL Classification: J13, J16, J24, L82

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doi:10.3368/jhr.54.2.0316.7819R1

I. Introduction

Since television was introduced to a large audience around the mid-20th century, its effects have been debated. A widespread concern has been that television encourages a particularly passive form of engagement, and thus may be damaging to intellectual development. This view has been argued by social commentators (e.g. Postman 1985), but has also received support in professional circles: American pediatricians have concluded that television affects children negatively, and recommend limiting children's television time (American Academy of Pediatrics 2001; Strasburger, Jordan, and Donnerstein 2010). The complete opposite view has also found supporters. Johnson (2006), for example, argues that popular culture, including television, has become more complex and intellectually demanding over time and that this gives beneficial cognitive payoffs.

Cognitive skills are essential for individual (Griliches and Mason 1972; Cunha and Heckman 2007) as well as aggregate economic outcomes (Hanushek and Woessmann 2008). After a long period with generally rising IQ scores in industrialized countries, recent empirical evidence indicates that this development may now have gone into reverse; see Dutton and Lynn (2015) for a recent overview of the literature.[1] Since its introduction, television has spread all over the world; hence, its effects are also likely to be ubiquitous. If television viewing indeed can be harmful to the development of cognitive skills, this may be one explanation why IQ scores have stagnated or even started to decline in many countries. If so, this is critical knowledge for policy makers and families alike.

The existing empirical evidence is not conclusive, however. In a review of the pediatrics literature, Jolin and Weller (2011) point out that statistical evaluations are often based on cross-sectional data, and they lament the lack of longitudinal research designs. There are some experimental studies focusing on short-term impacts, but the external validity of such studies is questionable; see Thakkar, Garrison, and Christiakis (2006) for a review. An influential study within the economics literature is Gentzkow and Shapiro (2008), who analyze the effect of the introduction of television in the US in the 1940s and 1950s on standardized test scores. They find that, contrary to popular worries, television exposure during pre-school age not only failed to lower test scores, but in fact raised reading and general knowledge scores for socially disadvantaged groups. On the basis of this effect heterogeneity, they conclude that “the cognitive effects of television exposure depend critically on the educational value of the alternative activities that it crowds out (p. 282).” As most societies have undergone large changes in their educational and home environments since the early post-war era, this makes it pertinent to reexamine the issue. The impacts of television exposure also clearly depend on the contents of the programs that children are exposed to. Kearney and Levine (2015) examine the effects of the introduction of an explicitly educational children’s show – Sesame Street – into a television programming space dominated by entertainment shows. They find support for the positive educational effect of Sesame Street, in particular for boys and children from disadvantaged backgrounds.

In this paper, we examine how a geographically staggered expansion of access to commercial cable television in Norway during the 1980s and 1990s affected children’s cognitive skill developments and subsequent high school graduation rates. As we explain in more detail below, the introduction of cable television in Norway implied access to a wide range of channels broadcast by satellites, and it turned out to have huge impacts both on children’s overall exposure to television and on the type of programs they watched. Whereas the state broadcaster, which held a legal monopoly on television broadcasts until 1981, offered a single TV channel only, based on a clear educational mandate, the new commercial channels were almost entirely dominated by light entertainment without any educational content. We provide empirical support for the view that the expansion of commercial cable television indeed had negative effects on men’s cognitive skills – as measured by intelligence test scores at time of military service enrolment – and that it also reduced their high school completion rates. For women, we find no significant effects on high school completion rates. Data on intelligence test scores exist only for men.

When television was deregulated in Norway in the beginning of the 1980s, it became legal to forward television signals broadcast by satellites in local cable networks, and a large rollout of cable networks was initiated. We argue that the growth in cable networks was a supply-led development driven by geographical factors and settlement patterns, and the key explanatory variable in our analysis is the time-varying cable television coverage rate at the municipality level. Because residence decisions may be endogenous to cable television coverage, we either include family fixed effects in our regression models or use the future coverage in an individual's municipality of birth to instrument for actual exposure.

Our results indicate that one year of living in a municipality with full coverage of cable television during childhood and adolescence lowers ability test scores of young men by 0.53 % standard deviations, corresponding to 0.18 IQ points. It reduces the high school completion rate for males by 0.4 percentage points. These effects are not huge, yet far from negligible. They appear to be driven by consumption of light television entertainment crowding out more cognitively stimulating activities such as reading. Point estimates suggest that the effects are most negative for boys from more educated families. For women, we do not find convincing evidence of a negative effect on high school completion, thus a net effect of commercial TV expansion was to widen the educational gender gap. A policy lesson that potentially applies to other forms of light media entertainment as well is that although consumption of such entertainment is not necessarily harmful in itself, one should be alert about what activities it substitutes for, in particular for boys.

Our paper adds to a rapidly growing literature in economics on the effects of media. Television in particular has been found to impact outcomes as diverse as voter turnout in the

US (Gentzkow 2006), party choice in the US and Russia (DellaVigna and Kaplan 2007; Enikolopov, Petrova, and Zhuravskaya 2011; Martin and Yurukoglu 2014), social capital in Indonesia (Olken 2009), fertility, women's status and school enrollment in India (Jensen and Oster 2009), and divorce and fertility in Brazil (Chong and Ferrara 2009; La Ferrara, Chong, and Duryea 2012).

Our study also contributes to the literature on the educational gender gap. In most developed nations, the traditional male education premium has been completely reversed, such that girls now have higher high school graduation rates and higher tertiary education than boys (OECD, 2014; 2015). In the US, girls had in fact higher high school graduation rates than boys for the most part of the twentieth century (Goldin and Katz 2008); however from the 1970 the gap has widened (DiPrete and Buchmann 2013; Murnane 2013). In the same period, girls also made gains relative to boys on standardized math and reading tests (Goldin, Katz, and Kuziemko 2006; Cho, 2007) and grades (Fortin, Oreopoulos, and Phipps 2015). Previous research has found evidence that boys are more sensitive than girls with respect to both parental (Bertrand and Pan 2013; Riphahn and Schwientek 2015) and school/preschool inputs (Krueger 1999; Machin and McNally 2008; Chetty et al. 2011; Havnes and Mogstad 2011). This is supported by evidence showing that boys benefit more strongly than girls from early childhood interventions (Campbell et al. 2014; Conti, Heckman, and Pinto 2016) and are more impatient (Bettinger and Slonim 2007; Dohmen, Falk, and Sunde 2010; Castillo et al. 2011; Golsteyn, Grönqvist, and Lindahl 2014).

II. Data and Institutional Background

Television was introduced in Norway in the 1960s. Until 1981, the state-controlled Norwegian Broadcasting Corporation held a legal monopoly on broadcasting in the country, and for most Norwegians, only a single TV-channel was available. In December 1981, the newly elected government announced that 30 other agents would obtain broadcasting licenses the following year, thereby breaking the public monopoly. It then became legal to forward television signals broadcast by satellites in local cable networks. All such local cable networks had to register with the Post- and Telecommunications Authority. The legalization in 1981 initiated a large-scale roll-out of local cable networks. Because of economies of scale in laying the necessary cables, the roll-out took place primarily in densely populated areas (Norwegian Ministry of Culture 1995). Mandatory registration continued until 2004, at which point 40 % of the population was covered. The aggregate evolution of the number of households covered is shown in Figure 1.

The television data consist of the universe of Norwegian local cable networks up to 2004. They contain more than 11,000 unique networks, each with the number of households covered, the first date of operation, and the municipality. We combine this with data on the number of households in a municipality to obtain the yearly coverage rate in each municipality up to 2005. The maps in Figure 2 show three snapshots of coverage rates across the country between 1985 and 2005. They illustrate the considerable geographical disparities in the roll-out process, with cable networks first established in the Oslo-area, and then expanded to other densely populated areas throughout the country. To arrive at individualized exposed-to-TV-variables, we construct two variables for each person born between 1974 and 1987: the cumulative cable TV coverage over their first 18 years both in their municipality of actual residence at any time and in their municipality of birth. The resultant TV coverage variables thus vary from zero (for individuals who grew up in municipalities were no one had access to cable TV before they turned 18) to 18 (for individuals who grew up in municipalities with full coverage already from birth).

Unfortunately, we do not have the same kind of data on commercial television coverage by parabolic antennas. This is a minor problem in the present context, however, as parabolic antennas were providing only a small amount of television coverage in this period. When

Statistics Norway started their media survey in 1991, only 5 % of the households had a parabolic antenna. Since parabolic antennas and cable television were substitutes for each other, the presence of parabolic antennas will nevertheless tend to attenuate our estimated effects of commercial television access slightly, as we implicitly will assume that cable networks are the only providers of these channels.

Coinciding with the expansion of commercial television in Norway, there has been a marked change in the way young people spend their leisure time. Figure 3 illustrates some key findings from a sequence of time use surveys provided by Statistics Norway. Unsurprisingly, time spent watching television increased considerably for both boys and girls during the 1980s and 1990s. To a large extent, this substituted for reading, particularly among boys aged 16-24, for which time spent reading dropped by as much as 74 percent; from 39 minutes per day in 1980 to 10 minutes per day in 2000.[2] The reason why we focus on 16-24 year olds here is that there is no time use data collected for younger persons. However, from 1991, there have been media surveys also covering 9-18 year olds. While the media surveys do not allow us to examine the longer-term trends, they confirm the picture of a considerable rise in time spent television watching and a corresponding decline in the time spent reading. We return to these data in section VI, where we examine the relationship between cable TV access and media consumption more closely.

