Early Attention Problems and Children's Reading Achievement: A Longitudinal Investigation

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ABSTRACT

Objectives: To determine whether attention problems predict the development of reading difficulties and examine whether screening for attention problems could be of practical value in identifying children at risk for reading underachievement. **Method:** Three hundred eighty-seven children were monitored from kindergarten through fifth grade. Standardized assessments of attention problems and reading achievement were conducted at multiple time points. **Results:** Attention problems predicted reading achievement even after controlling for prior reading achievement, IQ, and other behavioral difficulties. Inattentive first graders with normal reading scores after kindergarten were at risk for poor reading outcomes. **Conclusions:** Attention problems play an important role in the development of reading difficulties for some children, and screening for attention problems may help identify children at risk for reading difficulties. *J. Am. Acad. Child Adolesc. Psychiatry,* 2000, 39(7):859–867. **Key Words:** reading achievement, inattention, attention-deficit hyperactivity disorder.

Although an association between inattention and reading achievement has been repeatedly documented (Frick et al., 1991; Horn and Packard, 1985; McGee et al., 1985; Rowe and Rowe, 1992), the nature of this relationship remains uncertain. After reviewing the relationship between externalizing difficulties and academic underachievement, Hinshaw (1992) concluded that inattention-hyperactivity is specifically linked to reading underachievement in early and middle childhood. He noted, however, that ". . . causal models have rarely been tested with sufficient rigor and inferences regarding unidirectional links can not be made" (p. 149). Hinshaw stressed the need for longitudinal studies that (1) reliably assess antecedent variables (e.g., parental involvement, IQ, language difficulties) which may contribute to associations between reading achievement and attention problems and (2) use statistical analyses which adequately control for correlated predictors and antecedents.

In addition to these recommendations, it is now evident that inattention and hyperactivity-impulsivity emerge as distinct factors in analyses of teacher and parent behavior ratings (DuPaul, 1991). Understanding the relationship between attention problems and reading achievement thus also requires that the distinction between inattention and hyperactivity-impulsivity be preserved. This distinction has not been made in many investigations, however, making it difficult to disentangle the independent contribution of these different symptoms to children's reading difficulties.

Subsequent to Hinshaw's (1992) review, other investigators have reported associations between inattention-hyperactivity and reading achievement. Fergusson and Horwood (1992) investigated relationships between attention-deficit hyperactivity disorder (ADHD) and reading achievement in 777 children and concluded that attention deficits at age 12 negatively influenced reading, but that reading ability at this age did not affect children's attention problems. Because children were already in middle childhood when initially assessed, however, the

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possibility of reciprocal influence at an earlier age cannot be ruled out. Velting and Whitehurst (1997) examined the predictive relation between preschool inattention-hyperactivity and elementary school reading achievement in a sample of 105 children of low socioeconomic status who were enrolled in Head Start. They reported that attention problems did not inhibit early reading development in preschool and kindergarten when the attentional requirements were modest, but they did exert an adverse influence when more sustained mental effort was required. Because their measure of inattention-hyperactivity was more focused on overactivity, however, they cautioned that their study did not provide a strong test of the relationship between attention problems specifically and early reading achievement.

The failure to distinguish between inattentive and hyperactive-impulsive symptoms, and the use of parents rather than teachers as informants, may have obscured the relationship between attention problems and reading achievement in several other studies. For example, Wood and Felton (1994) monitored 204 children from grade 1 through the end of grade 5 and collected measures of ADHD symptoms and reading achievement in grades 1, 3, and 5. Attention problems were not associated with reading achievement at any time, while first-grade reading achievement explained more than 50% of the variance in fifth-grade reading. The authors concluded that inattention has no concurrent or predictive relation to reading achievement. This association may not have been found, however, because attention ratings were obtained from parents rather than teachers, and teachers are better reporters of children's inattentive behaviors in the classroom. In addition, the attention problems score combined ratings of inattentive and hyperactive-impulsive symptoms and was thus not a pure measure of inattention.

