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Television and Video Game Exposure and the Development of Attention Problems



WHAT'S KNOWN ON THIS SUBJECT: Television exposure is associated with attention problems in children.



WHAT THIS STUDY ADDS: The association of video games and attention problems is similar to the association of television and attention problems. These associations appear in middle childhood and late adolescence/early adulthood.

abstract

FREE

OBJECTIVES: Television viewing has been associated with greater subsequent attention problems in children. Few studies have examined the possibility of a similar association between video games and attention problems, and none of these has used a longitudinal design.

METHODS: A sample of 1323 middle childhood participants were assessed during a 13-month period by parent- and child-reported television and video game exposure as well as teacher-reported attention problems. Another sample of 210 late adolescent/early adult participants provided self-reports of television exposure, video game exposure, and attention problems.

RESULTS: Exposure to television and video games was associated with greater attention problems. The association of television and video games to attention problems in the middle childhood sample remained significant when earlier attention problems and gender were statistically controlled. The associations of screen media and attention problems were similar across media type (television or video games) and age (middle childhood or late adolescent/early adult).

CONCLUSIONS: Viewing television and playing video games each are associated with increased subsequent attention problems in childhood. It seems that a similar association among television, video games, and attention problems exists in late adolescence and early adulthood. Research on potential risk factors for attention problems should be expanded to include video games in addition to television.

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KEY WORDS

attention deficit, television, video games

ABBREVIATIONS

ADHD—attention-deficit/hyperactivity disorder

ASRS—Adult ADHD Self-Report Scale

BSCS—Brief Self-Control Scale

BIS-11—Barratt Impulsiveness Scale 11

OR—odds ratio

CI—confidence interval

AAP—American Academy of Pediatrics

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Attention problems, often manifested in the form of attention-deficit/hyperactivity disorder (ADHD), are associated with negative outcomes for children and adolescents, including poorer school performance and increased aggression.^{1,2} Research has examined exposure to television and video games in childhood and adolescence as a potential risk factor for subsequent attention problems.^{3–18} It has been hypothesized that most television shows are so exciting that children who frequently watch television have more difficulty paying attention to less exciting tasks (eg, school work).³ Others have hypothesized that because most television programs involve rapid changes in focus, frequent exposure to television may harm children's abilities to sustain focus on tasks that are not inherently attention-grabbing.¹⁴

Most research on media and attention has looked exclusively at television, yet there are conceptual reasons to suspect that video games could show a similar pattern. Many video games seem to share many features (eg, high excitement, rapid changes in focus) that have been identified as potentially relevant to the television association with attention problems, making a similar association between video game playing and attention problems plausible. Most cross-sectional studies (single time point) have found television exposure to be associated with greater attention problems.^{4–7} Longitudinal studies of television viewing have generally found a similar link, providing evidence that television viewing is a risk factor for subsequent attention problems^{3,8–11}; however, a few studies have not found a statistically significant association (single time point or longitudinal) between television viewing and attention problems.^{12–14} Fewer studies to date have examined the possibility that video games can produce a

similar increase in attention problems. Some single time point studies found an association between video game playing and attention problems and/or ADHD diagnoses.^{10,17,18} Other studies associated violent television and/or video game playing with poorer executive functioning and proactive cognitive control, which may be related to attention problems.^{19,20} More research is clearly needed to examine the effects of video game playing on attention problems, particularly by using longitudinal designs.*

Although some research has indicated that television increases attention problems only among children in the first 3 years of life,^{3,11} others have not found evidence for this early childhood vulnerability.¹⁰ Some other studies have found prospective effects of television exposure on attention problems in adolescent samples, providing additional evidence that television viewing may increase attention problems beyond early childhood.^{8,9} Given these differing findings, more longitudinal research is necessary to provide a more complete picture of the ages at which screen media can influence attention problems. Furthermore, only 1 published study has examined television exposure in relation to attention problems beyond age 16.⁹ More research with samples of late adolescents and adults would be valuable in establishing the persistence of the association of television exposure and attention problems into late adolescence and early adulthood. These studies addressed 3 questions: (1) Are both television and video game exposures associated with greater concurrent attention problems? (2) Are television

*Other studies have identified improvements in visual attention after repeated video game playing^{21–24}; however, it should be noted that these improvements in visual attention consist of the rapid and accurate extraction and processing of information from the visual field, abilities quite distinct from the attention problems that are associated with disorders such as ADHD.

