

Extensive Television Viewing and the Development of Attention and Learning Difficulties During Adolescence

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Objective: To investigate the association of television viewing with educational and intellectual outcomes during adolescence and early adulthood.

Design: Prospective epidemiological study.

Setting: Families participating in the Children in the Community Study, a prospective longitudinal investigation, were interviewed at mean offspring ages 14, 16, and 22 years.

Participants: A community-based sample of 678 families from upstate New York.

Main Exposures: Television viewing, attention difficulties, learning difficulties, and educational achievement during adolescence and early adulthood.

Main Outcome Measures: The Disorganizing Poverty Interview and age-appropriate versions of the Diagnostic Interview Schedule for Children.

Results: Frequent television viewing during adoles-

cence was associated with elevated risk for subsequent attention and learning difficulties after family characteristics and prior cognitive difficulties were controlled. Youths who watched 1 or more hours of television per day at mean age 14 years were at elevated risk for poor homework completion, negative attitudes toward school, poor grades, and long-term academic failure. Youths who watched 3 or more hours of television per day were the most likely to experience these outcomes. In addition, youths who watched 3 or more hours of television per day were at elevated risk for subsequent attention problems and were the least likely to receive postsecondary education. There was little evidence of bidirectionality in the association of television viewing with attention and learning difficulties.

Conclusion: Frequent television viewing during adolescence may be associated with risk for development of attention problems, learning difficulties, and adverse long-term educational outcomes.

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CHILDREN AND ADOLESCENTS in most industrialized societies spend an average of 2 or more hours per day watching television.¹⁻⁴ Many youths who watch 3 or more hours of television per day spend as much time watching television in an average year as they do receiving classroom instruction.¹⁻⁴ Most children and adolescents spend more time watching television than reading, and television viewing time is inversely associated with reading time and reading comprehension.^{1,5-7} These findings are a cause of concern because research has suggested that extensive viewing of entertainment and general audience programming during childhood may be associated with poor academic achievement and deficits in attention and cognitive functioning.^{3,6-14} Although viewing

educational television may be associated with positive outcomes,² most children spend more than 90% of their television viewing time watching entertainment and general audience programming.^{1-4,15}

Frequent viewing of entertainment and general audience television programming during childhood and adolescence has been hypothesized to contribute to persistent reductions in educational and intellectual functioning¹⁴ because it displaces reading and homework, requires relatively little intellectual effort, and promotes attention problems and disinterest in school.^{2,6,7,11,16,17} Research findings supporting this hypothesis have indicated that overall television viewing time during childhood and adolescence may be associated with elevated risk for the development of attention problems, educational difficulties, poor reading comprehen-

PARTICIPANTS AND PROCEDURE

sion, and other cognitive deficits.^{6-9,11,13,14} Entertainment and general audience television viewing may be differentially associated with decreases in reading and educational activities, and informative programs designed for children may be associated with improvements in letter and word recognition.² However, because educational television viewing time declines with age during childhood,² the beneficial effects of educational television may become decreasingly evident from childhood through adolescence.

A second hypothesis is that youths with a history of poor academic or intellectual skills tend to engage in more frequent television viewing than do their peers.^{7,12,18} This hypothesis has been supported by findings suggesting that youths with learning difficulties, attention problems, and other intellectual deficits may be more likely than other youths to engage in frequent television viewing.^{12,18} Such findings, considered together with the larger body of evidence supporting the first hypothesis cited earlier, have suggested that there may be a bidirectional association between television viewing time and attention or learning problems.

A third hypothesis is that the association between television viewing and attention or learning difficulties may be attributable to "third variables" such as low socioeconomic status (SES) or childhood neglect that may contribute to both extensive television viewing and attention or learning difficulties.^{4,12} For example, low SES may contribute to television viewing time for reasons including a restricted range of nonclassroom educational activities, poor nutrition, and environmental adversities associated with low SES.¹² Inadequate parental supervision may contribute to frequent television viewing, and neglected children may have attention and learning difficulties attributable to insufficient parental support. Findings supporting the third-variable hypothesis have indicated that frequent television viewing was associated with poor educational outcomes before but not after SES and other covariates were controlled.¹² In addition, the association of television viewing with attention and learning problems has been found to vary as a function of variables including age, SES, and television programming content.² Accordingly, differences in the findings of studies supporting the 3 major hypotheses are likely to have been owing in part to differences in sample characteristics, control variables, measures, and follow-up intervals.

