

An Examination of Problem Behaviors and Reading Outcomes in Kindergarten Students

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Abstract

This study examined the influences of problem behaviors on kindergarten reading outcomes and investigated the extent to which explicit, code-based reading instruction moderated those relations among 206 children identified as being at risk of reading difficulty. Children from the classrooms of 57 kindergarten teachers in 12 schools were randomly assigned to an early reading intervention program or school-determined comparison intervention. In both conditions, children received 30 minutes of small-group supplementary reading instruction for 21 weeks. Findings from multilevel modeling revealed many associations between problem behaviors and reading outcomes for children in both conditions. Interaction analyses indicated that explicit, code-based reading intervention moderated the negative impact of externalizing problem behavior on end-of-kindergarten measures of alphabet knowledge, phonemic blending, and word reading. This type of intensive systematic reading instruction also moderated the influence of hyperactivity on children's alphabet knowledge and phonemic blending. There were no moderator effects for internalizing problem behavior.

Keywords

problem behavior, early reading intervention, Tier 2 reading intervention

Research underscoring linkages between problem behavior and poor academic performance is plentiful, and the implications for practice are complex. Collectively, empirical findings provide evidence of the intertwined and likely reciprocal nature of the problem behavior–achievement association (Fleming, Harachi, Cortes, Abbott, & Catalano, 2004; Hinshaw, 1992b; Lane, 1999; Maguin & Loeber, 1995). The linkages between problem behaviors and reading difficulties are particularly well documented (Al Otaiba & Fuchs, 2002; Maguin & Loeber, 1995; McGee, Williams, Share, Anderson, & Silva, 1986; Morgan, Farkas, Tufis, & Sperling, 2008; Nelson, Benner, & Gonzalez, 2003).

Al Otaiba and Fuchs's synthesis (2002) of 23 investigations examining characteristics of children who failed to respond to early literacy intervention identified nine studies that documented the co-occurrence of attention deficits and behavioral problems and inadequate response to early reading intervention. Likewise, Nelson and colleagues (2003) conducted a synthesis of the characteristics of young learners (preschool through third grade) associated with nonresponse to early reading intervention and found problem behavior to be among the strongest predictors of poor reading outcomes, with that strength of relation second only to rapid automatized naming. Both reviews highlighted a need

for more research to examine the extent to which social behaviors may account for variance in reading outcomes. More recently, Morgan et al. (2008) investigated the degree to which reading and behavior problems were interrelated in a hypothesized bidirectional causal model. Using multilevel logistic regression modeling to quantify whether and to what degree one condition operated as a risk factor for another, they found that first-grade reading problems predicted third-grade problem behaviors, including acting out, withdrawing from classroom activities, poor self-control, and task avoidance. Conversely, with the exception of task engagement, none of their problem behavior measures (i.e., poor self-control, poor interpersonal skills, externalizing problem behaviors, internalizing problem behaviors) predicted third-grade reading problems.

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Dimensions of Problem Behavior Associated With Reading Difficulty

Studies exploring relations between problem behaviors and academic performance have used diverse approaches to define (and subsequently measure) problem behavior. Definitions range from broad single-dimension constructs, such as a combination of attention and/or all conduct problems (e.g., Al Otaiba & Fuchs, 2002), to more fine-grained classifications of problem behavior and their respective roles in predicting academic outcomes (e.g., Hinshaw, 1992a; Lane, O'Shaughnessy, Lambros, Gresham, & Beebe-Frankenberger, 2001; Morgan et al., 2008; Rabiner, Coie, & the Conduct Problems Prevention Research Group, 2000).

Several investigations examined the independent contributions of externalizing and internalizing behaviors to academic achievement, and the majority concluded that externalizing problem behaviors were more strongly associated with poor academic outcomes (Mattison, Spitznagel, & Felix, 1998; Nelson, Benner, Lane, & Smith, 2004; Nelson, Benner, Neill, & Stage, 2006). Yet, some researchers noted that students with internalizing problem behaviors also had lower academic outcomes relative to students with behaviors regarded as normal (Gresham, Lane, MacMillan, & Bocian, 1999; Harris, Oakes, Lane, & Rutherford, 2009). Others acknowledged the comorbidity of externalizing and internalizing problem behaviors (Gresham et al., 1999; Halonen, Aunola, Ahonen, & Nurmi, 2006; Hinshaw, 1992b; McConaughy & Skiba, 1993).

Some studies focused on more specific measures of problem behavior to identify children at risk of reading failure or to explore relations between behavior and reading achievement. Lane et al. (2001) used separate measures of externalizing behavior and hyperactivity along with low phonological awareness to identify first-grade children at risk of reading and behavior problems. Using single-case research, they examined the effects of explicit phonological awareness training on reading outcomes and disruptive classroom behaviors (a more precise type of externalizing problem behavior). They reported improved reading outcomes (on measures of nonsense word fluency and oral reading fluency) and noted that, as participating students' academic performance improved, their disruptive classroom behaviors decreased. In another single-case study of children with comorbid reading and behavioral problems, Lane et al. (2002) examined the effects of systematic phonics instruction using decodable chapter books on first graders' disruptive classroom behaviors and negative social interactions. Using direct observation to measure these more specific types of externalizing problem behaviors, they found increases in nonsense word fluency as well as decreases in both measures of problem behavior.

Rabiner et al. (2000) isolated hyperactivity from externalizing problem behaviors and inattention and measured their respective influences on reading outcomes for 387 children. They found small but statistically significant correlations ranging from $-.24$ to $-.27$ for three types of problem behaviors (overactivity, externalizing, and internalizing) and kindergarten word reading outcomes. These three types of problem behavior continued to have a similar negative influence with virtually the same strength of negative correlation on children's first- and fifth-grade reading outcomes.

In summary, correlational and intervention studies have documented that behavioral and reading problems are interrelated. These relations vary to some degree by behavior topography, with hyperactivity and externalizing behaviors more commonly associated with lower academic outcomes. Although there is no consensus regarding the directionality of this linkage, there is consensus among researchers that children at risk of reading problems often exhibit problem behaviors and that children who exhibit problem behaviors at school are at heightened risk of reading problems. There also is broad agreement that existing research fails to sufficiently identify effective reading interventions for children with coexisting problem behaviors and academic deficits (Coleman & Vaughn, 2000; Gunter & Denny, 1998; Rivera, Al-Otaiba, & Koorland, 2006; Wehby, Falk, Barton-Arwood, Lane, & Cooley, 2003).

