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Are Television and Video Games Really Harmful for Kids? Empirical evidence from the Longitudinal Survey of Babies in the 21st Century[1]

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Abstract

Are watching television and playing video games really harmful for children's development? This is a very intriguing question for both parents and policy circles, although measuring the rigorous effects is difficult due to data and methodological limitations. By making use of a unique longitudinal dataset with detailed information on children's development and health, we examine the effect of hours of television watched or of video games played on school-aged children's problem behavior, positive orientation to school, and obesity. The results drawn from the fixed and random effects models while controlling for the time-invariant unobserved omitted variables in this paper suggest that the answer to the question is yes and that the negative effect would be dramatically increased by an excessive amount of exposure to television or video games. However, the magnitude of the effect is small enough to be negligible. The results are robust to within twin fixed effects.

Keywords: Behavior problem index, Positive orientation to school, Obesity, Endogeneity
JEL classification codes: I10, I20

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Introduction

For young children, there are a lot of good things about watching television and playing video games. Television and video games provide very sophisticated entertaining environments with a high level of technologies and graphics that may stimulate a great deal of children's new thoughts and feelings through gaining knowledge that they would never be exposed to in their own community. Television and video games can increase children's interest in and awareness of a wide variety of social problems ranging from violence to natural disasters. According to the Cabinet Office, the Government of Japan (2001) reported that school-aged children in Japan spend a large fraction of time in front of television or video games during weekends, meaning that television or video games are a substantial part of children's lives today.

Putting aside the good aspects, many parents are in fact concerned when their children spent a lot of time in front of television or video games. There are numerous articles raising alarm over childhood exposure to television or video games: for example, as of August 4, 2009, *TIME* headlined "Watching TV: Even Worse for Kids than You Think" and warned how sedentary behavior, such as watching television or playing video games, has a strong influence on the obesity of young children. As of November 3, 2008, *CNN* broadcasted "Violent Video Games Linked to Child Aggression" and showed that children who were exposed to video games are more likely to exhibit out-of-control behaviors over time than their peers who were not. The widespread perception among people, especially parents, is that watching television and playing video games affect children's behavior, health and cognitive development in negative ways, though rigorously measuring the effects is difficult due to data and methodological limitations. Much policy debate on this topic hinges on more concrete and scientific evidence: the Government of Japan, e.g., Ministry of Education, Culture, Sports, Science, and Technology and Cabinet Office have launched research committees and sought rigorous evidence of how childhood exposure to television or video games affects violence and communication skills, etc. However, in part due to data limitations, research on how television or video games affect children's development is relatively unexplored in a social context, particularly in Japan.

Not only such public discourse but also recent research into the implications of watching television and playing video games has found them to be significantly associated with children's cognitive and non-cognitive development. However, while much is known about the cross-sectional relationship between television or video games and children's development, little is known regarding the extent to what would have happened to the causal mechanisms of children's development if children who actually spent more time in front of television or video games had spent less time doing so. It is highly possible that the observed differences in hours watching television or playing video games may merely reflect a selection in what kind of parents allow their child watch more television or play more video games; the selection bias

arises when part of children's development can be explained by unobserved parental characteristics. More specifically, "bad" parents may allow their child to be more exposed to television or video games without serious consideration, and technically, the unobserved characteristics behind this "bad" parenting may be associated with reducing children's healthy development. In other words, observed correlations using cross-sectional data in previous literature do not provide a full description of the effect of television or video games and result in biased and inconsistent estimates. In this research, we would like to answer the questions of whether childhood exposure to television and video games *causes* children's development.

Given the considerable attention from both the general public and policy circles who would like to identify the causes of children's development, understanding the effects of watching television and playing video games may have significant implications. In this paper, we examine the impact of watching television and playing video games on three outcome measures of children's development: children's problem behavior, positive orientation to school, and obesity. These measurements are considered as a strong predictor of subsequent outcomes later in life, such as educational attainment and socioeconomic status, as suggested by a large number of research bodies (e.g., McLeod & Kaiser, 2004; Miech et al 1999).

This paper aims to go beyond the current literature on the causal relationship between television or video games and children's development by using several methods. First of all, we estimate the OLS while controlling for a wide range of parental and children's socioeconomic status; secondly, we employ fixed effects and random effects models to control for time-variant unobserved heterogeneity across individuals; and thirdly we employ the approach of twin comparison, relating within twin differences in hours of television watched or video games played to differences in twins' development. Twins who share the same (or similar) DNA pattern and grow up in the same household provide us with a control for genetic endowments as well as family environments. Once we have accounted for selection of unobserved factors, is the effect of watching television or playing video games on children's development negative? To answer this research question, this paper takes advantage of a nationally representative longitudinal dataset collected between 2008 through 2010 to rule out unobserved heterogeneity and to isolate the pure effects of watching television or playing video games on children's development.

The most significant finding of this paper is that, after addressing the potential bias, we find that hours watching television and video games have a negative impact on children's problem behavior, orientation to school, and obesity, but the magnitude of the effect is quite small. We then explore whether the amount of hours of television watched or video games played matter for children's behavior and health. According to the results drawn from rolling regressions, we also find that the negative effect would be dramatically increased by an excessive amount of exposure to television or video games.

The rest of this paper is organized as follows: the next section reviews the relevant

literature to sort out information on what we still do not know and explains how we tackle the methodological problems in previous research. The following sections introduce empirical specifications to be estimated, identify the potential bias emerging in the econometric analysis, and determine the analytical techniques to be used to obtain unbiased estimates of the impact of television or video games on children's development. Then in the final section, we describe the nationally representative longitudinal dataset used for empirical analysis and present the empirical results.

Relevant Literature

In this section, we survey the previous literature about the link between childhood exposure to television and children's development. A great number of studies on the effect of television are produced in the field of medical science, psychology, and social sciences, which may be classified into three lines of research: first of all, some correlational studies, mostly in the field of medical science, have provided considerable evidence of the negative effect of television on various outcomes of children. For example, Christakis et al (2004) used the National Longitudinal Survey of Youth 1979 (NLSY79) and found that television exposure at the ages of 1 through 3 was negatively associated with the cognitive development of a child at the age of 7, particularly measured by children's attention problems. In a subsequent study, Zimmerman & Christakis (2005) showed that television exposure at an older age, such as at the ages of 3 through 5, also affected several measures of cognitive development of a child at the ages 6 or 7. Another study conducted by Zimmerman et al (2005) found that television exposure at the age of 4 was a predictor of subsequent bullying at school. A negative effect was also confirmed on academic performance of school-aged children: Keith et al (1986) used the first wave of the High School and Beyond (HS&B) and presented the effect of the time spent watching television on student achievement, as did Hornik (1981), Morgan & Gross (1980) and Sharif & Sargent (2006).

In addition to studies focusing on cognitive development of young children, some studies have examined the longer-term effect of childhood exposure to television. For example, Hancox et al (2005) revealed that the time spent watching television during childhood was significantly associated with a higher probability of dropping out from high school without a diploma and a lower probability of entering college. Other studies have focused on health outcomes of an individual. For example, Gortmaker, et al (1996) revealed that excessive exposure to television for youths aged 10 to 15 years old is strongly linked with obesity of adults aged 25 to 32 years old.

