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Electronic Play, Study, Communication, and Adolescent Achievement, 2003 to 2008

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Abstract

Adolescents' time spent messaging, exploring websites, and studying on the computer increased between 2003 and 2008. Using data from the Panel Study of Income Dynamics Child Development Supplement, this study examines how such changes have influenced individual achievement and behavior from childhood to adolescence. Greater communications and Internet web time proved detrimental to vocabulary and reading whereas the increased use of computer games was associated with increased reading and problem-solving scores, particularly for girls and minority children. Increased use of the computer for studying was associated with increased test scores for girls but not boys. The consequences are more benign than many feared. Groups that have traditionally used the computer less (girls, minority children) appear to benefit from greater use.

Keywords

computer; email; Internet; video games; adolescents; achievement

The development of new technologies has transformed the way we live our lives; this transformation has been most notable for children and adolescents, who grow up in a world most adults could never have imagined two decades ago. For example, in 1997 researchers worried about the influence of television on children's lives, but television did not accompany children 24/7 as can today's media. In the late 1990s, Huston, Wright and others completed a comprehensive set of media studies that demonstrated the value of educational compared with entertainment television (Anderson, Huston, Schmitt, Linebarger & Wright, 2001). However, by 2003 video games had become an important part of children's lives and researchers began examining the impact on behavior of virtual play instead of physical play (Schmitt & Anderson, 2002). The advent of the home computer and high-speed Internet has changed the way families organize and operate, and the ways children study, interact, and play. Changes in media use between 2003 and 2008 and potential future changes have led both parents and experts to question the consequences.

Although there is substantial research on the implications of increased computer and video game play for children's behavior (Brown & Bobkowski, 2011), implications for children's cognitive achievement are less understood (Subrahmanyam, Greenfield, Kraut & Gross, 2001). The present research contributes to the literature on the effects of media on

achievement in two ways. First, in contrast to previous reports (Rideout, Foehr & Roberts, 2010), the present study uses newly released data from a large-scale nationally representative study that followed children and adolescents over time, recording their activities in a detailed time diary and assessing their achievement using standardized tests. Instead of comparing different children, we compare changes in each child's media use to changes in his or her achievement over the same period. Even though media use has increased over time, some children have increased their use at greater rates than others and we take advantage of these relative changes over the past five years to test whether electronic play, study, and communication influence achievement.

The objectives of this paper are:

1. To describe changes in use of the computer (for play, study, and communication), television, and video game devices among 10-18 year olds between 2003 and 2008.
2. To examine the association between changes in computer, video game use, and television viewing and changes in achievement for individual children by gender and race/ethnicity.

Background and Framework

Many early investigations of the impact of new media on achievement anticipated negative effects. Probably the most important concern was that new media might displace traditional learning-related activities such as the reading, studying, and nonscreen play that are essential to healthy development (Anderson et al., 2001). A second concern was that computer and video game use per se might not contribute to development because children learn through interaction with their physical environment; media could in some way detract from that direct interaction (Cordes & Miller, 2000). However, more recent research suggests that these concerns were too simplistic. Unlike television, the new media are interactive and engaging, perhaps leading to more learning. Game play, with its use of representational images and symbols, may link to scientific and problem-solving abilities; it has already been shown to increase spatial ability (Subrahmanyam & Greenfield, 2008). The ability to concentrate or to divide one's attention, a component of computer use and game playing, may improve cognitive abilities, perhaps through improved test taking. Communicating via e-mail and reading website information may be associated with improved vocabulary and reading skills (Subrahmanyam et al., 2001). Some research has linked home computer use to better grades and test scores (Durkin & Barber, 2002; Jackson et al., 2006) whereas other research has not (Hunley et al., 2005). The results to date are inconclusive.

Interaction between Media and Context

The influence of media is likely to depend on context. Depending on their motivation, interests, background, and environment, children will differ in their response to media. Therefore, it is important to take a more individualistic approach to examining the consequences of media use, including consideration of gender and racial/ethnic differences.