To investigate all 3 hypotheses, it is necessary to conduct a series of assessments of television viewing and educational outcomes during childhood or adolescence and to assess potential risk factors that might underlie this association. It is important to investigate these associations during adolescence, a critical period for cognitive development and educational advancement. We describe findings of the Children in the Community Study,¹⁹ a community-based longitudinal investigation that meets these methodological criteria. The primary objective of our present study was to investigate the association of frequent television viewing during adolescence with risk for persistent attention and learning difficulties^{6,7,11,16,17} and with poor long-term educational outcomes.¹⁴

The participants were a community-based sample of 678 mothers and their offspring (50.0% female) who completed a series of comprehensive psychosocial interviews conducted during the adolescence and adulthood of the offspring. The interviews were conducted in 1983 (mean [SD] offspring age, 13.7 [2.8] years), 1985 to 1986 (mean [SD] offspring age, 16.3 [2.8] years), 1991 to 1993 (mean [SD] offspring age, 22.1 [2.7] years), and 2001 to 2004 (mean [SD] offspring age, 33.2 [2.9] years). The families were randomly sampled on the basis of residence in 2 upstate New York counties in 1975, when maternal interviews were conducted regarding 1 randomly sampled child between the ages of 1 and 10 years from each family. The participating families were demographically representative of families in the sampled region. Seven hundred seventy-eight families participated in the baseline interviews that were conducted at mean offspring age 14 years. The 678 participants in the present study did not differ significantly at the baseline assessment from the 100 other participants at their baseline assessment with regard to baseline demographic, behavioral, or parental characteristics. The study procedures have been approved by the Columbia University College of Physicians and Surgeons Institutional Review Board and the New York State Psychiatric Institute Institutional Review Board. A National Institutes of Health Certificate of Confidentiality has been obtained for these data. Written informed consent or assent was obtained from all of the participants after the interview procedures were fully explained. Additional information regarding the study methods is available from previous articles¹⁹⁻²¹ and on the study Web site (<http://nyspi.org/childcom>).

ASSESSMENT OF ATTENTION AND LEARNING DIFFICULTIES

Attention and learning difficulties were assessed at mean ages 14 and 16 years using the parent and child versions of the Diagnostic Interview Schedule for Children²² and at mean age 22 years using a modified and age-appropriate version of the Diagnostic Interview Schedule for Children administered to the offspring. Attention and learning difficulties were considered present if reported by either informant. Research²³ has supported the reliability and validity of the Diagnostic Interview Schedule for Children as administered in our study. Frequent attention difficulties were identified as being present if the youth had 1 or more symptoms of attention-deficit disorder. Negative attitudes about school were identified if it was reported that the youth "hated" school. Frequent failure to complete homework was identified if the youth was reported to "hardly ever" do his or her homework. Frequent boredom at school was considered present if it was reported that the youth was "often" or "very often" bored at school. Youths were identified as having poor school grades if their average grades were reported to be D (poor) or F (failing). Overall academic failure was identified as present if the average grade through secondary school was D (poor) or F (failing), if the youth fell 1 or more years behind school peers, or if his or her secondary education was not completed.