Existing Reading Research on Children With Problem Behavior

Not surprisingly, a growing number of researchers are underscoring the need to better understand the curricular and instructional conditions under which students who exhibit problem behaviors can experience academic success (Coleman & Vaughn, 2000; Gunter & Denny, 1998; Harris et al., 2009; Vaughn, Levy, Coleman, & Bos, 2002; Wehby et al., 2003). Given that this population's resistance to intervention increases over time (Kazdin, 1993; Lane et al., 2002; Walker & Severson, 2002), the need for academic intervention early in their school careers is of critical importance.

Rivera et al. (2006) identified 11 investigations examining the efficacy of reading instruction for children with problem behaviors in primary grades (K–3). They examined whether studies incorporated five components of effective reading instruction identified by the National Reading Panel (2000): phonemic awareness, phonics, fluency, vocabulary, and comprehension. Eight studies incorporated one or more of the panel's components. Four studies included interventions focusing on phonemic awareness, six incorporated phonics, two studies addressed fluency, and one included text comprehension. None addressed vocabulary. Three of the earlier studies in Rivera and colleagues' review did not

address any of the effective reading components identified by the panel, instead focusing on sight word recognition. Furthermore, six studies incorporated strategies to improve student behavior (e.g., contingent use of verbal or tangible reinforcement, skills training for parents, skills training for children) in addition to some type of reading instruction. All 11 investigations reported improved reading outcomes. Rivera et al. (2006) surmised that, collectively, the studies provided some evidence supporting instructional approaches—including direct instruction, peer tutoring, and behaviorally based strategies, such as time delay prompting, trial and error, and differential reinforcement. Nonetheless, they cautioned, “Because of the lack of robust and systematic research, it is too early to conclude that scientifically based reading interventions can help leave no children with behavior challenges behind” (p. 335).

More evidence is needed to confirm the components of effective reading instruction that are effective among children with comorbid behavioral and reading problems. A logical approach would be to begin with the reading content and instructional practices proven to be effective for children at risk of reading difficulty and then examine the extent to which these evidence-based practices are sufficient for children who also exhibit behavioral difficulty.

Effective Early Reading Instruction

A substantial knowledge base provides strong consensus of the essential features of effective beginning reading instruction (National Reading Panel, 2000; National Research Council, 1998; Scamacca, Vaughn, Roberts, Wanzek, & Torgesen, 2007). This convergent body of research illuminates what to teach and provides guidance regarding how to effectively teach that information to learners at risk of reading difficulties (Foorman, Breier, & Fletcher, 2003; Foorman & Torgesen, 2001).

The Content of Beginning Reading Instruction

Descriptive and intervention research underscores the importance of phonemic awareness and alphabetic knowledge in kindergarten. These essential skills have significant implications for learning to read and predicting success in later grades (Elbro & Petersen, 2004; Foorman & Torgesen, 2001; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). Optimal beginning reading instruction integrates both phonemic and alphabetic/decoding skills. In a study of the necessity of the alphabetic principle for effective phonemic awareness instruction, Foorman and colleagues (2003) explained, “What seems to matter are activities where *phonemes* are blended and segmented in speech, then connected explicitly and systematically to graphemes in print, through phonics instruction” (p. 317, emphasis in original).

As children learn the connections between phonemes and graphemes, they must receive abundant opportunities to apply that knowledge. Code-based instruction that effectively combines phonemic and alphabetic skills has been found to be important for children at risk of reading difficulty (Brown & Felton, 1990; Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Hatcher, Hulme, & Ellis, 1994; Lovett, Borden, Lacerenza, Benson, & Brackstone, 1994; Torgesen et al., 1999; Vellutino et al., 1996). Accordingly, code-focused instruction on target phonemic skills (i.e., isolating first and last sounds, blending, and sequential segmentation) and alphabetic knowledge (i.e., relating letters to sounds, phonologically decoding and encoding words, applying skills in decodable text) provides optimal early reading content for at-risk learners.

The Pedagogy of Effective Beginning Reading Intervention

The National Reading Panel’s synthesis (2000) identified a set of critical features as being positively related to kindergarten and first-grade phonemic awareness and phonics outcomes, including emphasis on a few priority phonemic awareness skills, integration of letters with sounds, small-group instruction, and use of explicit, systematic instruction. In a more recent synthesis of intervention research targeting struggling readers, Scamacca et al. (2007) concluded that no single intervention program or particular method stood out as “the one right way” (p. 30) to provide extensive early intervention, but they did note that all the effective interventions they reviewed shared a number of essential elements: phonological awareness, decoding, and word study training; guided and independent reading using progressively more difficult text; writing exercises; and practice of comprehension strategies while reading.

Foorman and Torgesen (2001) explained that the primary difference between instruction appropriate for all children versus that required by children at risk for reading difficulties relates to the manner in which that instruction is delivered: “Specifically, instruction for children who have difficulties learning to read must be more *explicit* and *comprehensive*, more *intensive* and more *supportive* than the instruction required by the majority of children” (p. 206; emphasis in the original). They maintained that children at risk for reading failure acquire skills more slowly than do other children, but must still acquire the same skill set to become proficient readers.

The terms *systematic* and *explicit* are frequently associated with effective phonemic and phonics instruction (National Reading Panel, 2000; Pullen & Lloyd, 2007). According to Adams (1990), systematic instruction involves a logical, methodological progression of previously taught information that enables a learner to be successful with

newly taught skills. For example, by teaching children to phonemically segment a word into its constituent sounds (/s/ /a/ /t/) and associate the phonemes and graphemes, they will be prepared to learn how to blend and segment words. *Explicit instruction* refers to the clear, unambiguous communication of information to learners, which often involves the teacher's modeling the skill that students are to learn (Carnine, Silbert, Kameenui, & Tarver, 2004). Indeed, the explicit steps in phonemic and phonics instruction often progress from a teacher model to guided practice then to independent practice. In summary, recent reviews of the extant research provide many converging recommendations regarding what to teach and how to teach beginning reading skills to benefit students at risk of reading difficulty (Cavanaugh, Kim, Wanzek, & Vaughn, 2004; National Reading Panel, 2000; Scammacca et al., 2007).