TABLE 1 Sample Characteristics

| Characteristic | Sample | |
|---|-------------------|----------------------------------|
| | Middle Childhood | Late Adolescence/Early Adulthood |
| Age range, y | 6–12 ^a | 18–32 ^b |
| Sample size | 1323 | 210 |
| Female gender, % | 53 | 60 |
| Study design | Longitudinal | Single time point |
| Time lag between first and last assessments, mo | 13 | NA |

NA indicates not applicable.

^a Age is reported as measured at the first wave of data collection. A total of 98.8% of this sample was between 8 and 11 years at this time. Analysis that excluded those who were younger than 8 or older than 11 did not differ meaningfully from analysis that used the full sample; therefore, participants of all ages were included in the reported analyses.

^b A total of 96.2% of this sample was between 18 and 24 years at the time of assessment. Excluding those who were older than 24 years did not meaningfully change the results of the analyses; therefore, participants of all ages were included in the reported analyses.

and video game use associated with changes in attention problems over time in middle childhood? (3) Are associations of television and video game exposures with attention problems different in middle childhood compared with late adolescence/early adulthood?

METHODS

Participants

This research includes 2 samples of males and females: 1 sample from middle childhood and another sample from late adolescence/early adulthood. Table 1 displays sample sizes, gender composition, and age ranges for these 2 samples. The middle childhood sample was recruited from 10 schools in 2 Midwestern US states. The data for this sample were collected as part of the SWITCH obesity prevention project.²⁵ This intervention had 3 major goals: reducing screen media exposure, increasing physical activity, and increasing fruit and vegetable consumption. These children were third-grade (430), fourth-grade (446), and fifth-grade (423) students at the initial

assessment (mean age: 9.6 years). Reports were collected from children, parents, and teachers at 4 points during a 13-month period (only 3 time points include all measures).† The 13-month follow-up rates for children, parents, and teachers were 86%, 70%, and 88%, respectively.

The late adolescent/early adult sample consisted of undergraduate students from a large public research university in the Midwestern United States (mean age: 19.8 years). This sample was assessed in a single laboratory session. These participants were recruited from introductory psychology courses and received partial course credit for their participation. All ethical procedures of the American Psychological Association were followed, and local institutional review board approval was obtained.

Television and Video Game Exposure

Both samples completed similar measures of television viewing and video game playing.²⁶ Television exposure was based on the average time spent on weekdays during 4 time periods (6 AM to 12 PM, 12 PM to 6 PM, 6 PM to 12 AM, and 12 AM to 6 AM) and separately on weekends during those same 4 time periods. These questions were then repeated for video game exposure. In the middle childhood sample, both parents and children completed these questions regarding the child's weekly television and video game exposure.‡

†Correlational analyses for this sample are based on a weighted average of the 3 time points containing relevant data. Only the baseline and final assessment are used in longitudinal analyses. The concurrent and time-lagged associations of television, video games, and attention problems were not meaningfully different between the intervention and control groups, so data that are based on the full sample are used in all reported analyses.

‡There was no a priori reason to consider 1 reporter more accurate (children may have difficulty estimating or bias their responses, but parents may be unaware of their child's behavior or similarly bias their responses), so an average weekly

For the late adolescent/early adult sample, only self-reports of television and video game exposure were completed.

Attention Problems

Attention problems were assessed in the childhood sample by teacher report. Teachers answered 3 items that measured attention problems in the classroom on a 5-point scale, with responses ranging from "never true" to "almost always true" (eg, "This child: has difficulty staying on task; has difficulty paying attention; often interrupts other children's work."). These items showed good internal reliability ($\alpha = .91$ at time 1 and $.92$ at time 4). Attention problems were assessed in the late adolescent/early adult sample by using a composite of 3 self-report measures: the Adult ADHD Self-Report Scale (ASRS; 18 items), the Brief Self-Control Scale (BSCS; 13 items), and the Barratt Impulsiveness Scale (BIS-11; 30 items).²⁷⁻²⁹ The ASRS, BSCS, and BIS-11 all showed good internal reliability coefficients ($\alpha = .89, .85,$ and $.84,$ respectively) in this sample. Missing values on these scales were replaced with mean response for the item for participants who were missing no more than 20% of the items on the scale. The ASRS is intended as a screening tool for ADHD, showing convergent validity with clinical ADHD diagnosis, suggesting a clear conceptual link to attention problems.²⁶ Decreased ability to exert self-control and a tendency to behave in more impulsive ways are viewed by some researchers as a central impairment in ADHD,³⁰ suggesting the potential usefulness of measures of trait self-control (BSCS) and impulsiveness (BIS-11) in identifying those with attention problems. In this sample, the

amount was calculated by averaging the parent and child reports. Very similar results for the key analyses were obtained with only parent or only child reports of television/video game exposure.