The data we use in the statistical analysis of the effects of cable TV exposure are collected from different administrative registers, and cover the complete population. The outcomes we focus on are cognitive ability score at age 18 for young men, and a dichotomous variable indicating high school completion by age 21 (two years after the “normal” graduation age) for both men and women. Our measure of cognitive ability is based on data from the Norwegian Armed Forces. Before compulsory military service, all Norwegian men undergo an assessment of suitability. From 1969/70, this assessment has included intelligence testing. All test-takers receive a score which is a composite of three tests, on arithmetic, word similarities and pattern recognition. In this paper we have standardized the test scores such that point estimates will be directly interpretable as percentage points of a standard deviation, though for expositional purposes we sometimes refer to the corresponding IQ scores.[3]

Figure 4 (left panel) shows that there has indeed been a negative development on this test since the early 1990s, in line with previous findings reported by Sundet, Burlaug, and Torjussen (2004). Another notable phenomenon was a widening of the gender gap in high school completion, which increased by more than 6 percentage points (right panel).

We match the two outcomes with data on parental characteristics and on the municipality of residence from the year of birth and onwards. The first cohort in our sample is the cohort born in 1974, which is the first year from which we have data on residence at birth. We include all subsequent cohorts until and including the one born in 1987, which turned 18 years old in 2005. The reason why we stop at the 1987 birth cohort is that we do not have the data needed to compute total cable television coverage for later cohorts, as the mandatory registration of networks ended in 2004. To sum up, our sample consists of the birth cohorts 1974-1987, with outcomes measured in 1992-2005 (ability test scores) and 1995-2008 (high school completion). To allay worries concerning an increasing share of people with immigrant background taking the test, we include only individuals born in Norway to Norwegian-born parents.

Table 1 presents an overview of the data we use in this paper, with descriptive statistics for the two outcomes and for the various control variables we are going to use in the statistical analysis. In total, we have around 311,000 male and 294,000 female observations. On average, the persons in our dataset had access to cable TV in only 3.45 years during their childhood and youth. But TV exposure increased considerably over time, from less than 2 exposure-years on average for our first cohorts to more than 5 for our last (not shown in the table). Figure 5 provides a more detailed description of the TV coverage variable is distributed within our analysis population. It shows that the typical coverage rates have been quite moderate, with approximately half of the population being attributed less than three years of exposure. Note that in our data, a given level of exposure can come about through different combinations of years with exposure and exposure intensity. For example, a cable TV coverage of 0.8 can come about by living one year in a municipality with 80 percent coverage, or by living four years in a municipality with 20 percent coverage.

The control variables are defined at the individual or at the municipality-by-cohort levels, in both cases measured no later than the time of birth. In addition, we will in some cases use municipality characteristics measured in 1980 (pre-legalization) interacted with time-indicators. Individual characteristics comprise the educational attainment and earnings levels of both parents, whereas municipality characteristics cover socio-economic factors, such as average education, employment, and earnings; see Table 1 for details.

III. Empirical Strategy

In order to identify the causal impacts of cable network expansion on the ability test score and schooling outcomes, we use the municipality-by-cohort specific coverage rate described in Section II as the key explanatory variable. The identifying assumption is then that the geographical rollout of cable TV was as good as randomly assigned with respect to other factors that could have generated local variations in the developments of cognitive ability and high school completion rates, conditional on the control variables we use in the analysis. We argue that we can rule out reverse causation in this case, as there is evidence that the cable network expansion during the 1980s and 1990s was solely supply side driven. Building cable networks required heavy investment in infrastructure, and was only profitable in densely populated areas. Given that there was a large excess demand for cable TV everywhere, the actual expansion pattern was determined by economies of scale and physical/topological constraints. Participants from the supply side of the cable television market in this period have confirmed that it is hard to see any factors other than suppliers' capacity and population density that had an impact on where networks were built, and that the deregulation suddenly allowed suppliers to cater to a demand that had been present for a long time.[4]

In 1999, a government White paper concluded that "significant development of cable networks beyond today's level will most likely not be profitable (Norwegian Ministry of Culture 1999, Ch. 2.2)," and that "one does not expect significant further development of cable utilities beyond today's coverage of around 38 % (Norwegian Ministry of Culture 1999, Ch. 2.3)." From Figure 1 we see that this assessment proved correct. The report cites topographical and physical barriers as reasons for why full coverage would not be possible.

As an empirical check on the supply-driven expansion pattern, we run a regression where we use the potential years of coverage (in the municipality of birth) as the dependent variable and a number of pre-expansion (1980) municipality population characteristics as explanatory variables, including their changes from 1970 to 1980. As can be seen from the results reported in Table 2, the variable that most clearly stands out as having affected cable television is the level of population density at the start of the expansion period. There does not appear to have been any clear-cut relationships with other municipality variables, such as average education and income. In particular, we find no indication whatsoever that the pattern of cable TV expansion was statistically associated with local levels and trends in cognitive ability up to 1980.

Although demand did not play a significant role for the rollout of cable TV in Norway, we cannot a priori rule out that some families have taken cable TV coverage into account in their residential decisions. Neither can we rule out that the (typically densely populated) areas selected for early expansion have been characterized by different post-expansion developments in ability scores and schooling outcomes than other areas for reasons unrelated to the cable television expansion. Such differential developments may have come about through selective migration of families to and from densely populated areas, or through different developments of the learning environments in rural and urban districts. Hence, an important element of our empirical strategy is to control for geographically differentiated developments along these lines, and also to examine our results robustness with respect to the exact way in which this is done.

To empirically assess the impacts of cable TV coverage, we use linear regression models with the two outcomes (cognitive ability score and a dichotomous indicator for high school completion) as dependent variables and the number of years with cable TV coverage until age 18 as the central explanatory variable. Our identification strategy will throughout this paper be based on two alternative approaches. The first is a control function strategy, where we use a wide range of control variables to achieve identification. To account for selective migration decisions, this approach relies on an instrumental variables strategy, where we use the TV coverage in the municipality of birth as an instrument for actual TV coverage. The second approach instead relies on family fixed effects, implying that we essentially compare brothers and sisters who to varying degrees have been exposed to cable TV. For this model, we use actual TV coverage as the central explanatory variable, as selective migration decisions will have been equally selective for all offspring belonging to the same family.

We now describe the baseline versions of the two models in more detail. We will return to a number of extensions/modifications of these models later on in order to examine robustness and mechanisms. Let *i* be a subscript for individuals, *m* for municipality of birth, and *t* for year of birth. We can then write the second step regression in our *instrumental variables* (IV) model as:

$$y_i = \beta\widehat{TV} + \delta_m + \theta_t + \boldsymbol{p_i}'\boldsymbol{\eta} + \varepsilon_i \qquad (1)$$

where y_i is an individual outcome measured at age 18 or age 21, $\widehat{TV}$ is predicted cumulative cable TV exposure during the first 18 living years, δ_m is a birth-municipality fixed effect, θ_t is a birth-year fixed effects, and $\boldsymbol{p_i}$ is a vector of parental characteristics. The predicted cable TV exposure is the linear prediction from a first stage equation where actual TV exposure (based on correctly assigned municipality in every year) is the left-hand side variable and the corresponding TV exposure in the municipality of birth is the right-hand side variable, together with the other controls included in (1). An important point to note is that *all* the explanatory variables in (1) are predetermined at birth or earlier. The birth-municipality fixed effects are included to control for any time-invariant factors that vary between municipalities in a way that correlates with cable TV expansion. The birth-year fixed effects are included to control for any common trends. And the vector of parental characteristics is included to control for any sorting of families through selective migration as well as to improve efficiency. It includes indicator variables for both parents' incomes and educational attainments, measured in the offspring's birth year.[5]

Let *j* be a subscript for family. The *family fixed effects* (FFE) model can then be described as follows:

$$y_i = \beta TV + \varphi_j + \theta_t + \boldsymbol{b_i}'\boldsymbol{\gamma} + \varepsilon_i \qquad (2)$$

where TV is actual exposure and $\boldsymbol{b_i}$ is a vector of birth order fixed effects. The latter are included to avoid birth order effects to contaminate our estimate of β, as it will almost always be the case that the younger sibling has been exposed to at least as much TV at age 18 as the older sibling. Since we analyze boys and girls separately, the FFE model can only use data from families with at least two sons or two daughters, respectively.