These attention and learning difficulties were investigated as outcomes because they are among the hypothesized sequelae of frequent television viewing.^{2,6-9,11,13,14,16,17} Verbal intelligence was assessed at mean ages 14 and 16 years with a picture vocabulary test.²⁴ Verbal IQ scores were averaged and dichotomized (<100 vs ≥100). We investigated whether television viewing time was associated with attention and learn-

Table 1. Descriptive Statistics of 678 Families

Characteristic	Baseline Assessment*	Follow-up Assessment†
Television viewing time, h/d, No. (%)		
None or almost none	21 (3.1)	23 (3.4)
<1	61 (9.0)	73 (10.8)
1-2	179 (26.4)	213 (31.4)
2-3	192 (28.3)	177 (26.1)
3-4	134 (19.8)	101 (14.9)
>4	91 (13.4)	91 (13.4)
Attention and learning difficulties and indices of academic failure, No. (%)		
Frequent attention difficulties	145 (21.4)	140 (20.6)
Hardly ever does homework	53 (7.8)	149 (22.0)
Often bored at school	230 (33.9)	247 (36.4)
Reports that he or she hates school	147 (21.7)	150 (22.1)
Poor grades in school	47 (6.9)	83 (12.2)
Academic failure‡	184 (27.1)	136 (20.1)
No postsecondary education	NA	190 (28.0)
Demographic variables		
Offspring history of childhood neglect, No. (%)	95 (14.0)	95 (14.0)
Low family income (<100% of US poverty index), No. (%)	101 (14.9)	76 (11.2)
Parental education including both parents, mean (SD), y	13.10 (2.34)	13.16 (2.33)

Abbreviation: NA, not applicable.

*The baseline assessment was conducted at mean offspring age 14 years.

†Follow-up data regarding attention and learning difficulties through secondary school were obtained during interviews conducted at mean offspring ages 16 and 22 years. Postsecondary education was assessed at mean offspring age 33 years. Follow-up data regarding family income, parental education, and television viewing are from the interview conducted at mean offspring age 16 years. Childhood neglect data were compiled from interview data at mean offspring ages 14, 16, and 22 years and with data obtained from a central childhood maltreatment registry.

‡Youths were identified as having experienced academic failure if their average grades in school were D (poor) or F (failing), if they fell 1 or more years behind their peers in school, or if they failed to complete their secondary education by mean age 22 years.

ing difficulties among youths with above- and below-average verbal IQ scores. At mean age 33 years, respondents provided information regarding their secondary and postsecondary education. This was included as an outcome variable to investigate whether television viewing time at mean age 14 years was associated with years of postsecondary education by mean age 33 years.

ASSESSMENT OF TELEVISION VIEWING

Television viewing time was assessed at mean ages 14, 16, and 22 years with items from the Disorganizing Poverty Interview.²⁰ These items assessed whether the youths watched 1 or fewer hours, 1 to 2 hours, 2 to 3 hours, 3 to 4 hours, or 4 or more hours of television on a typical day. These data were used to compute an index of television viewing with 3 categories: (1) less than 1 hour per day of television viewing; (2) 1 to 3 hours per day of television viewing; and (3) 3 or more hours per day of television viewing.

ASSESSMENT OF PARENTAL CHARACTERISTICS AND CHILDHOOD NEGLECT

Parental education and income were assessed at each maternal interview. An index of family income, adjusted for family

size, was computed as a percentage of the US poverty levels at each assessment. Parental SES was computed as the standardized sum of standardized measures of years of maternal and paternal education, maternal and paternal occupational status, and family income. Childhood neglect was assessed based on 2 types of data.²¹ Information regarding cases that had been referred to state agencies, investigated by Child Protective Services, and officially confirmed was obtained from a central registry. In addition, maternal interview data were used to assess cognitive, emotional, physical, and supervision neglect.²¹ Childhood neglect was identified as having been present if the neglect scale scores were 2 or more SDs above the sample mean for each type of neglect.

DATA ANALYSIS

Logistic regression analyses were conducted to investigate whether the youths' television viewing was associated with adverse educational and intellectual outcomes when the covariates (age, sex, parental SES, childhood neglect, and baseline attention and learning difficulties) were controlled statistically. Low SES and childhood neglect were controlled because they may contribute to both extensive television viewing and attention or learning difficulties. Age and sex were controlled because they are associated with certain types of attention or learning difficulties and television viewing. Baseline attention and learning difficulties were controlled because they are associated with current television viewing time and subsequent attention or learning difficulties.