Pennington et al. (1993) compared the patterns of cognitive functioning in children with pure ADHD (assessed using *DSM-III-R* criterion), pure reading disability, or combined ADHD and reading disability. They found that children with ADHD were deficient on measures of "executive functioning" and children with reading disability showed deficits in phonological processes. Of special interest was that deficits of children in the comorbid group mirrored those of children with reading disability rather than those of children with ADHD. The authors interpreted these results to indicate that in children with ADHD and reading disability, ". . . the presence of a primary reading disability leads to secondary symptoms of ADHD" (p. 520). Because their diagnoses of ADHD were based on *DSM-III-R* criteria, however, inattentive symptoms and hyperactive-impulsive symptoms were not considered separately. It is quite possible that a different pattern of results would have been obtained in children with the predominantly inattentive subtype of ADHD.

As is evident in the discussion thus far, the nature of the relationship between attention problems and reading achievement remains uncertain; the primary objective of this study is to provide a more complete examination of this relationship than has been conducted to date. We were particularly interested in whether early attention problems predict poorer reading and lead to clinically significant reading impairment for some children. To examine these issues, we used a longitudinal design which included assessments of inattention and reading achievement at multiple time points and which began in kindergarten, when formalized reading instruction generally begins. Measures of inattention and of hyperactivity-impulsivity were considered separately and were obtained from those who are in the best position to rate children's inattentive classroom behavior—their teachers. Finally, we collected measures of other variables linked to reading achievement so that the relationship between inattention and reading achievement could be examined when other explanatory variables were controlled. Although prior studies have incorporated one or more of these elements, to our knowledge this is the first study in which these important design elements have been simultaneously included. Contingent on the results pertaining to this primary objective, we were also interested in whether early screening for attention problems might be of practical value in identifying children at risk for reading difficulties.

METHOD

Participants

Participants were 387 children from a longitudinal, multisite investigation of the development and prevention of conduct problems. The details of this investigation have been described elsewhere (Conduct Problems Prevention Research Group [CPPRG], 1992; Lochman and CPPRG, 1995). Sites included Durham, North Carolina; Nashville, Tennessee; Seattle, Washington; and rural central Pennsylvania. Schools at each site were randomly assigned to intervention or control groups, and during the spring of kindergarten, teachers provided behavior ratings for all children enrolled in these schools. In addition to selecting "high-risk" children to serve as intervention and control subjects, a "normative" sample of 100 children per site was obtained at the control schools by randomly selecting 10 children from each decile of the teacher rating score distributions

(Teacher Screen Problem Behavior) (Lochman and CPPRG, 1995). This selection respected the race and sex group composition obtained within each Teacher Screen decile and was thus representative of the population in the high-risk schools targeted in the larger investigation. One site provided only 87 children because one of its schools was dropped from the study during the first year. Fifty percent of the children were boys, and 49% of the sample had a minority ethnic background (43% African American and 6% other).

Data collection for this study covered a 5-year period, and complete data were not available for all children. No significant differences were found, however, between children with complete and incomplete data on any of the measures collected (all p values $>.10$). This suggests that participants with complete data are representative of the entire normative group.

Measures

Reading Achievement. Reading achievement during kindergarten and first grade was measured using the Letter-Word Identification subtest from the Woodcock-Johnson Psychoeducational Battery-Revised (Woodcock and Johnson, 1989), an assessment of single-word reading skills. Single-word reading skills have been shown to depend on phonological decoding ability (Shankwiler and Liberman, 1989), and the Word Identification subtest has been used by other researchers as a measure of early reading ability (Wood and Felton, 1994). The number of items answered correctly on this subtest was converted to a standard score and served as our measure of early reading achievement. At the fifth-grade assessment, the Passage Comprehension subtest was also administered and children's reading achievement score reflected the standardized average of these subtests. Comprehension abilities were assessed to provide a more sensitive indicator of reading achievement in older children than is provided by single-word reading skills alone, a practice that is consistent with prior work in this area (Rowe and Rowe, 1992). The Woodcock-Johnson tests of reading achievement are reliable, correlate highly with other standardized measures of reading achievement, and discriminate between gifted, normal, and learning-disabled students (Woodcock and Johnson, 1989).

Attention. In kindergarten, children's inattentive behavior was assessed using the inattentive items from the Child Attention Problems Scale (Edelbrock, 1990). This scale includes 7 items from the Teacher's Report Form (TRF) (Achenbach, 1991) that directly assess inattention (e.g., "Has difficulty concentrating"). Each item is rated on a 3-point scale to denote whether it is "not true" for the child (0), "sometimes true" (1), or "very true" (2). This scale was used rather than the standard Attention Problems scale because it is a pure measure of inattention and does not contain items pertaining to hyperactivity and academic achievement. The coefficient α for this scale was .87.