IV. Main Results

The main results from the baseline instrumental variables (IV) and family fixed effects (FFE) models are presented in Table 3. A first point to note is that the results are remarkably similar for the IV and FFE models, despite that they rely on different sources of identification and also involve different datasets (the number of observations is 60 % lower in the FFE models than in the IV models). With the standardized cognitive ability score as the outcome, both models give an estimated coefficient on our television exposure measure of -0.012, i.e. a negative effect of exposure of 1.2 % of a standard deviation. Since the IQ scale has a standard deviation of 15, this estimated effect of one additional year of full television coverage would roughly correspond to a 0.18 points reduction in IQ. By comparison, Brinch and Galloway (2012) estimate the effect of one year of schooling to be around 3.7 IQ points using an education reform in Norway in the 1960s. Likewise Carlsson et al. (2015) use a quasi-experimental setting in Sweden to exploit variation in test taking date for young Swedish males preparing for military service. Their results imply that one year of schooling raises crystallized (synonyms and technical comprehension) test scores by around 20 % of a standard deviation, corresponding to around 3 IQ points, but has no effect on fluid (spatial and logic) intelligence tests. Taken at face value, our estimate thus indicates that, say, 10 years of full cable TV coverage has a negative impact on cognitive ability (-1.8 IQ) comparable to around half a year's schooling.

Moving on to high school completion, our results indicate that one extra year of cable TV coverage reduces the probability of high school completion for men by age 21 by around 0.4 percentage points. To again put the results in perspective, we note that the estimated effect on high school completion of one year of cable TV exposure constitute 1/12 of the corresponding statistical association between one additional year of parental education and high school completion, as reported by Bratsberg, Raaum, and Røed (2012, Figure 5). For women, we find no effect at all on high school completion, regardless of model specification. This is consistent with the research showing greater importance of the home and school inputs for boys than for girls. Boys' higher impatience may also make them more susceptible to the temptation of easy entertainment at the expense of more cognitively challenging activities.[6]

V. Robustness

In this section, we evaluate the robustness of our findings with respect to the sources of identification – in terms of the way we allow for differentiated time trends in the two outcomes – and with respect to the functional form of the relationship between TV exposure and outcomes.

A. Differentiated Time Trends

Although we are confident that the expansion of cable television was supply side driven, and thus not causally affected by factors deermining local trends in cognitive ability, we have emphasized that spurious correlations cannot be ruled out. We now examine our findings' robustness with respect to the inclusion of additional sets of control variables that are designed to capture differentiad time trends in the two outcome variables. In the IV model, these variables serve the purpose of controlling for any selective migration unacaounted for by parental characteristics $(\mathbf{p}_i)$ as well as for developments of local learning environments that are spuriously correlated with cable TV expansion, whereas in the FFE model they only serve the latter purpose. We add three types of differentiated trend controls. The first is a set of time-varying municipality characteristics included to account for differential local trends in peer environments that potentially vary across municipalities; i.e.

$$y_i = \text{Baseline (Eq. 1 or 2)} + \text{Municip. char. in birth year} \qquad (3)$$

The vector of municipality characteristics includes municipality-level average education, male and female income, and male and female employment rates (5 variables). These are all measured in the year of each cohort's birth; hence, they are not absorbed by the municipality-fixed effects (which are common for all cohorts).

The second type of trend control is a vector of county-by-birth-year fixed effects, entered in the form of 247 additional dummy variables:

$$y_i = \text{Baseline (Eq. 1 or 2)} + \text{Municip. char. in birth year} \\ + \text{County-by-birth-year fixed effects} \tag{4}$$

We can obviously not use municipality-year fixed effects in our models, as that would totally absorb the effects of interest and induce a multicollinearity problem. However, by including regional birth-year fixed effects at a somewhat higher geographical level, we can control for time variations that are common within regions. There are 19 counties in Norway, and each county covers approximately 23 municipalities on average. A somewhat unfortunate consequence of using county-year fixed effects is that we effectively eliminate the influence of observations from Oslo, the capital city, which is by far the largest municipality and forms its own county.

Finally, we add in a vector of pre-reform (1980) birth-municipality characteristics interacted with birth-year dummy variables; i.e.

$$y_i = \text{Baseline (Eq. 1 or 2)} + \text{Municip. char. in birth year} \\ + \text{County-by-birth-year fixed effects} \\ + \text{Municip. char. in 1980 interacted with birth year dummies} \tag{5}$$

The pre-reform municipality characteristics include variables capturing the average education, income, and employment rates in the adult population as well as population density and average ability level among men; see Table 1 for details. This gives us 91 additional covariates, which are included in the manner of Duflo (2001) to control for unobserved local trends in outcomes that vary systematically with factors that potentially influenced (or correlated spuriously with) network expansion. Trends that differ according to initial population density are included here for the reason that population density was a particularly important factor behind the cable network expansion.[7] And trends that differ according to the initial average ability level are included to account for possible influences of mean-reversion tendencies in the data.

By including all these additional trend terms in our model, we run the risk of "over-controlling" and thus erroneously attribute some of the true impacts of cable TV to other factors, as some of the trends we control for may have been endogenously caused by differential exposure to commercial TV. This could for example be the case if the true effects of exposure are heterogeneous or non-linear, such that they are not appropriately captured by our single TV exposure variable, but instead soaked up by the heterogeneous trend terms. We nevertheless think of this as a useful exercise in order to assess robustness with respect to alternative identification sources. The results are presented in Table 4. The point estimates vary somewhat from model to model, with a pattern of declining effects as we allow for more differentiated local trends. Although this suggests that we should be a bit careful about interpreting the point estimates, we view the main results as rather robust. None of the qualitative conclusions from the previous section need to be modified, although the statistical significance for the FFE model do evaporate in the model with all trend terms included simultaneously. It is notable that while point estimates differ across the different model specifications, the estimated standard errors are almost the same. The reason for this is that although the added controls soak up variation in the TV coverage variable – leading to larger standard errors – they also contribute to a drop in the overall residual variance – leading to smaller standard errors. In our case, these two forces largely cancel out.

B. Functional Form

We now turn to the issue of functional form specification. So far we have assumed that the effects of cable TV exposure operates in a linear fashion, such that the marginal effect of an additional exposure year is the same regardless of initial exposure. Although this appears to be a rather restrictive – and poorly justified – assumption, we will argue that it is defendable on the ground that we need to exploit the admittedly small independent variation that we have in TV exposure as efficiently as possible. However, it accentuates the need for checking whether this somewhat arbitrary functional form restriction is critical for our findings. Hence, we now relax the linearity assumption, and instead include cable TV exposure in our models in the form of a series of dummy variables, representing [0-2), [2-4), [4-6), [6-8), [8-10), [10-12), [12-14), [14-16), and [16-18] years of exposure, respectively. Otherwise, the estimated models are exactly as in the baseline models (Eq. 1 and 2) described in Section III.

We present the results from this exercise graphically; see Figure 6. While there are some differences between the IV and FFE models, the main message coming out of these results is that the identified negative impacts for boys are indeed monotonously increasing in the exposure time, and the linearity assumption is not critical for our findings. For girls, the FFE model now actually indicates a positive impact on high school completion of TV exposure. Such an effect may be rationalized directly by the negative impact on boys, as poorer school performance among boys in areas with high coverage may have contributed to a lowering of the overall high-school passing standards and thus reduced the degree of competition for girls. However, given that these results are not confirmed in the IV estimation, and also that only one of the FFE coefficients is statistically significant, we should probably not put too much emphasiz this result.

VI. Mechanism

Why does access to commercial cable TV reduce the cognitive ability and educational performance of young boys? And why do we not see a similar negative effect on educational performance for young girls? A simple answer to the first question is that large doses of the kind of light entertainment that commercial TV offers are not particularly cognitively stimulating. However, this does not explain why girls are not negatively affected.

In this section, we take a closer look at what auxiliary data sources on youths' actual time use can tell us about the relationship between cable TV access, TV viewing, and the alternative activity of reading. In doing this, we also examine the role of socioeconomic background, as we suspect that cable TV access may affect offspring in different types of families differently, both in terms of its impact on the volume of TV consumption in terms of the kind of activities that it substitutes for. Finally, we examine the extent to which there are "critical ages" at which access to cable TV has a particularly large (or small) influence on cognitive developments.

A. TV Consumption and the Role of Socioeconomic Status (SES)

Access to commercial television channels can affect the nature of television consumption in two ways: By affecting the total time spent watching TV and by affecting the type of programs being watched. The Norwegian Broadcasting Corporation (NRK), which held a legal monopoly until 1981, has had and continues to have a broad public service mandate. In their articles of association, it is stated that "The purpose of the NRK's overall public media services is to meet democratic, social and cultural needs in society (NRK 1997)." Further, "[t]he NRK should promote public debate," "offer services which can be a source of inspiration, reflection, experience and knowledge through programs of high quality," and "contribute to public education and learning." The new channels that arrived with cable television had no public service mandate, and no regulation of content other than pornography and violence (Regulations relating to broadcasting 1997). And their program profiles were indeed markedly different: According to a comparative analysis undertaken in 1993, the contents of the main Scandinavian cable channels in Norway (TVNorge and TV3) were 75 % entertainment and 10 % advertisements, while that of the NRK was almost 40 % news, documentaries, science, nature, or similar (NRK 1993) and no advertisements. It is also clear that the new channels were watched – in 1992, the NRK's share of total viewing time was down to 64 % (MMI 1992)

In this subsection, we use auxiliary data from media surveys to shed light on how the introduction of cable TV influenced media habits among offspring from families with different socioeconomic status (SES). Statistics Norway has since 1991 undertaken surveys of the population's media habits. An effort is made to obtain responses from kids as young as 9 years old, thus for the age group 9-18 we can get a quite good picture of how having a cable connection correlates with actual television watching in the period from 1991 onwards. When it comes to television, respondents are asked both about what type of connection they have, and about how much they watched yesterday. They are also asked what type of programs they watched yesterday, and each program is coded as belonging to one of several categories. This makes it possible to distinguish educational programs (news, debates, information and documentaries, science, nature, quiz) from other more entertainment-oriented shows (sports, kids/youth, religious, theatre and ballet, classical music, films, TV series, pop music, other entertainment).

