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Reading, Mathematics, and Behavioral Difficulties Interrelate: Evidence from a Cross-lagged Panel Design and Population-based Sample

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Abstract

We examined three questions. First, do reading difficulties increase children's risk of behavior difficulties? Second, do behavioral difficulties increase children's risk of reading difficulties? Third, do mathematics difficulties increase children's risk of reading or behavioral difficulties? We investigated these questions using a sample of 9,324 children followed from third to fifth grade as they participated in a nationally representative dataset, conducting multilevel logistic regression modeling and including statistical control for many potential confounds. Results indicated that poor readers in third grade were significantly more likely to display poor task management, poor self-control, poor interpersonal skills, internalizing behavior problems, and externalizing behavior problems in fifth grade (odds ratio [OR] range = 1.30 – 1.57). Statistically controlling for a prior history of reading difficulties, children with poor mathematics skills in third grade were also significantly more likely to display poor task management, poor interpersonal skills, internalizing behavior problems, and reading difficulties in fifth grade (OR range = 1.38 – 5.14). In contrast, only those children exhibiting poor task management, but not other types of problem behaviors, in third grade were more likely to be poor readers in fifth grade (OR = 1.49).

Keywords

reading difficulties; mathematics difficulties; behavioral difficulties; longitudinal; upper elementary

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Researchers have repeatedly documented the co-occurrence of reading and behavior difficulties in children (e.g., Arnold et al., 2005; Greenbaum et al., 1996; Kauffman, Cullinan, & Epstein, 1987; McGee, Williams, Share, Anderson, & Silva, 1986; Nelson, Benner, Lane, & Smith, 2004). For example, Arnold et al.'s (2005) longitudinal study found

that adolescents with poor reading skills exhibited greater internalizing and externalizing behaviors than peers with typical reading abilities. However, reasons for this observed co-occurrence have yet to be firmly established. Four possible mechanisms have been advanced in the literature. We briefly detail these below.

Theoretical Explanations of the Co-occurrence Between Reading and Behavioral Difficulties

Reading difficulties cause later behavioral difficulties

One possibility for the observed co-occurrence is that early reading difficulties cause later behavioral difficulties. For example, Stanovich (1986) hypothesized that early difficulties acquiring basic literacy skills such as phonological processing result in later, more generalized reading difficulties. This is because poor readers with difficulties in phonological processing struggle with deficient decoding skills, difficult materials, and lack of practice. These negative experiences make poor readers less engaged in reading activities, thereby exacerbating their reading difficulties. This in turn may hinder children's reading skills growth, vocabulary, motivation, strategy use, and cognitive growth in the verbal domain (Echols, West, Stanovich, & Zehr, 1996; Griffiths & Snowling, 2002; Guthrie, Schafer, & Huang, 2001; Senechal, LeFevre, Hudson, & Lawson, 1996). In addition, children with poor reading skills may experience lower academic performance. These children may then internalize evaluations of their poor performance made by teachers and peers, which in turn may result in negative feelings about themselves. This repeated exposure to negative feedback about their increasingly generalized academic difficulties may result in peer rejection, depressed mood, and behavioral difficulties (Chen, Rubin, & Li, 1995; Dishion, Patterson, Stoolmiller, & Skinner, 1991; Maughan, Rowe, Loeber, & Stouthamer-Loeber, 2003). Indeed, poor readers in the elementary grades have been found to be more likely to have lower academic self-concepts (Chapman, 1988; Chapman, Tunmer, & Prochnow, 2000), feel depressed (Maughan et al., 2003), think of themselves as angry, distractible, sad, lonely, and unpopular (Morgan, Farkas, & Wu, 2012), display internalizing and externalizing problem behaviors (Morgan, Farkas, & Wu, 2009), and experience peer rejection and lower social status (Lopes, Cruz, & Rutherford, 2002) than normally performing students.

Although many empirical studies have directly tested this hypothesized causal relation (e.g., Bennett, Brown, Boyle, Racine, & Offord, 2003; Carroll, Maughan, Goodman, & Meltzer, 2005), its directionality remains unclear (Rivera, Al-Otaiba, & Koorland, 2006). Some researchers have found that improving children's reading skills decreased behavior problems (e.g., Allyon & Roberts, 1974; Coie & Krehbiel, 1984). Others have found this not to be the case (Barton-Arwood, Wehby, & Falk, 2005; Nelson, Stage, Epstein, & Pierce, 2005; Wehby, falk, Barton-Arwood, Lane, & Cooley, 2003).

Behavioral difficulties cause later reading difficulties

A second possible explanation is that behavioral difficulties cause later reading difficulties. This may occur due to a lack of self-regulatory processes resulting from executive functioning deficits. Deficits in executive functioning impede planning, organizational

skills, selective attention, and inhibitory control (Morgan & Lilienfeld, 2000). Children with executive functioning deficits may not be able to self-regulate their behaviors in a learning environment, and thus may experience academic difficulties. For example, poor self-regulation might result in reduced attentional focus and engagement during classroom learning activities, as well as being withdrawn or passive (Roeser, van der Wolf, & Strobel, 2001), thereby contributing to later academic failure. Empirical studies provide some support this causal relation (e.g., Fitzpatrick & Pagani, 2012; Jorm, Share, Matthews, & MaClean, 1986; Spira, Bracken, & Fischel, 2005).

Bi-directional effects between reading and behavioral difficulties

A third explanation is that reading and behavioral difficulties bi-directionally affect each other. That is, the two factors reciprocally influence each other over time through a negative feedback cycle (McGee et al., 1986). Hinshaw (1992) concluded that such a relation exists between the two factors. Some studies have also supported this bi-directional model (e.g., Morgan, Farkas, Tufis, & Sperling, 2008; Onatsu-Arvilommi & Nurmi, 2000). For example, Morgan and his colleagues (2008) examined bi-directional effects between reading and behavioral difficulties. The study's results indicated that poor readers in first grade were more likely to display behavioral difficulties in third grade, and children who displayed poor task management in first grade were more likely to be poor readers in third grade. These relations held despite statistical control for a wide range of confounding variables (e.g., parental education level, whether the family's income was below the federal poverty level, child's race and ethnicity, child's gender, whether the child's school was located in an urban or rural area, whether English was the language spoken at home). However, longitudinal studies investigating bidirectional relations between reading and behavioral difficulties are relatively rare (Morgan et al.), particularly in older samples of children who have already transitioned from "learning to read" to "reading to learn" (Kempe, Gustafson, & Samuelsson, 2011).