For reasons having to do with the larger Fast Track study, the TRF was not administered to the normative sample in grades 1 and 2 and teacher ratings of inattention were collected instead, using the ADHD Rating Scale (DuPaul, 1991). Separate inattention and impulsivity-overactivity scores were computed for each child, using the scoring guidelines suggested by DuPaul (1991). The coefficient α values for the inattention factor were .94 and .96 at grades 1 and 2, respectively.

In addition to these primary measures, we also obtained measures of other variables which may mediate the association between inattention and reading achievement or which may influence children's reading independently. These are indicated below.

Intelligence. IQ was estimated by summing children's scaled scores on the Vocabulary and Block Design subtests from the WISC-R. These subtests were selected because they show the highest correlations with the Verbal and Performance IQ scales, respectively (Wechsler, 1974).

Hyperactivity. During kindergarten, hyperactivity was measured using the Overactivity scale from the Child Attention Problems Scale. This scale includes 5 items from the TRF that directly assess activity level (e.g., "Can't sit still"). As noted above, the TRF was not administered to the normative sample in grades 1 and 2, and hyperactivity was assessed during these years using children's scores on the hyperactive-impulsive factor of the ADHD Rating Scale (DuPaul, 1991). The α values for each assessment of hyperactivity were greater than .90.

Internalizing and Externalizing Problems. Because reading achievement has been linked to internalizing and externalizing behavior problems (Richman et al., 1982; Rutter and Yule, 1970), measures of these classes of childhood difficulties were obtained using the TRF (Achenbach, 1991). These ratings were available only when children were in kindergarten. Scale scores were computed according to standard procedures, except that 2 items overlapping with the Overactivity scale were removed. Raw scores on these scales were used as the dependent variables.

Parental Involvement in Education. Because parental involvement in children's education has been found to predict reading achievement (Rowe and Rowe, 1992; Rutter and Yule, 1970), we measured this construct using the Parent-Teacher Involvement Questionnaire-Teacher Version (CPPRG, unpublished, 1990). The items on this scale reflected teachers' perception of a parent's general involvement in the child's schooling (e.g., "How often has this child's parents stopped by to talk to you in the past year?"). Each item was rated on a 5-point scale, with higher scores indicating greater involvement Although we hypothesized that such involvement would correlate with parental involvement/support of reading activities, items specific to reading were not included in this measure. The coefficient α for this scale was .82.

Procedure. Data collection began in kindergarten when teachers completed the TRF and the assessment of parental involvement during the latter portion of this year. Several months later, but prior to first grade, the WISC-R and Woodcock-Johnson subtests were individually administered as part of a larger battery of measures by trained members of the research staff. A similar schedule was followed for the first-grade data collection and for the second-grade behavior data. The final assessment of reading achievement occurred during the summer after fifth grade.

RESULTS

Correlations of Measures With Reading Achievement

Table 1 shows the correlations between reading achievement at each grade with IQ and with teacher ratings of inattention, overactivity, parental involvement, and internalizing/externalizing problems. As can be seen, virtually all correlations are significant. IQ and attention ratings consistently show the strongest association with reading achievement.

Path Analyses

To test for longitudinal associations between reading achievement and the other measures, a path analysis was conducted using multiple regression procedures (Pedhazur, 1982). All variables were initially included, but only those predicting reading achievement, or predicted by reading achievement, were retained in the final model.

TABLE 1
Correlations Between Predictor Variables and Reading Achievement

	Kindergarten	First Grade	Fifth Grade
IQ	0.50†	0.53†	0.55†
K-inattention	−0.43†	−0.39†	−0.41†
K-overactivity	−0.24**	−0.27***	−0.26***
K-externalizing	−0.20**	−0.23***	−0.26†
K-internalizing	−0.27†	−0.25***	−0.29†
K-parent involvement	0.09	0.14*	0.23***
First-grade inattention	−0.43†	−0.55†	−0.47†
First-grade overactivity	−0.24**	−0.34†	−0.38†
First-grade parent involvement	0.19**	0.27†	0.32†
Second-grade inattention	−0.24**	−0.34†	−0.38†
Second-grade overactivity	−0.14*	−0.22**	−0.25***

Note: $n = 211$.
* $p < .05$; ** $p < .01$; *** $p < .001$; † $p < .0001$.