In Table 5, we present a summary of these data, illustrating time use and television content for boys and girls by socioeconomic status (SES), as well as a series of regression coefficients capturing the estimated influence of access to cable TV. We have defined three SES-groups based on the education of the head of household: less than high school, high school, or college/university. And for each of these groups, we have estimated ordinary least square regressions, using minutes spent yesterday on TV and reading, respectively, and the number of educational and other shows watched, as the dependent variables, and a dummy indicating access to cable TV as the key explanatory variable. In these data, we expect a considerable attenuation bias, as they are collected in a period with relatively high coverage of commercial TV channels through parabolic antennas in the no-cable group (approximately

30 %). To come as close as possible to the approach in our main analysis, we have include controls for area type (cities with population>100 000, 20 000-100 000, <20 000, and “rural” areas), age, and year.

Although the conclusions that can be drawn from the results presented in Table 5 are limited, given the small sample sizes and the resultant large statistical uncertainty, there are some noticeable patterns that emerge. First, for both boys and girls, there is a social gradient in TV watching, possibly related to variations in parents’ patience and effort in keeping their offspring focused on more cognitively stimulating activities. Time spent watching TV is decreasing with parental education. Second, particularly for boys, there is also a social gradient in reading. Time spent reading is increasing with parental education. Moving on to the estimated impacts of cable TV on media use, we note that access to cable TV implies much more television watching, as well as a marked shift toward non-educational shows. And, interestingly, it appears that the estimated impacts on time use are generally larger for offspring with higher SES. This is particularly the case when we look at the impacts on reading, where we find the strongest negative effects of cable TV among boys and girls with a college/university educated parent. Hence, there is some suggestive evidence here indicating that the higher TV consumption resulting from cable TV access substituted for more cognitively stimulating activities in families with higher SES.

Given these differences in impacts on actual time use, we now return to the impacts of cable TV on cognitive ability and high school completion, and re-estimate the baseline model described in Section III separately for offspring with different SES. The results are presented in Table 6. Although the differences are relatively small and not statistically significant, the point estimates show indications of larger effects for families with higher SES. For the highest SES group, we now even obtain a slightly negative impact on high school completion for girls. In light of the examination of time use patterns, it is natural to interpret these findings as a result of the larger impacts that cable TV access has on time use in families with higher SES. It appears that TV viewing substitutes for more valuable and cognitively stimulating alternative activities – such as reading – in families with more educated parents. This also suggests that it may not be the TV viewing itself that primarily gives rise to the adverse impacts identified in this paper, but rather the reduction in the alternative activities that it substitutes for.

Our finding that the adverse impacts of cable TV are larger for offsrping with educated parents may at first sight seem surprising, given the previous evidence reported by Gentzkow and Shapiro (2008) and Kearney and Levine (2015) that TV has the largest impacts on offspring with low SES. Howver, it should be kept in mind that Gentzkow and Shapiro (2008) evaluated the introduction of TV *as such* whereas Kearney and Levine (2015) evaluated the impacts of a particularly educating show (Sesame Street), and both reported *positive* impacts on the cognitive developments of pre-schoolers. In contrast, we examine the impacts of the introduction of commercial entertainment channels into an already existing TV environment, and find *negative* impacts. Since we also provide suggestive evidence indicating that it is neither the TV vieweing itself nor its content-shift after deregulation, but rather the activities it crowds out that lies behind the adverse effects, it is perhaps not surprising that the effects may be larger for offspring with higher SES.

B. Exposure at Different Ages

In our baseline model, we have assumed that commercial television exposure has the same impacts on cognitive ability and schooling outcomes, regardless of its timing within the 0-18 year age span. This is a questionable assumption. The literature on the importance of relatively early environments (Heckman 2006; Conti, Heckman, and Pinto 2016; Chetty, Hendren, and Katz 2016) and “critical periods” for cognitive development (Bleakley and Chin 2004; Van den Berg et al. 2014) suggests strongest effects in the pre-school and elementary school periods.

Before we examine the impacts of cable TV exposure at different ages, Figure 7 shows what the media surveys can tell about the age profiles for actual television watching “yesterday” among those with and without access to cable TV. Up to age 14, there is a steady increase in the number of minutes spent on television watching for both groups. And those with cable connection watch considerably more television than those without, with a possible exception for the very youngest respondents.

To examine exposure impacts by age, we have split the television exposure variable into three separate periods of six years each, corresponding to the pre-school, elementary school, and middle and high school periods, respectively, and include all three variables simultaneously in the baseline models (Eq. (1) and (2)) instead of the single TV exposure variable. The results are presented in Table 7. Since the three coverage variables are highly correlated, and since exposure in early childhood almost always implies exposure at higher ages also, it is difficult to obtain a sharp identification of age-specific exposure effects, and few of the coefficients in Table 7 are statistically significant. However, taken at face value, they indicate that the adverse impacts on cognitive ability are highest for exposure in middle and high school periods, whereas the impacts on high school completion are larges for exposure during elementary school. Hence, our analysis does not lend support to the hypothesis that the pre-school age is the most important period in this context. This is consistent with the suggestive evidence presented above that the adverse effects of TV viewing to some extent results from its displacement of reading, which is not a very common activity for pre-school children. It is also consistent with the age profiles for actual TV watching shown i Figure 7, which suggests that access to cable TV has a smaller influence on time spent watching for the smallest kids.

VII. Conclusion

In this paper, we have used the geographically staggered expansion of cable TV in Norway during the 1980s and 1990s to examine the impacts of access to commercial TV channels on children and youths. Our outcome measures include ability test scores (measured at age 18) for men and high school completion at age 21 for both men and women. Our findings indicate that commercial TV affects ability test scores and high school completion rates *negatively* for men, but has *no significant effect* on high school completion for women. The estimated effects on male outcomes are moderately sized, but far from negligible. For example, one year of full cable television coverage lowers intelligence test scores by approximately 1.2 % of a standard deviation, corresponding to 0.08 IQ points. This is roughly 4.5 % of the previously estimated impact of one year extra schooling (Brinch and Galloway, 2012). The same increase in cable TV reduces the high school completion rate of men at age 21 by around 0.4 percentage points.

We started out this paper by pointing out that many countries have seen a recent decline in intelligence test scores and questioned whether this could be explained by the increased access to commercial television channels. During the data period covered by our analysis, the average IQ score among Norwegian male conscripts declined by around 1.9 points (conf. Figure 4), and average cable television exposure increased by three years. Based on our baseline model and data for aggregate cable televsion coverage, we estimate that the expansion of cable TV can account for a 0.5 point decline; i.e. around 26 % of the overall decline. Hence, although we do find negative effects of commercial televion access on cognitive ability, the rollout of cable television can only explain a modest fraction of the apparent overall decline in IQ scores.

Another motivation was the educational gender gap. In the same manner as with intelligence test scores, we can calculate cable television's contribution to the increasing gender gap in high school graduation. Taking the estimates of a zero effect for women and a negative effect of 0.4 percentage points per year of exposure for men, we get that cable television explains a 1.2 percentage point decline in high school gradution for men in this period, or about 20 % of the increase in the gender gap. One may speculate whether the asymmetric effect across gender, which has a priori support in previous research, applies also to other types of media that provide light entertainment.

Our findings suggest that offspring from families with the highest sosioeconomic status are not at all immune from the harmful effects of comercial television. To the contrary, our point estimates indicate that the negative impacts of TV exposure are largest for boys with highly educated parents. We have provided suggestive evidence that this apparently “inverted” social gradient arises because the activities crowded out by TV-wathcing are more congitively stiumlating in families with highly educated parents. In particular, based on time-use data, we have shown indications that the negative effect of cable TV access on time spent reading is particularly large for boys with educatted parents. Based on these findings, we hypothesize that the negative effects identified in our paper do not primarilly stem from increases in TV consumption *per se*, but rather from the resultant reduction in reading activities.

If it indeed is the case that the adverse effect of commercial TV arises because non-productive television vieweing crowds out more cognitively stimulating reading, we might expect adverse effects also on other outcomes normally assumed to be positively affected by reading. There is a large literature showing that there appears to be (small) positive impacts of leisure reading on non-cognitive skills such as empathy and the capacity to identify and understand other people’s states of mind; see Mumper and Gerrig (2017) for a recent survey and meta-analysis, and Kidd and Castano (2013) for experimental evidence. There is also a literature indicating that reading may be a fruitful long-term strategey for keeping the brain active and for preventing the risk of Alzheimer’s disease and other forms of dementia; see Stern and Munn (2010). However, how a more broadbased transition from leisure reading to consumption of modern multi media entertainment will affect social and cognitive skills among men and women over the longer term is still basically unknown – and a facinating area for future reasearch.