Purpose of Study

The purpose of this study was (a) to further understand the influence of different types of problem behaviors on the reading development of kindergarten children identified as being at risk of reading difficulty and (b) to determine the extent to which explicit, code-based reading instruction moderated these relations. We addressed two primary research questions: What is the relation between type of problem behavior (i.e., externalizing, internalizing, hyperactivity) and reading achievement in kindergarten children identified as being at risk of reading difficulty? To what extent does explicit, systematic, code-based reading intervention moderate the impact of problem behavior on reading achievement?

In answering these questions, we accounted for the clustering structure of the data (i.e., students nested within teachers); specifically, we used multilevel modeling (Hox, 2002; Raudenbush & Bryk, 2002; Snijders & Bosker, 1999) with student- and teacher-level variables. To our knowledge, this is the first study to use multilevel modeling to examine the interaction of behavior, type of instruction, and reading achievement in kindergarten children at risk of reading difficulty. This approach allowed us to control for other variables while determining whether reading intervention can moderate the influences of problem behavior. We hypothesized that (a) children with higher levels of problem behavior on any subscale measure would exhibit lower levels of reading achievement and (b) an intensive reading intervention using explicit, systematic, code-based instruction (ESC) would moderate the effects of problem behaviors on subsequent reading outcomes.

Method

The study was part of a large-scale investigation that examined the effects of early reading intervention on kindergarten

children's reading achievement (Simmons et al., 2011). Fifty-seven kindergarten teachers and the 206 students in their classrooms who were considered at greatest risk for reading problems were randomly assigned to an explicit, systematic early reading intervention program or a school-determined intervention (SDI) for comparison. Children in both conditions received supplementary reading instruction in small groups for 30 minutes daily for 21 weeks.

Settings and Participants

Four schools from south-central Texas and eight from Connecticut participated in the study. All but one school received Title I funding and served a large number of children from families with low income. The percentages of students qualifying for free and reduced-cost lunch ranged from 69% to 81% in Texas schools and 50% to 81% in Connecticut. School enrollments ranged from 278 to 985 students in Texas and from 266 to 749 in Connecticut.

Interventionists and assignment to condition. Researchers randomly assigned kindergarten classes within schools to either a program of ESC ($n = 31$) or SDI ($n = 26$). Both conditions were present in every school. Schools determined who would provide intervention for each kindergarten classroom (i.e., the classroom teacher, paraprofessional, reading specialist). Across the 12 participating schools, interventionists consisted of 48 certified kindergarten teachers and 9 paraprofessionals. (One interventionist was a reading specialist who was also certified to teach kindergarten.) Forty-eight interventionists were White, 4 were Hispanic or Latino, and 2 were African American. Fifty-three teachers spoke English as their primary language, and 4 (2 in each condition) spoke Spanish as their primary language. For 31 teachers, the highest degree earned was a bachelor's, 17 held a graduate degree, and 9 had less than a 4-year degree. Teaching experience averaged 12.16 years in the ESC condition and 14.12 years in SDI. Chi-square analyses were conducted on categorical data, and independent sample t tests were conducted for continuous variables to assess equivalence between conditions on interventionist demographics. These analyses revealed no reliable group differences on the interventionists' gender, total years of teaching experience, years of kindergarten teaching experience, highest degree earned, ethnicity, or primary language.

Students. Students were selected at the beginning of kindergarten on the basis of reading risk without regard to problem behavior. Participants had to be at least 5 years of age, receive reading instruction in English, and be considered in need of supplemental reading support. First, school personnel examined existing school-administered measures and consulted with kindergarten teachers to nominate six to eight students per kindergarten classroom for further consideration. Researchers then screened children with

Table 1. Student Demographics by Condition

Variable	ESC (n = 112)		SDI (n = 94)		χ^2/F	df	p
	n	%	n	%			
Gender					0.15	1	.70
Male	59	52.68	47	50.00			
Female	53	47.32	47	50.00			
Ethnicity					2.89	4	.58
Asian	1	0.89	0	0.00			
American Indian/Alaska Native	1	0.89	0	0.00			
Black or African American	24	21.43	15	15.96			
Hispanic or Latino	44	39.29	42	44.68			
White	42	37.50	37	39.36			
Receive special education services ^a	15	13.39	9	9.57	0.72	1	.40
Bilingual/English-language learner	24	21.43	29	30.85	2.38	1	.12
Age: M (SD)	5.49 (0.32)		5.39 (0.27)		3.01	205	.08

Abbreviations: ESC, explicit, systematic, code-based instruction; SDI, school-determined intervention.

^aOf 15 ESC children receiving special education services, 14 were served for speech/language impairment, and 1 was classified with a developmental delay. Within the SDI condition, 8 of 9 children in special education were identified for speech/language impairment, and 1 was classified with developmental delay.

parental consent using the *Dynamic Indicators of Basic Early Literacy Skills* Letter-Naming Fluency measure (Good & Kaminski, 2002) and the *Comprehensive Test of Phonological Processing* (CTOPP) Sound Matching subtest (Wagner, Torgesen, & Rashotte, 1999). Students scoring at or below the 33rd percentile on the Letter-Naming Fluency measure or at or below the 37th percentile on the Sound Matching subtest were determined to be at risk for reading problems and thus selected for inclusion in the study. Of the 206 children who completed the study, 136 met both criteria, 64 met the phonemic awareness criterion only, and 6 qualified solely on the Letter-Naming Fluency measure.

Table 1 outlines demographic information for participating students. Group equivalence for student demographic variables was evaluated using independent sample *t* tests for continuous variables (e.g., age) and chi-square tests for categorical variables (e.g., gender, ethnicity). These analyses indicated no statistically significant difference between treatment groups on any of the student characteristic measures.

Attrition analysis. Initially, 232 kindergarten students were selected to participate in the study. Of this group, 206 children (89%) participated in both pretest and posttest assessments. Twenty-six students (11%) did not complete the study, because they were not available at posttest. The primary reason for attrition was that students transferred to other schools.

To determine whether there was differential attrition between students who exited the study (the 26 attritors) and those who remained (the 206 nonattritors), the groups were

compared using attrition analyses across all screening measures, pretest measures, and demographic variables—including gender, age, bilingual status, special education status, and group (ESC versus SDI conditions). No significant differences were found between the attritors and the nonattritors on any variable except gender, with the attritor group containing a higher proportion of male students (21 of 26 attritors were male and 106 of 206 nonattritors were male). Analyses conducted between groups at posttest indicated no statistically significant relation between condition and attrition; 6.93% of SDI students and 13.85% of ESC students did not complete the study.