Influence of other factors including mathematics difficulties or environmental risk

It may also be that the relation between reading and behavioral difficulties is spurious, and instead results at least in part from the influence of additional variables. One strong possible confound may be mathematics difficulties. Reading and mathematics difficulties frequently co-occur (e.g., Fuchs, Fuchs, & Prentice, 2004; Jordan, Kaplan, & Hanich, 2002; Vukovic & Siegel, 2010). In addition, mathematics difficulties have previously been hypothesized to result in behavioral difficulties. Rourke (1988) hypothesized that specific patterns of central processing abilities and deficits cause the manifestation of specific learning disabilities; and also, cause specific types of socioemotional disturbance. Specifically, Rourke reported that those with non-verbal disabilities exhibited higher level of internalizing psychopathology than those with verbal disabilities. Rourke further hypothesized that children exhibiting non-verbal disabilities rely principally on their verbal abilities for social relating. However, the lower quality of their language communication results in unsuccessful social interaction with their peers, and so increases the risk for the development of internalized socioemotional pathology, including social withdrawal, anxiety, and depression (Rourke, Young, & Leenaars, 1989). Some studies have supported this hypothesis of a causal relation between mathematics difficulties and internalizing behavior problems (Greenham, 1999; Morgan et

al., 2012; White, Moffitt, & Silva, 1992). Consequently, at least part of the observed co-occurrence between reading and behavioral difficulties may instead result from impaired non-verbal processes involved in mathematics learning as indicated by mathematics difficulties.

It may also be that the observed co-occurrence between reading and behavior problems is due to shared environmental factors that result in both reading and behavior difficulties. That is, it may be that association between reading and antisocial behavior is due to environmental risk factors common to both (Trzesniewski, Moffitt, Caspi, Taylor, & Maughan, 2006). Examples of the common environmental risk factors included lower quality home environment and care, parental education and income, and social class. However, Trzesniewski and her colleagues (2006) also reported that the combination of the common environmental risk factors only weakly mediated the association between reading achievement and antisocial behavior.

Methodological Limitations

The aforementioned work has identified four possible and, to varying degrees, competing mechanisms for the observed co-occurrence between reading and behavioral difficulties. However, several methodological and substantive limitations also currently characterize the extant work, thereby making it difficult to ascertain which of the aforementioned theoretical accounts best explains the observed co-occurrence between children's reading and behavioral difficulties. Many studies have relied on small convenience samples (e.g., Ayllon & Roberts, 1974; Barton-Arwood et al., 2005; Wehby et al., 2003). It is therefore unclear to what extent reading, mathematics, and behavioral difficulties inter-relate in the more general population of U.S. schoolchildren. Few studies have included a prior history of mathematics difficulties as another potential explanatory variable when investigating the co-occurrence of reading and behavioral difficulties (Morgan et al., 2012), despite it constituting a strong possible confound of the observed co-occurrence. Additionally, many existing studies failed to control for either earlier reading problems or behavior problems (Hinshaw, 1992) or did not include other potentially relevant variables in their analyses (Fleming, Harachi, Cortes, Abbott, & Catalano, 2004). Variables such as gender, race/ethnicity, and socioeconomic status may help explain the observed co-occurrence between reading and behavioral difficulties (e.g., Feil et al., 2005; Kaplan & Walpole, 2005; Lepola, 2004). It is therefore important to include these additional factors in the analyses as statistical controls so as to more rigorously investigate the hypothesized inter-relations. Moreover, few studies have examined the association between reading difficulties and behavior problems during upper elementary grades, including the time period between third and fifth grade. Yet this time period constitutes a major transition in children's academic and behavioral development, particularly as children begin to "read to learn" instead of "learn to read" and increasingly relying on peer networks. This transition might be expected to exacerbate any inter-relation between reading and behavioral difficulties, as the negative impacts of reading failure become increasingly generalized and children's peer evaluations become more important (Chapman, 1988; Morgan et al., 2012; Stanovich, 1986;). We attempted to advance the field's knowledge base by investigating three specific research questions collectively designed to address methodological and substantive limitations in the extant work.

Study's Purpose

We sought to answer three specific questions. First, we examined whether and to what extent early reading difficulties increase children's risk for later behavioral difficulties. Specifically, we examined whether students who are poor readers in third grade are more likely to display problem behaviors in fifth grade, including poor task management, poor self-control, poor interpersonal skills, externalizing problem behaviors, and internalizing problem behaviors. Second, we examined to what extent earlier behavioral difficulties increased children's risk of later reading difficulties. We therefore examined whether children displaying behavior difficulties in third grade are more likely to be poor readers, controlling for whether the children were already poor readers in third grade, and additional confounds. Third, we investigated whether and to what extent mathematics difficulties may at least partly explain the observed co-occurrence between reading and behavioral difficulties. Prior work has suggested that this may be the case, although the relation may be specific only to internalizing problem behaviors. We further extended prior investigations of earlier elementary time periods (e.g., Morgan et al., 2008) by examining the relation between reading difficulties and behavior problems during the critical time period between third and fifth grade. Academic expectations correspondingly increase as children become older, more independent learners, as do their reliance on peer networks. For example, children may also increasingly use peer social comparisons to judge their own relative skill level. As these changing expectations and increasing peer evaluations occur, it may therefore be that being a poor reader begins to result in a more pronounced and increasingly generalized risk for maladaptive behavioral functioning.

Method

Data Source

We analyzed data from the Early Childhood Longitudinal Study – Kindergarten Class of 1998–99 (ECLS-K), which is maintained by the U.S. Department of Education's National Center for Education Statistics (NCES). The ECLS-K followed a large-scale, nationally representative sample of children from kindergarten through the 8th grade. Participating children attended public and private schools and full-day and part-day kindergarten programs. Data were collected from children, their families, their teachers, and their schools in the fall and spring of kindergarten (1998–99), the fall and spring of 1st grade (1999–2000), the spring of 3rd grade (2002), the spring of 5th grade (2004), and the spring of 8th grade (2007).

Analytical Sample

We constrained our sample to those having complete data on all the dependent variables used in the analysis (as described below, we multiply imputed missing data for the study's independent variables). We also excluded the students who attended different schools between the two survey rounds, which were the spring of third grade and the spring of fifth grade. The reason for this exclusion was because we used school level variables for the study's multilevel logistic regression modeling analysis. This model assumes that students are nested within the same schools at each of the time points. Therefore, students who

changed schools between these survey rounds were excluded in our analyses. Consequently, the analytical sample included 9,324 students attending 966 public and private elementary schools. Table 1 displays the characteristics of the sample. Fifty percent of the sample was male. The average age of the students was approximately 68 months when data were first collected in the fall of kindergarten.