Gender—Although there are gender similarities in use of the computer for web sites and studying, boys play computer games and video games more frequently (Gross, 2004), whereas girls tend to be more active in communications (Jackson et al., 2006). Because girls lag so far behind in frequency of play, we expect a greater benefit from increased game playing for girls. Similarly, given their lag behind girls in e-mail use, we expect greater benefit from increased communications for boys. No previous research has examined the link between electronic communication and achievement.

Race/ethnicity—Except for video games, which are used equally by Blacks and Whites, electronic media are used more by Whites than Blacks or Latinos (Pew Internet and American Life Project, 2009; Roberts, Foehr, Rideout & Brodie, 1999). Black boys, in particular, are the lowest users of the Internet (Jackson et al., 2006), though they may be catching up (Rideout et al., 2010). One reason for the lag is lesser access to high speed home Internet services. In 2002, 10% of adults had access to broadband at home and, of those, 85% were White (Horrigan, 2008). By 2008, 48% of Whites, 40% of Blacks and 47% of English speaking Latinos had access to broadband at home. Although foreign-born Latinos lag behind the native born (Pew Hispanic Center, 2010), online use increased the fastest for Whites and Latinos. Because they still lag behind, we expect stronger positive effects of media use for Black and Latino than for White children.

Selectivity

Finally, our approach needs to acknowledge that the media do not necessarily influence child achievement. The association may be spurious if smarter children both use the computer for studying and score better on achievement tests. Instead of focusing on associations at one point in time, we examine change. An association between increased use of the computer over time and increased achievement is unlikely to be due to the intellectual capacity of the child, because that does not change over time the way technology does. Nor does greater achievement lead to more computer use at a later time point (Jackson et al., 2006). This paper uses a fixed effects methodology that compares the change in each child's achievement and behavior to change in media time between 2003 and 2008 (Allison, 2005). The intuition is that we are not comparing across individuals, but, rather, comparing each individual's change in achievement from 2003 to 2008 to their own change in media use over the period. Compared with cross-sectional analysis, the fixed effects approach provides a stronger test of causality.

Method

Data and Participants

This study utilizes a newly released wave of data from the nationally representative Panel Study of Income Dynamics Child Development Supplement. The PSID is a 42-year longitudinal survey of a representative sample of U.S. individuals and their families; it has been conducted annually at the University of Michigan from 1968 to 1997, and biannually thereafter (Panel Study of Income Dynamics, 2011). In 1997, the PSID inaugurated the first Child Development Supplement (CDS I), which was administered to the parents of children aged 0-12 and up to two children. The first wave of the CDS included 3,563 children from 2,380 families, with a response rate of 88%. These same families were recontacted at approximately 5-year intervals. In the second wave (CDS II), conducted in 2002 and 2003, 2,907 out of 3,191 eligible children and adolescents aged 5-18 (living at home/did not complete high school) completed interviews; this represented a response rate of 91%. In the third wave (CDS III), conducted in 2007 and 2008, 1,506 out of 1,676 eligible children 10-18 participated (a 90% response rate). When weights are applied, these data are representative of the U.S. population.

Each wave in which the Child Development Supplement was administered, the study also collected diaries of children's activity types, durations, and locations. Of the 2,907 children who participated in CDS II, 2,566 children had complete time diaries. Diaries were completed for 1,441 children in CDS III. Because there were no children under 10 in CDS III, we excluded children under 10 in CDS II. In addition, only children who were the biological, step, or adopted son or daughter of the head of household were included. After

these restrictions were applied, the sample size was 1,620 (63%) children from CDS II and 1,366 (95%) children from CDS III.