While these studies examined a wide variety of outcomes of children, they reached a consensus on the effect of the television exposure: the findings generally support a negative and significant relationship. However, one may be skeptical about whether this relationship can

be said to be causal. It is highly possible that these correlations are due to other unobserved characteristics of parents or families that are associated with poorer outcomes of children.

Therefore, recent research has paid more attention to the causal question. The second line of research, mostly in the field of social sciences, uses longitudinal datasets and attempts to address the causal inference. However, the results drawn from these studies are quite mixed. For example, Aksoy and Link (2000) estimated fixed and random effects models to account for omitted variable bias by using a nationally representative sample from the National Education Longitudinal Study (NELS88) and showed that the amount of time a high school student watched television a day had a negative impact on student achievements measured by standardized mathematics scores. The literature on learning suggested that the mechanism behind this negative effect is that, for high school students, the time spent watching television might take away time spent doing homework or studying by themselves (Godmaker et al, 1990).

Contrary to Aksoy and Link (2000), some studies using the longitudinal datasets did not find a negative association between hours of television watched and academic achievement after controlling for socioeconomic factors (Gaddy, 1986; Gortmaker, et al, 1990; Zavodny, 2006). In particular, Zavodny (2006) carefully conducted robustness tests: she estimated the same regressions using three different kind of longitudinal datasets – NLSY, HS&B and NELS – and her results rejected that the amount of television watched negatively affected academic achievement measured by standardized test scores. The result is robust to a comparison across siblings, including twins.

Thirdly, some studies involved exploiting historical events which altered the accessibility of television to identify the effect of television on academic achievement. One of the most influential studies in this field is Gentzkow & Shapiro (2008). They utilized the randomness of the introduction of television in the United States during the period 1948-1954 and found significant evidence against previous literature. Their conclusion drawn from the empirical evidence was that childhood television exposure had not shown a negative impact on standardized test scores later in life. Rather, according to their point estimates, an additional year of preschool television exposure raised average test scores by approximately 0.02 standard deviations, and the positive effect was larger for individuals from socio-demographically disadvantaged families. They also examined how preschool exposure to television caused non-cognitive skills measured by behavioral and attitudinal outcomes, such as the number of hours spent on homework, the number of books read during the summer, and the highest grade a student desired to complete, but found no evidence of significant effects, except for the number of books read during the summer. Another significant study in this line of research is Olken (2009), which, however, did not directly investigate the link between television or radio and children's outcomes. He utilized geographic heterogeneity in the introduction and the signal reception of television and radio to identify the effect of television

and radio on social capital in Indonesia, which is playing an important role in village governance. According to his findings, television and radio are associated with less participation in social organizations and with lower self-reported trust.

Is there any significant study using data in Japan? Kureishi and Yoshida (2013) used micro data provided by the Research Institute for Advancement of Living Standard and concluded that the hours of television watched did not have any impact on student performance measured by self-reported academic achievement at school ranging from "upper" (=5) to "lower" (=1). While they showed that the correlation between early exposure to television and academic achievement was significantly negative, the effect became insignificant after they employed the identification procedure with an instrumental variable. However, their IV, the geographic variations in the number of broadcast channels at the prefecture level, accounted for little of the variations in the hours of television watched across individuals.

Our empirical strategies follow the protocol of the second line of research, such as Zavodny (2006). We use the nationally representative longitudinal dataset collected by the Government of Japan to study the effect of television or video games on children because, as Kirkorian et al (2008) pointed out, not only the "amount" of television watched but also the "content" of television watched is an important determinant of children's outcomes. Apparently, there is a high level of country and time variations in how much people rely on television or video games and what kind of programs or type of games they prefer, although the case of Japan is relatively unexplored so far. An economic analysis of the effect of television or video games in Japan with the latest dataset would lead to persuasive policy recommendations and help to shape appropriate policy agendas.

This study makes several contributions to understanding the effect of watching television or playing video games on children's outcomes: (i) to focus on children's behavior, attitude and health as outcomes, which are strong predictors of educational attainment and socioeconomic status of an individual later in life; (ii) to use a longitudinal dataset to control for unobserved variations in parental characteristics that tend to bias OLS estimates;
(iii) to examine the effect of video games in addition to television, which has become more popular among children in recent years, but, to the best of our knowledge, has been given little attention in previous literature.

Methodology

In order to address our research question of whether television or video games affect children's development, we begin with an analysis using OLS estimates to confirm the results drawn from much previous research, in which researchers have shown negative correlations. The model can be formally expressed by the following mathematical equation where y_{it} is the outcome, T_{it} is the number of hours of television watched, V_{it} is the number of hours of video

games played, and X_{it} is a vector of individual-level socioeconomic and demographic control variables. We include the both television and video games variables in the same regression model because the amount of television viewed and video games played are weakly but positively correlated (the more children spent time on television, the more they did on video games, and vice versa).

$$y_{it} = X_{it}\beta + \gamma T_{it} + \delta V_{it} + \varepsilon_{it} \quad (1)$$

In OLS estimate, the coefficient for T_{it} or V_{it} is interpreted as the effect of child *i*'s exposure to television or video games at time *t*, holding constant all observed factors. However, it is highly plausible that observed differences in hours watching television or playing video games may simply reflect a selection in what kind of parents let children spend more time on television or video games; "bad" parents may allow their child to be more exposed to television or video games without serious consideration and substantial costs (because these electronic devices seem to be the cheapest babysitter in the world), and technically, the unobserved characteristics behind this "bad" parenting may be associated with reducing children's emotional well-being. If a selection on unobserved characteristics is present, the equation (1) may be subject to omitted variable bias and will yield inconsistent estimates of the effect of watching television or playing video games.

The fixed and random effects models enable us to control for time-invariant unobservables that affect both dependent and key independent variables and let us answer the questions of whether childhood exposure to television and video games *causes* children's development. More specifically, the fixed and random effects models incorporate an individual-specific time invariant factor, A_i as specified in equation (2).

$$y_{it} = X_{it}\beta + \gamma T_{it} + \delta V_{it} + A_i + v_{it} \quad (2)$$

where $\varepsilon_{it} = A_i + v_{it}$. v_{it} is an idiosyncratic error term assumed independent of all other terms in the equation. If we can assure that A_i is not correlated with independent variables and is normally distributed, then the random effects model will be appropriate. However, if A_i is correlated with some independent variable, the fixed effects model would be appropriate. In this case, the results will be inconsistent across models and it will be possible to confirm that unobserved heterogeneity biases the random effects result. The choice of the model is based on the Hausman specification test, as first proposed in Hausman (1978). One can eliminate the time-invariant unobservables by taking time-demeaned transformation induced by repeated observations on the same individual yielding:

$$(y_{it} - \bar{y}_i) = (X_{it} - \bar{X}_i)\beta + \gamma(T_{it} - \bar{T}_i) + \delta(V_{it} - \bar{V}_t) + v_{it} \quad (3)$$

Data

The data that we used in our empirical analysis was drawn from the Longitudinal Survey of Babies in the 21st Century, a 9-year nationally representative longitudinal data organized in a total of 9 waves, collected by the Ministry of Health, Labour and Welfare of Japan between 2001 and 2010. The data targets 53,575 new-born babies who were born in Japan during January 10-17and July 10-17, 2011. The respondents were primary caregivers, mostly parents. From Wave 1 through Wave 6, the surveys were conducted at 6 months postpartum as of August 1, 2001 and February 1, 2002, respectively. One and a half years after Wave 6, Waves7 through Wave 9 were conducted on January 18 and July 18, indicating that the subjects in these waves reached school age in the same grade (G1 through G3) at the time of the survey[3]. The unique characteristic of this data is that it includes samples of twins and triplets, although no information is provided to identify whether each twin or triplet is monozygotic or dizygotic.