ASRS, BSCS, and BIS-11 were highly correlated with each other (absolute values of r from 0.65 to 0.75), and all were moderately correlated with self-reports of a past diagnosis with an attention disorder, such as attention-deficit disorder or ADHD (absolute values of r from 0.23 to 0.36). Each scale total was converted to a standard score, and these scores were averaged (with self-control reversed) to form a measure of attention problems.

RESULTS

To examine the strength of the overall association between various types of media exposure and concurrent attention problems, we computed correlation coefficients among weekly television exposure, weekly video game exposure, weekly total screen media exposure (ie, combined weekly television and video game exposure), and attention problems within the middle childhood and late adolescent/early adult samples. Table 2 reports these correlation coefficients and corresponding odds ratios (ORs).³¹ Television exposure and video game exposure showed small to moderate correlations with concurrent attention problems in both samples (r between 0.17 and 0.23), with substantially overlapping confidence intervals (CIs) across samples and type of screen media.

Because the data from these samples (particularly the middle childhood sample) are potentially relevant to the American Academy of Pediatrics (AAP) recommendation that children spend no more than 2 hours per day with television and video games combined, we computed logistic regressions comparing the risk for being above the me-

§These ORs correspond to a median split of the media and attention variables. In other words, these ORs reflect the odds that a child or an adolescent/adult above the median in a particular type of media exposure would also be above the median in attention problems.

TABLE 2 Amount of Media Exposure Associations With Concurrent Attention Problems

| Parameter | Mean Daily Exposure | Median Daily Exposure | Correlation Coefficient, <i>r</i> | 95% CI | OR | 95% CI |
|------------------------------------|---------------------|-----------------------|-----------------------------------|-----------|------|-----------|
| Middle childhood sample | | | | | | |
| Television exposure | 2.92 | 2.29 | 0.17 | 0.11–0.23 | 1.55 | 1.33–1.79 |
| Video game exposure | 1.34 | 0.66 | 0.23 | 0.18–0.29 | 1.82 | 1.57–2.11 |
| Total screen media exposure | 4.26 | 3.86 | 0.23 | 0.17–0.29 | 1.81 | 1.56–2.11 |
| Late adolescent/early adult sample | | | | | | |
| Television exposure | 3.75 | 3.29 | 0.20 | 0.07–0.33 | 1.68 | 1.19–2.37 |
| Video game exposure | 1.07 | 0.29 | 0.23 | 0.10–0.36 | 1.82 | 1.29–2.56 |
| Total screen media exposure | 4.82 | 4.36 | 0.27 | 0.14–0.40 | 2.04 | 1.45–2.88 |

Correlation coefficients are based on analysis of continuous variables; ORs are based on a median splits of media and attention variables. Means and medians of daily exposure are included to provide context.

dian in attention problems for participants above and below the AAP-recommended television and video game levels.^{32,33} Those who exceeded the AAP-recommended amount of daily television and video game exposure were more likely to be above average in attention problems (ORs: 1.67 [95% CI: 1.27–2.21] and 2.23 [95% CI: 1.13–4.39]) for the middle childhood and late adolescent/early adult samples, respectively.||

General linear models were computed to examine the longitudinal associations of television and video game exposure with attention problems in the middle childhood sample (Table 3) and to control statistically for gender and grade level in both samples (Tables 3 and 4).¶ These general linear models

||Similar estimates can be obtained for the risk for being above the 95th percentile in attention problems (which should more closely match the prevalence of ADHD in these populations) on the basis of being above or below the AAP-recommended amount of screen media exposure (ORs: 2.05 and 2.92 for the middle childhood and late adolescent/early adult samples, respectively). Given the relatively small numbers of those with such high levels of attention problems in these samples, the power for this analysis is considerably reduced, giving these estimates much wider 95% CIs (1.00 to 4.25 and 0.36 to 23.44 for the middle childhood and late adolescent samples, respectively).

¶We also tested the possibility that the effect of additional screen time on later attention problems occurs only for those whose screen time is relatively high, by including a quadratic term in preliminary screen time analyses. There was no evidence of a curvilinear effect of screen time, so the quadratic terms were dropped in all reported analyses.

and all other subsequent analyses are based on continuous predictor and outcome variables. Such models provide more sensitive tests of the hypotheses than the logistic models, because they use information in the data that dichotomous logistic analyses ignore.