Measures of Reading and Reading Related Skills

To determine eligibility, children nominated by the school were screened using phonemic awareness and alphabet knowledge measures. Those children identified through screening to have the greatest potential for reading problems were placed in the study and administered the remaining pretest reading measures. At the end of the school year, a range of reading and reading-related outcomes were measured (for the former, word identification, word attack; for the latter, phonemic awareness, alphabet knowledge).

Phonemic awareness. Phonemic awareness was measured using two subtests of the CTOPP battery (Wagner et al., 1999). The Sound Matching subtest presents a stimulus picture to the child, then three additional pictures. The child is to select the corresponding picture that begins or ends (depending on skill level) with the same sound as the stimulus picture. Twenty items are included: 10 first-sound and

10 last-sound identification tasks. A ceiling rule eliminates the presentation of unnecessary items. Alpha coefficients of reliability for children aged 5, 6, and 7 ranged from .92 to .93. CTOPP's Blending Words subtest requires students to verbally blend individual sounds into a whole word, as aurally presented through audio recording. Items increase in difficulty and length as the test progresses. The subtest contains 20 items, and a ceiling rule limits administration of unnecessary items. Internal reliability with alpha coefficients was .86 to .89 for children aged 5 through 7. For both phonemic awareness measures, age-based standard scores were used in analyses.

Alphabet knowledge. Children's ability to identify letter names and letter sounds was assessed using the Supplementary Letter Checklist for lowercase letters of the *Woodcock Reading Mastery Tests-Revised/Normative Update*, Form G (Woodcock, 1998). To measure letter name knowledge, the child is asked to identify lowercase letters presented in a randomized format. The measure contains 29 letters, accounting for variations of the letters *a*, *g*, and *q* (two each). Letter sound knowledge was assessed using a similar format. Students were presented with letters in random order and asked to produce their sounds. This measure included 7 commonly occurring phonemic combinations (e.g., *ch* or *oo*) for a total of 36 stimulus items (including the 29 individual letters presented). Both these alphabet knowledge measures are criterion based with no standardized scores.

Word reading. Children's ability to read words was measured using the Word Attack and Word Identification subtests of the *Woodcock Reading Mastery Tests-Revised/Normative Update*, Form G (Woodcock, 1998). The Word Attack measure requires a student to read combinations of letters forming nonwords or low-frequency words in the English language. Basal and ceiling rules limit the need to present all 45 items. Reliability coefficients for kindergarten were not reported; however, split-half reliability coefficients for first-, third-, and fifth-grade students ranged from .91 to .98, with the coefficient decreasing as grade level increased. The Word Identification subtest requires a child to read whole words in increasing difficulty. Basal and ceiling rules eliminate the need to present all 106 test items. Reliability coefficients were not detailed for kindergarten. First-, third-, and fifth-grade students' scores ranged in split-half reliability coefficients from .89 to .94, with the coefficients decreasing as grade level increased. For both word reading measures, age-based standard scores were used in analyses.

Measures of Problem Behavior

Children were selected on the basis of reading risk with no regard to problem behavior. Shortly after the study began,

classroom teachers were given the *Social Skills Rating System for Teachers* (SSRS-T; Gresham & Elliott, 1990), a questionnaire designed to assess social behaviors at school. The rating scale was given approximately 10 weeks into the school year to ensure that teachers had sufficient time to observe and interact with students and therefore provide informed ratings.

The *Problem Behavior Scale* of the SSRS-T consists of 18 items equally distributed across three subscales: Externalizing, Internalizing, and Hyperactivity. Total raw scores on the *Problem Behavior Scale* can range between 0 and 36. For kindergarteners, scores between 0 and 2 (girls) or 0 and 3 (boys) reflect less-than-average levels of problem behavior; scores between 3 and 13 (girls) or 4 and 17 (boys) are considered average levels of problem behavior; and scores between 14 and 36 (girls) or 18 and 36 (boys) are considered to be above-average levels of problem behavior. Raw *Problem Behavior Scale* scores may be converted to standard scores. There are no standard scores for SSRS-T subscale measures.

Externalizing behavior. The Externalizing subscale of the SSRS-T contains six questions detailing overt problem behaviors, and it queries the extent to which a child engages in fighting or arguing with others, talking back to his or her teacher, or exhibiting temper tantrums. Raw scores can range from 0 to 12. For kindergarten-aged children, raw subscale scores of 0 to 4 (girls) and 0 to 6 (boys) are considered average levels of externalizing problem behavior. Scores between 5 and 12 (girls) or 7 and 12 (boys) are considered more-than-average levels of problem behavior.

Internalizing behavior. The SSRS-T's Internalizing subscale consists of six questions assessing more covert behaviors that reflect isolation, depressed mood, and anxiety around other children. Raw scores for this subscale range from 0 to 12. For kindergarteners, raw scores between 0 and 6 (for girls and boys) are considered average levels of internalizing behavior. Scores from 7 to 12 are considered more-than-average levels of internalizing behavior.

Hyperactivity. The Hyperactivity subscale of the SSRS-T consists of six questions that address behaviors such as fidgeting, impulsivity, and distractibility. For kindergarten-aged children, raw scores between 0 and 4 (girls) or 0 and 6 (boys) are considered average levels of hyperactivity. Scores between 5 and 12 (girls) or 7 and 12 (boys) are considered more-than-average levels of hyperactivity.

The internal coefficient alphas for the Elementary Form of the SSRS-T Externalizing, Internalizing, and Hyperactivity subscales are .88, .78, and .87, respectively. Test-retest reliability coefficients provide evidence of temporal stability for the subscales, with the average difference between ratings 4 weeks apart being $-.02$, $-.09$, and $-.04$. Regarding criterion-related validity, the SSRS-T subscales correlate with the *Child Behavior Checklist* (Achenbach &

Edelbrock, 2001) at .75 (Externalizing), .59 (Internalizing), and .73 (Hyperactivity).

Procedures

Children from 57 kindergarten classrooms were selected to participate in the study. Within schools, small groups of 3 to 5 children per classroom were randomly assigned to receive supplemental reading support via ESC instruction or reading intervention as determined by their respective teachers and schools (SDI). A number of common components were standardized across the two conditions: Instructional groups were limited to three to five students. Interventionists were asked to teach their groups for 30 minutes, 5 days per week, over the course of the intervention period. Content in both conditions focused on early literacy skills.