This eliminated all variables except IQ, teacher attention ratings, and ratings of parental involvement during grade 1. Only children for whom complete data were available ($n = 211$) were included in this analysis. As noted previously, these children did not differ from children with incomplete data on any of the measures collected during the study.

Figure 1 displays the results of the path analysis conducted using the retained variables. Standardized β coefficients for significant paths are shown, as is the percentage of variance accounted for in each variable. A significant path coefficient between 2 variables indicates that the variable measured earlier accounted for significant variance in the second variable, after all other variables measured prior to the second variable were controlled for. For example, the significant path coefficient of −0.29 between kindergarten inattention and reading achievement indicates the magnitude of the negative relationship between these variables after controlling for IQ and teacher ratings of parental involvement. Models for boys and girls were similar, and only the model combining both genders is presented. (Although parental involvement during kindergarten did not predict reading achievement, it was retained because of its strong association with first-grade parental involvement.)

As seen in Figure 1, IQ is a positive predictor and attention problems are a negative predictor of reading achievement after kindergarten. Ratings of attention problems in first grade were negatively associated with IQ and positively associated with kindergarten attention ratings. In addition, first-grade inattentiveness showed a negative

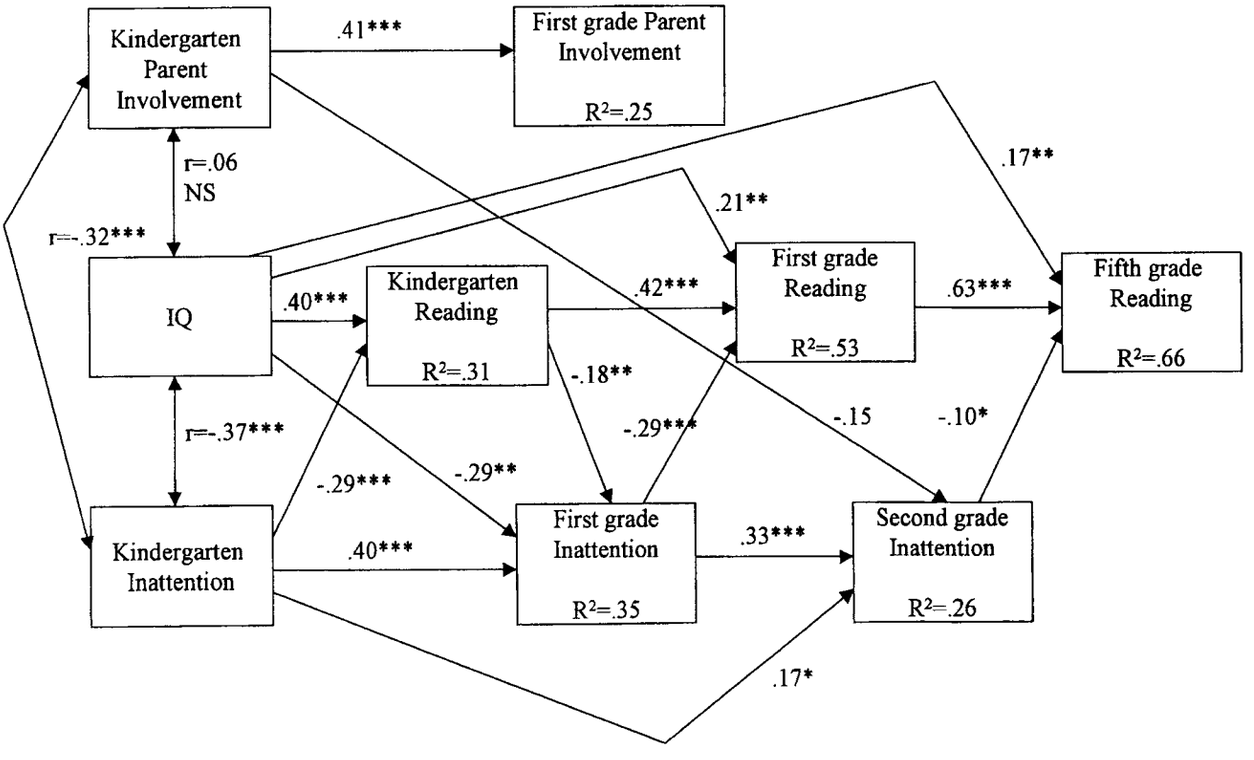

Fig. 1 Longitudinal associations between classroom inattention and reading achievement. *$p < .05$; **$p < .01$; ***$p < .001$; $n = 211$.

association with kindergarten reading achievement, even after controlling for earlier attention ratings. This indicates that lower reading achievement after kindergarten predicted an increase in attention problems during first grade. Teacher ratings of parental involvement during first grade were predicted only by similar ratings during kindergarten.