Models 1 through 4 (Table 3) examined the middle childhood participants' teacher-reported attention problems at time 4, including gender, grade, and teacher-reported attention problems at time 1 as covariates to provide more rigorous tests. Across models 1

TABLE 3 General Linear Models Predicting Attention Problems in Middle Childhood

| Parameter | Test Statistic | <i>P</i> | β | SE |
|-----------------------------|-----------------------|----------|---------|-------|
| Model 1 | | | | |
| Attention problems (wave 4) | $F_{4,1012} = 116.90$ | .000 | | |
| Total screen media exposure | $t_{1012} = 2.72$ | .007 | .083 | 0.031 |
| Attention problems (wave 1) | $t_{1012} = 18.89$ | .000 | .520 | 0.028 |
| Grade | $t_{1012} = -2.85$ | .004 | -.073 | 0.026 |
| Gender | $t_{1012} = 3.07$ | .002 | .083 | 0.027 |
| Model 2 | | | | |
| Attention problems (wave 4) | $F_{4,1014} = 116.33$ | .000 | | |
| Television exposure | $t_{1014} = 1.95$ | .051 | .059 | 0.030 |
| Attention problems (wave 1) | $t_{1014} = 19.04$ | .000 | .525 | 0.028 |
| Grade | $t_{1014} = -2.87$ | .004 | -.074 | 0.026 |
| Gender | $t_{1014} = 3.65$ | .000 | .096 | 0.026 |
| Model 3 | | | | |
| Attention problems (wave 4) | $F_{4,1013} = 117.78$ | .000 | | |
| Video game exposure | $t_{1013} = 3.07$ | .002 | .099 | 0.032 |
| Attention problems (wave 1) | $t_{1013} = 19.32$ | .000 | .524 | 0.027 |
| Grade | $t_{1013} = -2.75$ | .006 | -.071 | 0.026 |
| Gender | $t_{1013} = 2.22$ | .027 | .063 | 0.028 |
| Model 4 | | | | |
| Attention problems (wave 4) | $F_{5,1011} = 94.11$ | .000 | | |
| Television exposure | $t_{1011} = 0.54$ | .588 | .019 | 0.035 |
| Video game exposure | $t_{1011} = 2.43$ | .015 | .090 | 0.037 |
| Attention problems (wave 1) | $t_{1011} = 18.92$ | .000 | .522 | 0.028 |
| Grade | $t_{1011} = -2.77$ | .006 | -.071 | 0.026 |
| Gender | $t_{1011} = 2.29$ | .022 | .067 | 0.029 |

TABLE 4 General Linear Models Predicting Attention Problems in Late Adolescence/Early Adulthood

| Parameter | Test Statistic | <i>P</i> | β | SE |
|-------------------------------|--------------------|----------|---------|-------|
| Model 5 | | | | |
| Attention problems | $F_{3,203} = 5.21$ | .002 | | |
| Total screen media exposure | $t_{203} = 3.62$ | .000 | .257 | 0.071 |
| Age | $t_{203} = -0.11$ | .916 | -.007 | 0.069 |
| Gender (female = 0, male = 1) | $t_{203} = 0.50$ | .620 | .036 | 0.072 |
| Model 6 | | | | |
| Attention problems | $F_{4,203} = 4.12$ | .003 | | |
| Television exposure | $t_{202} = 2.17$ | .031 | .152 | 0.070 |
| Video game exposure | $t_{202} = 2.55$ | .012 | .198 | 0.078 |
| Age | $t_{202} = -0.06$ | .953 | -.004 | 0.069 |
| Gender (female = 0, male = 1) | $t_{202} = 0.13$ | .898 | .010 | 0.077 |

through 4, time 1 attention problems were strongly predictive of time 4 attention problems (r from 0.52 to 0.53), showing high stability of attention problems over time, as would be expected. Gender also showed a positive association with attention problems in models 1 through 4 (r from 0.06 to 0.10), indicating that males were more likely than females to experience increased attention problems from time 1 to time 4. Grade level at time 1 was negatively associated with changes in attention problems (r from -0.07 to -0.08), indicating that children in the lower grade were more likely than those in the higher grades to experience increased attention problems from time 1 to time 4.