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Appendix

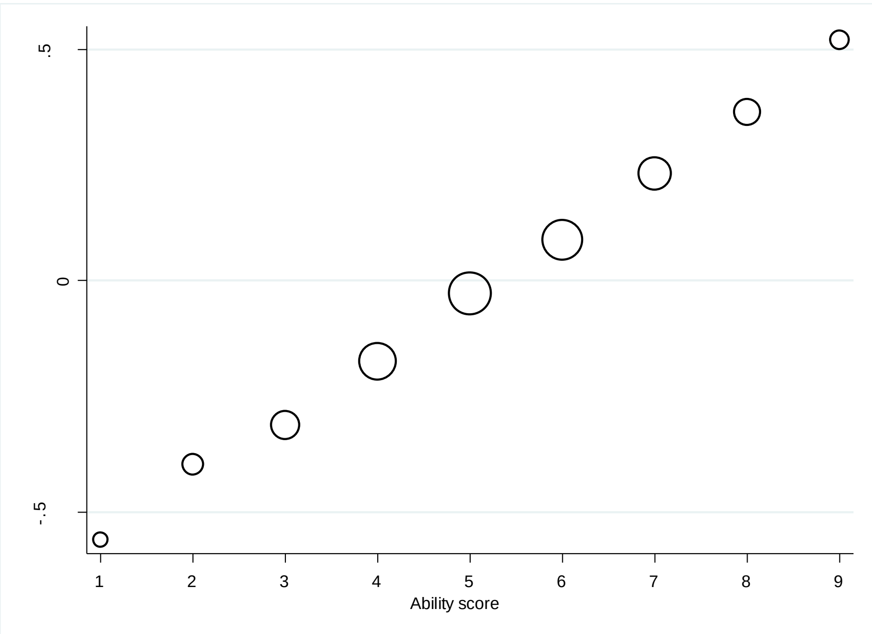

Figure A.1

Standardized income at age 40 by ability test score

Note: Data based on income of 40-year old men in 2013. Income is first averaged by ability score, then standardized.

Tables

Table 1.

Descriptive Statistics

	Boys		Girls			
	mean	sd	mean	sd	min	max
Outcomes						
ability test score at age 18 (standardized)	0.08	(0.87)			-2.00	2.00
high school completed at age 21	0.67	(0.47)	0.75	(0.47)	0.00	1.00
Main explanatory variable						
TV, actual years of coverage until age 18 (municipality of residence)	3.31	(3.54)	3.29	(3.52)	0.00	18.00
TV, potential years of coverage until age 18 (birth municipality)	3.45	(3.70)	3.42	(3.69)	0.00	18.00
Controls						
Parental characteristics in birth year						
years of education, fathers	11.29	(2.51)	11.27	(2.50)	9.00	21.00
years of education, mothers	10.81	(2.21)	10.79	(2.20)	9.00	21.00
income father, 1000 USD	69.11	(30.44)	69.09	(30.47)	0.00	259.09
income mother, 1000 USD	20.94	(22.87)	20.76	(22.83)	0.00	259.09
Municipality characteristics in birth year						
schoolyears attained	11.45	(0.44)	11.44	(0.44)	8.90	12.84
income males, 1000 USD	62.57	(8.17)	62.54	(8.15)	31.39	88.98
income females, 1000 USD	25.52	(7.30)	24.46	(7.28)	6.58	45.94
employment rate males	0.80	(0.04)	0.80	(0.04)	0.42	0.90
employment rate females	0.44	(0.12)	0.44	(0.12)	0.08	0.71
Municipality characteristics pre reform (1980)						
schoolyears attained 1980	11.45	(0.41)	11.45	(0.41)	10.14	12.63
income males 1980, 1000 USD	64.43	(7.28)	64.40	(7.26)	38.75	82.53
income females 1980, 1000 USD	25.88	(5.51)	25.85	(5.50)	12.72	37.48
employment rate males 1980	0.81	(0.03)	0.81	(0.03)	0.56	0.89
employment rate females 1980	0.45	(0.09)	0.45	(0.09)	0.18	0.62
population density 1980	0.69	(0.27)	0.69	(0.27)	0.00	0.99
average ability level 1980	-0.03	(0.19)	4.93	(0.18)	-0.68	0.43
Observations	310430		293643			

Note: Income is annual earnings measured in 2013 prices, converted to USD with an exchange rate of 1 USD=6.5 NOK and right-censored at 20 times the "basic amount" (BA) used by the Norwegian Social Insurance Scheme (1 BA= NOK 85 245=$13,115 in 2013) ; all municipality level covariates are based on inhabitants with Norwegian-born parents; municipality level income and employment are calculated based on inhabitants aged 18-60; in calculating employment rates, we count as employed individuals with annual earnings at least 2 times the basic amount, corresponding to around USD 26 000; population density is defined as the share of the municipality inhabitants living in a “densely populated” area.

Table 2

TV Exposure in Birth Municipality as Dependent Variable. Regression Results (OLS).

	Cable TV coverage, years	
	(1)	(2)
Baseline municipality characteristics		
Population density 1980	3.38**	2.57*
	(1.36)	(1.40)
…change from 1970 to 1980		-1.03
		(1.93)
Average schoolyears 1980	1.61	1.65
	(1.10)	(1.12)
.. change from 1970 to 1980		-1.89
		(1.52)
Average income males 1980	0.09	0.08
1000 USD	(0.07)	(0.10)
.. change from 1970 to 1980		0.001
		(0.17)
Average income females 1980,	-0.23	-0.67
1000 USD	(0.35)	(0.61)
.. change from 1970 to 1980		0.73*
		(0.42)
Employment rate males 1980	-9.54	-11.70
	(8.62)	(8.71)
.. change from 1970 to 1980		-12.12
		(10.60)
Employment rate females 1980	16.35	36.39
	(19.05)	(33.05)
.. change from 1970 to 1980		-32.75
		(23.43)
Average male ability 1980	0.57	0.67
	(1.07)	(1.19)
.. change from 1970 to 1980		-0.67
		(0.68)
cohort f.e.	Yes	Yes
ymean	3.44	3.48
N obs	604073	589759
N municipalities	430	409

Note: The numbers of municipalities and observations are lower in column (2) because some municipalities did not exist in 1970. Standard errors clustered on municipality. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 3

Main results. Instrumental Variables and Family Fixed Effects Estimates of the Effect of One Additional Year with Cable Television Coverage

	Men				Women	
	Standardized Ability		High school graduation		High school graduation	
	IV	FFE	IV	FFE	IV	FFE
Baseline estimates	-0.0120***	-0.0120*	-0.0046**	-0.0042*	-0.0015	0.0040
	(0.0026)	(0.0063)	(0.0019)	(0.0023)	(0.0014)	(0.0028)
y mean	0.08	0.09	0.67	0.68	0.75	0.76
N	279,954	108,138	310,427	119,736	293,641	107,610

Note: All models include 14 birth-year fixed effects. The IV models also include 430 municipality fixed effects and parental characteristics (26 dummies representing education and earnings; see footnote 5). The FFE models include family fixed and birth-order fixed effects. Standard errors (in parentheses) are clustered on municipality. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table 4
Robustness with respect to differentiated time trends. Instrumental Variables and Family Fixed Effects Estimates of the Effect of One Additional Year with Cable Television Coverage

	Men				Women	
	Standardized Ability		High school graduation		High school graduation	
	IV	FFE	IV	FFE	IV	FFE
(1)	-0.0120***	-0.0120*	-0.0046**	-0.0042*	-0.0015	0.0040
Baseline, from Table 3 (Equation 1/2)	(0.0026)	(0.0063)	(0.0019)	(0.0023)	(0.0014)	(0.0028)
(2)	-0.078***	-0.0112*	-0.0070***	-0.0043*	-0.0014	0.0030
+ municipality characteristics, birth year (Equation 3)	(0.029)	(0.0058)	(0.0015)	(0.0025)	(0.0017)	(0.0029)
(3)	-0.0089***	-0.0097*	-0.0065***	-0.0028	-0.0023	0.0019
+ county-by-birth-year fixed effects (Equation 4)	(0.0025)	(0.0054)	(0.0014)	(0.0026)	(0.0015)	(0.0027)
(4)	-0.0054*	-0.0077	-0.0033**	-0.0012	-0.0003	0.0029
+ pre-reform municipality characteristics interacted with birth year dummies (Equation 5)	(0.0025)	(0.0057)	(0.0015)	(0.0027)	(0.0015)	(0.0029)
y mean	0.08	0.09	0.67	0.68	0.75	0.76
N	279,954	108,138	310,427	119,736	293,641	107,610

Note: All models include birth-year fixed effects, except when county-by-birth-year fixed effects are included. The IV models also include municipality fixed effects and parental characteristics. The FFE models include family fixed and birth-order fixed effects. Standard errors (in parentheses) are clustered on municipality. * p<0.10, ** p<0.05, *** p<0.01.