Measures

Reading achievement/reading difficulties—The Reading Test was constructed and designed by NCES for the ECLS-K sampled children. It measures basic skills (e.g., print familiarity, letter recognition, beginning and ending sounds, rhyming sounds, and word recognition), vocabulary (receptive vocabulary), and comprehension (listening comprehension and words in context). Comprehension questions were designed to evaluate initial understanding, developing interpretation, personal reflection, and demonstrating critical stance. Children first completed a routing test. Based on the performance on the routing items, one of three forms of the Reading Test was administered to the child. This form contained items of appropriate difficulty for that child's level of ability, as indicated by his or her performance on the preceding battery of routing items. The Reading Test was individually administered. Item Response Theory (IRT) methods were employed to derive scale scores that were comparable across grade levels. Content validity was established by examining national and state performance standards in the domains, the judgments of curriculum experts and teachers, and also the comparison with the reading part of the Woodcock-McGrew-Werder Mini-Battery of Achievement (MBA; Woodcock, McGrew, & Werder, 1994). The fifth graders' scores correlated .73 with the MBA (Tourangeau, Nord, Lê, Pollack, & Atkins-Burnett, 2006), and the third graders' scores correlated .83 with MBA (NCES, 2004). The reliability of IRT scale scores was .93 for both third and fifth grade (NCES, 2004; Tourangeau et al., 2006). To identify children displaying reading difficulties at third and fifth grade, we used a 10% cutoff at the bottom of the distribution of scores from the third and fifth grade administration of the Reading Test. This 10% cutoff was based on previous empirical studies, reporting the prevalence of reading difficulties (Catts, Fey, Zhang, & Tomblin, 2001; Konold, Juel, & McKinnon, 1999).

Mathematics achievement/mathematics difficulties—The Mathematics Test was designed for the ECLS-K as a direct cognitive assessment. It contains items measuring children's knowledge of number and shape, relative size, ordinality sequence, addition/ subtraction, multiplication/division, place value, rate and measurement, fractions, and area and volume. Like the Reading Test, the Mathematics Test was designed to reflect the progression of these skills and knowledge. The Mathematics Test was individually administered, and a routing procedure was used. Third graders' scores correlated .84 with MBA (NCES, 2004). The reliability of IRT scale scores was .94 for the third grade (NCES, 2004). We used 10% cutoff at the bottom of the distribution of the Mathematics Test scores to identify children with mathematics difficulties. This 10% cutoff criterion is considered to be consistent with the reported prevalence of mathematics difficulties (Geary, 2004; Shalev, Auerbach, Manor, & Gross-Tsur, 2000).

Behavioral functioning/behavioral difficulties—The scale used in the ECLS-K contained 26 items measuring children's social development. There were five subscales, including Approaches to Learning, Self-control, Interpersonal Skills, Externalizing Problem Behaviors, and Internalizing Problem Behaviors. Teachers were asked to report how often students exhibited certain social skills and behaviors. Each item was rated by teachers on a scale of one ("never") to four ("very often"). The Approaches to Learning scale contains six items and assesses behaviors that affect how well students can benefit from the learning environment (e.g., attentiveness, task persistence, eagerness to learn, learning independence, flexibility, and organization). (This scale is also called "task management skills" and we use the two terms interchangeably throughout the paper.) The 4-item Self-Control scale measures the child's ability to control his or her behavior (e.g., respecting the property rights of others, controlling temper, accepting peer ideas for group activities, and responding appropriately to peer pressure). The Interpersonal Skills scale contains five items that rate the child's skill in forming and maintaining friendships, getting along with people, comforting or helping others, expressing feelings, ideas, and opinions in positive ways, and showing sensitivity to the feelings of others. The Externalizing Problem Behaviors scale includes six items asking how frequently the child displays acting out behaviors (e.g. arguing, fighting, getting angry, acting impulsively, disturbing ongoing activities, and talking during quiet study time). The Internalizing Problem Behaviors scale has four items and asks about the presence of anxiety, loneliness, low self-esteem, and sadness. The split-half reliabilities of the five social skills scale scores for the third and fifth grade respectively were .91 and .91 (Approaches to Learning), .79 and .79 (Self-control), .89 and .88 (Interpersonal), .89 and .89 (Externalizing Problem Behaviors), and .76 and .77 (Internalizing Problem Behaviors). To identify children with specific behavioral problem, we used 10% cutoff at the bottom or "worse" end of the distributions of scores of the five subscales measuring children's social development. The 10% cutoff was employed based on the reported prevalence of behavioral difficulties by empirical work (Feil, et al., 2005; Roberts, Attkisson, & Rosenblatt, 1998).

Controlled confounds—We also included many other variables that might be potential confounds for the co-occurrence between reading and behavioral difficulties. Because we extended prior investigations of earlier elementary time periods in Morgan et al.'s study (2008) to upper elementary grades, we used the same set of controlled confounds as the one used in their study. These confounding variables were selected from the database of the ECLS-K. They included the child's race/ethnicity, the child's gender, the child's age at kindergarten entry, the child's household structure, number of siblings, the mother's age at first birth, whether the racial composition of the child's school was more than 25% Black or Hispanic, the percentage of the school's students eligible for free lunch, and whether the child's school was located in an urban or rural area. We also included confounds describing the child's family resources, such as mother's and father's education levels, whether the family's income was below the federal poverty level, and whether the family participated in federal assistance programs, such as Aid to Families with Dependent Children (AFDC), food stamps, Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), or Head Start. Additionally, as further detailed below, we included autoregressive prior history of academic or behavioral difficulties, operationalized as whether the child was

displaying a very low (i.e., bottom 10%) level of functioning on the reading or behavioral measure in analyses of the risk, respectively, of later reading or behavioral difficulties.

Analytical Strategy

We examined whether children who were poor readers in third grade were more likely to display any of the five types of behavioral difficulties in fifth grade, as well as whether those displaying behavioral difficulties in third grade were more likely to be poor readers in fifth grade. We also examined whether children who were poorly skilled in mathematics in third grade were more likely to display reading and/or behavioral difficulties in fifth grade.

We then used multilevel logistic regression modeling to conduct six separate analyses (as reported in Table 2). The first five regressions each included a different one of the five types of problem behaviors in the fifth grade as the dichotomous dependent variable. These regressions examined how each of the problem behaviors in fifth grade was predicted by reading difficulties in third grade by also controlling for a prior history of the specific problem behavior, a prior history of mathematics difficulties, and other potential confounding variables at the previous time point. To address this question, the key independent variable of interest was the dummy variable for reading difficulties in the spring of third grade (see the row labeled as "T5 reading problems" in the first five columns of Table 2). The last analysis included reading difficulties by the fifth grade as the dichotomous dependent variable, and examined whether any of the problem behaviors in the third grade acted as risk factors for the later reading difficulties while controlling for a prior history of reading difficulties, mathematics difficulties, and other confounding variables at the prior (third grade) time point. To answer this question, the key independent variable was the five types of behavior problems as operationalized by dummy variables (see the rows labeled as "T5 approaches problems," "T5 self-control problems," "T5 interpersonal problems," "T5 externalizing problems," and "T5 internalizing problems" in the final column of Table 2). Among these six regression analyses, we also examined whether mathematics itself was a risk factor for reading and behavioral difficulties, and whether reading difficulties continued to constitute a risk factor for behavioral difficulties after also accounting for mathematics difficulties (see the row labeled as "T5 math problems").

We reported odds ratios (ORs) in our logistic regression. Odds ratios provide a basic interpretation for the magnitude of the parameter estimates (Agresti, 2002). Specifically, an estimated odds ratio indicates that for every unit increase in the predictor variable, the odds of the event being present is multiplied by the odds ratio.