In our paper, we use three consecutive waves from Wave 7 through Wave 9, which provide detailed series of questions on children's behavior both at home and at school that parents/primary caregivers are particularly concerned about in daily life. Because the targeted children in these three waves have reached the age of entering primary school, their behaviors may be more clearly observed by parents/primary caregivers in the process in which children get to establish relationships with others. Our sample is restricted to children whose parents are both Japanese because children of immigrants, though small in number, may be more likely to be involved in different educational settings, such as international or ethnic schools.

One of our main outcomes is defined as the Behavior Problem Index (hereafter BPI), originally developed by Peterson & Zill (1986), which has been commonly used by researchers in measuring children's socio-emotional adjustment and well-being. In this paper, the BPI

[3] The response rate of each wave is, on average, 90% as shown in Table below. 75% of its initial sample completed the questionnaire of the latest wave, indicating that the response rates are nevertheless very high. In addition to the low level of data attrition as a whole, as pointed out by Kitamura (2013), the attrition bias is not a serious concern in our study. Since the respondents of this survey are primary caregivers, mostly mothers, the reason why respondents stop responding to the survey may be unrelated to children's development.

	Numbers distributed (a)	Numbers collected (b)	Response rate (b)/(a)
Wave 1	53,575	47,015	87.8%
2	46,966	43,925	93.5%
3	46,897	42,812	91.3%
4	44,837	41,559	92.7%
5	43,559	39,817	91.4%
6	42,187	38,537	91.3%
7	40,598	36,785	90.6%
8	39,261	36,136	92.0%
9	37,932	35,264	93.0%

(Source) Ministry of Health Labour, and Welfare

consists of 19 items of behavior problems reported by parents/primary caregivers, such as using violent language, telling lies, and having fights with friends. It is important to note that the original survey includes 20 items of behavior problem, but we exclude the item regarding television or video games: "S/he spends many hours watching TV or playing video games" to rule out that watching television or playing video games are part of problem behavior, inducing a potential endogeneity.

The questionnaires on problem behavior list 19 items and ask respondents to check all the items they are concerned about. Each item is coded as 1 if the respondent checks, and 0 otherwise (The items comprising the BPI are listed in Table 1). The BPI is then calculated as the sum of all items coded, indicating that the BPI ranges from 0 to 19. It can be said that the higher the BPI, the greater are the behavior problems in children. Figure 1-(1) shows the distribution of BPI, suggesting that almost 70% of children exhibit some sort of problem behavior. As shown in Table 2, the mean for the BPI is 1.639 with a standard deviation of 1.621 during the three consecutive waves.

The second outcome is defined as positive orientation to school (hereafter, POS), which attempts to measure student attitude and motivation toward school and learning, originally conceptualized by Jessor et al (1995). The POS consists of 5 items of children's feeling or attitude toward school observed by parents/primary caregivers. Each item is coded as 1 if the respondent answered yes, -1 if s/he answered no, and 0 otherwise (The items comprising the POS are listed in Table 1 as well). The POS is then calculated as the sum of all items coded, indicating that the POS ranges from -5 to 5. Many studies suggest that the POS is a strong predictor of educational attainments and student achievements (see Fall & Roberts, 2012; Ladd & Dinella, 2009; Li & Lerner, 2011). We can say that the larger the POS, the more children exhibit positive attitudes toward school. Figure 1-(2) shows the distribution of POS, suggesting that almost 50% of children have rated 5 for all the questions and exhibit positive feelings toward school. As shown in Table 2, the mean for the POS is 4.053 with a standard deviation of 1.387 during the three consecutive waves.

The third outcome is childhood obesity or overweightness measured by Body Mass Index (hereafter, BMI). Many studies suggest that watching television and playing video games is strongly associated with being overweight and this effect will carry on into overweightness after maturity (Lumeng, et al 2006, etc.). This line of medical research revealed that childhood obesity is a risk factor for a wide variety of adulthood health problems, such as a high level of cholesterol (Wright et al 2001, etc.). Taken as a whole, childhood obesity is a strong predictor of adulthood health status, which is an important component of human capital of an individual. As shown in Table 2, the mean for the BMI is 15.894 with a standard deviation of 2.112 during the three consecutive waves.

The key independent variables of interest refer to the average hours of television watched and video games played a day, computing the average of multiplying the numbers of

hours of television watched or video games played during weekdays by 5 and during weekends by 2[4]. We also control for a wide range of children or parental socioeconomic and demographic variables corresponding to: (i) children's demographic factors, such as gender; (ii) parental socioeconomic status, such as household income, parental employment status, and parental educational backgrounds; (iii) family structure, such as the number of siblings and whether children live with their grandparents; and (iv) lifestyle habits, such as breakfast and sleeping routine.

Some control variables deserve more comment. One cannot always determine the direction of the impact of family structure on outcomes *a priori*: the numbers of siblings may possibly have both positive and negative effects, as does whether children live with their grandparents. The mechanism that fewer siblings have a positive effect on children's development is where parents are allowed to allocate more household resources or attention toward each child. Children are not often forced to assist in running household errands. However, previous research found that the larger the family size, the faster children's scholastic progress because older siblings are often available to help with the homework of younger ones (Bianchi & Robinson, 1997).

The effect of children living with their grandparents on outcomes is also ambiguous. Sometimes children may be able to receive extra support and attention from grandparents, increasing children's well-being at home. However, they may become confused and unstable due to the death or illness of grandparents if they have a strong emotional attachment toward them. The total effect is thus *a priori* unclear and is a question to be resolved empirically.

As Hofferth & Standberg (2001) pointed out, having breakfast at home regularly may be associated with a more stable and organized family life and thus with children having fewer behavior and health problems. Further, sleeping routine seems to be crucially important for children's development as is shown by Sekine et al (2002). We thus include a set of control variables in our estimations that represent breakfast and sleeping routine. In addition, all regressions include survey year fixed effects.

The descriptive statistics summarized in Table 2 show that the average child in the sample is raised within the nuclear family; s/he watches television for 2 hours a day and plays video games for 1 hour a day while s/he sleeps 9 hours a day; his/her father graduated from high school and currently engages in full-time job while mother graduated from a 2-year college or a vocational school and is a housewife who does not work outside the home; the average annual household income, including income other than compensation of employees, such as an income from property, is 6.30 million JPY.

[4] The response category in the original questionnaire ranged from 1 (=no television or video games) through 6 (over 6 hours). We set the minimum at zero and maximum at 6 hours. Then we took the median value for categories between 2 (0.5=less than 1 hour) and 5 (5.5=5-6 hours).