Model 1 showed that total screen media exposure (television and video games combined) was associated with greater subsequent attention problems, even after controlling for gender, grade, and time 1 attention problems. Models 2 and 3 showed that both television and video game exposures were separately associated with greater time 4 attention problems, although television exposure was only a marginally significant predictor in model 2 ($P = .051$). Model 4 includes television exposure and video game exposure as separate, unique predictors of attention problems. These are conservative tests of the unique associations of television and video game exposure with attention, because the collinearity of these types of media ($r = 0.46$) reduces their ability to predict attention problems uniquely. In model 4, video game exposure but not television exposure remained a significant unique predictor of time 4 attention problems. This indicates that exposure to video games was a more robust predictor of attention problems in this sample.

Models 5 and 6 (Table 4) tested the concurrent association between tele-

vision and video game exposure (as a single, combined predictor and as unique predictors) and attention problems in the late adolescent/early adult sample, with participants' age and gender included as covariates. In the late adolescent/early adult sample, both television and video game exposure uniquely predicted attention problems. Neither age nor gender was associated with attention problems in the late adolescent/early adult sample ($r < 0.04$). Exposures to television and video games both were associated with greater attention problems when combined (model 5) or as unique predictors (model 6).

To illustrate further the association of television and video game exposure on later attention problems, we generated a maximum likelihood structural equation model on the basis of 3 separate correlation matrices (1 for each grade of the middle childhood sample) by using LISREL 8.5 procedures (Fig 1).³⁴ This model fit the data quite well ($\chi^2(19) = 17.93$, $P > .50$, normed fit index (NFI) = 0.967, comparative fit index (CFI) = 1.000, root mean square error of approximation (RMSEA) = 0.000, 90% CI: 0.000–0.044). Allowing the path from total screen media exposure at time 1 to time 4 attention problems to vary by gender or by grade level did not improve model fit

(changes in χ^2 were nonsignificant), suggesting that gender and grade level do not moderate this effect. In other words, the longitudinal effect of time spent watching television and playing video games was essentially the same for boys and girls and for third-, fourth-, and fifth-graders.

DISCUSSION

In addition to replicating some past research on television exposure in children, these studies fill several important gaps in the research literature on screen media and attention problems. First, these studies demonstrate that amount of time spent playing video games is associated with greater attention problems. Second, the video game association to attention problems was similar in magnitude to the television association. In fact, the video game association in the middle childhood sample proved more reliable than the television association to attention problems, but caution is warranted in drawing conclusions about the relative importance of video game playing and television viewing on the basis of these data. In the late adolescent/early adult sample, both television viewing and video game playing were uniquely associated with attention problems. In both samples, the total time spent with screen media (both

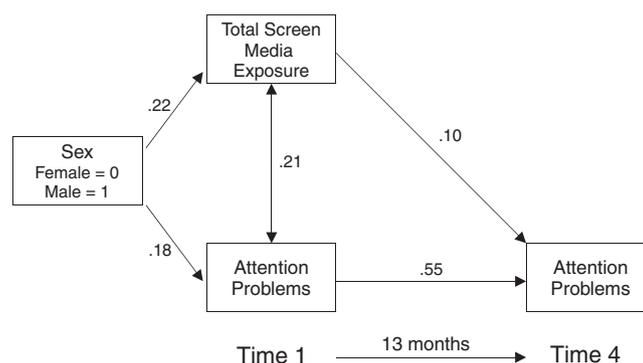


FIGURE 1

Longitudinal model of exposure to screen media (television and video games) and the association with attention problems, assessed 13 months later, in middle childhood. Path coefficients are standardized. All paths are significant.

television and video games) was positively related to attention problems. Future research should include more detailed measures of both television and video game exposure to determine which features (eg, rapid scene changes) are most important. It may also prove useful to examine other forms of electronic media use (eg, films, music, cellular telephones) for similar associations with attention problems.

The middle childhood sample provided a third important new finding. Exposure to screen media was associated with later attention problems even when earlier attention problems and gender were statistically controlled. This provides stronger evidence than analyses of single time point data that screen media may influence attention problems; controlling for earlier attention problems makes it less likely that the association of each type of medium with attention problems is attributable to other potential influences on attention problems. For example, it rules out the possibility that the association between screen media use and attention problems is merely the result of children with attention problems being especially attracted to screen media. To our knowledge, no previous longitudinal study has examined video game playing and subsequent attention problems. These studies provide some early evidence that video game playing in middle childhood may increase later attention problems.