For our outcome analysis, children who were interviewed in CDS II and who were interviewed as adolescents in CDS III (N=1,441) were tracked. Only two time points were included because most children old enough to have used media in CDS I were adults by CDS III. Because the data collections were conducted at five year intervals, the youngest children in this longitudinal sample were 5 to 13 in CDS II and 10 to 18 years of age in CDS III. After selecting only biological, step, or adopted children of the head of household, 1,221 children remained in the sample for this longitudinal study.

Cognitive Achievement

Children's cognitive achievement was measured using three subsets of the Woodcock-Johnson Revised Test: letter-word identification, a test of children's ability to identify and respond to letters and words; passage comprehension, a test that measures reading comprehension skills; and applied problems, a test of skill in analyzing and solving practical numerical problems (Woodcock & Mather, 1989). These tests were standardized with a mean of 100 and a standard deviation of 15. Cognitive achievement was measured by trained interviewers in homes in which the survey was conducted; this study included only those children who had a test score in both waves. The sample sizes were 1,095 children for the letter-word test, 1,071 for passage comprehension, and 1,091 for applied problems. Families who were located far from an interviewer (primarily rural) were interviewed by phone and tests were not administered. Differences among those who took and did not take the test were small; the families interviewed by phone were slightly more likely to be White.

Media Variables

The time diary was completed by the parents of young children, or by the parents and child together in the case of older children and adolescents, as a 24-hour record of children's primary activities, the start and end-times for these activities, the people who accompanied the child, and the location of the activities. Because they are obtained within context and bounded, diaries provide more valid estimates of time expenditures than do questions that ask respondents simply to estimate the time spent in activities (Hofferth, 2006). Considering possible uses of the computer for children aged 6-18, four common computer-related activities – playing games, recreational website visits, on-line communication, and academic tasks – were drawn from a set of home computer-related activities for this study. Excluded were shopping, financial services and working time, since few children engaged in them prior to adolescence. Handheld electronic video games such as Nintendo, Sony, Game Boy, and Sega, were coded separately from computer games because of differential access to these two platforms. Time spent watching television was also included as a related use of media. In sum, the following six media-related activities, tracked across waves, were used for trend analysis and fixed effects models: game play, web site visits, email or instant messaging (IM), and study using the computer; video game play on a hand-held device or console; and television viewing. To calculate total weekly time spent using each form of media (in hours), the total weekday time multiplied by 5, along with the total weekend time multiplied by 2, were added together. This improves cross-study comparison.

Control Variables

The individual factors of gender, age, and race/ethnicity (nonLatino White, nonLatino Black, and Latino) were used to examine group differences. Changes in family characteristics over the period were treated as control variables that might influence the child's behavior problems and achievement test scores. For example, children with more family resources may be more likely to use a computer and have higher test scores. The

previous year's total family income was collected by the PSID in both waves. The number of children in the family unit, including the target child, was also obtained each wave. The average change represents a loss/gain in the number of children. A dummy variable for family type was created using number of parents (two versus one) so the difference indicates change in family type over the period. Because few mothers completed additional education over the period, maternal education change was not included. Change in age, averaging 5 years, was included to adjust for variation in the period between interviews. Age in 2003 adjusts for cohort differences.

Procedure

We first present levels of electronic media use among children 10-18 in 2003 and 2008, among age, gender, and racial/ethnic groups. Second, we separately regress changes in the Woodcock Johnson Subtests of Basic Achievement (letter-word, passage comprehension, and applied problems) on changes in time spent on the web, using email, playing computer games, studying, playing video games, and watching television, controlling for change in age, family income, number of children, number of parents, and age of child in 2003. In these models characteristics that do not change over time, such as race/ethnicity and gender, are not included. The final analysis separately reports fixed effects for six racial/ethnic and gender subgroups.

Results

Descriptive Analysis of Changes in Media Use over Time

Table 1, last column, shows the overall percentage participating in weekly media activities in 2003 and 2008. Over the period, the percentage of children who used the computer for websites increased 25%, the percentage using the computer for email doubled, and the percentage using the computer for study increased three-fold. In contrast, playing video games increased only slightly and computer game playing did not change.