Missing Data

Data were missing in the ECLS-K for each of the predictors used in this study in each survey wave. We did not consider the occurrence of missing values as missing completely at random (MCAR). However, the ECLS-K contains a large amount of information on children and their families, including variables that help account for the mechanisms resulting in missing data (e.g. race/ethnicity, age, gender, and SES). Therefore, controlling for these variables leads to the reasonable assumption of missing at random (MAR). Given the pattern of missing data, we employed multiple imputation using the IVEware computer program

(Raghunathan, Lepkowski, Van Hoewyk, & Solenberger, 2001). The imputation procedures involved two steps. First, we imputed values for those variables with missing data five times to create five complete data sets. Then, the five data sets were combined into one set of findings using formulas developed by Rubin (1977). Multiple imputation procedures enabled us to retain the largest possible number of children in our analytical sample and minimize selection bias resulting from dropping cases due to missing data. In contrast to single imputation, multiple imputation incorporates uncertainty into the standard errors of imputed values by accounting for variance between imputed solutions (Acock, 2005; Allison, 2002; Rubin, 1996; Schafer 1999).

Results

Do Reading Difficulties Increase Children's Risk of Behavioral Difficulties?

The first column in Table 2 displays the results for predicting problems in task management. The odds ratio for reading difficulties was 1.45 ($p < .01$), indicating that, for children who were poor readers in the third grade, the odds that they displayed poor task management skills in the fifth grade were 1.45 times higher than the odds for average-to-good readers, statistically controlling for poor task management skills in the third grade, mathematics difficulties in the third grade, and many additional child-related, family-related, and school-related variables. The second column in Table 2 presents the results for difficulties in self-control. The odds that poor readers in the third grade displayed self-control problems in the fifth grade were 1.4 times higher than the odds for otherwise similar children who were average-to-good readers. In the third column for interpersonal skills, the results indicated that, for those children who were poor readers in the third grade, the odds that they showed poor interpersonal skills in the fifth grade was 1.57 times higher than the odds for average-to-good readers, statistically controlling for poor interpersonal skills in the third grade, poor mathematics performance, and the study's additional confounds. In the fourth column, the analysis also showed a significant finding for externalizing problem behaviors. We find that for those children who were poor readers in the third grade, the odds of displaying externalizing problem behaviors in the fifth grade were 1.31 times greater than the odds for otherwise similar average-to-good readers. The fifth column indicates that the being a poor reader in the third grade increased children's odds by 1.30 of experiencing internalizing problem behaviors in the fifth grade compared to those who were average-to-good readers. Overall, these five regressions indicate a consistent and statistically significant relation between earlier reading difficulties and later behavioral difficulties. Reading difficulties in the third grade increase children's risk of behavioral difficulties in the fifth grade over and above a prior history of behavioral difficulties and many additional potential confounds. The relation is evident across five distinct indicators of maladaptive behavioral functioning.

Do Behavioral Difficulties Increase Children's Risk of Reading Difficulties?

The final column in Table 2 displays the results of regression analysis predicting reading difficulties in the fifth grade with the five types of behavioral difficulties included as independent variables. Only difficulties in task engagement is a statistically significant predictor of reading difficulties. Specifically, if a child displayed low skills in task management in third grade, the odds of being a poor reader in the fifth grade for that child

were 1.49 times higher than the odds for an average-to-good reader, statistically controlling for a prior history of reading and mathematics difficulties in the third grade and additional confounding variables. These factors remain predictive of later reading difficulties despite the very strong OR of almost 20 associated with being a poor reader in third grade for the odds of being a poor reader in fifth grade.

Do Mathematics Difficulties Increase Children's Risk of Reading or Behavioral Difficulties?

Table 2 results indicate that mathematics difficulties in third grade predicted three types of behavioral difficulties in fifth grade, including task management problems (OR = 1.52), interpersonal skills problems (OR = 1.38), and internalizing behavioral problems (OR = 1.81). Thus, otherwise similar children who were poorly skilled in mathematics in third grade were more likely to display low skills in task management and low interpersonal problems, as well as internalizing behavior problems in fifth grade than otherwise similar children with average-to-good mathematics performance. This includes statistical control for a prior history of reading difficulties. The last column displayed the results of how reading and mathematics difficulties relate to each other. For those children who displayed mathematics difficulties in third grade, their odds of displaying reading difficulties in fifth grade were 5.14 times greater than the odds of children who displayed average-to-good math performance in third grade, controlling for all other variables, including the very strong OR associated with a prior history of reading difficulties.

Predictive Effects of Potential Confounds

Our analyses also revealed significant predictive effects of some potential confounds on reading and behavioral difficulties. We found a statistically significant effect of gender on reading and behavior problems. Boys were more likely to be poor readers and to display the five types of behavior problems than girls when all other variables were controlled. Household structure had a significant effect on all five types of behavior problems. Compared to children living with two biological parents, children living in a single-parent family or other-structure family (e.g., one biological parent and one stepparent or adoptive parent, and two stepparents or adoptive parents) were more likely to display each of the five behavior problems in 5th grade, controlling for all other variables. We also found that lower maternal education and family income below poverty level also were significant risk factors for reading difficulties.

Discussion

Our study examined three questions. First, we investigated whether reading difficulties increase children's risk for behavioral difficulties. In order to better estimate the relation between reading and behavioral difficulties, our analyses controlled for a wide range of potential confounds (i.e., prior behavior difficulties and mathematics difficulties in third grade, gender, race/ethnicity, and family structure). We also analyzed the risk associated with reading difficulties across five specific indicators of socio-emotional maladjustment. Results indicated that poor readers in third grade were repeatedly more likely to experience behavioral difficulties in fifth grade. The odds of exhibiting poor task management, poor self-control, poor interpersonal skills, externalizing behavior problems, or internalizing

behavior problems in fifth grade were 1.45, 1.40, 1.57, 1.31, and 1.30 times higher respectively for poor readers than for average-to-good readers. These estimates were adjusted for many potential confounds, including the autoregressive prior history of behavioral difficulties.

Second, we examined whether and to what extent behavioral difficulties increase children's risk for reading difficulties. We again controlled for many confounding variables, such as prior reading and mathematics difficulties in third grade, gender, race/ethnicity, mother's education, family poverty level, and family structure. The results indicated that only a prior history of poor task engagement in third grade increased children's risk for reading difficulties in the fifth grade. Specifically, the odds of being a poor reader in fifth grade were 1.49 times higher for children who displayed poor task management skills than for children who did not display poor task management problems in third grade. Thus, our study yielded no evidence that other types of behavioral difficulties (e.g., internalizing or externalizing problem behaviors) increase children's risk for later reading difficulties.