Attention problems, low homework completion, and negative attitudes about school were investigated as potential mediators of the association between television viewing at mean age 14 years and academic failure by mean age 22 years. Mediation hypotheses were tested in a series of logistic regression analyses in accordance with established statistical procedures.^{25,26} Three fundamental conditions are required for a hypothesized mediating variable to mediate the association between hypothesized predictor and outcome variables.²⁵ First, the hypothesized predictor, assessed at baseline, must be significantly associated with the outcome variable. Second, the hypothesized predictor must be significantly associated with the hypothesized mediator(s). Third, the hypothesized mediator(s) must be significantly associated with the outcome after the predictor variable is controlled statistically.

RESULTS

DESCRIPTIVE STATISTICS

Descriptive statistics for the study variables are shown in **Table 1**. Based on these frequency distributions, above-median television viewing time was identified as present if the youth was reported to spend 3 or more hours per day watching television.

TELEVISION VIEWING DURING ADOLESCENCE AND SUBSEQUENT ATTENTION OR LEARNING DIFFICULTIES

Television viewing time at mean age 14 years was associated with elevated risk for subsequent frequent attention difficulties, frequent failure to complete homework assignments, frequent boredom at school, failure to complete high school, poor grades, negative attitudes about school (ie, hates school), overall academic failure in sec-

Table 2. Television Viewing at Mean Age 14 Years and Attention or Learning Difficulties Reported at Follow-up Interviews for 678 Families

Attention or Learning Difficulties*	Participants, No. (%)			Adjusted OR (95% CI)†
	Television Viewing <1 h/d (n = 82)	Television Viewing 1-3 h/d (n = 371)	Television Viewing ≥3 h/d (n = 225)	
Specific attention and learning difficulties reported at follow-up assessments				
Frequent attention difficulties	12 (14.6)	62 (16.7)	66 (29.3)‡	1.44 (1.04-2.01)
Hardly ever does homework	10 (12.2)§	78 (21.0)	61 (27.1)‡	1.38 (1.01-1.89)
Often bored at school	18 (22.0)§	133 (35.8)	96 (42.7)‡	1.42 (1.09-1.86)
Reports that he or she hates school	8 (9.8)§	77 (20.8)	65 (28.9)‡	1.53 (1.10-2.12)
Indices of academic failure reported at follow-up assessments				
Poor grades in school	3 (3.7)§	40 (10.8)	40 (17.8)‡	1.64 (1.08-2.48)
Academic failure	8 (9.8)§	59 (15.9)	69 (30.7)‡	1.82 (1.29-2.56)
No postsecondary education	14 (17.1)§	89 (24.0)	87 (38.7)‡	1.61 (1.20-2.16)

Abbreviations: CI, confidence interval; OR, odds ratio.

*Follow-up data regarding attention and learning difficulties through secondary school were obtained during interviews conducted at mean offspring ages 16 and 22 years. Postsecondary education was assessed at mean offspring age 33 years.

†Adjusted ORs indicate the average increase in the odds for the attention or learning difficulty associated with an increase in the level of television viewing (eg, from <1 h/d to 1-3 h/d of television viewing) after controlling for the following covariates: age, sex, parental socioeconomic status, childhood neglect, and the presence of any attention or learning difficulty at mean age 14 years. The corresponding attention or learning difficulty at mean age 14 years was also included in these analyses as a covariate, with the exception of analysis for no postsecondary education. In this analysis, the most closely corresponding variable (academic failure at mean age 14 years) was included as a covariate and controlled statistically.

‡Significantly higher prevalence of attention or learning difficulty than among youths who watched less than 3 hours of television per day at mean age 14 years ($P < .05$).

§Significantly lower prevalence of attention or learning difficulty than among youths who watched 1 or more hours of television per day at mean age 14 years ($P < .05$).

||Youths were identified as having experienced academic failure if their average grades in school were D (poor) or F (failing), if they fell 1 or more years behind their peers in school, or if they failed to complete their secondary education by mean age 22 years. The academic failure covariate in the logistic regression analyses was considered present at mean age 14 years if the youth's average grades were D (poor) or F (failing) or if he or she had fallen 1 or more years behind his or her peers in school.

ondary school, and failure to obtain postsecondary (eg, college, university, training school) education. These associations remained significant after the covariates were controlled (**Table 2**). Television viewing time at mean age 14 years was associated with academic failure through secondary school among youths with above-median (odds ratio [OR], 2.23; 95% confidence interval [CI], 1.33-4.39) and below-median (OR, 1.49; 95% CI, 1.13-2.47) verbal intelligence scores and among the offspring of parents with more than 12 years (OR, 2.42; 95% CI, 1.32-4.41) and 12 or fewer years (OR, 1.66; 95% CI, 1.13-2.47) of education.