Table 5

The Estimated Impact of Cable Connection on Television Consumption and Reading for Adolescents Aged 9-18 by the Head of Household's Highest, Completed Education

	Boys				Girls			
	Time use		Television content		Time use		Television content	
	Minutes		Number of shows wathced		Minutes		Number of shows wathced	
	TV	Reading	Educational	Other	TV	Reading	Educational	Other
(1)	1.2	-0.7	-0.29*	0.20	21.1	0.4	0.19	0.68**
Less than High School	(21.7)	(6.6)	(0.16)	(0.31)	(18.9)	(7.7)	(0.15)	(0.27)
ymean	147.1	30.8	0.50	1.8	141.6	33.7	0.35	1.91
R-sqr	0.135	0.188	0.099	0.109	0.161	0.130	0.108	0.156
N	215	215	177	177	196	195	155	155
(2)	24.8***	-0.4	0.09	0.60***	29.2***	2.3	-0.05	0.43***
High School	(9.6)	(3.6)	(0.08)	(0.14)	(9.8)	(4.5)	(0.07)	(0.137)
ymean	138.1	33.2	0.52	1.94	120.5	35.0	0.34	1.73
R-sqr	0.072	0.049	0.045	0.065	0.076	0.052	0.026	0.053
N	777	778	647	647	732	732	615	615
(3)	14.6	-8.3*	-0.04	0.43**	9.5	-4.9	-0.08	0.33**
College	(8.9)	(4.6)	(0.108)	(0.17)	(9.3)	(3.9)	(0.07)	(0.13)
ymean	123.7	40.8	0.56	1.93	109.3	36.5	0.35	1.71
R-sqr	0.088	0.084	0.037	0.069	0.090	0.076	0.073	0.090
N	518	518	422	422	511	511	415	415

Note: Each cell in rows (1)-(3) report the estimated impact of access to cable TV on time use and television consumption yesterday for individuals aged 9-18. Each estimate is based on a separate OLS regression. All models include fixed effects for area type, year, and age, and a dummy variable for a connection parabolic antenna. Content categorization: "Educational" (news, debates, information and documentaries, science, nature, quiz), "Other" (sports, kids/youth, religious, theatre and ballet, classical music, films, TV series, pop music, entertainment, other). Four area types: cities with population>100 000, 20 000-100 000, <20 000, and "rural" areas. Robust standard errors. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Source: Media Use Survey 1991-2004.

Table 6
Instrumental Variables and Family Fixed Effects Estimates of the Effect of One Additional Year with Cable Television Coverage. By parents' education.

	Men				Women	
	Standardized Ability		High school graduation		High school graduation	
	IV	FFE	IV	FFE	IV	FFE
(1)	-0.0070**	-0.0103	-0.0060***	-0.0059	-0.0018	0.0031
Parents less than High school	(0.0029)	(0.0094)	(0.0022)	(0.0039)	(0.0029)	(0.0039)
y mean	-0.18	-0.18	0.56	0.57	0.65	0.66
N	139,457	53,349	156,522	59,769	149,416	54,491
(2)	-0.0116***	-0.0185	-0.0042*	-0.0070	-0.0004	0.0041
At least one parent High school	(0.0037)	(0.0154)	(0.0022)	(0.0073)	(0.0021)	(0.0070)
y mean	0.13	0.14	0.70	0.71	0.79	0.80
N	63,091	23,215	69,580	25,588	65,444	22,930
(3)	-0.0117***	-0.0136	-0.0058***	-0.0039	-0.0022*	0.0026
At least one parent College/University	(0.0042)	(0.0134)	(0.0017)	(0.0036)	(0.0013)	(0.0043)
y mean	0.51	0.52	0.79	0.84	0.89	0.90
N	77,406	31,574	84,325	34,379	78,781	30,189

Note: All models include birth-year fixed effects, except when county-by-birth-year fixed effects are included. The IV models also include municipality fixed effects and parental characteristics. The FFE models include family fixed and birth-order fixed effects. Standard errors (in parentheses) are clustered on municipality. * p<0.10, ** p<0.05, *** p<0.01.

Table 7
Instrumental Variables and Family Fixed Effects Estimates of the Effect of One Additional Year with Cable Television Coverage. By age of exposure.

	Men				Women	
	Standardized Ability		High school graduation		High school graduation	
	IV	FFE	IV	FFE	IV	FFE
(1)	-0.0090	-0.0106	-0.0040	-0.0055	0.0023	0.0073
Exposure age 0-5	(0.0056)	(0.0099)	(0.0030)	(0.0043)	(0.0026)	(0.0045)
(2)	-0.0119**	-0.0099	-0.0080**	-0.0024	-0.0036	0.0027
Exposure age 6-12	(0.0054)	(0.0093)	(0.0038)	(0.0048)	(0.0048)	(0.0047)
(3)	-0.0172**	-0.0175	0.0002	-0.0053	-0.0044	0.0010
Exposure age 13-18	(0.0077)	(0.0118)	(0.0005)	(0.0059)	(0.0050+)	(0.0057)
y mean	0.08		0.67		0.75	
N	279,954	108,138	310,427	119,736	293,641	107,610

Note: All models include birth-year fixed effects, except when county-by-birth-year fixed effects are included. The IV models also include municipality fixed effects and parental characteristics. The FFE models include family fixed and birth-order fixed effects. Standard errors (in parentheses) are clustered on municipality. * p<0.10, ** p<0.05, *** p<0.01.