ESC. For the ESC program, we used the *Early Reading Intervention*, a commercial program (Pearson/Scott Foresman, 2004) designed to provide intensive instruction on key phonemic and alphabetic skills to kindergarten children. In an earlier experimental study of a prototype of the program, effect sizes comparing the *Early Reading Intervention* with a commercial condition were moderate to large for all measures, with students who had the lowest preintervention scores benefiting most (Simmons et al., 2007). More recently, the program's effects with 12 English-language learners were examined in a single-case, multiple-baseline, across-participants design (Gyovia, Cartledge, Kourea, Yurikk, & Gibson, 2009), the researchers of which observed increases in participants' phonemic segmentation fluency and nonsense word fluency and noted that gains were commensurate with the amount of instruction received.

The first half of each lesson focuses on phonological awareness and alphabetic understanding; the remaining half integrates writing and spelling with previously taught phonemic and alphabetic skills. Lessons are highly specified with detailed teacher language provided to ensure clear and consistent communication of information and to reduce variability in implementation. Scheduled instruction, review, and feedback are explicitly incorporated. Each lesson that introduces new information includes a specified number of instructional interactions in which the teacher first models the information. Students practice the new skill with the teacher and then apply it to new untaught discrimination or generalization tasks. In addition, the intervention provides teachers with explicit instructional language and procedures for correcting errors and extending practice for difficult items.

ESC teachers received 2 days of professional development. The first day took place before the start of the intervention and introduced the *Early Reading Intervention* curriculum and materials, oriented the interventionists to the design of the program, and provided guidance for implementation.

Interventionists viewed publisher-developed video clips of lesson elements and participated in hands-on practice using the curriculum materials. They were also shown how to set up and manage materials and student groups. Finally, time was devoted to addressing critical instructional techniques, such as giving immediate corrective feedback and providing group and individual turns to students during instruction. The second day of professional development was held midway through the intervention period, when interventionists completed half the program. Following a format similar to that of the first professional development day, this session focused on lessons and materials for the third and fourth parts of the program.

Treatment fidelity. ESC and SDI interventionists kept implementation logs to document dates when instruction occurred, the length of instructional sessions, and student attendance. In addition, research staff observed each instructional group over the course of the school year to assess treatment fidelity within ESC and to document the instructional content delivered in the SDI condition. Post-intervention descriptive analyses indicated that, on average, the ESC and SDI groups were composed of four students. SDI teachers reported delivering their small-group intervention for 106.03 days ($SD = 14.87$), and ERI teachers, for 103.37 days ($SD = 13.67$).

ESC groups were observed three times (fall, winter, and spring). For each of seven activities in a lesson, observers evaluated procedural fidelity using a 4-point scale (1 = *low compliance* or *low quality*, 4 = *high compliance* or *high quality*): completion of all components (e.g., modeled examples, provided practice opportunities) and fluency with lesson wording and activities. Across the three observations, ESC teachers averaged 3.07 ($SD = 0.64$) on the procedural fidelity items. At the end of an observation, observers rated the overall quality of implementation, the average of which was 3.01 ($SD = .63$). A second observer was present for 25% of the observations to determine interrater reliability. Percentage of agreement was calculated using kappa (K). Interrater reliability for each of the two procedural fidelity items was $K = .63$. For the overall quality of implementation item, agreement was $K = .87$.

All SDI groups were observed twice (late fall and early spring) to document the content of their lessons. The content and instructional approaches within this condition were allowed to vary naturally, and a variety of teacher-made and published materials were observed in use. Some teachers used materials from published programs. Others developed interventions by creating their own materials or gathering materials from multiple sources. Slightly fewer than half the interventionists in the SDI condition (48%) reported sustained implementation of a published curriculum, whereas the majority (52%) used a compilation of teacher-made and commercial materials.

Table 2 summarizes the instructional content observed during SDI lessons, reporting the percentage of lesson activities during which a type of content was addressed during the fall, spring, and combined observations. As illustrated, the instructional content focused on a range of beginning reading and literacy skills. The majority of lesson activities (90%) included some type of alphabetic and decoding content, with 67% of the observed activities including content related to letter names and 63% targeting letter sounds. The second-most-prominent type of content observed during SDI lessons was phonological awareness, with 49% of the observed activities (53% in fall and 43% in spring) incorporating content related to phonological processing. Forty-one percent of the observed SDI activities focused on phoneme-level instruction. Furthermore, some type of writing and/or spelling was incorporated during 39% of the observed SDI activities, whereas vocabulary instruction and listening comprehension were each observed during 14% of the SDI activities.

In the comparison fall and spring SDI observations, a substantial shift was noted in emphasis for some types of instructional content. For example, activities incorporating phonemic awareness, letter name knowledge, letter sound knowledge, and writing letters and sounds were observed far more frequently during fall observations than during spring. As expected, markedly more instructional activities in the spring focused on reading connected text, vocabulary, and listening comprehension relative to the content lessons observed during fall.

During 29% of the SDI observations, two observers independently coded the instructional content of all lesson activities using the categories listed in Table 2. As based on kappa to calculate percentage of agreement, the reliability of codes for focus of instruction was $K = .73$.

Data Analyses

To address the first research question, we began by examining zero-order correlations for all 206 participants' problem behavior scores and reading outcome measures. We then examined correlations in the ESC and SDI groups separately. We followed with multilevel modeling to control for other variables while examining the influence of different types of problem behaviors on end-of-year reading outcomes.

All multilevel models were analyzed using hierarchical linear modeling software (HLM 6.06, Scientific Software International, Chicago, IL; Raudenbush, Bryk, Cheong, & Congdon, 2004). We used restricted maximum likelihood to estimate all the models. Hierarchical linear modeling allowed us to account for the nested structure of the data (i.e., students nested within classrooms). Ignoring the nonindependence of observations commonly results in unbiased fixed effects (or regression coefficients) but

underestimates the corresponding standard errors, which in turn leads to inflated type I error rates and influences the tests of significance of the fixed effects (Hox, 2002; Raudenbush & Bryk, 2002; Snijders & Bosker, 1999).

To address the second research question, we used hierarchical linear modeling to test for the hypothesized moderation effects of intervention type (ESC versus SDI) on the relations between problem behavior and reading outcomes. We hypothesized that children with more problem behaviors would demonstrate lower kindergarten reading outcomes and that this relation would be substantially stronger for children in the SDI group than for those in the ESC condition.