Kindergarten reading had a strong direct effect on first-grade reading and an indirect effect that flowed through first-grade attention problems. In addition, higher inattention ratings during first grade predicted lower reading achievement, even after controlling for prior reading achievement. IQ was also a predictor of grade 1 reading. Although teacher ratings of parental involvement were not a significant predictor, they were in the expected direction ($p < .12$). Collectively, 53% of the variance in first-grade reading achievement was explained.

As expected, attention problems during second grade were predicted by similar ratings from prior years. The significant negative association with prior reading, however, was no longer found. Thus, although kindergarten reading achievement was negatively associated with grade 1 attention problems, lower reading scores after grade 1 did not predict greater inattention during second grade. Second-grade attention problems were also negatively associated with early parental involvement during kindergarten.

Fifth-grade reading was predicted by several variables. Grade 1 reading was clearly the most important predictor, but IQ and grade 2 attention also made independent contributions. Although parental involvement in children's education during first grade was not a significant predictor, it was once again in the expected direction ($p < .13$). It should also be noted that when parental involvement during kindergarten and first grade were combined to create a composite index of parental involvement over children's first 2 years of schooling, this composite index of early parental involvement was a significant predictor of fifth-grade reading achievement. Collectively, 66% of the variance in children's fifth-grade reading achievement was explained.

To evaluate the variance in early reading achievement that is explained by attention problems above and beyond IQ and parental involvement, we repeated the path analysis described above without including teacher attention ratings in the model. The variance accounted for was reduced from 31% to 25% for kindergarten reading and from 53% to 47% for first-grade reading. These reductions were comparable in magnitude with those obtained when attention problems were retained in the model and IQ was removed.

Prediction of Serious Reading Problems and Serious Attention Problems

Although the analysis described above presents the longitudinal associations between inattention and reading achievement after controlling for other variables, it does not directly indicate whether children become highly inattentive as a result of early reading problems and/or whether attention problems lead to serious reading difficulty. To examine this, we identified children who were poor readers after kindergarten (i.e., children with standardized reading scores after kindergarten <–1) and computed changes in their attention problem scores between kindergarten and first grade. Similarly, we identified highly inattentive first graders (i.e., standardized first-grade inattention ratings >1.0) to see whether they showed substantial declines in reading achievement between kindergarten and first grade. To increase our sample of children with these extreme characteristics, all children with data through the end of grade 1 were included ($n = 301$).

For children who were poor readers after kindergarten, the mean standardized attention problems increased from 0.67 to 0.76 between kindergarten and first grade, a nonsignificant difference ($F_{1,36} = 0.20$, $p = .66$). Attention problems increased for 20 children and declined for 17, and there was not a single child for whom early reading difficulty predated deviant attention problems (i.e., Z score >1.0) that were sustained for a 2-year period. Results for the first- and second-grade data were essentially identical.

We then looked at the relative change in reading achievement between kindergarten and first grade for highly inattentive first graders (i.e., Z score >1.0). Mean standardized reading achievement scores for these children declined from –0.52 to –0.86 ($F_{1,56} = 11.51$, $p < .01$), with 43 of the 57 children showing a decline. Four years later the average standardized reading score for inattentive first graders was still substantially below the group mean at –0.71.

Finally, we examined the inattention ratings of children with a discrepancy between their IQ and reading achievement results of at least 1 SD during either kindergarten or first grade, one of the criteria public schools use to determine eligibility for special educational services. In kindergarten, 43 children showed such a discrepancy. In first grade, there were 42. The percentage of these children who were also highly inattentive doubled between kindergarten and first grade, from 16% to 33%. A logis-

tic regression analysis indicated that after controlling for IQ and kindergarten reading scores, inattentive first graders were almost 3 times more likely than peers to show this discrepancy (odds ratio = 2.96, $p < .0001$).