Age—All age groups experienced increased computer use for websites and email and increased computer use for studying, although the percentage increases in use were generally larger for younger children. There was a slight but significant reduction in the percentage who watched some television, mainly among the 13-15 year olds. Finally, gaming and television viewing peaked at ages 10-12 whereas the use of the computer for websites, email, and studying was higher at older ages. The electronic revolution affected children of all ages, but the largest changes were experienced by younger children.

Gender—Table 2 shows participation and hours participating in 2003 and 2008, by gender. In 2003, girls were more likely than boys to send messages and surf websites and boys were more likely than girls to play computer or video games. There was no difference in computer use for studying in either year. Between 2003 and 2008 gender differences in surfing websites declined to nonsignificance, whereas video and computer game play remained significantly different. Finally, boys and girls watched television at equally high levels. The results for time spent are similar to the results for the percentage using the form of media because time reflects both the proportion doing the activity and the amount of time spent in it.

Racial and Ethnic Differences—In 2003 Black and Latino children were less likely than White children to use the computer for websites, email, or to play computer games. Black children were *more* likely than White children to play video games, a clear reflection of the former's lesser access to computers and greater access to hand-held game platforms. There were no racial/ethnic differences in studying with the computer; few did so. Although

minorities increased their use of computers for websites, email, and studying from 2003 to 2008 and video game use declined, large difference between Blacks and Whites remained. In 2008, time spent in computer use for websites was very similar for White and Black children, but time spent using the computer for email, time spent playing computer games, and time spent studying on the computer remained lower for Blacks than Whites (Table 3). Video game time had been higher for Blacks in 2003, but was similar for White and Black children in 2008. Television viewing declined for both Whites and Blacks but remained higher for the latter in 2008.

Latino children spent less time than Whites in most forms of media except for television viewing. For example, in 2008 they spent less time than White children using the computer for websites and for studying. However, they had caught up to Whites in the use of the computer for email and computer game play. Latino children also spent less time than White children playing video games. The television viewing time of Latino and White children was similar.

Fixed Effects Regressions for Changes in Media Use over Time: Means

In Table 4 we show the means and standard deviations for the variables in the fixed effects models for the full sample and for subgroups of White boys, White girls, Black boys, Black girls, Latino boys, and Latino girls. Except for age in 2003, these variables represent changes in individual scores and characteristics between 2003 and 2008. For example, the average child was 9 years old in 2003 (age in 2003) and 5 years older in 2008 (age). The average change on the achievement tests was negative, indicating a decline in achievement. The largest decline (8 points) was in passage comprehension; the decline was greater for Black and Latino boys and girls than for White boys and girls. Except for television, the use of media increased over the period; additionally, video game play time declined for Black girls. Family income generally increased, with larger income increases for White than Black children. The number of children declined, which can be explained by older children reaching age 18 and leaving home. There was also a decline in the number of parents, presumably resulting from separation and divorce.

Fixed Effects Regressions for Changes in Media Use over Time: Achievement

Computer game play—We found one consistently positive set of associations of computer time with achievement. For all children, increased time spent in computer game play was associated with increased achievement on two tests: passage comprehension and applied problems ($b = .31, p < .01$; $b = .35, p < .001$, respectively, not shown). These results held for White girls ($b = .86, p < .001$; $b = .57, p < .01$), for Black boys ($b = .70, p < .05$) and marginally for Black girls ($b = .61, p < .10$), but not for White boys or Latino boys and girls (Table 5). For girls as a group, the results were also statistically significant on both tests (passage comprehension, $b = .63, p < .001$; applied problems, $b = .57, p < .001$; not shown).