It should be noted that the β for the time-lagged association of television and video game exposure ($\beta = .10$) is relatively small and that the link between initial attention problems and attention problems 13 months later ($\beta = .55$) is large. This suggests considerable stability of attention problems over this period. It may be, as some authors have contended, that attention problems are less malleable

after early childhood.³ Nonetheless, public health concerns (eg, the effect of lead intake on IQ in children) are often based on small effect sizes, and even such a small effect may be of considerable social importance given the ubiquity of television and video games.^{35**}

A fourth important finding is that television viewing and video game playing were associated with attention problems in both middle childhood and late adolescent/early adult samples. That these associations were very similar in strength is somewhat surprising, given the different methods of assessment used in each sample: self-report, parent report, and teacher reports among children compared with self-report only among adolescents/young adults. These similar associations across age groups raise an important possibility about the persistence of television or video game exposure effects on attention problems. Whatever the ages at which watching television or playing video games may increase attention problems, the consequences may be quite long lasting or cumulative. Longer term longitudinal studies, perhaps including a randomly assigned intervention, are needed to test these hypotheses.

Although these studies provide useful evidence for television and video game effects on attention problems, there are several limitations. Because both studies rely on correlational data rather than randomly assigned treatments, this limits the ability to make causal conclusions. Some unmeasured variable that is systematically associated with tele-

**Also, note that the β of .10 represents a very conservative estimate of the potential effect of screen media exposure on attention problems. Just as the simple correlation of .23 may include variance that is not attributable to the predictor and thus be an overestimation of the true effect, the partial correlations and β s may exclude some variance that actually is attributable to the predictor and thus be an underestimation.

vision or video game exposure may account for some of the changes in attention problems. Controlling for earlier attention problems in the middle childhood sample likely removes the effects of most other influences on attention problems, but it cannot account for variables that had a new impact on attention problems between initial and final measurements of attention problems (eg, if children began taking medications for attention disorders during the study). The late adolescent/early adult sample is measured at a single time point, making conclusions about the direction of causality inappropriate within this sample.

Another limitation of these studies is that the television and video game exposure measures were global. It is possible that certain types of television programs and video games are associated with attention problems whereas others are not. For example, there is some evidence that educational television is not associated with increased attention problems.¹⁰ Educational television may differ from noneducational television in terms of pacing or violent content or other features (although we are not aware of any evidence to date of such differences), which might account for such a difference. Similarly, there are many differences in features among video games, differences that may lead to differential effects on attention problems. As future research examines television and video games and their influence on attention problems, differences that are based on finer grained analyses of screen media features should be examined.

Despite these limitations, these studies extend knowledge about television and video game effects on attention problems. There are several areas in which additional research would be

beneficial, such as differences that are based on features. It will be important to replicate the findings of a video game playing association with attention problems in other longitudinal samples. Most of the research evidence thus far supports the conclusion that exposure to television and video games increases the risk for subsequent attention problems. These studies demonstrate that the

risk could be reduced if parents followed the recommendation of the AAP to limit children's exposure to television and video games to no more than 2 hours per day.^{32,33} Furthermore, there are theoretical reasons to believe that slower paced educational, nonviolent content is less likely to cause attention problems, but more studies on this issue are especially needed.

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The Human Genome Project at Ten Years: Still a Work in Progress: While we celebrated the tenth anniversary of the human genome project this past June, genetic scientists remain cautious as to whether or not knowledge of the genome will truly result in new pharmaceutical approaches to treating diseases. According to an article in *The New York Times* (Pollack A, June 15, 2010), only over the past year or so have drugs that block the effects of genetic abnormalities and that are thought to contribute to tumor growth, osteoporosis, and lupus began to reach the market. In fact while research and development spending by major pharmaceutical companies has doubled in the past decade—reaching \$46 billion—the number of new drugs approved each year has not changed (25 in 2009). Drug manufacturers attribute the status quo to stiffer testing requirements by the Food and Drug Administration rather than to the inability of the human genome project to yield what was hoped to be a myriad of new pharmacotherapeutics. Robert R. Ruffolo Jr, who oversaw research and development at Wyeth Pharmaceuticals until 2008, said that “If on the first day we had discovered a new molecular target [as a result of the human genome project], it’s still going to take 15 to 20 years to make the drug. Genomics did not speed up drug development. It gave us more rapid access to new molecular targets.” Perhaps the 20th anniversary of the genome project will bear more fruit than the 10th.

Noted by JFL, MD

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