Empirical Results

Problem Behavior

To begin with, we estimate the conventional OLS given in equation (1) to measure the effect of hours of television watched or video games played on children's problem behavior, keeping a wide variety of parental socioeconomic factors constant. As illustrated in the first columns of Table 3-1, the results, coupled with the positive coefficient for television and video games, suggest that these devices affect problem behaviors of children. The coefficient of television means that one additional hour of television watched is associated with a 0.164 increase and of video games played is associated with a 0.071 increase in behavior problems. It can be said that television and video games, on average, lead to worse emotional well-being, but the effect is small enough in magnitude that more than 6 hours of television a day and 14 hours of video games a day would result in a one-item increase on the BPI in their child. With respect to changes in the impacts of other control variables, one counter-intuitive result is presented: parental socioeconomic status does not matter much. More specifically, the household income is statistically insignificant: a greater access to economic resources does not reduce behavior problems. However, not surprisingly, mothers' employment status matters while fathers' employment status does not. Housewives are better able to support their children's development through spending a large block of time together with their children and keeping a close eye on them while it is quite difficult for working mothers to do so.

There exists quite a gender disparity in children's problem behavior: boys are more likely to exhibit problem behavior than girls. In addition, children with siblings are clearly at an advantage in raising their emotional well-being compared to their counterparts without siblings. Interestingly, breakfast and sleeping routine do have the effect of reducing the behavior problems of a child. Taken as a whole, the results may imply that non-economic assets, such as cultural capital, are more important as a determinant of children's behavior problems than the parental economic resources available over a short period of time.

The second and third columns of Table 3-1 give estimates from the fixed and random effects models. The results show that the coefficients of hours of television watched are statistically significant, and that they drop to 0.065 for fixed effects and 0.124 for random effects. Meanwhile, the coefficients of video games played are also statistically significant, dropping to 0.022 for fixed effects but rising to 0.093 for random effects. Overall, the results from the fixed and random effects provide a similar story: both television and video games have a statistically significant effect on children's problem behavior with the estimated effect small enough in magnitude. According to the Hausman specification test, the choice of model is fixed effects. As expected, the coefficients for other control variables are almost the same as the result from the conventional OLS. However, the effect of the numbers of siblings in fixed effects is the opposite: the more siblings there are, the fewer the problem behaviors of a child,

implying that parental attention or resources might be dispersed among children. Moreover, the coefficients among mother's employment status indicate that the difference in whether or not a mother is a housewife matters.

The data contains a substantial number of twin and triplet pairs (227 pairs). We thus restrict to samples of twins or triplets to test the robustness of the results presented above. The advantage of using a sample of twins or triplets enables us to more rigorously control for genetic endowments and family environments. Unfortunately, however, information on whether twins or triplets are monozygotic or dizygotic is not available. As shown in the fourth column of Table 3-1, the twins fixed effects model also shows that the effect of television and video games is positive and statistically significant, but the magnitude remains small. Consequently, we can draw the conclusion from these empirical results that while often negative in direction, more television watching and video game playing is never significantly detrimental to children's problem behavior.

Positive Orientation to School

We proceed to investigate the effect of television or video games on the second outcome of interest, the positive orientation to school (POS). According to the empirical results demonstrated in the first column of Table 3-2, only video games are harmful for children's orientation to school, holding other factors constant. The coefficient of video games is that one additional hour of video games played is associated with a 0.136 decrease in positive orientation to school. While television is harmless, video games, on average, place children at the risk of maladjustment at school, but the magnitude of the effect is quite small: more than 7 hours of playing video games a day would result in a one-item increase in the POS of the child.

Although most socioeconomic variables are not statistically significant, household income contributes to an increase in the POS. This may imply that, as many studies suggest, since greater access to economic resources can help improve academic performance at school, children from high-income households are more likely to have positive feelings toward school. There also exists a substantial gender difference in school orientation: girls are more likely to exhibit a positive attitude toward school than boys. Having siblings and eating breakfast are associated with positive orientation to school.

The second and third columns of Table 3-2 provide estimates from the fixed- and random effects models. Contrary to the result from OLS, both television and video games negatively affect POS, but the magnitude is much smaller than OLS estimates. The random effects model places more emphasis on the role of family structure in school orientation, but the fixed effects model does not. On the other hand, both specifications agree that lifestyle habits, such as breakfast and sleeping routines, are important determinants of POS. According to the Hausman specification test, the choice of the model is fixed effects. The twin fixed effects model with a sample of 226 pairs provides an ambiguous result: television has a negative

impact on POS, while video games do not. Consequently, regardless of the specifications, the magnitude of the effect is small enough to conclude that both television and video games are not detrimental to orientation to school.

Obesity

We also begin by estimating the OLS to measure the effect of hours of television watched or video games played on childhood obesity without accounting for time-variant unobserved heterogeneity across children. The first column of Table 3-3 shows that television is associated with childhood obesity, but video games are not. The coefficient of television indicates that one additional hour of television watched is associated with a 0.206 increase in the BMI, which can be concluded as an estimated effect small enough in magnitude. Most variables regarding parental socioeconomic status are not statistically significant. Consistent with previous literature, such as Sekine et al (2002), we also confirm that hours of sleep per day are associated with obesity.

The second and third columns of Table 3-3 show the results from fixed- and random effects models. The effect of the magnitude drops to 0.039 for the fixed effects and 0.118 for the random effects, which is nearly one fifth and a half of the estimate from OLS, respectively. Family structure, particularly siblings, and lifestyle habits may play a crucial role in reducing obesity. According to the Hausman specification test, the choice of model is fixed effects. The results shown in the fourth column of Table 3-3 are robust to within twin fixed effects difference with a sample of 222 pairs. Consequently, all the specifications, except for the random effects model, indicate that the coefficient of television is statistically significant, but the magnitude of the effect is quite small.

Robustness Tests

We check the robustness of our estimations in the following ways. First of all, we run the factor analysis with principal-component factors for the BPI and the POS and replicate the same analysis with the same set of independent and control variables. The results are indistinguishable from the analysis using BPI or POS. Second, as mentioned earlier, the respondents in the survey we used in this study are primary caregivers of a child: 92.3% of the respondents are mothers, but the rest of them are fathers, grandparents and other guardians. One may question whether the observations regarding children are significantly different between mothers and other caregivers. We replicated the same analysis on the restricted sample with mothers, but the results are indistinguishable from the analysis with the whole sample. Both results will be provided upon request.

Is there any difference in the amount of TV watched or video games played?

The empirical results in this paper assume that the relationship between hours of

television watched or video games played are linear with children's outcomes, but some studies suggest that the effect is not linear (e.g., Williams et al, 1982). Furthermore, because anti-TV or video games are not realistic policies for parents today, they may be more interested in how much television or video games are significantly harmful for children rather than whether or not they are harmful. Is the negative effect larger with the time spent watching television or playing video games? Figure 2 shows the results drawn from fixed effects rolling regressions. It indicates that the negative effect of the first one hour is indistinguishable from zero or relatively small. In other words, the negative effect would be dramatically increased by excessive exposure to television or video games. We include quadratic hours of television watched and video games played and then confirm that the quadratic terms are statistically significant across specifications.

Is it really a causal relationship?