Computer use for studying—Increased computer study time was positively associated with increased passage comprehension test scores for White girls but the coefficient, though large, was only marginally statistically significant ($b = .41, p < .10$) (Table 5). After pooling across all girls, computer use for study was significantly associated with the letter-word test score and marginally with the passage comprehension test score for all girls ($b = .35, p < .05$; $b = .30, p < .10$; not shown). There were no significant associations for boys.

Computer use for websites—Greater time spent surfing web sites with the computer was associated with reduced letter-word test scores over all children ($b = -.27, p < .05$, not shown). Even though coefficients were not statistically significant for subgroups, the

coefficients were large. Again, pooling indicated that its association with the letter-word test score was significant for girls ($b = -.40$, $p < .05$, not shown).

Computer use for email—Email using the computer had both positive and negative associations with achievement. Over all children there was no significant association; however, some subgroups showed significant effects. Greater email time was associated with reduced vocabulary scores for White boys ($b = -.47$, $p < .05$). It was associated with marginally increased vocabulary scores ($b = .64$, $p < .10$) but reduced applied problems scores for Latino girls ($b = -.44$, $p < .10$)(Table 5). Greater email time did not have a significant effect for White girls, for Black boys and girls, or for Latino boys.

Video game play—Increased time spent playing video games was associated with significantly reduced passage comprehension test scores for Black girls ($b = -.44$, $p < .001$) and Black boys ($b = -.16$, $p < .05$)(Table 5). In contrast, it was associated with marginally increased passage comprehension scores for Latino boys ($b = .45$, $p < .10$).

Television—Although there were no significant effects for Whites or Blacks, increased TV viewing was associated with a marginally significant reduction in the applied problems score for Latino girls ($b = -.26$, $p < .10$)(Table 5).

Summary and Conclusion

Between 2003 and 2008 use of the computer for email and studying increased. The use of the computer to find websites increased at the youngest age level (10-12), reflecting the increased spread of access to the Internet across the youngest populations. There was no increase in computer game-playing and video game playing increased only slightly, suggesting that game playing may have peaked. Even though television use had remained stable between 1997 and 2003 (Hofferth, 2010), it declined between 2003 and 2008, reflecting expanded access to a variety of new media.

Substantial gender, racial, and ethnic differences in media use remained in 2008. The most important gender differences were that boys spent more time playing video and computer games and girls spent more time on computer communications such as email and IM. The racial and ethnic digital divide was still very much present. On every indicator of computer use except web surfing, Black children spent less time than White children. These differences likely reflect differences in preferences, because Blacks did not differ from Whites in computer web use or video game use. Reflecting lesser access to both broadband and computers, Latino children spent less time than White children in computer use such as surfing the web and email (boys). They also spent less time studying on the computer and less time playing games.

The fixed effects results showed the most consistent and positive association of increased computer game playing with achievement. Greater use of the computer for playing games was associated with increased scores on the passage comprehension and applied problems tests for all children. When broken down by race and gender, this turned out to be because of its positive association for Black boys, Black girls, and White girls.

Increased computer use for websites was associated with reduced vocabulary achievement, an association that applied to all children. Surfing the web may prove to be a time waster without much learning opportunity, displacing other activities; unfocused web activity does not appear to have positive learning outcomes. It also appears that web use loses its attraction over time. Between 2003 and 2008, web surfing increased for younger children

but not for older children. Intervention studies have found that effects of installing a computer decline within a year (Subrahmanyam et al., 2001); our results are consistent.

The expectation that increased email and IM would lead to greater verbal achievement was not supported. Increased Internet use for email was associated with a lowered letter-word score for White boys, though not for other groups. Greater email and IM not only do not increase vocabulary, they may lower it.

For White girls (and for all girls) there was a marginally significant association between increased time spent using the computer for studying and increased passage comprehension scores and there was a significant association with the letter-word test score for all girls. In contrast, this study found no overall association between increased computer studying and increased achievement test scores for boys. More research to substantiate and better explain the links with vocabulary and reading for girls but not boys is needed.