Results

Teacher Ratings of Problem Behavior

All problem behavior rating scores were normalized on the basis of age and gender. Table 3 summarizes the descriptive statistics for children's scores on the *SSRS-T Problem Behavior Scale*, along with their scores for Externalizing, Internalizing, and Hyperactivity subscales. Data are summarized for all students combined, as well as separately for the ESC and SDI conditions. No statistically significant mean differences were found between the ESC and SDI groups for the composite *Problem Behavior Scale* ($p < .66$) or any of the subscale measures (Externalizing, $p < .19$; Internalizing, $p < .53$; Hyperactivity, $p < .56$). The standard scores on the *Problem Behavior Scale* for children in the ESC condition ranged from 84 (average) to 139 (above average) with a mean standard score of 101.19. Problem behavior scores for children in the SDI condition were similar, ranging from 84 (average) to 134 (above average), with a mean standard score of 100.25. Both groups' means fell within the average range provided in the *SSRS Rating System Manual* (Gresham & Elliott, 1990), and none of the children in either condition had problem behavior scores that fell within the fewer-than-average range of problem behavior.

Relations Between Problem Behavior and Kindergarten Reading Outcomes

Correlational analyses. First we examined zero-order correlations between *Problem Behavior Scale* scores and kindergarten reading outcome measures for all 206 children (ESC and SDI combined). Analyses produced statistically significant negative correlations between *Problem Behavior Scale* scores and all six reading outcome measures. The *SSRS-T Problem Behavior Scale*'s weakest correlation was on the phonemic blending words measure ($-.19, p < .01$); the remaining correlations ranged between $-.30$ and $-.36$

Table 2. Content of Instruction During Fall and Spring Observations of School-Designated Interventions

Content of instruction	Lesson activities (%)		
	Fall ^a	Spring	Combined ^b
Concepts of print	13.33	9.52	11.76
Phonological awareness	53.33	42.86	49.02
Syllable/word level	13.33	14.29	13.73
Phoneme level	50.00	28.57	41.18
Sound blending and segmenting	13.33	28.57	19.61
Alphabetic/reading/decoding	96.67	80.95	90.20
Letter names	80.00	47.62	66.67
Letter sounds	73.33	47.62	62.75
Decodable words	43.33	38.10	41.18
Sight words	23.33	14.29	19.61
Reading connected text	13.33	47.62	27.45
Writing/spelling	46.67	28.57	39.22
Writing letters	30.00	14.29	23.53
Writing sounds	16.67	4.76	11.76
Spelling/encoding	10.00	19.05	13.73
Vocabulary	3.33	28.57	13.73
Listening comprehension	6.67	23.81	13.73

^aFall and spring percentages reflect the number of activities in which a type of instructional content was addressed during observed school-determined intervention lessons, divided by the total number of activities within those lessons.

^bCombined percentages are the total number of observed activities (fall plus spring) that included a particular type of instructional content, divided by the total number of activities across the two observed lessons.

and were all statistically significant. We then examined three subscales of problem behavior and their respective correlations with kindergarten reading outcomes for all 206 children. With the exception of one relation (internalizing behaviors and phonemic blending words), all subscale scores and reading outcome correlations were negative and statistically significant. In other words, children with higher ratings of problem behaviors on any of the subscale measures tended to score somewhat lower on end-of-kindergarten reading measures.

Next we examined correlations between problem behavior and reading outcomes within each intervention group separately. Table 4 provides descriptive statistics and zero-order correlations for the ESC and SDI conditions. In SDI, a pattern of results similar to the combined group correlations was observed, with *Problem Behavior Scale* and subscale scores negatively correlated with the majority of reading outcomes. Of the 24 scale and subscale score correlations, all but 3 were statistically significant (internalizing behavior's relation with letter name knowledge, letter sound knowledge, and blending words).

Correlational analyses within ESC differed in many respects. There were no statistically significant relations between externalizing behaviors and any reading or reading-related

outcome measure. All but one of the negative correlations between hyperactivity and reading outcomes were statistically significant, although the coefficients within ESC were smaller than those in SDI. Internalizing problem behavior was the only subscale with a similar pattern of negative relations in both ESC and SDI conditions.

Hierarchical linear modeling analyses. We used multilevel modeling to control for student- and teacher-level variables (i.e., pretest performance levels, student age, gender, ethnicity, Peabody Picture Vocabulary Test—Third Edition (PPVT-III; Dunn & Dunn, 1997) scores, special education status, bilingual status, total hours of intervention, and educational level of interventionist) and to examine the direct influence of problem behaviors on kindergarten reading outcomes for all 206 children. For the Level 1 model (student level), we used hierarchical linear modeling with the following settings:

$$\begin{aligned} \text{Posttest}_{ij} = & \beta_{0j} + \beta_{1j} \text{Pretest}_{ij} + \beta_{2j} \text{PPVT-III}_{ij} \\ & + \beta_{3j} \text{Age}_{ij} + \beta_{4j} \text{Gender}_{ij} + \beta_{5j} \text{Hispanic}_{ij} \\ & + \beta_{6j} \text{African American}_{ij} + \beta_{7j} \text{Sped}_{ij} \\ & + \beta_{8j} \text{PB_sub}_{ij} + \beta_{9j} \text{Dosage}_{ij} \\ & + \beta_{10j} \text{Bilingual}_{ij} + e_{ij}, \end{aligned} \quad (1)$$

where i represents the i th student ($i = 1 \dots 206$) and j represents the j th group ($j = 1 \dots 57$). Posttest_{ij} was the score of one of the six target reading outcome measures for the i th student in the j th intervention group. PB_sub_{ij} was each problem behavior subscale for the i th student in the j th group. In this student-level model, we included the corresponding pretest score (Pretest_{ij}) and the PPVT-III score (PPVT-III_{ij}) as an indicator of each student's beginning receptive language level, as well as demographic variables such as the student's age (Age_{ij}), gender (Gender_{ij}), ethnicity (represented by two dummy-coded variables: Hispanic_{ij} and $\text{African American}_{ij}$), special education status (Sped_{ij}), total hours of intervention reported by teachers (Dosage_{ij}), and bilingual status (Bilingual_{ij}). Finally, e_{ij} is the within-group random error and the corresponding variance, $V(e_{ij}) = \sigma^2$, captures the within-group variation. For the Letter Sound Checklist, which did not have a corresponding pretest, we used untimed letter identification as the covariate because of its high association with the letter sound measure.