Enhancing the Early Identification of Poor Readers: Does Screening for Attention Problems Really Help?

An important question not directly addressed above is whether screening for attention problems could identify children at risk for reading difficulties who would not already be identified by early reading assessments. One way to address this question is to determine whether first-grade attention problems alter the reading outcomes for children who are good or poor readers at the end of kindergarten. For example, among children reading poorly after kindergarten, are those without attention problems more likely to recover? Similarly, do attention problems in first grade impede reading development for children reading within normal limits after kindergarten?

Figure 2 presents the mean standardized reading scores after kindergarten, first, and fifth grade for groups derived by crossing kindergarten reading achievement with grade 1 attention ratings. The largest group (n = 162) includes children who were neither poor readers after kindergarten (i.e., standardized reading achievement score >–1.0) nor highly inattentive during first grade (i.e., standardized attention problems score <1.0). The next group (n = 35) contained inattentive first graders who had "normal" postkindergarten reading scores. Fourteen children were poor readers after kindergarten but not highly inattentive in grade 1, and 17 were both poor readers after kindergarten and highly inattentive during first grade.

As seen in Figure 2, the reading trajectories for these groups look quite different. Children who were "normal" on both dimensions had reading scores that were consistently above the mean and show little relative change over time. Only 12 of these children—approximately 7%—had fifth-grade reading scores <–1.0. Achievement scores for children reading in the normal range after kindergarten but inattentive during first grade declined substantially between kindergarten and grade 1 and remained more than one-half SD below the group mean after fifth grade. Twelve of these children—approximately 34%—had grade 5 reading scores <–1.0.

Poor readers after kindergarten remained more than 1 SD below the fifth-grade mean regardless of whether they were also highly inattentive. The noninattentive children who were poor readers appeared to make a relative gain between kindergarten and grade 1, but this was not sustained.

This descriptive analysis was followed by a logistic regression to predict normal or deviant fifth-grade read-

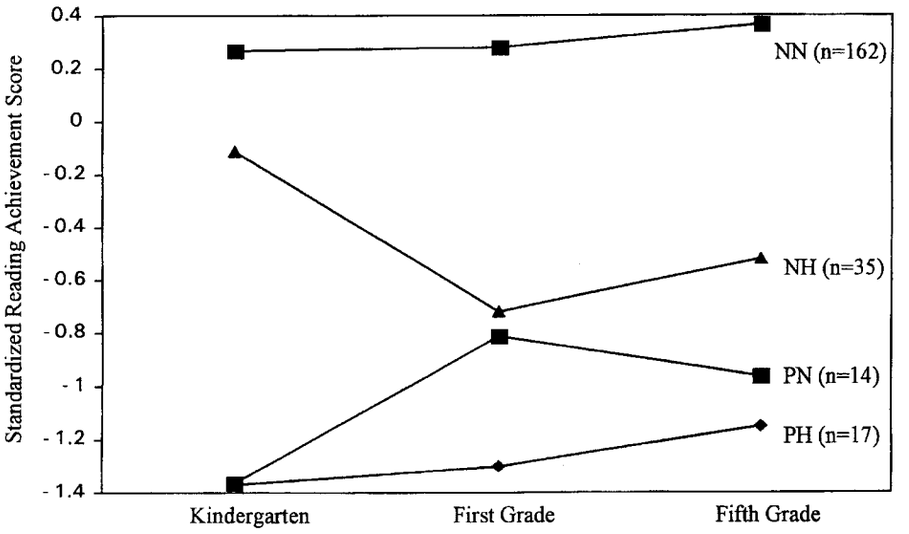

Fig. 2 Mean standardized reading achievement scores for groups formed by crossing kindergarten reading achievement with first-grade attention ratings. PN = poor readers after kindergarten and not inattentive in first grade; PH = poor readers after kindergarten and inattentive in first grade; NH = normal reading after kindergarten and inattentive in first grade; NN = normal reading after kindergarten and not inattentive in first grade. Poor reading after kindergarten is defined as standardized achievement score <–1.0. Inattentive in first grade is defined as standardized attention problems score >1.0.

ing outcome (i.e., standardized reading achievement score <–1.0) for children performing adequately after kindergarten. IQ, first-grade reading achievement, first-grade attention problems, and teacher ratings of parental involvement in grade 1 were used as predictors. Only attention problems (odds ratio = 0.68, $p < .05$) and parental involvement (odds ratio = 0.55, $p < .01$) were significant predictors. Inattentive first graders and children whose parents were less involved in their education in first grade were less likely to still be reading in the normal range after grade 5. When kindergarten ratings for attention problems and parental involvement were included instead as predictors, the results were not significant.