The crucial assumption in this model is that unobserved factors are constant over time. If there are time-variant unobservables, our result may be difficult to interpret in a causal way. The absence of random assignments or external variations of watching television or playing video games makes it difficult to conduct flawless causal analysis. Unfortunately, there are unlikely to be any valid instruments in our dataset which ought to correlate with the hours of television watched or video games played but not with children's development. However, it may be plausibly assumed that we can restrict our estimates: if, for example, children who exhibit bad behaviors and attitudes at home or at school watch television or play video games for longer hours at the same time, then we should expect our estimate of watching television or playing video games to be upwardly biased. If children's development affects the formation of television or video games habits, this will also lead to an overestimate. Therefore, we may be able to interpret the coefficients we presented in this section as the upper limit of the effect of television or video games on children's development. In other words, if these biases are corrected, the magnitude of the negative effect would be smaller. Therefore, we can still confirm that the negative effect is small enough to be negligible.

Conclusion

This paper asks a straightforward question: do television or video games harm children's development? While much of the previous literature has documented a negative relationship between television and children's cognitive and non-cognitive development, some studies have found significant evidence against previous literature after controlling for unobserved characteristics among children and families. This paper takes advantage of the nationally representative longitudinal dataset collected between 2008 through 2010 to rule out unobserved heterogeneity and to isolate the pure effects of watching television or playing video

games on children's problem behavior, school orientation, and obesity. The conclusion drawn from the empirical results is that the answer to this question is yes, but while often negative in direction, more television watching and video game playing are never significantly detrimental to children's problem behavior, school orientation, and obesity after controlling for unobservables. In sum, lifestyle habits, such as breakfast and sleeping routine, are more important for children's development than parental employment status and family structure, which it may suggest that policy makers should target interventions on proximate determinants of the "proper" lifestyle of a child at home, rather than attempting to prevent children from watching television or playing video games. However, we should keep in mind that the negative effects would be dramatically increased by an excessive exposure to television or video games.

Table 1: Items of Behavior Problem Index and Positive Orientation to School

Behavior Problem Index (BPI):
1. S/he uses violent words.
2. S/he tells lies or is not true to his/her words.
3. S/he doesn't talk to people often.
4. S/he is beyond control.
5. S/he plays in dangerous places.
6. S/he commits acts of delinquency.
7. S/he likes a sedentary lifestyle.
8. S/he begs for whatever he/she wants persistently.
9. S/he doesn't play with friends.
10. S/he often has fights with friends.
11. S/he bullies or is bullied.
12. S/he doesn't want to go to school.
13. S/he has problems with his/her study.
14. S/he has problems with his/her eating habits.
15. S/he differs in development
16. S/he has bad eyesight.
17. S/he is prone to illness.
18. S/he has problems with sexuality.
19. S/he has problems other than those listed above.

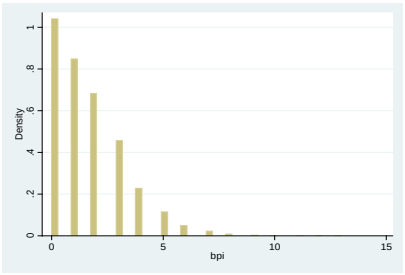
Positive Orientation to School (POS):
1. S/he enjoys seeing his/her friends at school.
2. S/he enjoys studying (including physical and music education) at school.
3. S/he enjoys eating school meals.
4. S/he enjoys seeing and trusts teachers at school.
5. S/he enjoys school events, such as sports days and field trips.

(Note) The item regarding television or video games, "S/he spends many hours watching TV or playing video games", is excluded from the components of the BPI.

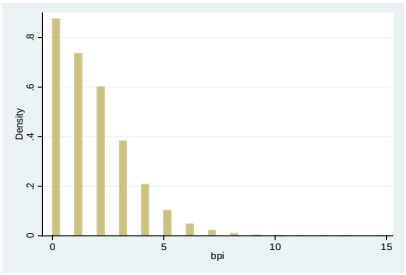
(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Figure 1: Distribution of Outcomes

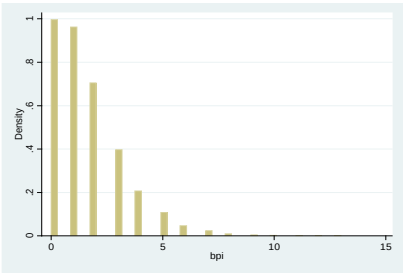
(1) Behavior Problem Index (BPI)



【Wave 7】

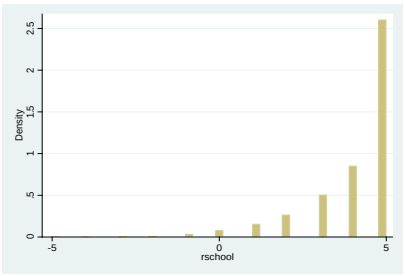


【Wave 8】

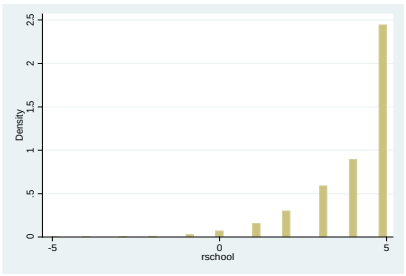


【Wave 9】

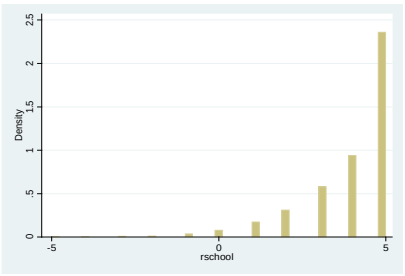
(2) Positive Orientation to School (POS)



【Wave 7】

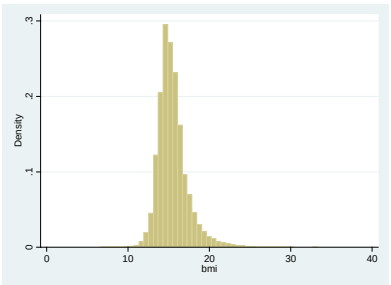


【Wave 8】

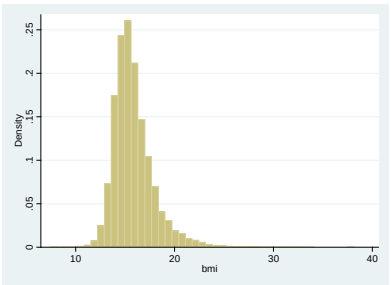


【Wave 9】

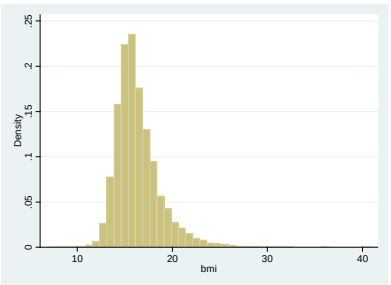
(3) Body Mass Index (BMI)



【Wave 7】



【Wave 8】



【Wave 9】

(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Table 2: Variable Description and Summary Statistics