For the Level 2 models (group level), we specified the intervention group, as shown below:

$$\begin{aligned} \beta_{0j} = & \gamma_{00} + \gamma_{01} \text{ESC}_j + \gamma_{02} \text{Teacher Educational Level}_j \\ & + \gamma_{03} \text{School}_{1j} + \gamma_{04} \text{School}_{2j} + \dots \\ & + \gamma_{014} \text{School}_{11j} + U_{0j}; \\ \beta_{1j} = & \gamma_{10}, \beta_{2j} = \gamma_{20}, \beta_{3j} = \gamma_{30}, \beta_{4j} = \gamma_{40}, \beta_{5j} = \gamma_{50}, \\ \beta_{6j} = & \gamma_{60}, \beta_{7j} = \gamma_{70}, \beta_{8j} = \gamma_{80}, \beta_{9j} = \gamma_{90}, \beta_{10j} = \gamma_{100}. \end{aligned} \quad (2)$$

Table 3. Means of the SSRS-T Problem Behavior Scale and Subscales for Total, ESC, and SDI Groups at Pretest

SSRS-T	Total				ESC (n = 112)				SDI (n = 94)			
	M	SD	Range	n	M	SD	Range	n	M	SD	Range	n
Problem behavior (standardized)	100.77	13.88	84–139	201	101.19	13.82	84–139	110	100.25	14.02	84–134	91
Problem behavior	8.91	6.68	0–31	201	9.10	6.77	0–31	110	8.68	6.60	0–28	91
Externalizing	1.84	2.78	0–12	202	2.07	2.97	0–12	111	1.56	2.52	0–10	91
Internalizing	3.16	2.67	0–12	202	3.27	2.78	0–12	111	3.03	2.54	0–12	91
Hyperactivity	3.93	3.47	0–12	202	3.80	3.33	0–12	111	4.09	3.64	0–12	91

Abbreviations: SSRS-T, Social Skills Rating System for Teachers; ESC, explicit, systematic, code-based instruction; SDI, school-determined intervention. The SSRS-T does not provide standard scores for subscales.

Table 4. Means, Standard Deviations, and Zero-Order Correlations of Reading Outcomes With Problem Behavior Scores in ESC and SDI

Outcome Measure	End of kindergarten reading performance		Correlations between problem behavior scores and reading outcomes							
			ESC intervention				SDI comparison condition			
	ESC	SDI								
	M (SD)	M (SD)	PB	E	I	H	PB	E	I	H
Phonemic awareness ^a										
Sound Matching	9.64 (1.97)	9.05 (2.06)	-.29**	-.18	-.20*	-.28**	-.41**	-.23*	-.38**	-.34**
Blending Words	10.49 (1.96)	10.00 (2.33)	-.17	-.08	-.19	-.10	-.22*	-.26*	-.06	-.23*
Alphabet knowledge ^b										
Letter Name Checklist	25.61 (4.28)	25.00 (4.80)	-.25**	-.18	-.16	-.24*	-.42**	-.40**	-.18	-.42**
Letter Sound Checklist	24.93 (6.00)	22.86 (7.50)	-.26**	-.15	-.18	-.27**	-.40**	-.42**	-.15	-.43**
Word reading ^b										
Word Attack	108.09 (9.20)	105.16 (10.99)	-.24*	-.13	-.21*	-.26**	-.39**	-.35**	-.23*	-.34**
Word Identification	104.10 (11.15)	103.26 (14.75)	-.26**	-.11	-.23*	-.26**	-.45**	-.39**	-.33**	-.37**

Abbreviations: ESC, explicit, systematic, code-based instruction; SDI, school-determined intervention; PB, Problem Behavior Scale; E, Externalizing subscale; I, Internalizing subscale; H, Hyperactivity subscale.

^aBased on the Comprehensive Test of Phonological Processing.

^bBased on the Woodcock Reading Mastery Test–Revised/Normative Update.

* $p < .05$. ** $p < .01$.

where ESC_j was the dummy-coded intervention condition ($0 = SDI$ condition, $1 = ESC$ condition), Teacher Educational Level _{j} was the highest educational level attained by the teacher/interventionist, and School _{$1j$} to School _{$11j$} were the dummy-coded school variables used to capture the school-level variation. This is an intercept-as-outcome model (Raudenbush & Bryk, 2002) with only one random effect (U_{0j}) associated with the intercept model. The variance of U_{0j} , $V(U_{0j}) = \tau_{00}$, captures the between-group variation. The simplicity of this model (with only two random parameters: U_{0j} and e_{ij}) can reduce possible computational difficulty and prevent the potential nonconvergence issue.

Results of this hierarchical linear modeling analysis (summarized in Table 5) indicated that all three types of problem behavior were negatively associated with the majority of reading outcomes. Students with higher ratings

of problem behaviors (whether externalizing, internalizing, or hyperactivity) tended to score lower on reading and reading-related measures at the end of kindergarten, and these relations were statistically significant even after controlling for other variables (i.e., pretest performance levels, student age, gender, ethnicity, PPVT-III scores, special education status, bilingual status, total hours of intervention, and educational level of interventionist). Externalizing problem behaviors and hyperactivity were each statistically significantly associated with all but one outcome measure (phonemic blending words). Statistically significant coefficients for externalizing problem behaviors and reading performance ranged from $-.08$ ($p < .05$) for phonemic sound matching to $-.59$ ($p < .05$) for word identification. In other words, for every 1.00 point on higher externalizing behaviors, students averaged 0.08 points lower on sound

Table 5. Effects of Problem Behaviors on Reading and Reading Related Outcomes for All Children: ESC and SDI Combined

Reading outcome measure	Problem behavior subscale		
	Externalizing	Internalizing	Hyperactivity
Phonemic awareness ^a			
Sound Matching	-.08 [†]	-.15 ^{***}	-.11 ^{**}
Blending Words	-.03	-.11 [*]	-.02
Alphabet knowledge ^b			
Letter Name	-.20 [*]	-.02	-.32 ^{***}
Checklist			
Letter Sound	-.34 ^{**}	-.26 [†]	-.58 ^{***}
Checklist			
Word reading ^b			
Word Attack	-.46 [*]	-.57 [*]	-.58 ^{***}
Word Identification	-.59 [*]	-.86 ^{***}	-.57 ^{**}

Abbreviations: ESC, explicit, systematic, code-based instruction; SDI, school-determined intervention.

All coefficients are unstandardized partial coefficients—that is, the effect of a type of behavior problem on reading outcomes after controlling for the corresponding pretest score and other student- and teacher-related variables, including ethnicity, gender, age, Peabody Picture Vocabulary Test—Third Edition score, special education status, bilingual status, total hours of intervention, and interventionist's educational level.