Third, we examined whether and to what extent mathematics difficulties increased children's risk for reading and/or behavioral difficulties. Prior work has indicated that mathematics difficulties may explain the co-occurrence of reading and behavioral difficulties, although this relation may be limited to internalizing problem behavior. Results indicated that, even after controls for possible confounds, mathematics difficulties constituted a risk factor for behavioral difficulties, and that this risk was observed for poor task engagement and poor interpersonal skills as well as internalizing problem behaviors. These ORs were similar in magnitude to those observed for reading difficulties, ranging from 1.38 (interpersonal skills) to 1.81 (internalizing problem behaviors). Our results also indicated that mathematics difficulties greatly increased children's risk for reading difficulties, even following statistical control for autoregressive prior reading difficulties. Specifically, the odds that children experiencing mathematics difficulties in third grade would experience reading difficulties in fifth grade were 5.14 times greater than for otherwise similar children who had not experienced mathematics difficulties. This predicted effect was observed despite the enormously strong OR of almost 20 associated with a prior history of reading difficulties, as well as statistical control for many additional factors.

Contributions to the Extant Knowledge Base

Our results demonstrating a link between reading and behavior problems support the findings in the previous studies, which have reported a bi-directional relationship between the two factors (Hinshaw, 1992; Morgan et al., 2008; Onatsu-Arvilommi & Nurmi, 2000). However, our study helps clarify that reading difficulties increase the risk for generalized socio-emotional maladjustment, while only one specific type of behavioral difficulties (i.e., poor task engagement) increases the risk for reading difficulties. This pattern of findings is consistent with Morgan et al.'s (2008) prior study using a younger sample of children (i.e., children from first to third grade). One difference between Morgan et al.'s findings and ours is that we found that reading difficulties in third grade significantly increase the risk for all five types of behavioral difficulties in fifth grade while Morgan et al.'s study reported that reading difficulties in first grade increase the risk for only four types of behavioral

difficulties in third grade. In their prior study, they did not observe reading difficulties as a significant risk factor for poor interpersonal skills. This difference may indicate that early reading difficulties make generalized socio-emotional maladjustment "worse" from third to fifth grade as apposed to first to third grade. Our findings extend other investigations by analyzing a larger and more nationally representative sample, statistically controlling for prior reading and behavior variables, and adding many potential confounding variables in our analyses (e.g., Ayllon & Roberts, 1974; Barton-Arwood et al., 2005; Wehby et al., 2003; Hinshaw, 1992; Feil et al., 2005; Kaplan & Walpole, 2005; Lepola, 2004). Moreover, our study extends previous work by examining the risk attributable uniquely to mathematics difficulties, and by situating the analyses within the time period between third and fifth grades when children transition from "learning to read" to "reading to learn."

Our finding of the relations between mathematics and behavioral difficulties also contributes to the related literature. We found that mathematics difficulties in third grade are statistically significantly associated with three types of behavior problems in fifth grade – poor task management, poor interpersonal skills, and internalizing behavior problems. Prior work has suggested that mathematics difficulties may increase children's risk of behavioral difficulties, and so may help explain the observed co-occurrence between reading and behavioral difficulties, although the relation may be limited to increasing children's risk for internalizing problem behaviors (Morgan et al., 2012; Rourke, 1988; Rourke et al, 1989). Our study supports the conclusion that mathematics difficulties uniquely increase children's risk for behavioral difficulties. However, and contrary to these prior investigations, we find that this risk generalizes to other types of behavior problems. Thus, mathematics difficulties, independent of reading difficulties, increases children's risk of generalized socio-emotional maladjustment. We find that reading difficulties continue to predict the later occurrence of a fuller range of behavioral difficulties, even after accounting for a prior history of mathematics difficulties.

Limitations

Several limitations characterize this study. First, we evaluated children's social skills and behaviors based only on the information provided from teachers. Teachers may only observe certain social skills and behaviors that happen more frequently in school settings, but be less able to report on behaviors occurring outside of classrooms. Multiple informants about children's exhibition of social skills and behavior, such as parents' reports or experimenters' observations, may produce more informative and thorough data. Another limitation is that in order to capture some important confounding variables at school level within the time period between third and fifth grade, we constrained our sample to those children who attended the same school between the two time points. We may have failed to capture certain characteristics of the children who were excluded from the study. We also used scores from the reading and mathematics assessing general achievement, as these IRT-scaled scores are best suited for analyzing achievement growth. However, we are unable to report on specific types of cognitive characteristics (e.g., working memory, phonological sensitivity) or academic sub-skills (e.g., addition, reading fluency) that may be most predictive of later academic or behavioral difficulties. Another limitation is related to the analytical approaches taken in the current study. We used multilevel logistic regression to analyze our data and

considered it as an appropriate statistical technique to answer our research questions. Logistic regression is a commonly employed analytical tool to identify risk factors for disorders or conditions (Ely, Dawson, Mehr, & Burns, 1996). However, there are many other analytical techniques that can be used. One possibility is path analysis in the structural equation modeling family, where a structural model that represents all causal hypotheses is specified in advance based on empirical evidence and then tested. Onatsu-Arvilommi and Nurmi (2000) employed structural equation modeling approach and reported a bi-directional relation between reading and behavioral difficulties. One advantage of our analyses as presently reported is that they focus the findings on the relations of interest, including how these relations are mediated or moderated by the study's many additional predictors.

Implications for Future Research and Practice

This study has both theoretical and educational implications. Theoretically, our findings raise several questions requiring further investigation. First, our study provides strong evidence of a predictive relation between reading and behavior difficulties, yet the responsible mechanisms remain to be identified. Second, we also found a predictive relation between mathematics and behavioral difficulties even following adjustment for a prior history of reading difficulties. However, we did not look into the question whether early behavioral difficulties is a risk factor for later mathematics difficulties. This directionality of the relationship requires further investigation. Previous research has established the predictive relation between reading and behavioral difficulties from first to third grade (Morgan et al., 2008). Our study suggests that this relation extends to the time period between third and fifth grade, and is not explained by many other confounding factors including mathematics difficulties. However, whether and to what extent this relation between academic and behavioral difficulties extends to the middle and high school grades remains unclear.

In terms of educational implications, our findings suggest that preventing both reading and mathematics difficulties in third grade may help reduce children's risk of later experiencing socio-emotional maladjustment in fifth grade. Moreover, this conclusion is consistent with previous research reporting similar findings from first to third grade (Morgan et al., 2008). The findings from the two studies suggest that for those children with reading difficulties in first grade and experiencing socio-emotional maladjustment in third grade, as they age, the situation does not get better, but persists and even gets worse from third to fifth grade. Therefore, it necessitates a greater focus on early screening, monitoring, and interventions for practitioners. It is also clear from our study that intervening to prevent mathematics difficulties and poor task engagement may help reduce children's risk of later experiencing reading difficulties (although preventing reading difficulties by third grade would clearly be the most important target of intervention identified in our analyses for preventing reading difficulties by fifth grade). This also suggests that preventing other types of behavior problems but not specifically poor task engagement is unlikely to have much of an effect on academic difficulties. Collectively, the study's analyses indicate that reading, mathematics, and behavioral difficulties inter-relate, with both reading and mathematics difficulties independently increasing children's risk for later behavioral difficulties. In contrast, only those types of behavioral difficulties most closely associated with classroom learning (e.g.,

inattention, disorganization) increase children's risk of later reading difficulties. Thus, these findings support theoretical accounts that reading and mathematics difficulties may each contribute to increasing socio-emotional maladjustment and, as indicated here, this occurs as children are beginning the critical transition to middle school.