Greater video game play was not consistently associated with achievement. In the fixed effects models, for all girls and for Black girls, in particular, increased video game play was associated with lower achievement on the passage comprehension test. For Latino boys it was associated with a marginally significant increased score on the passage comprehension test. Except for Latino boys, video game play does not support academic achievement.

Consistent with expectations, the achievement of minority children improved more than that of White boys with increased computer use. Similarly, White girls' achievement was impacted more by changes in computer use than that of White boys. Even though they indicated similar computer use for studying and web sites, girls may not feel as comfortable as White boys. One infrequent activity for girls, computer game play, appeared to be beneficial.

Conclusion

The overall conclusion from this study is that the new media are not harmful to children. Only a few associations were negative and these were small. The results were mostly positive. Surprisingly, it was not computer study but computer game play that was consistently associated with increased achievement. Overall, the results also showed more benefits for girls than for boys. As girls' use approaches boys, we would expect benefits to diminish.

Finally, the digital divide remains. Minority boys and girls benefitted from the use of computers, probably because their overall exposure to computers has been lower. As more resource-rich children become proficient in the use of computers and cell phones, less resource-rich children will have to spend increased time on the computer in order to catch up to their peers. To the extent that large differences across racial and ethnic groups of children in access to computers remain, the racial and ethnic divide in achievement will continue.

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Table 1

Percentage of Children 10-18 Participating in Media Activities, 2003 vs. 2008, by Age

Activities	Age 10-12		Age 13-15		Age 16-18		All ages	
	2003	2008	2003	2008	2003	2008	2003	2008
<i>N</i>	568	398	522	559	499	394	1589	1351
Computer use for websites	13%	22% ***	21%	26% *	28%	29%	20%	26%
Computer use for email	6%	20% ***	18%	36% ***	22%	40% ***	15%	33%
Computer use for studying	5%	10% **	5%	18% ***	7%	20% ***	5%	16%
Computer game play	23%	24%	19%	18%	14%	12%	19%	18%
Video game play	39%	44%	35%	42% *	25%	27%	34%	38%
Television	97%	97%	94%	90% *	92%	91%	95%	92%

 $p < .001$,**
 $p < .01$,*
 $p < .05$,+
 $p < .10$ two-tailed *t* test

Table 2

Percentage Participating and Mean Hours in Media Activities, by Gender and Year

	2003				2008			
	Boys		Girls		Boys		Girls	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Percentage Participating:								
Computer use for websites	15%	0.35	26%	0.44 ^{***}	26%	0.43	26%	0.44
Computer use for email	11%	0.31	19%	0.40 ^{***}	28%	0.45	38%	0.49 ^{***}
Computer use for studying	5%	0.22	6%	0.23	15%	0.36	18%	0.39
Computer game play	21%	0.40	17%	0.38 ⁺	22%	0.41	14%	0.34 ^{***}
Video game play	55%	0.49	13%	0.34 ^{***}	56%	0.49	19%	0.39 ^{***}
Television	95%	0.22	94%	0.24	92%	0.27	93%	0.26
Weekly Hours:								
Computer use for websites	0.74	2.34	1.34	3.81 ^{***}	1.13	3.11	0.98	2.74
Computer use for email	0.88	3.76	1.01	3.44	1.63	4.01	2.06	4.08 ⁺
Computer use for studying	0.19	0.93	0.28	1.47	1.06	3.91	1.11	3.38
Computer game play	1.61	4.65	0.87	3.03 ^{***}	1.86	5.47	0.71	2.65 ^{***}
Video game play	4.63	7.08	0.82	2.95 ^{***}	5.00	7.62	0.94	2.67 ^{***}
Television	15.89	12.18	14.58	10.97 [*]	14.08	11.26	12.10	10.49 ^{***}
N	782		807		690		661	

Note: Data are weighted.