Variable Description	【Wave 7】 Mean (S.D.)	【Wave 8】 Mean (S.D.)	【Wave 9】 Mean (S.D.)
Dependent Variables:			
Behavior Problem Index (BPI)	1.637	1.684	1.597
	(1.612)	(1.660)	(1.589)
Positive Orientation to School (POS)	4.115	4.051	3.991
	(1.367)	(1.364)	(1.428)
Body Mass Index (BMI)	15.496	15.846	16.342
	(1.857)	(2.068)	(2.300)
Key Independent Variables:			
Hours of television watched a day	1.921	2.020	2.118
	(0.856)	(0.898)	(0.949)
Hours of video games played a day	0.788	0.890	1.012
	(0.677)	(0.686)	(0.706)
Control Variables:			
(i) Child's demographic factors:	0.520	0.520	0.520
Gender (male=1)	(0.500)	(0.500)	(0.500)
(ii) Family structure:			
Number of siblings	1.211	1.231	1.244
	(0.763)	(0.769)	(0.774)
Number of grand parents	0.355	0.386	0.375
	(0.711)	(0.732)	(0.721)
(iii) Parental socioeconomic status:			
Mother's highest education (ref=junior high school)	0.054		
1=High school	0.393		
2=2-yr college or vocational school	0.416		
3=4-yr college or above	0.137		
Father's highest education (ref=junior high school)	0.082		
1=High school	0.398		
2=2-yr college or vocational school	0.157		
3=4-yr college or above	0.363		
Mother's employment status (ref=unemployed)	0.091	0.090	0.087
1=Housewife or not looking for a job	0.340	0.292	0.263
2=Part-time	0.331	0.370	0.394
3= Self-employed	0.061	0.061	0.063
4=Full-time	0.178	0.188	0.193
Father's employment status (ref=unemployed)	0.005	0.009	0.009
1=Househusband or not looking for a job	0.002	0.003	0.004
2=Part-time	0.009	0.008	0.009
3= Self-employed	0.137	0.142	0.143
4=Full-time	0.847	0.837	0.836
Household income (father's income + mother's income + other income, 10,000 JPY)	629.102 (350.083)		
(iv) Lifestyle habits:			
Having breakfast every day (ref=not at all)	0.965	0.965	0.992
	(0.183)	(0.185)	(0.090)
Hours of sleep per day	9.335	9.220	9.106
	(0.521)	(0.529)	(0.551)

(Note) Data on parental highest education and household income are collected only for Wave 7.
(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Table 3-1: Dependent Variable: Problem Behavior Index

	OLS	Fixed Effects	Random Effects	Twin Triplets
Key Independent Variables:				
TV	0.164***	0.065***	0.124***	0.179*
	(0.026)	(0.010)	(0.007)	(0.096)
Video games	0.071**	0.022*	0.093***	0.250**
	(0.032)	(0.012)	(0.008)	(0.108)
Control Variables:				
Gender (male=1)	0.279***			
	(0.040)			
Siblings	-0.199***	0.097***	-0.124***	
	(0.025)	(0.037)	(0.010)	
Grandparents	0.042	0.032	0.025**	
	(0.025)	(0.025)	(0.010)	
Mother's education (ref=junior high)				
High school	-0.224**			
	(0.113)			
2-yr college	-0.235**			
	(0.114)			
4-yr college or above	-0.201			
	(0.124)			
Father's education (ref=junior high)				
High school	-0.104			
	(0.080)			
2-yr college	-0.004			
	(0.088)			
4-yr college or above	-0.192**			
	(0.086)			
Mother's employment status (ref=unemployed)				
Housewife	-0.216	-0.056**	-0.083***	
	(0.155)	(0.023)	(0.019)	
Part-time	-0.280**	-0.023	-0.097***	
	(0.112)	(0.023)	(0.018)	
Self-employed	-0.458***	-0.013	-0.166***	
	(0.135)	(0.046)	(0.032)	
Full-time	-0.240**	-0.032	-0.114***	
	(0.117)	(0.040)	(0.023)	
Father's employment status (ref=unemployed)				
House-husband	0.663	0.124	-0.013	
	(0.407)	(0.130)	(0.106)	
Part-time	0.222	0.041	0.099	
	(0.259)	(0.096)	(0.074)	
Self-employed	0.238	-0.083	-0.089	
	(0.213)	(0.074)	(0.056)	
Full-time	0.156	-0.005	-0.056	
	(0.205)	(0.066)	(0.053)	
Household income (10,000 JPY)	-8.95e-06			
	(0.000)			
Having a breakfast	-0.617***	-0.144***	-0.399***	
	(0.119)	(0.045)	(0.032)	
Hours of sleep per day	-0.060	-0.024	-0.049***	
	(0.041)	(0.015)	(0.011)	
Year fixed effects (ref=2008)				
2009		0.040***	0.026***	
		(0.010)	(0.010)	
2010		-0.069***	-0.092***	
		(0.012)	(0.010)	
Constant	3.005***	1.770***	2.459***	
	(0.493)	(0.171)	(0.121)	
Number of Observations	6,866	82,903	82,903	685 (227 pair)

(Note) 1. *** indicates statistical significance at a 1% level and ** at a 5% level. Parentheses in the table indicate heteroskedasticity-robust standard errors.
2. OLS is estimated by using only Wave 7, which contains information on parental highest education and household income.
(Source) Authors' calculations from the Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Table 3-2: Dependent Variable: Positive Orientation to School

	OLS	Fixed Effects	Random Effects	Twin Triplets
Key Independent Variables:				
TV	0.014	-0.030***	-0.037***	-0.210***
	(0.020)	(0.008)	(0.006)	(0.079)
Video games	-0.136***	-0.052***	-0.144***	-0.103
	(0.027)	(0.010)	(0.007)	(0.089)
Control Variables:				
Gender (male=1)	-0.216***			
	(0.032)			
Siblings	0.051**	-0.008	0.056***	
	(0.021)	(0.031)	(0.008)	
Grandparents	0.057	-0.019	0.027***	
	(0.020)	(0.022)	(0.008)	
Mother's education (ref=junior high)				
High school	0.169			
	(0.105)			
2-yr college	0.287***			
	(0.106)			
4-yr college or above	0.286**			
	(0.113)			
Father's education (ref=junior high)				
High school	0.009			
	(0.062)			
2-yr college	-0.026			
	(0.070)			
4-yr college or above	0.030			
	(0.067)			
Mother's employment status (ref=unemployed)				
Housewife	0.082	-0.009	0.018	
	(0.119)	(0.021)	(0.017)	
Part-time	0.025	-0.021	0.025	
	(0.084)	(0.021)	(0.017)	
Self-employed	0.002	-0.006	0.075***	
	(0.102)	(0.043)	(0.028)	
Full-time	0.077	-0.040	0.147***	
	(0.088)	(0.036)	(0.021)	
Father's employment status (ref=unemployed)				
House-husband	0.504	0.117	0.140	
	(0.382)	(0.121)	(0.095)	
Part-time	0.101	0.179	0.057	
	(0.263)	(0.081)	(0.068)	
Self-employed	0.063	0.016**	0.043	
	(0.226)	(0.066)	(0.051)	
Full-time	0.022	0.041	0.093*	
	(0.223)	(0.058)	(0.049)	
Household income (10,000 JPY)	1.18e-03**			
	(0.000)			
Having breakfast	0.404***	0.111***	0.290***	
	(0.106)	(0.035)	(0.029)	
Hours sleep per day	0.018	0.025*	0.055***	
	(0.033)	(0.014)	(0.010)	
Year fixed effects (ref=2008)				
2009		-0.053***	-0.046***	
		(0.010)	(0.009)	
2010		-0.106***	-0.092***	
		(0.010)	(0.010)	
Constant	3.337***	3.884***	3.317***	
	(0.418)	(0.151)	(0.108)	
Number of Observations	6,837	82,447	82,447	678 (226 pair)