References

Acock AC. Working with missing values. Journal of Marriage and Family. 2005; 67:1012–1028.

Agresti, A. Categorical data analysis. 2nd ed. New York: John Wiley & Sons; 2002. Logistic regression; p. 165-210.

Allison, PD. Missing data. Thousand Oaks, CA: Sage; 2002.

Allyon T, Roberts MD. Eliminating discipline problems by strengthening academic performance. Journal of Applied Behavior Analysis. 1974; 7:71–76. [PubMed: 4465374]

Arnold EM, Goldston DB, Walsh AK, Reboussin BA, Daniel SS, Hickman E, et al. Severity of emotional and behavioral problems among poor and typical readers. Journal of Abnormal Child Psychology. 2005; 33:205–217. [PubMed: 15839498]

Barton-Arwood SM, Wehby JH, Falk KB. Reading instruction for elementary-age students with emotional and behavioral disorders: Academic and behavioral outcomes. Exceptional Children. 2005; 72:7–27.

Bennett KJ, Brown KS, Boyle M, Racine Y, Offord D. Does low reading achievement at school entry cause conduct problems? Social Science and Medicine. 2003; 56:2443–2448. [PubMed: 12742607]

Catts HW, Fey ME, Zhang X, Tomblin JB. Estimating the risk of future reading difficulties in kindergarten children: A research-based model and its clinical implementation. Language, Speech, and Hearing Services in Schools. 2001; 32:38–50.

Carroll JM, Maughan B, Goodman R, Meltzer H. Literacy difficulties and psychiatric disorders: Evidence for comorbidity. Journal of Child Psychology and Psychiatry. 2005; 46:524–532. [PubMed: 15845132]

Chapman JW. Learning disabled children's self-concepts. Review of Educational Research. 1988; 58:347–371.

Chapman JW, Tunmer WE, Prochnow JE. Early reading-related skills and performance, reading self-concept, and the development of academic self-concept: A longitudinal study. Journal of Educational Psychology. 2000; 92:703–708.

Chen X, Rubin KH, Li B. Depressed mood in Chinese children: Relations with school performance and family environment. Journal of Consulting and Clinical Psychology. 1995; 63:938–947. [PubMed: 8543716]

Coie JD, Krehbiel G. Effects of academic tutoring on the social status of low-achieving, socially rejected children. Child Development. 1984; 55:1465–1478.

Dishion TJ, Patterson GR, Stoolmiller M, Skinner ML. Family, school, and behavioral antecedents to early adolescent involvement with antisocial peers. Developmental Psychology. 1991; 27:172–180.

Echols LD, West RF, Stanovich KE, Zehr KS. Using children's literacy activities to predict growth in verbal cognitive skills: A longitudinal investigation. Journal of Educational Psychology. 1996; 88:296–304.

Ely JW, Dawson JD, Mehr DR, Burns TL. Understanding logistic regression analysis through example. Family Medicine. 1996; 28:134–140. [PubMed: 8932495]

Feil EG, Small JW, Forness SR, Serna LA, Kaiser A, Hancock TB, et al. Using different measures, informants, and clinical cut-off points to estimate prevalence of emotional or behavioral disorders in preschoolers: Effects on age, gender, and ethnicity. Behavioral Disorders. 2005; 30:375–391.

Fitzpatrick C, Pagani LS. Toddler working memory skills predicts kindergarten school readiness. Intelligence. 2012; 40:205–212.

Fleming CB, Harachi TW, Cortes RC, Abbott RD, Catalano RF. Level and change in reading scores and attention problems during elementary school as predictors of problem behavior in middle school. Journal of Emotional and Behavioral Disorders. 2004; 12:130–144.

Fuchs LS, Fuchs D, Prentice K. Responsiveness to mathematical problem-solving instruction: Comparing students at risk of mathematics disability with and without risk of reading disability. Journal of Learning Disabilities. 2004; 37:293–306. [PubMed: 15493402]

Geary DC. Mathematics and learning disabilities. Journal of Learning Disabilities. 2004; 37:4–15. [PubMed: 15493463]

Greenbaum PE, Dedrick RF, Friedman RM, Kutash K, Brown EC, Lardieri SP, et al. National Adolescent and Child Treatment Study (NACTS): Outcomes for children with serious emotional and behavioral disturbance. Journal of Emotional and Behavioral Disorders. 1996; 4:130–146.

Greenham SL. Learning disabilities and psychosocial adjustment: A critical review. Child Neuropsychology. 1999; 5:171–196.

Guthrie JT, Schafer WD, Huang C-W. Benefits of opportunity to read and balanced instruction on the NAEP. Journal of Educational Research. 2001; 94:145–162.

Griffiths YM, Snowling MJ. Predictors of exception word and nonword reading in dyslexic children: The severity hypothesis. Journal of Educational Psychology. 2002; 94:34–43.

Hinshaw SP. Externalizing behavior problems and academic underachievement in childhood and adolescence: Causal relationships and underlying mechanisms. Psychological Bulletin. 1992; 111:127–155. [PubMed: 1539086]

Jordan NC, Kaplan D, Hanich LB. Achievement growth in children with learning difficulties in mathematics: findings of a two-year longitudinal study. Journal of Educational Psychology. 2002; 94:586–597.

Jorm AF, Share DL, Matthews R, Maclean R. Behaviour problems in specific reading retarded and general reading backward children: A longitudinal study. Journal of Child Psychology and Psychiatry. 1986; 27:33–43. [PubMed: 3949905]

Kaplan D, Walpole S. A stage-sequential model of reading transitions: Evidence from the Early Childhood Longitudinal Study. Journal of Educational Psychology. 2005; 97:551–563.

Kauffman JM, Cullinan D, Epstein MH. Characteristics of students placed in special programs for the seriously emotionally disturbed. Behavioral Disorders. 1987; 12:175–184.

Kempe C, Gustafson S, Samuelsson S. A longitudinal study of early reading difficulties and subsequent problem behaviors. Scandinavian Journal of Psychology. 2011; 52:242–250. [PubMed: 21332486]

Konold, TR.; Juel, C.; McKinnon, M. Building an integrated model of early reading acquisition (Technical Report. No. 1–1003). 1999. Retrieved from http://www.ciera.org/library/reports/inquiry-1/1-003/1-003.html

Lepola J. The role of gender and reading competence in the development of motivational orientations from kindergarten to grade 1. Early Education and Development. 2004; 15:215–240.

Lopes J, Cruz C, Rutherford RB. The relationship of peer perceptions to student achievement and teacher ratings of 5th and 6th grade students. Education and Treatment of Children. 2002; 25:476–495.