 $p < .001$,**
 $p < .01$,*
 $p < .05$,+
 $p < .10$ two-tailed *t* test

Table 3
Percentage Participating and Mean Hours in Media Activities, by Race/Ethnicity and Year

	2003						2008						Black vs. White			Latino vs. White								
	White			Black			Latino			White			Black			Latino			2003			2008		
	Mean	SD		Mean	SD		Mean	SD		Mean	SD		Mean	SD		Mean	SD		2003	SD		2008	SD	
Percentage Participating:																								
Computer use for websites	23%	0.48		12%	0.20		13%	0.45		28%	0.51		22%	0.25		19%	0.53		***			*		*
Computer use for email	20%	0.46		2%	0.10		8%	0.37		36%	0.55		23%	0.25		22%	0.56		***			***		**
Computer use for studying	6%	0.27		4%	0.12		4%	0.27		17%	0.43		9%	0.17		11%	0.42					***		+
Computer game play	22%	0.47		12%	0.21		14%	0.46		20%	0.46		9%	0.17		15%	0.47		***			***		*
Video game play	31%	0.53		49%	0.32		33%	0.64		39%	0.56		36%	0.28		39%	0.65		***			***		
Television	93%	0.29		97%	0.11		98%	0.18		92%	0.31		91%	0.17		96%	0.27		**			**		
Weekly Hours:																								
Computer use for websites	1.30	4.23		0.55	1.35		0.31	1.31		1.11	3.50		1.38	2.16		0.51	1.99		***			***		**
Computer use for email	1.34	5.03		0.07	0.41		0.30	1.51		1.96	4.62		1.37	2.15		1.54	5.71		***			**		**
Computer use for studying	0.24	1.45		0.18	0.72		0.20	1.39		1.13	4.35		0.61	1.39		0.50	2.16					**		**
Computer game play	1.41	4.55		0.40	0.92		0.77	3.79		1.36	5.17		0.46	1.07		1.12	4.61		***			***		*
Video game play	2.68	6.61		3.68	4.40		1.88	5.71		3.19	7.38		3.47	4.03		2.27	4.98		**			**		*
Television	14.47	13.55		18.41	6.91		15.27	12.42		12.75	12.31		14.35	6.45		14.00	15.82		***			*		
N	772			626			111			667			509			113								

Note: Data are weighted.

 $p < .001$,

**
 $p < .01$,

*
 $p < .05$,

+
 $p < .10$ two-tailed t test

Table 4

Means and Standard Deviations of All Variables in Fixed Effects Models

Variables	Total		White Boys		White Girls		Black Boys		Black Girls		Latino Boys		Latino Girls	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Difference in test scores between 2008 and 2003														
Letter-word	-3.36	12.74	-1.97	14.42	-2.82	13.60	-5.94	6.33	-6.57	5.90	-3.66	15.63	-7.93	20.06
Passage comprehension	-7.84	12.85	-6.41	14.31	-7.25	14.94	-10.85	8.01	-11.02	6.32	-7.59	15.36	-9.13	16.04
Applied problems	-0.67	13.20	-0.45	15.67	-0.74	15.59	-0.94	6.83	-1.24	6.24	1.84	16.96	-3.84	14.35
Difference in hours between 2008 and 2003														
Computer use for websites	0.80	3.45	0.93	4.45	0.65	3.93	1.39	2.59	1.33	2.33	0.73	2.50	0.33	1.94
Computer use for email	1.65	4.07	1.66	4.85	1.65	4.27	0.72	1.79	2.20	2.67	0.77	2.67	3.10	8.01
Computer use for studying	1.03	3.82	0.95	5.01	1.11	4.04	0.75	1.70	0.45	1.13	0.36	1.62	0.65	2.26
Computer game play	0.22	3.96	0.40	5.36	-0.25	4.20	0.00	1.78	-0.33	1.16	1.30	5.15	1.00	4.50
Video game play	0.51	7.10	1.70	10.45	0.02	4.22	-0.20	6.18	-1.06	4.17	0.96	8.21	0.36	3.74
Television	-0.72	13.91	0.39	16.21	-0.41	15.22	-4.67	8.07	-1.69	7.74	-0.27	21.46	-5.39	17.04
Difference in background between 2008 and 2003														
Child age	4.93	0.38	4.95	0.41	4.90	0.44	4.96	0.23	4.90	0.22	4.99	0.34	4.98	0.44
Family income	14,167	58,665	19,261	77,792	11,896	79,039	8,163	17,141	9,961	19,359	11,692	28,940	12,011	51,460
Number of children	-0.20	1.00	-0.24	1.02	-0.17	1.03	-0.10	0.75	-0.37	0.68	-0.26	1.45	-0.11	1.76
Number of parents	-0.03	0.34	-0.04	0.39	-0.06	0.35	-0.01	0.31	-0.05	0.23	-0.02	0.28	0.07	0.45
Child age in 2003	9.25	2.15	9.25	2.39	9.02	2.49	9.92	1.32	9.53	1.18	8.92	2.75	9.04	2.71
<i>N</i>	1221		285		285		217		201		50		48	