(Note)1. *** indicates statistical significance at a 1% level and ** at a 5% level. Parentheses in the table indicate heteroskedasticity-robust standard errors.
2. OLS is estimated by using only Wave 7, which contains information on parental highest education and household income.
(Source) Authors' calculations from the Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

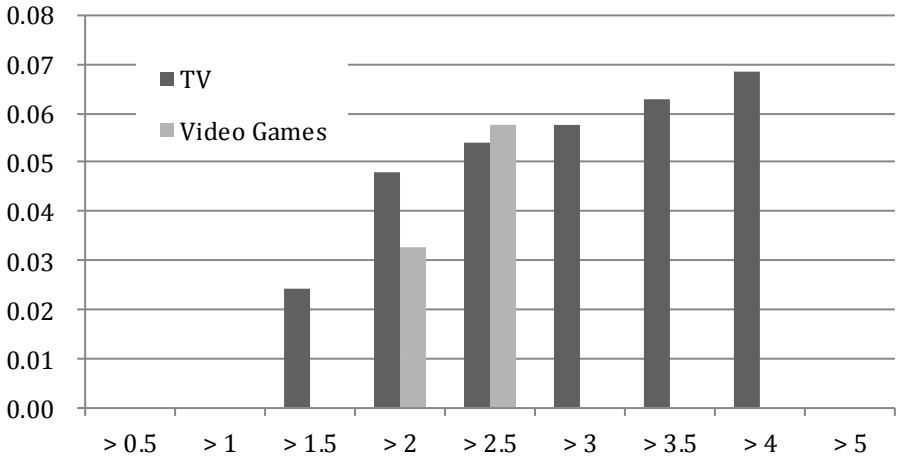
Table 3-3: Dependent Variable: Obesity

	OLS	Fixed Effects	Random Effects	Twin Triplets
Key Independent Variables:				
TV	0.206***	0.039***	0.118***	0.332**
	(0.030)	(0.009)	(0.008)	(0.133)
Video games	0.021	-0.017	0.046***	0.091
	(0.039)	(0.011)	(0.009)	(0.152)
Control Variables:				
Gender (male=1)	0.175***			
	(0.048)			
Siblings	-0.006	-0.055*	-0.043***	
	(0.032)	(0.034)	(0.013)	
Grandparents	0.119***	-0.017	0.106***	
	(0.033)	(0.024)	(0.013)	
Mother's education (ref=junior high)				
High school	0.069			
	(0.150)			
2-yr college	0.085			
	(0.152)			
4-yr college or above	0.056			
	(0.163)			
Father's education (ref=junior high)				
High school	0.181*			
	(0.150)			
2-yr college	0.015			
	(0.106)			
4-yr college or above	0.043			
	(0.104)			
Mother's employment status (ref=unemployed)				
Housewife	0.089	0.024	0.011	
	(0.167)	(0.022)	(0.020)	
Part-time	-0.120	0.003	0.020	
	(0.126)	(0.022)	(0.020)	
Self-employed	-0.085	-0.064	0.050	
	(0.156)	(0.046)	(0.037)	
Full-time	0.036	0.006	0.143***	
	(0.136)	(0.039)	(0.028)	
Father's employment status (ref=unemployed)				
House-husband	-1.068**	-0.116	-0.075	
	(0.475)	(0.129)	(0.115)	
Part-time	-0.684	0.085	0.031	
	(0.475)	(0.086)	(0.079)	
Self-employed	-0.411	-0.023	-0.005	
	(0.430)	(0.071)	(0.061)	
Full-time	-0.434	-0.017	-0.067	
	(0.425)	(0.061)	(0.057)	
Household income (10,000 JPY)	2.21e-05			
	(0.000)			
Having breakfast	0.179	0.082**	-0.014	
	(0.130)	(0.038)	(0.035)	
Hours of sleep per day	-0.078*	-0.045***	-0.117***	
	(0.047)	(0.015)	(0.012)	
Year fixed effects (ref=2008)				
2009		0.331***	0.311***	
		(0.010)	(0.010)	
2010		0.811***	0.769***	
		(0.011)	(0.011)	
Constant	15.822***	15.855***	16.370***	
	(0.667)	(0.161)	(0.136)	
Number of Observations	6,192	76,195	76,195	638 (222 pair)

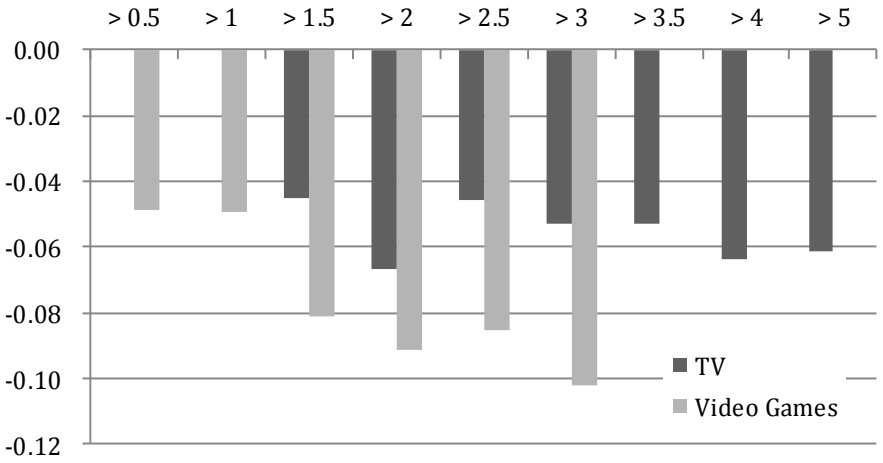
(Note)1. *** represent statistically significant at a 1% level and ** at a 5% level. The parenthesis in the Table indicates the heteroskedasticity-robust standard errors.
2. OLS is estimated by using only Wave 7, which contains information on parental highest education and household income.
(Source) Authors' calculations from the Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Figure 2: Magnitude of the effect

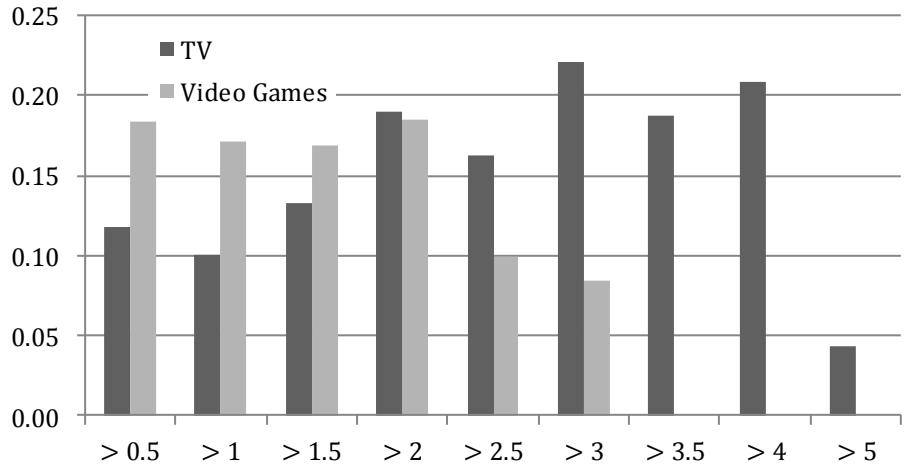
(1) Behavior Problem Index (BPI)



(2) Positive Orientation to School (POS)



(3) Body Mass Index (BMI)



(Source) Longitudinal Survey of Babies in the 21st Century, Ministry of Health, Labour and Welfare

Reference

Aksoy, T. & Link, C. R. (2000). A panel analysis of student mathematics achievement in the US in the 1990s. *Economics of Education Review*, 19(3), 261-277.