Youths who watched 3 or more hours of television per day at mean age 14 years were twice as likely as those who watched less than 1 hour of television per day to fail to obtain a postsecondary education by mean age 33 years (OR, 3.06; 95% CI, 1.62-5.78) (**Figure 1**). The association of television viewing time at mean age 14 years with failure to obtain a postsecondary education was statistically significant in the subsamples of individuals with (OR, 1.51; 95% CI, 1.09-2.10) and without (OR, 2.07; 95% CI, 1.14-3.74) 1 or more attention or learning difficulties at mean age 14 years.

The association of television viewing time at mean age 14 years with subsequent academic failure was mediated by attention difficulties, frequent failure to complete homework, and negative attitudes about school at mean age 16 years (**Figure 2**). All of the 3 established statistical criteria for mediation were met^{25,26}: (1) baseline television viewing time predicted subsequent academic failure; (2)

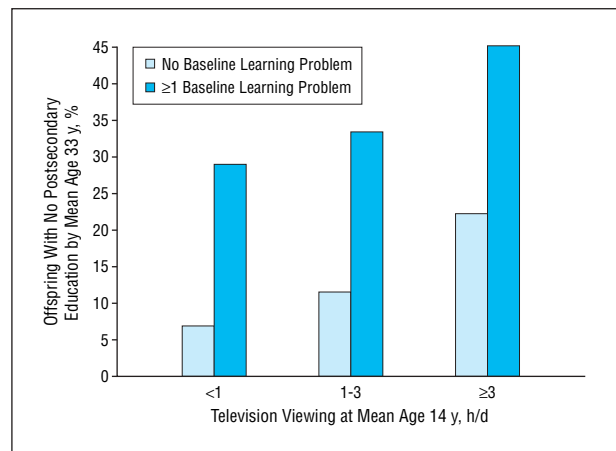


Figure 1. Association of television viewing time at mean age 14 years and postsecondary education through mean age 33 years.

baseline television viewing time predicted attention problems, low homework completion, and negative attitudes about school; and (3) attention problems, low homework completion, and negative attitudes about school predicted subsequent academic failure after baseline television viewing time was controlled statistically. Attention difficulties at mean age 16 years accounted for 22.9% of the variance, frequent failure to complete homework at mean age 16 years accounted for 9.3% of the variance, and negative attitudes about school at mean age 16 years accounted for 19.5% of the variance in the association of tele-