DISCUSSION

The objectives of this study were to examine the predictive relationship between attention problems and reading achievement, to evaluate whether early attention problems contribute to clinically significant reading difficulties for some children, and to determine whether screening for attention problems could help identify children at risk for reading difficulties. Our study provided a strong test of these questions because it used a longitudinal design, included multiple assessments of inattention and reading achievement that began when children were first learning to read, and controlled for other variables that may impact reading achievement. In addition, we measured inattention separately from hyperactivity-impulsivity and collected these data from teachers, who are best able to report on children's inattentive behavior in the classroom. To our knowledge, this is the first study of the relationship between attention problems and reading achievement to include simultaneously these important elements.

In contrast to the other behavior variables that we examined (i.e., hyperactivity, internalizing problems, and externalizing problems), only attention problems predicted children's reading achievement after controlling for IQ, prior reading achievement, and parental involvement. Furthermore, the adverse effect of attention problems on reading achievement was often substantial. For example, among inattentive first graders with normal postkindergarten reading scores, more than one third had standardized fifth-grade achievement scores that were substantially below those of most of their peers (i.e., Z score <–1.0). The proportion of children with significant discrepancies between IQ and reading achievement who were highly inattentive—one of the criteria used to identify children as having a reading disability—doubled between kindergarten and first grade, and inattentive first graders were almost 3 times as likely to have such a discrepancy. Although there was some indication that reading difficulties during kindergarten also predicted increased attention problems during first grade, the magnitude of this effect was smaller and was not evident beyond grade 1. There was thus little evidence of early reading difficulties leading to persistently high levels of inattentive behavior.

Our results are discrepant from those of Wood and Felton (1994), who argued for separate linguistic and attentional factors in the development of reading. One explanation for this discrepancy is the manner in which attention was measured in each study. Wood and Felton (1994) used parent ratings of ADHD symptoms that combined inattentive and hyperactive symptoms. Teachers are likely to be better reporters of inattentive classroom behaviors than parents, however, and agreement between parent and teacher ratings of inattention is only moderate. Because they used parent ratings that combined inattentive and hyperactive symptoms, the importance of attention problems for children's reading achievement may have been obscured in their study. In fact, when we replicated as closely as possible their method for determining children's attention problems, the correlation with first-grade reading achievement declined from 0.54 to 0.23.

Our results are also not fully consistent with those of Pennington et al. (1993), who suggested that for children with ADHD and a reading disability, ADHD symptoms are secondary to a primary reading problem. It is instructive to look at this hypothesis in relation to first graders in our sample who were highly inattentive and who had a significant discrepancy between their IQ and reading results. Although the procedures we used are not sufficient to diagnose either ADHD or reading disability in these children, they certainly showed indications of these conditions. If reading problems were primary for these children, one would expect these problems to be evident when reading was first assessed. Only 4 of these 13 children, however, had standardized postkindergarten reading scores <–1.0 and only 7 had postkindergarten IQ–achievement discrepancies greater than 1.0. Thus, in almost half the cases, this discrepancy was not evident until after inattentive behavior could have interfered with the acquisition of early reading skills.

One explanation for this apparent inconsistency may be that we did not study a clinically diagnosed sample. It may

also be significant that the children in the Pennington et al. study were all males and were slightly older, and the children with ADHD were not restricted to those with the inattentive subtype. In addition, our data do not include the information on children's neuropsychological functioning that they collected. Finally, it is possible that the children we studied actually had a primary difficulty in reading, but this was not evident until first grade, when the demands associated with learning to read are greater.

We were also interested in whether early screening for attention problems could help identify children at risk for poor reading outcomes. To begin with, it is important to note that most children with poor fifth-grade reading outcomes were already having difficulty after kindergarten and tended to remain poor readers regardless of whether they were inattentive. These results provide strong evidence for the continuity of early reading difficulties that are independent of attention problems. We also found, however, that about one third of children who were reading in the normal range after kindergarten, but who were highly inattentive during first grade, had fifth-grade reading outcomes more than 1 SD below their peer group mean. These are children who would not necessarily have been identified as poor readers by early reading assessments alone.