Figures

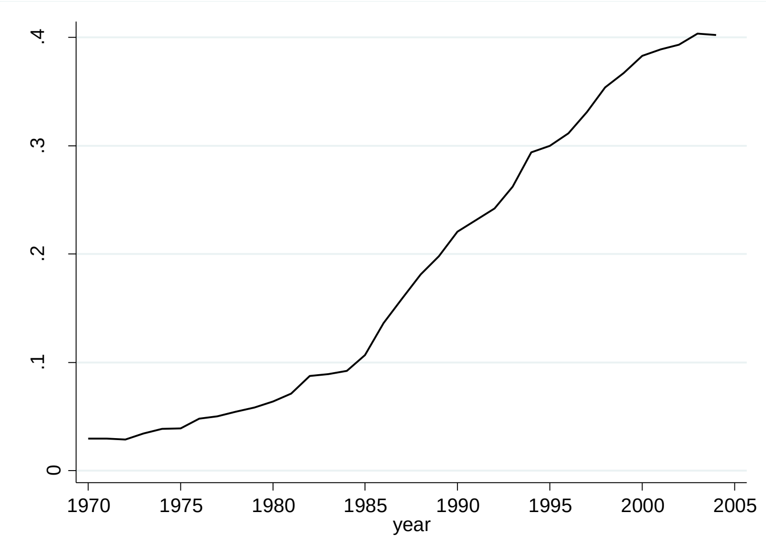

Figure 1

Share of households with cable television 1970-2005

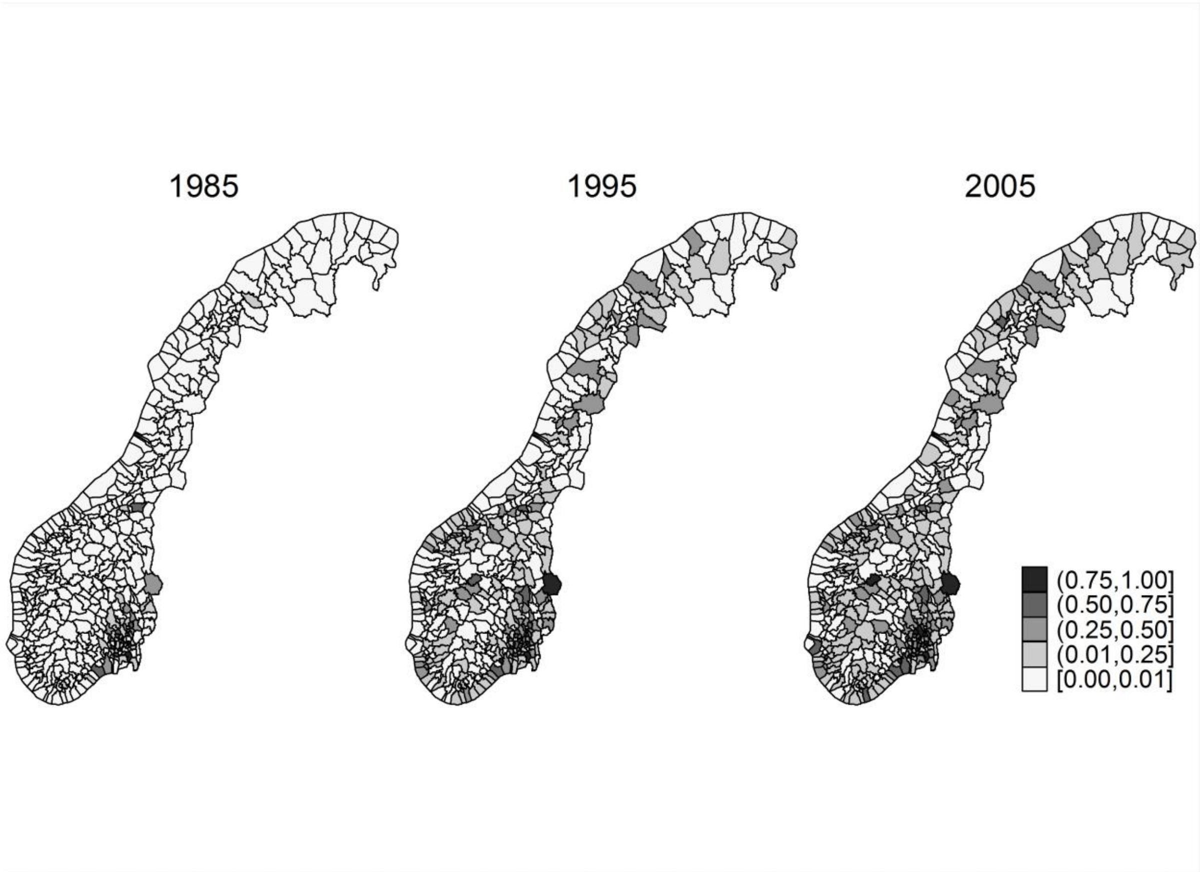

Figure 2

Cable television coverage by municipality, 1985-2005

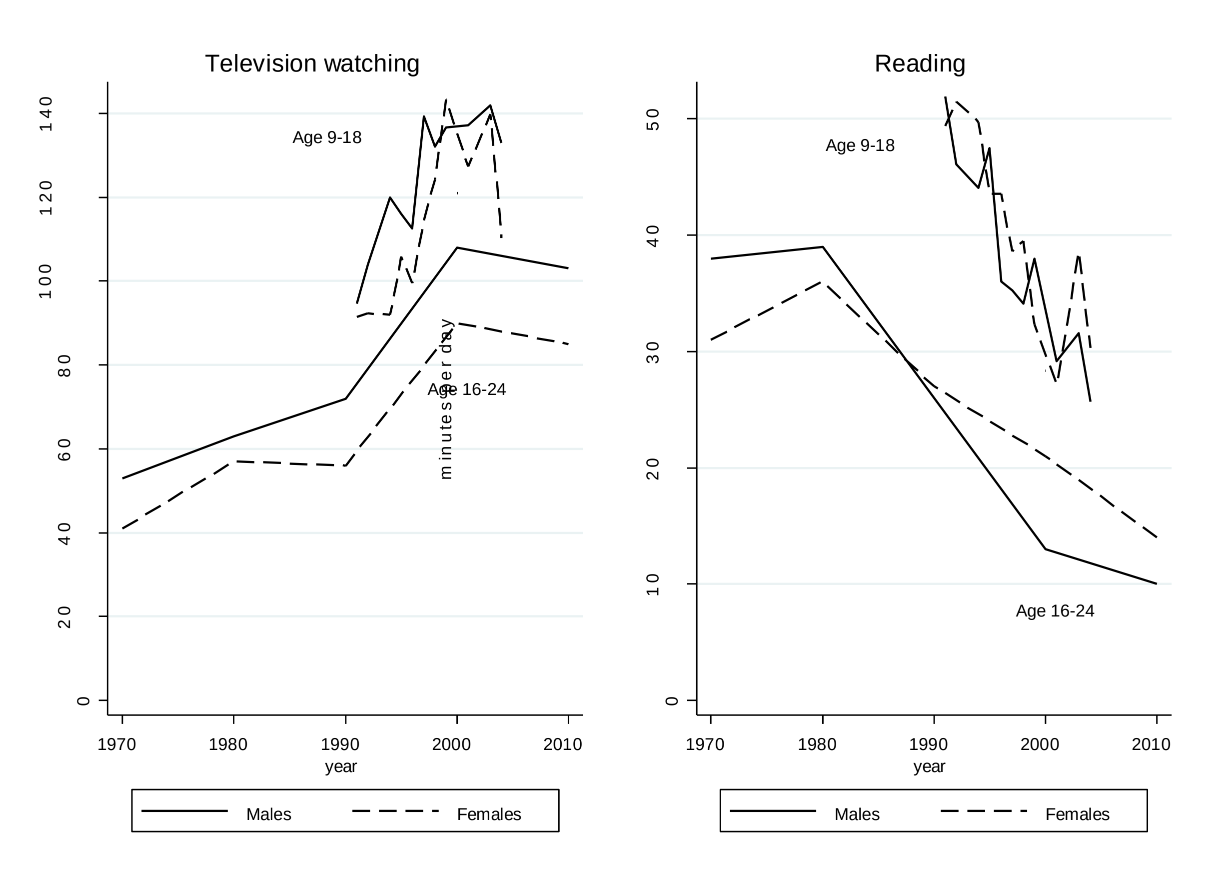

Figure 3.

Minutes Spent An Average Day On Television Wathcing (left panel) and Reading (right panel), Boys (Solid Lines) and Girls (Dotted Lines).

Sources: For age 16-24: Statistics Norway; time use surveys collected in 1970, 1980, 1990, 2000, and 2010. For age 9-18: Statistics Norway; media surveys collected annually 1991-2004

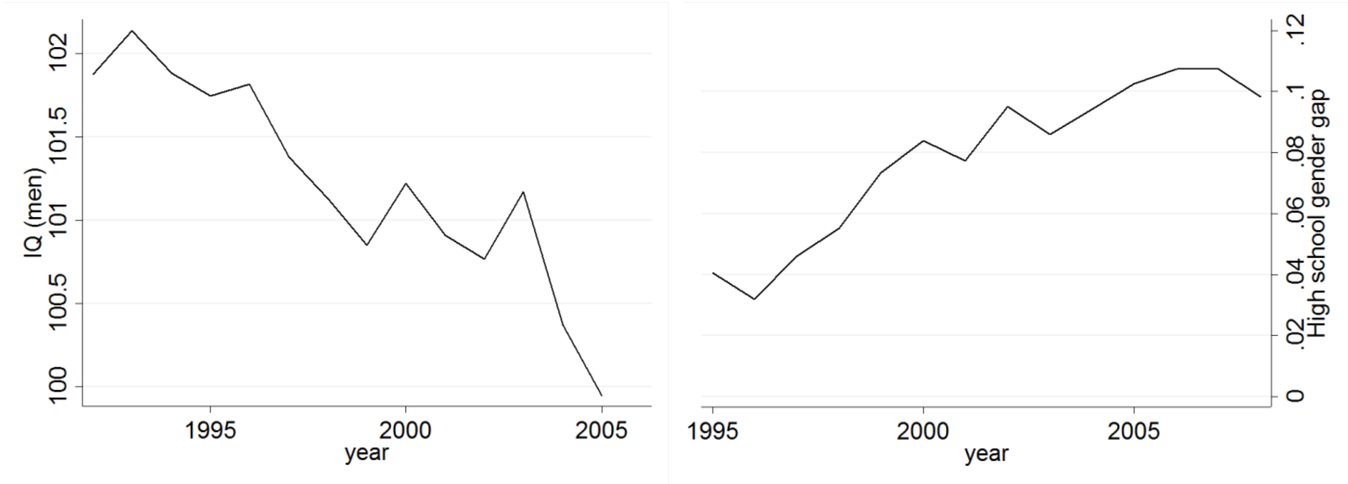

Figure 4

Left: IQ of Norwegian Conscripts 1992-2005.

Right: Female-male gender gap in high school completion at 21(percentage points)

Note: The IQ test was normed on the test cohort of 1980, which provides the reference point (i.e. 1980 mean = 100).

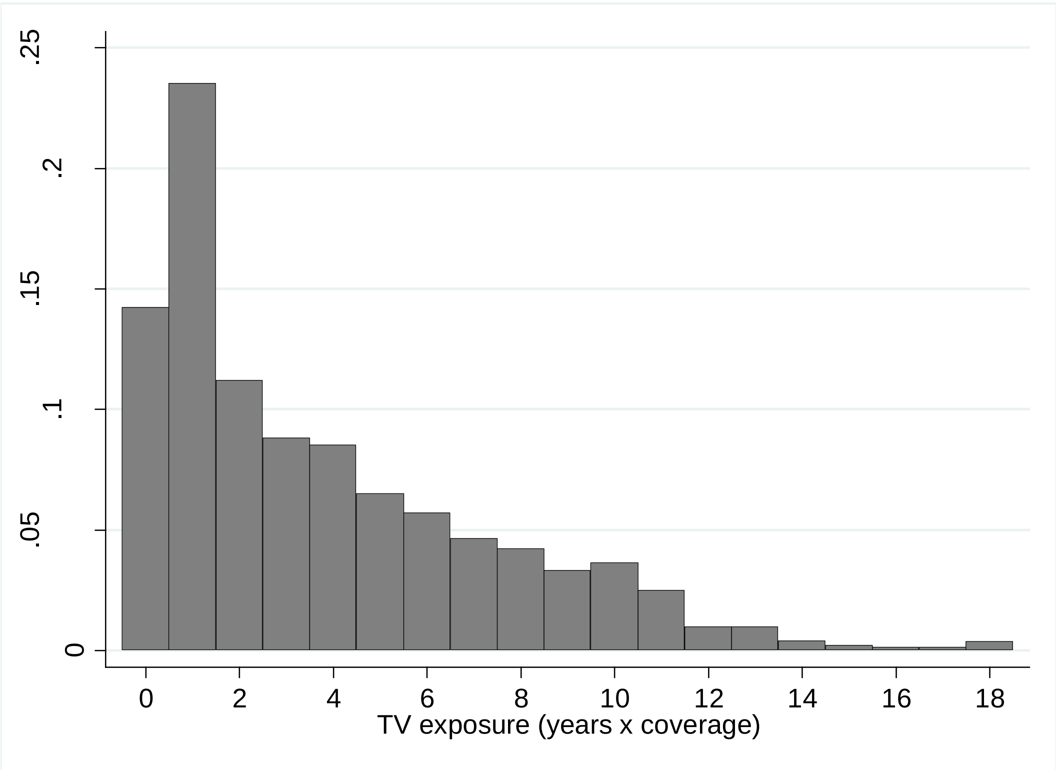

Figure 5

The distribution of cable TV exposure age 0-18

Note: The first bar shows the fraction with 0 cable TV exposure, the second bar shows the fraction with 0-1 coverage-year exposure, the third bar the fraction with 1-2 coverage-year exposure and so on.