Note: Data are weighted

Table 5

Fixed Effects Coefficients of Changes in Child Test Scores Regressed on Changes in Weekly Media Use Between 2003 and 2008^a

Variable	Letter-word	Passage Comprehension	Applied Problems
White Boys			
Computer use for websites	-0.29	0.05	-0.03
Computer use for email	-0.47 *	-0.19	-0.06
Computer use for studying	0.09	-0.18	0.21
Computer game play	-0.01	-0.12	0.09
Video game play	0.02	0.02	0.03
Television	0.04	-0.03	0.00
<i>N</i>	269	264	268
White Girls			
Computer use for websites	-0.48	-0.05	0.49
Computer use for email	-0.17	0.01	-0.19
Computer use for studying	0.33	0.41 +	-0.02
Computer game play	0.31	0.86 ***	0.57 **
Video game play	0.04	0.12	0.18
Television	0.10	-0.06	-0.03
<i>N</i>	262	257	262
Black Boys			
Computer use for websites	-0.08	0.05	0.08
Computer use for email	0.07	0.17	-0.11
Computer use for studying	-0.33	-0.22	0.22
Computer game play	0.45	0.38	0.70 *
Video game play	-0.12	-0.16 *	0.06
Television	-0.01	0.00	0.04
<i>N</i>	202	197	202
Black Girls			
Computer use for websites	-0.39	-0.16	-0.08
Computer use for email	0.09	-0.07	0.09
Computer use for studying	0.04	0.10	-0.17
Computer game play	0.18	0.61 +	0.27
Video game play	0.14	-0.44 ***	-0.06
Television	-0.05	-0.10 +	-0.01
<i>N</i>	183	180	182
Latino Boys			
Computer use for websites	1.41	1.11	0.78
Computer use for email	-0.49	-1.88	-1.08
Computer use for studying	0.78	4.52	4.64
Computer game play	-0.16	0.35	0.30

Variable	Letter-word	Passage Comprehension	Applied Problems
Video game play	0.04	0.45 ⁺	-0.29
Television	0.01	0.22 ⁺	-0.19
<i>N</i>	46	46	45
Latino Girls			
Computer use for websites	-0.75	-0.21	0.47
Computer use for email	0.64 ⁺	-0.40	-0.44 ⁺
Computer use for studying	1.16	1.36	-1.61
Computer game play	-0.42	-0.22	0.62
Video game play	-0.35	-0.54	-1.12
Television	0.26	0.03	-0.26 ⁺
<i>N</i>	44	43	44

^aControls for child age in 2003, and change in age, number of children, household income and number of parents.

 $p < .001$,

**
 $p < .01$,

*
 $p < .05$,

⁺
 $p < .10$ two-tailed test