Bianchi, S. & Robinson, J. (1997). What did you do today? Children's use of time, family composition and the acquisition of social capital. *Journal of Marriage and the Family*, 59(2), 332-344.

Cabinet Office (2001). dai 2kai seishounen no seikatsu to ishiki ni kansuru kihon chousa [The second round report on the life and feelings of adolescents in Japan], retrieved Feb 15, 2013 from http://www8.cao.go.jp/youth/kenkyu/cushion.html#seikatu2

Christakis, D. A., Zimmerman, F. J., DiGiuseppe, D. L. & McCarty, C. A. (2004). Early television exposure and subsequent attentional problems in children. *Pediatrics*, 113(4), 708 -713.

CNN (2008). Violent video games linked to child aggression. Retrieved Feb 15, 2013 from http://edition.cnn.com/2008/HEALTH/family/11/03/healthmag.violent.video.kids/index.html

Fall, A. & Roberts, G. (2012). High school dropouts: Interactions between social context, self-perceptions, school engagement, and student dropout. *Journal of Adolescence*, 35 787–798.

Gentzkow, M. & Shapiro, J. M. (2008). Preschool television viewing and adolescent test scores: historical evidence from the Coleman study. *Quarterly Journal of Economics*, 123(1), 279–323.

Gaddy, G. D. (1986). Television's impact on high school achievement. *Public Opinion Quarterly*, 50(3), 340–359.

Gortmaker, S. L., Salter, C. A., Walker, D. K. & Dietz, W. H. (1990). The impact of television viewing on mental aptitude and achievement. *Public Opinion Quarterly*, 54(4), 594–604.

Gortmaker, S. L., Must, A., Sobol, A. M., Peterson, K., Colditz , G. A., & Dietz, W. H. (1996). Television viewing as a cause of increasing obesity among children in the United States, 1986–1990. *Archives of Pediatrics and Adolescent Medicine,* 150(4), 356–362.

Ladd, G. W. & Dinella, L. M. (2009). Continuity and change in early school engagement: predictive of children's achievement trajectories from first to eighth grade?, *Journal of Educational Psychology*, 101(1), 190–206.

Li, Y. & Lerner, R. M. (2011). Trajectories of school engagement during adolescence: implications for grades, depression, delinquency, and substance use. *Developmental Psychology*, 47(1), 233–247.

Lumeng, C. J., Rahnama, S., Appugliese, D., Kaciroti, N., & Bradley, H. R. (2006). Television exposure and overweight risk in preschoolers. *Archives of Pediatrics & Adolescent Medicine*, 160(4), 417-422.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 46(6), 1251–1271.

Hancox R. J., Milne, B. J. & Poulton, R. (2005). Association of television viewing during childhood with poor educational achievement. *Archives of Pediatrics & Adolescent Medicine*, 159(7), 614-618.

Hofferth, S. L. & Sandberg, J. F. (2001). How American children spend their time. *Journal of Marriage and Family*, 63(2), 295–308.

Hornik, R. C. (1981). Out-of-school television and schooling: hypotheses and methods. *Review of Educational Research*, 51(2), 193–214.

Jessor, R., Van Den Bos, J, Vanderryn, J., Costa, F. M. & Turbin, M. S. (1995). Positive factors in adolescent problem behavior: moderator effects and developmental change. *Developmental Psychology*, 31(6), 923-933.

Keith, T. Z., Reimers, T. M., Fehrmann, P. G., Pottebaum, S. M., & Aubey, L. W. (1986). Parental involvement, homework, and TV time: direct and indirect effects on high school achievement. *Journal of Educational Psychology*, 78(5), 373–380.

Kirkorian, H. L., Wartella, E. A. & Anderson, D. R. (2008). Media and young children's learning, *The Future of Children*, 18(1), 39-61.

Kitamura, Y. (2013). Kodomo no seichou pata-n: 21-seiki shusshouji jyuudan chousa ni motoduku sokutei. [Human growth pattern: observations from the Longitudinal Survey of Babies in 21st Century in Japan], Global COE Hi-Stat Discussion Paper Series 278.

Kureishi, W. & Yoshida, K. (2013). Does viewing television affect the academic performance of children?, *Social Science Japan Journal*, 16(1), 87-105.

McLeod, J. D. and Kaiser. K. (2004). Childhood emotional and behavioral problems and educational attainment. *American Sociological Review*, 69(5), 636–58.

Miech, R. A., Caspi, A., Moffitt, T. E., Entner, R., Wright, B. & Silva, P. A. (1999). "Low socioeconomic status and mental disorders: a longitudinal study of selection and causation during young adulthood. *American Journal of Sociology*, 104(4), 1096–1131.

Morgan, M. & Gross, L. (1980). Television viewing, IQ and academic achievement. *Journal of Broadcasting*, 24(2), 117–133.

Olken, B. A. (2009). Do television and radio destroy social capital?: evidence from Indonesian villages, *American Economic Journal: Applied Economics*, 1(4), 1-33.

Peterson, J. L. & Zill, N. (1986). Marital disruption, parent-child relationships, and behavior problems in children. *Journal of Marriage and the Family*, 48(2), 295-307.

Sekine, M., Yamagami, T., Handa, K., Saito, T., Nanri, S., Kawaminami, K., Tokui, N., Yoshida, K., Kagamimori, S. (2002). A dose-response relationship between short sleeping hours and childhood obesity: results from the Toyama birth cohort study. *Childcare, Health and Development*, 28(2), 163-170.

Sharif, I. & Sargent, J. D. (2006). Association between television, movie, and video game exposure and school performance. *Pediatrics*, 118 (4), 1061-1070.

Time (2009). Watching TV: even worse for kids than you think. Retrieved Feb 15, 2013 from

http://www.time.com/time/health/article/0,8599,1914450,00.html

Williams, P. A., Haertel, E. H., Haertel, G. D., & Walberg, H. J. (1982). The impact of leisure-time television on school learning: a research synthesis. *American Educational Research Journal*, 19(1), 19-50.

Wright, M. C., Parker, L., Lamont, D., Craft, W. A., Spence, J. (2001). Implications of childhood obesity for adult health: findings from thousand families cohort study. *British Medical Journal*, 323(7324), 1280–1284.

Zavodny, M. (2006). Does watching television rot your mind?: estimates of the effect on test scores, *Economics of Education Review*, 25(5), 565–573.

Zimmerman, F. J. & Christakis, D. A. (2005). Children's television viewing and cognitive outcomes: a longitudinal analysis of national data. *Archives of Pediatrics & Adolescent Medicine*, 159(7), 619-625.