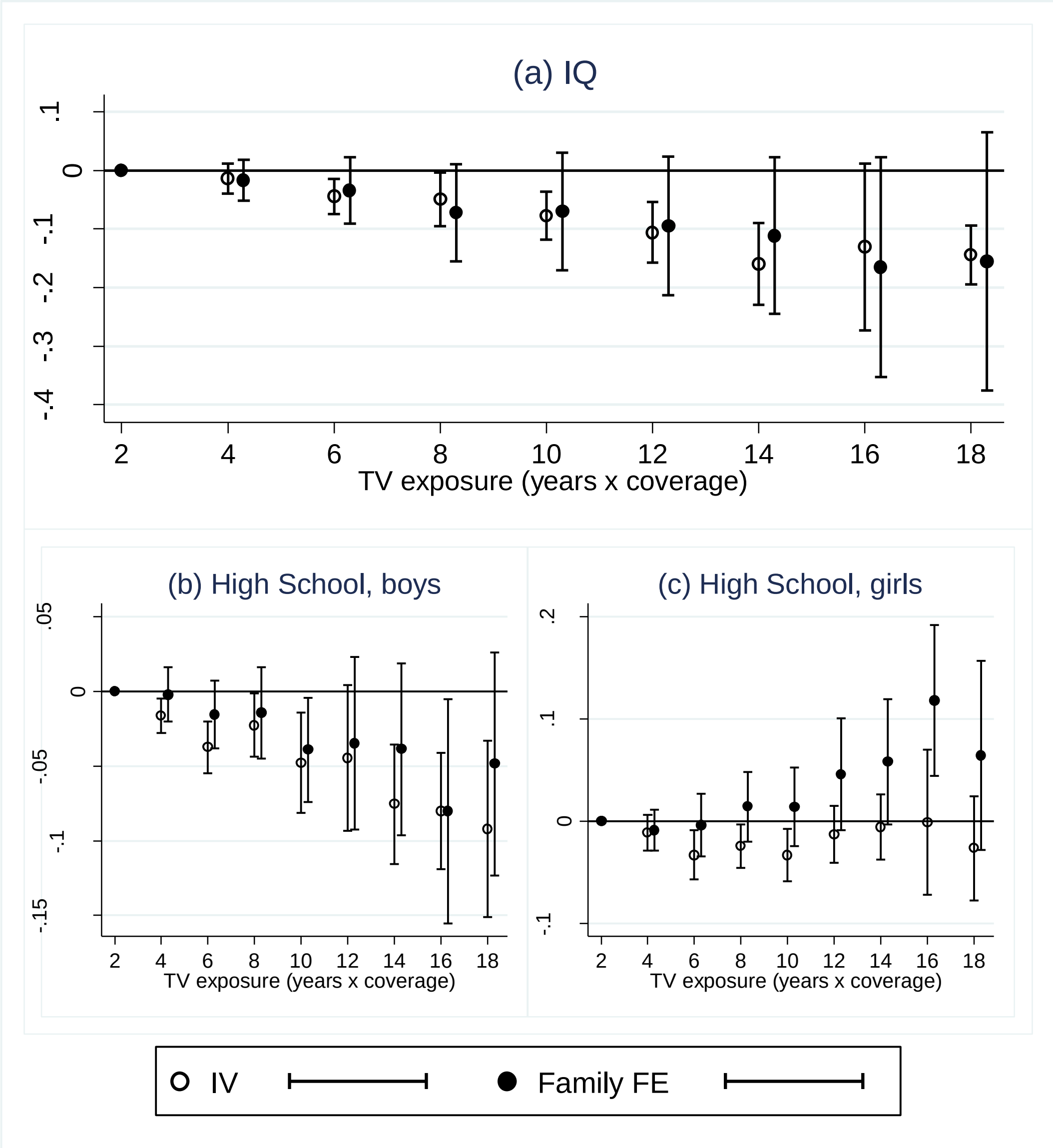

Figure 6.

Instrumental Variables and Family Fixed Effects Estimates of the Effect of Years with Cable Television Coverage (with 95 percent confience intervals).

Note: All models include birth-year fixed effects. The IV models also include municipality fixed effects and parental characteristics. The FFE models include family fixed and birth-order fixed effects. The confidence intervals are computed based on standard errors clustered on municipality.

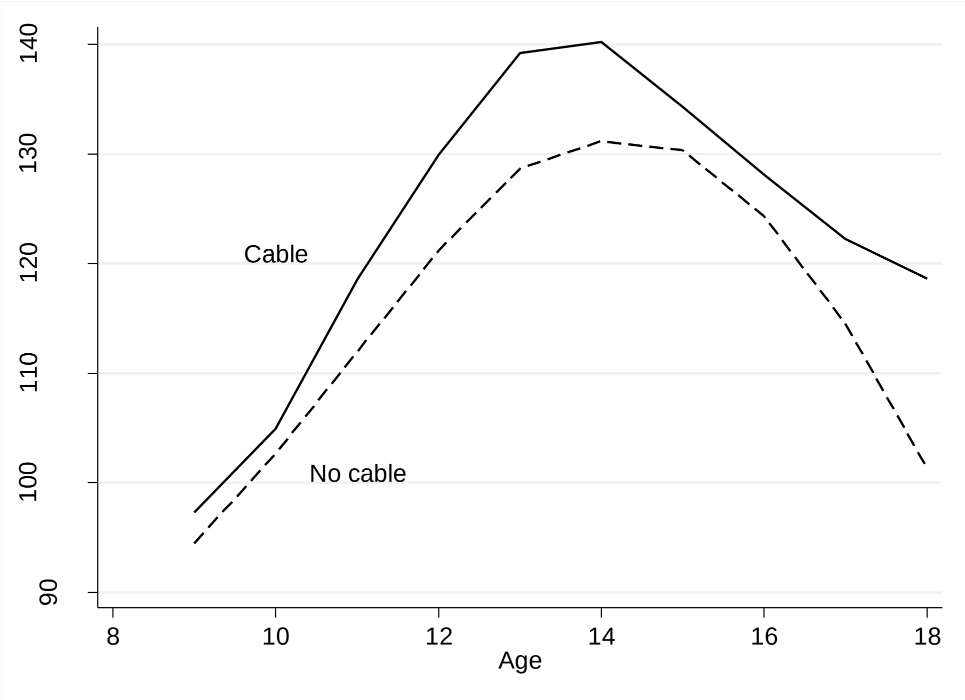

Figure 7

Television Watching by Age (Smoothed), From the Media Use Survey 1991-2004

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[1] Recent negative trends in IQ scores have been reported for Norway (Sundet, Burlaug, and Torjussen 2004), Australia (Cotton et al. 2005), Denmark (Teasdale and Owen 2008), Britain (Shayer, Ginsburg, and Coe 2007), Sweden (Rönnlund et al. 2013), the Netherlands (Woodley and Meisenberg 2013), Finland (Dutton and Lynn 2013), and France (Dutton and Lynn 2015).

[2] Time spent on sports and outdoor activities also declined somewhat during this period, from around 52 to 41 minutes for boys 39 to 28 minutes for girls.

[3] We treat the test score distribution as an interval scale, even though in principle it is ordinal. To test this assumption, we have rescaled the test scores according to the relationship between mean income levels by test scores for 40-year olds in 2013 in order to capture information about actual intervals between scores. Figure A.1 in the appendix shows the

highly linear relationship between the original ability scores and the rescaled, standardized measure. The rescaling makes essentially no difference for the results.

[4] Former head of the union of commercial cable-TV operators in Norway, Knut Børmer; personal communication. Terje Frøsland, of the state owned *Norwegian Telecommunications (Televerket, from 2005 Telenor)*; personal communication.

[5] Parental characteristics include 4 dummy variables for father's education (less than high school, high school, bachelor, master), 4 dummy variables for mother's education, 10 dummy variables for father's earnings, and 10 dummy variables for mother's earnings (with non-employment as separate categories).

[6] By pooling the data for for men and women and then incorporating gender-interactions on all variables (including the fixed effects), we have also tested the statistical significance of the gender difference in the reported effects on high school graduation. These tests show that the diference between the -0.0046 (for men) and the -0.0015 (for women) coefficients in the IV model is not statistically significant at conventional levels (p-value= 0.19), whereas the difference between the -0.0042 and 0.0040 coefficients in the FFE model is statistically significant at the 5 percent level (p-value=0.03).

[7] We have also estimated the model using a categorization of population density in deciles in this interaction in stead of using it directly as a scalar. This makes essentially no difference for the results.