Maughan B, Rowe R, Loeber R, Stouthamer-Loeber M. Reading problems and depressed mood. Journal of Abnormal Child Psychology. 2003; 31:219–229. [PubMed: 12735404]

McGee R, Williams S, Share DL, Anderson J, Silva PA. The relationship between specific reading retardation, general reading backwardness and behavioral problems in a large sample of Dunedin boys: A longitudinal study from five to eleven years. Journal of Child Psychology and Psychiatry. 1986; 27:597–610. [PubMed: 3771677]

Morgan AB, Lilienfeld SO. A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. Clinical Psychology Review. 2000; 20:113–136. [PubMed: 10660831]

Morgan PL, Farkas G, Tufis PA, Sperling RA. Are reading and behavior problems risk factors for each other? Journal of Learning Disabilities. 2008; 41:417–436. [PubMed: 18768774]

Morgan PL, Farkas G, Wu Q. Kindergarten predictors of recurring externalizing and internalizing psychopathology in the third and fifth grades. Journal of Emotional and Behavioral Disorders. 2009; 17:67–79.

Morgan PL, Farkas G, Wu Q. Do poor readers feel angry, sad, and unpopular? Scientific Studies of Reading. 2012; 16:360–381.

National Center for Education Statistics. User's manual for the ECLS-K third grade public-use data file and electronic code book (NCES 2004–001). Washington, DC: U.S. Department of Education, Institute for Education Sciences; 2004.

Nelson JR, Benner GJ, Lane K, Smith BW. Academic achievement of K-12 students with emotional and behavioral disorders. Exceptional Children. 2004; 71:59–73.

Nelson JR, Stage SA, Epstein MH, Pierce CD. Effects of a prereading intervention on the literacy and social skills of children. Exceptional Children. 2005; 72:29–45.

Onatsu-Arvilommi T, Nurmi J-E. The role of task-avoidant and task-focused behaviors in the development of reading and mathematical skills during the first school year: A cross-lagged longitudinal study. Journal of Educational Psychology. 2000; 92:478–491.

Raghunathan TE, Lepkowski JM, Van Hoewyk J, Solenberger P. A multivariate technique for multiply imputing missing values using a sequence of regression models. Survey Methodology. 2001; 27:85–95.

Rivera MO, Al-Otaiba S, Koorland MA. Reading instruction for students with emotional and behavioral disorders and at risk for antisocial behaviors in primary grades: Review of the literature. Behavioral Disorders. 2006; 31:323–337.

Roeser RW, van der Wolf K, Strobel KR. On the relation between social-emotional and school functioning during early adolescence: Preliminary findings from Dutch and American samples. Journal of School Psychology. 2001; 39:111–139.

Rubin DB. Formalizing subjective notions about the effect of nonrespondents in sample surveys. Journal of the American Statistical Association. 1977; 72:538–543.

Rubin DB. Multiple imputation after 18+ years. Journal of the American Statistical Association. 1996; 9:473–489.

Roberts RE, Attkisson CC, Rosenblatt A. Prevalence of psychopathology among children and adolescents. American Journal of Psychiatry. 1998; 155:715–725. [PubMed: 9619142]

Rourke BP. Socioemotional disturbances of learning disabled children. Journal of Consulting and Clinical Psychology. 1988; 56:801–810. [PubMed: 3060497]

Rourke BP, Young GC, Leenaars AA. A childhood learning disability that predisposes those afflicted to adolescent and adult depression and suicide risk. Journal of Learning Disabilities. 1989; 22:169–175. [PubMed: 2708893]

Schafer JL. Multiple imputation: A primer. Statistical Methods in Medical Research. 1999; 8:3–15. [PubMed: 10347857]

Senechal M, LeFevre J-A, Hudson E, Lawson EP. Knowledge of storybooks as a predictor of young children's vocabulary. Journal of Educational Psychology. 1996; 88:520–536.

Shalev RS, Auerbach J, Manor O, Gross-Tsur V. Developmental dyscalculia: Prevalence and prognosis. European Child and Adolescent Psychiatry. 2000; 9:58–64.

Spira EG, Bracken SS, Fischel JE. Predicting improvement after first-grade reading difficulties: The effects of oral language, emergent literacy, and behavior skills. Developmental Psychology. 2005; 41:225–234. [PubMed: 15656751]

Stanovich K. Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly. 1986; 21:360–407.

Tourangeau, K.; Nord, C.; Lê, T.; Pollack, JM.; Atkins-Burnett, S. U.S. Department of Education. Washington, DC: National Center for Education Statistics; 2006. Early childhood longitudinal study, kindergarten class of 1998–99 (ECLS-K), combined user's manual for the ECLS-K fifth-grade data files and electronic codebooks (NCES 2006–032).

Trzesniewski KH, Moffitt TE, Caspi A, Taylor A, Maughan B. Revisiting the association between reading achievement and antisocial behavior: New evidence from an environmental explanation from a twin study. Child Development. 2006; 77:72–88. [PubMed: 16460526]

Vukovic RK, Siegel LS. Academic and cognitive characteristics of persistent mathematics difficulty from first through fourth grade. Learning Disabilities Research & Practice. 2010; 25:25–38.

Wehby JH, Falk KB, Barton-Arwood S, Lane KL, Cooley C. The impact of comprehensive reading instruction on academic and social behavior of students with emotional and behavioral disorders. Journal of Emotional and Behavioral Disorders. 2003; 11:225–238.

White JL, Moffitt TE, Silva PA. Neuropsychological and socio-emotional correlates of specific-arithmetic disability. Archives of Clinical Neuropsychology. 1992; 7:1–16. [PubMed: 14589674]

Woodcock, RW.; McGrew, KS.; Werder, JK. Woodcock-McGrew-Werder Mini-Battery of Achievement. Itasca, IL: Riverside Publishing; 1994.

Table 1

Descriptive Statistics of the Study's Analytical Sample

Variable	*M*	*SD*	Min	Max
Gender – male (T1)	0.50		1.00	0.00
Age at K entry in months (T1)	68.49	4.23	79.00	54.00
Mother's educational level (T5)				
Less than high school	0.11		1.00	0.00
High school diploma or equivalent	0.26		1.00	0.00
Some college (including vocational/technical training)	0.35		1.00	0.00
Bachelor's degree or higher	0.28		1.00	0.00
Father's educational level (T5)				
Less than high school	0.13		1.00	0.00
High school diploma or equivalent	0.28		1.00	0.00
Some college (including vocational/technical training)	0.27		1.00	0.00
Bachelor's degree or higher	0.31		1.00	0.00
Family living below federal poverty level (T5)	0.18		1.00	0.00
Family received AFDC (T5)	0.03		1.00	0.00
Family received food stamps (past 12 months) (T5)	0.08		1.00	0.00
Received WIC (T1)				
During both pregnancy and childhood	0.27		1.00	0.00
During either pregnancy or childhood	0.06		1.00	0.00
During neither pregnancy nor childhood	0.66		1.00	0.00
Head start participation (T1)	0.12		1.00	0.00
Race (T1)				
Black non-Hispanic	0.11		1.00	0.00
Hispanic	0.17		1.00	0.00
Asian	0.06		1.00	0.00
Other	0.05		1.00	0.00
White non-Hispanic	0.61		1.00	0.00
Household structure (T5)				
Single-parent family	0.19		1.00	0.00
Other structure	0.12		1.00	0.00
Two parents, both biological	0.69		1.00	0.00
Number of siblings in household (T5)	1.57	1.17	11.00	0.00
Primary home language – not English (T4)	0.11		1.00	0.00
Current mom teenager at first birth – younger than 19 (T1)	0.21		1.00	0.00
Census region (T5)				
Northeast	0.18		1.00	0.00
Midwest	0.28		1.00	0.00
South	0.32		1.00	0.00
West	0.22		1.00	0.00
Urbanicity (T5)				