Because first grade is a critical time for the acquisition of early reading skills, one plausible hypothesis is that attention problems interfere with the acquisition of these skills and that it is difficult for children to "catch up" once this occurs. Screening for attention problems during kindergarten and/or first grade could identify these children as being at risk for poor reading outcomes. Although the false-positive rate would be quite high (i.e., only 34% of the inattentive children actually had poor fifth-grade outcomes), it is possible that relatively minor interventions designed to help these children master early reading skills could yield important long-term benefits for their achievement. This possibility is worth testing, and a positive result would indicate that such screening could have important practical value. In addition, even for the inattentive first graders who did not become poor readers, it is conceivable that some additional focus on their early reading development could have produced meaningful achievement gains for them as well.

Limitations

Several limitations of this study warrant consideration. Ideally, we would have included an independent assessment of language functioning as a control variable because language problems have been linked to both ADHD and academic underachievement (Hinshaw, 1992). Items specific to parents' involvement in reading activities with their child would have been helpful to include in the measure of parental involvement, although this variable was still a significant predictor of reading achievement in some analyses. Including a comprehensive assessment of children's neuropsychological functioning and their phonological processing abilities similar to that done by Pennington et al. (1993) would have permitted a more complete examination of the contribution made by phonological processes and attention deficits to the development of reading difficulties for different types of children. The absence of clinically established diagnoses of either ADHD or a reading disability for the children in our sample requires that considerable caution be invoked in extrapolating these data to clinically diagnosed youth. Finally, it is important to emphasize that this was a nonexperimental study, and firm conclusions about the causal role of attention problems in producing reading difficulties thus cannot be made.

Clinical Implications

The finding that first-grade attention problems significantly increase children's risk for reading difficulties has important clinical implications. Our data suggest that many inattentive children fail to develop critical reading skills during first grade and have difficulty catching up to peers after this occurs. This was especially true for inattentive children with no obvious reading impairment when first grade began, and these children may often "fall through the cracks" and fail to receive assistance that could enhance their short- and long-term reading outcomes. Although these results require replication, they suggest inattentive children should be identified and monitored during first grade so they can be provided with additional assistance if their acquisition of critical early reading skills begins to lag behind those of their peers.

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School Difficulties at Adolescence in a Regional Cohort of Children Who Were Extremely Low Birth Weight. Saroj Saigal, MD, Lorraine A. Hoult, BA, David L. Streiner, PhD, Barbara L. Stoskopf, RN, MHSc, Peter L. Rosenbaum, MD

Objectives: To compare measures of psychometric assessment and school difficulties in a cohort of extremely low birth weight (ELBW) teenagers and term controls, and to determine whether there is stability in psychometric measures between age 8 and the teen years. *Study Design:* Longitudinal follow-up; geographically defined region. *Participants:* 150 of 169 (89%) ELBW survivors born between 1977 and 1982 and 124 of 145 (86%) sociodemogaphically matched term controls between 12 and 16 years of age. Psychometric measures: Wechsler Intelligence Scale for Children-Revised, Wide Range Achievement Test-Revised, and a validated parent questionnaire. *Results:* Neurosensory impairments were present in 28% of ELBW and 1% of controls. The mean Wechsler Intelligence Scale for Children-Revised scores were ELBW: 89 ± 19 and controls: 102 ± 13. ELBW children did less well on Wide Range Achievement Test-Revised Reading, Spelling, and Arithmetic measures with mean scores in the range from 75 to 85. ELBW children <750 g were more disadvantaged, compared with those ≥750 g. A significantly higher proportion of ELBW children were receiving special educational assistance and/or had repeated a grade (ELBW: 58%; controls: 13%- odds ratio: 9.0). Paired analysis of within-cohort data at age 8 and teen years showed that for both cohorts Arithmetic scores declined, but there were small improvements in other measures, predominantly in the term children. *Conclusions:* Differences of 13 to 18 points in psychometric measures in ELBW teens compared with controls are both statistically significant and clinically relevant. Decreasing birth weight was associated with increased risk on all measures. The high utilization of special educational resources has economic implications, and the incremental cost attributable to being extremely premature needs to be determined. **Pediatrics** 2000;105:325–331. Reproduced by permission of *Pediatrics*, copyright 2000.