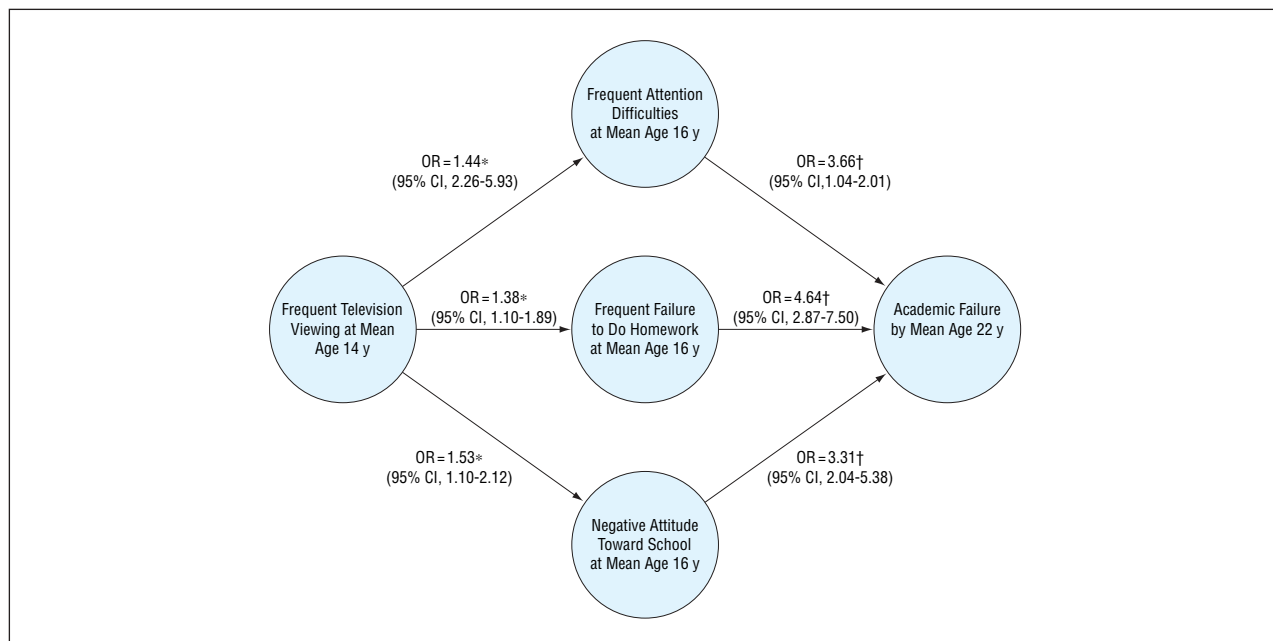


Figure 2. Attention difficulties, infrequent homework completion, and negative attitudes about school as mediators of the association between television viewing at mean age 14 years and secondary school academic failure assessed at mean age 22 years. Youths were identified as having experienced academic failure if they received grades of D (poor) or F (failing) in school, fell 1 or more years behind their peers in school, or failed to complete their secondary education. OR indicates odds ratio; CI, confidence interval. * $P < .05$. † $P < .005$; ORs are adjusted ORs controlling statistically for the frequency of television viewing at mean age 14 years.

vision viewing time at mean age 14 years with subsequent academic failure.

CHANGE IN TELEVISION VIEWING TIME AND RISK FOR ATTENTION AND LEARNING DIFFICULTIES

The association of television viewing time at mean age 14 years with subsequent academic failure was significantly mediated by television viewing time at mean age 16 years. Television viewing time at mean age 14 years predicted television viewing time at mean age 16 years and subsequent academic failure. Television viewing time at mean age 16 years predicted subsequent academic failure after television viewing time at mean age 14 years was controlled statistically. Among the youths who viewed less than 2 hours of television per day at mean age 14 years, a reduction of 1 or more hours per day in television viewing by mean age 16 years was associated with decreased risk for academic failure through secondary school (OR, 0.50; 95% CI, 0.28-0.89). Increased television viewing time was associated with elevated risk for academic failure. In comparison with the youths who watched less than 2 hours of television per day at mean ages 14 and 16 years, those who increased their daily viewing time by 1 or more hours and spent 2 or more hours per day watching television at mean age 16 years were at elevated risk for academic failure (OR, 2.01; 95% CI, 1.05-3.86).

ASSOCIATION OF ATTENTION AND LEARNING DIFFICULTIES WITH SUBSEQUENT TELEVISION VIEWING

Youths who received poor grades in school (adjusted OR, 2.22; 95% CI, 1.12-4.41) and youths who reported that

they hated school (adjusted OR, 1.56; 95% CI, 1.01-2.42) at mean age 14 years were more likely than youths without these difficulties to spend 3 or more hours per day watching television at mean age 16 years. However, no attention or learning problems that were assessed at mean age 14 years predicted aggregate mean television viewing time across the follow-up assessments at mean ages 16 and 22 years when age, sex, parental SES, childhood neglect, and television viewing time at mean age 14 years were controlled.