Variable	*M*	*SD*	Min	Max
Large and mid-size cities	0.36		1.00	0.00
Large and mid-size suburb and large town	0.38		1.00	0.00
Small town and rural	0.26		1.00	0.00
More than 25% Black students in school – Level 2 (T5)	0.15		1.00	0.00
More than 25% Hispanic students in school – Level 2 (T5)	0.19		1.00	0.00
% eligible for free lunch – Level 2 (T5)	35.53	26.87	95.00	0.00
Reading in bottom 10% (IRT scale) (T5)	0.10		1.00	0.00
Reading in bottom 10% (IRT scale) (T6)	0.10		1.00	0.00
Math in bottom 10% (IRT scale) (T5)	0.10		1.00	0.00
Math in bottom 10% (IRT scale) (T6)	0.10		1.00	0.00
Approaches to learning – bottom 10% (T5)	0.12		1.00	0.00
Approaches to learning – bottom 10% (T6)	0.08		1.00	0.00
Self-control – bottom 10% (T5)	0.10		1.00	0.00
Self-control – bottom 10% (T6)	0.06		1.00	0.00
Interpersonal skills – bottom 10% (T5)	0.12		1.00	0.00
Interpersonal skills – bottom 10% (T6)	0.08		1.00	0.00
Externalizing behavior problems – upper 10% (T5)	0.10		1.00	0.00
Externalizing behavior problems – upper 10% (T6)	0.10		1.00	0.00
Internalizing behavior problems – upper 10% (T5)	0.14		1.00	0.00
Internalizing behavior problems – upper 10% (T6)	0.15		1.00	0.00

Note. T1 = fall of kindergarten; T4 = spring of first grade; T5 = spring of third grade; T6 = spring of fifth grade; Level 1 is student level *n* = 9,324. Level 2 is school level *n* = 966. AFDC = Aid to Families with Dependent Children; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children; IRT = Item Response Theory.

Table 2

Odds Ratios in Multilevel Logistic Regression Analyses of Behavior and Reading Problems in the Spring of Fifth Grade

	T6 Approaches Problems	T6 Self-Control Problems	T6 Interpersonal Problems	T6 Externalizing Problems	T6 Internalizing Problems	T6 Reading Problems
			Odds Ratios			
T5 reading problems	1.45 **	1.40 *	1.57 ***	1.31 *	1.30 *	19.69 ***
T5 approaches problems	4.27 ***					1.49 **
T5 self-control problems		4.15 ***				0.68
T5 interpersonal problems			3.77 ***			1.10
T5 externalizing problems				5.50 ***		1.32
T5 internalizing problems					2.38 ***	1.29
T5 math problems	1.52 ***	1.23	1.38 *	1.25	1.81 ***	5.14 ***
More than 25% Black students	1.08	0.93	1.24	0.92	0.86	1.28
More than 25% Hispanic students	1.05	0.89	0.91	0.92	0.76 *	1.04
% eligible for free lunch	1.00	1.00	1.00	1.00	1.00	1.01
Gender (male)	3.08 ***	2.10 ***	2.32 ***	2.66 ***	1.24 ***	1.45 ***
Age at K entry	1.05	0.99	0.99	1.08	0.96	1.08
Mother's education						
Less than high school	1.45	0.94	1.14	0.82	0.91	2.38 ***
High school diploma	1.30	0.99	1.23	0.97	0.94	1.88 **
Some college	1.42 *	1.06	1.14	0.95	1.02	1.39
Father's education						
Less than high school	1.28	1.27	1.26	1.25	1.37 *	1.57
High school diploma	1.18	1.33	1.14	1.30 *	1.20	1.57 *
Some college	1.07	1.10	1.09	1.29 *	1.03	1.29

	T6 Approaches Problems	T6 Self-Control Problems	T6 Interpersonal Problems	T6 Externalizing Problems	T6 Internalizing Problems	T6 Reading Problems
				Odds Ratios		
Family below poverty level	1.02	1.26	1.08	1.04	1.14	1.59 ***
Federal programs						
Family received AFDC	1.07	0.66	1.06	1.08	1.34	0.99
Family received food stamps	1.18	1.14	1.18	1.19	1.01	0.80
WIC during both pregnancy and childhood	1.04	0.94	0.92	1.00	1.18 *	1.18
WIC during either pregnancy or childhood	0.96	1.04	0.85	1.12	1.19	1.06
Head start participation	1.12	1.17	1.30 *	1.05	0.93	1.05
Race						
Black non-Hispanic	1.40 *	1.42 *	1.19	1.76 ***	0.62 ***	1.47 *
Hispanic	0.94	1.16	0.94	1.15	0.81	1.13
Asian	0.51 *	0.48 *	0.64	0.45 **	0.60 **	1.46
Other	1.02	1.21	1.00	1.05	0.82	1.77 **
Household structure						
Single-parent family	1.35 **	1.46 **	1.4 **	1.63 ***	1.35 ***	1.16
Other structure	1.87 ***	2.07 ***	1.73 ***	1.92 ***	1.50 ***	1.09
Number of siblings	1.08	0.70 *	0.78	0.95	1.08	1.53 **
Home language not English	1.19	1.05	1.14	0.98	0.93	1.16
Mother's age at first birth	1.17	1.30	1.06	1.32 **	1.05	1.08
Census region						
Midwest	1.07	1.26	1.33	1.13	1.13	1.41 *
South	0.94	1.21	1.13	1.05	1.11	1.13
West	0.95	1.15	1.07	1.14	0.97	1.24
Urbanicity						

	T6 Approaches Problems	T6 Self-Control Problems	T6 Interpersonal Problems	T6 Externalizing Problems	T6 Internalizing Problems	T6 Reading Problems
				Odds Ratios		
Large and mid-size cities	1.13	1.20	1.06	1.07	1.16	0.87
Small town and rural	0.85	0.95	0.96	0.81	0.87	1.26
Level 2 variance	0.39	0.49	0.42	0.46	0.33	0.16

Note. T5 = spring of third grade; T6 = spring of fifth grade; Level 1 is student level n = 9,324. Level 2 is school level n = 966. AFDC = Aid to Families with Dependent Children; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children; IRT = Item Response Theory.

*
$p < .05$.

**
$p < .01$.

***
$p < .001$.