COMMENT

The findings of the present study are consistent with the hypothesis that frequent television viewing during childhood and adolescence may be associated with elevated risk for the development of attention problems, reduced levels of reading and homework completion, disinterest in school, poor grades, academic failure, and failure to obtain a postsecondary education.^{6-9,11,13,14,16} In addition, they support the inference that attention difficulties, frequent failure to complete homework, and negative attitudes toward school may each play an important mediating role in the association between extensive television viewing during adolescence and ultimate educational failure. These findings add to a growing body of evidence indicating that frequent entertainment and general audience television viewing during adolescence may be associated with risk for the development of a wide range of cognitive and behavioral deficits that are associated with risk for poor long-term educational achievement.^{6-9,11,13,14}

The findings provide little evidence of bidirectionality in the association of adolescent television viewing

with attention and learning difficulties. Only 2 of 14 multivariate analyses that were conducted to investigate associations of baseline attention and learning difficulties with television viewing provided evidence suggesting that attention or learning difficulties may be associated with risk for the incidence of frequent television viewing. The results suggest that although youths with attention or learning problems may spend more time watching television than do youths without these difficulties, this tendency may be unlikely to explain the preponderance of the association between television viewing and attention and learning difficulties during adolescence.

It is important to note that although there is evidence indicating that educational programming may have positive effects on cognitive development during childhood,² our findings suggest that the benefits of educational programming during childhood may tend to be outweighed by frequent viewing of entertainment and general audience programs during adolescence.² Research has indicated that most children spend less than 10% of their viewing time watching educational television¹⁵ and that educational television viewing tends to decline with age.² These findings, as well as evidence suggesting that frequent television viewing may be associated with risk for a range of adverse consequences,^{6-9,11,13,14} suggest that extensive viewing of entertainment and general audience television during childhood and adolescence may account for much of the observed association between overall television viewing time and educational outcomes.²

The limitations of the present study require acknowledgment. Because television viewing content was not assessed, it was not possible to investigate in a precise manner the associations of specific types of television programs with educational outcomes. It will be of interest for future community-based longitudinal studies to investigate the associations of specific types of television programming with educational and intellectual outcomes during adolescence and early adulthood. The age range at the baseline interview was sufficiently wide that 138 individuals were older than 16.3 years at the baseline interview. However, supplemental analyses conducted with the subset of 519 individuals who were aged 16 years or younger at the baseline assessment yielded results and effect sizes that did not differ in a substantive manner from the findings described earlier. It is also important to note that although baseline attention and learning difficulties were controlled statistically in the present study, it is possible that the results were partially attributable to the long-term effects of prior television viewing.

The present findings may have important clinical and public health implications. They suggest that by encouraging youths to spend less than 3 hours per day watching television, parents, teachers, and health care professionals may be able to help reduce the likelihood that at-risk adolescents will develop persistent attention and learning difficulties. The findings are consistent with the recommendation of the American Academy of Pediatrics that children should spend an average of no more than 1 to 2 hours per day watching television.⁹ It

will be of interest for future studies to investigate whether promoting opportunities for developmentally appropriate weekend, summer, and after-school extracurricular activities (eg, arts, crafts, athletics, community and family activities, music, and outdoor activities) may help to reduce risk for the development of attention and learning difficulties during the adolescent years.

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Author Contributions: Drs Johnson, Cohen, Kasen, and Brook had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Johnson, Kasen, and Brook. *Acquisition of data:* Johnson and Cohen. *Analysis and interpretation of data:* Johnson. *Drafting of the manuscript:* Johnson. *Critical revision of the manuscript for important intellectual content:* Johnson, Cohen, Kasen, and Brook. *Statistical analysis:* Johnson and Cohen. *Obtained funding:* Cohen and Brook. *Administrative, technical, and material support:* Cohen and Brook. **Financial Disclosure:** None reported.

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It is probable that such infectious diseases as small-pox, scarlet fever, diphtheria, and measles, each have for their cause a specific kind of minute organism, which, on gaining access to the parts affected, produces severe results. If the exact nature of each disease-producing organism were known—that is, just how it grows—what would kill it or prevent its spreading, we could better control the spreading of these diseases.

—From *Advanced Lessons in Human Physiology*, Indiana State Series by Oliver P. Jenkins, PhD, 1891