^aBased on the *Comprehensive Test of Phonological Processing*.

^bBased on the *Woodcock Reading Mastery Test—Revised/Normative Update*.

[†] $p < .10$, ^{*} $p < .05$, ^{**} $p < .01$, ^{***} $p < .005$ (one-tailed).

matching and 0.59 points lower on word identification. The pattern of results for hyperactivity was similar, with coefficients ranging from $-.11$ ($p < .01$) for phonemic sound matching to $-.58$ ($p < .005$) for letter sound matching and word attack. As with externalizing problem behaviors and hyperactivity, higher internalizing behavior ratings were most strongly associated with low word identification scores ($-.86$, $p < .005$). Unlike the other problem behavior subscales, the association between internalizing behavior and phonemic blending words, although small, was statistically significant ($-.11$, $p < .05$). Internalizing behavior also differed from the other subscales in that it was not related to letter name knowledge and the statistical significance of its relation to letter-sound knowledge was marginal ($-.26$, $p < .10$).

Moderating Effects of ESC

To examine whether the ESC reading intervention moderated the influence of problem behavior on kindergarten reading outcomes, we added the ESC_j predictor in the β_{8j} equation as shown in Equation 2 ($\beta_{8j} = \gamma_{80} + \gamma_{81} ESC_j$) to create the interaction effect ($\gamma_{81} ESC \times PB_sub_{ij}$). Substituting the new Equation 2 (with the additional ESC_j in the β_{8j} equation) back into Equation 1 yields the combined model, as shown below:

$$\begin{aligned} \text{Posttest}_{ij} = & \gamma_{00} + \gamma_{01} ESC_j + \gamma_{02} \text{Teaching-K-} \\ & \text{Experience}_j + \gamma_{03} \text{Educational Level}_j + \gamma_{04} \text{School}_{1j} \\ & + \gamma_{05} \text{School}_{2j} + \dots + \gamma_{014} \text{School}_{11j} + \gamma_{10} \text{Pretest}_{ij} \\ & + \gamma_{20} \text{PPVT-III}_{ij} + \gamma_{30} \text{Age}_{ij} + \gamma_{40} \text{Gender}_{ij} + \gamma_{50} \text{Hispanic}_{ij} \\ & + \gamma_{60} \text{African-American}_{ij} + \gamma_{70} \text{Sped}_{ij} \\ & + \gamma_{80} \text{PB_sub}_{ij} + \gamma_{90} \text{Dosage} + \gamma_{100} \text{Bilingual}_{ij} \\ & + \gamma_{81} \text{PB_sub}_{ij} \times ESC_j + U_{0j} + e_{it}. \end{aligned}$$

As stated previously, ESC_j was a dummy-coded variable ($1 = ESC$ condition, $0 = SDI$ condition). Therefore, the coefficient γ_{81} actually tested whether the effect of different types of problem behaviors on the outcome variables differed between the two intervention conditions after controlling for all other variables in the model.

We found no statistically significant interactions for internalizing behaviors by intervention condition. In other words, the effects of internalizing behavior on children's reading outcomes were similar in the ESC and SDI conditions, with internalizing problem behaviors predicting poorer reading and reading-related outcomes in both groups on all but the letter name knowledge measure. However, significant differences for problem behaviors by intervention conditions were found on both Externalizing and Hyperactivity subscales for some of the reading outcome measures. Table 6 presents the results.

Externalizing problem behavior and intervention condition had a significant interaction effect on letter name knowledge ($\gamma_{81} = 0.71$, $p < .005$), letter sound knowledge ($\gamma_{81} = 0.81$, $p < .01$), phonemic blending words ($\gamma_{81} = 0.19$, $p < .05$), and word identification ($\gamma_{81} = 1.23$, $p < .05$). Hyperactivity and intervention interactions were also statistically significant on measures of letter name knowledge ($\gamma_{81} = 0.48$, $p < .005$), letter sound knowledge ($\gamma_{81} = 0.42$, $p < .05$), and phonemic blending words ($\gamma_{81} = 0.15$, $p < .05$). However, ESC did not moderate hyperactivity's influence on word-level outcome measures. Children with high hyperactivity scores tended to score lower on the word reading measures in both conditions.

Findings indicate that the strength of relation between problem behaviors and end-of-kindergarten reading outcomes was stronger among children who received SDI on all measures except phonemic sound matching. In other words, after controlling for other variables, hierarchical linear modeling results reflect a pattern in which both externalizing problem behaviors and hyperactivity negatively affected end-of-year performance of children in the SDI condition, whereas their influence was mitigated in the ESC condition. The effect sizes (i.e., the change in the explained variance, R^2 ; Bickel, 2007; Snijders & Bosker, 1999) of statistically significant moderation effects ranged from .01 to .07. Given that effect sizes for interaction tests are often much smaller than effect sizes for main effects (Aiken & West, 1991), we plotted the statistically significant interactions in

Table 6. Interaction Effects of Problem Behavior (Externalizing and Hyperactivity) and Type of Reading Intervention (ESC or SDI)

Measure	Externalizing problem behavior				Hyperactivity			
	γ_{81}^a	γ_{SDI}^b	γ_{ESC}^c	R^2	γ_{81}^a	γ_{SDI}^b	γ_{ESC}^c	R^2
Phonemic awareness ^d								
Sound Matching	0.01	-0.10	-0.09 [†]	.00	-0.02	-0.10 [†]	-0.12 [*]	.00
Blending Words	0.19 [*]	-0.16 [*]	0.03	.01	0.15 [*]	-0.09 [†]	0.06	.01
Alphabet knowledge ^e								
Letter Name Checklist	0.71 ^{***}	-0.70 ^{***}	0.01	.07	0.48 ^{***}	-0.58 ^{***}	-0.10	.06
Letter Sound Checklist	0.81 ^{**}	-0.92 ^{***}	-0.11	.02	0.42 [*]	-0.81 ^{***}	-0.39 ^{**}	.01
Word reading ^e								
Word Attack	0.80 [†]	-1.06 ^{**}	-0.26	.01	0.30	-0.73 ^{**}	-0.43 [†]	.00
Word Identification	1.23 [*]	-1.47 ^{***}	-0.24	.04	0.39	-0.79 [*]	-0.40 [†]	.00

Abbreviations: ESC, explicit, systematic, code-based instruction; SDI, school-determined intervention.

^a γ_{81} , shown in Equation 3, was the tested difference of the effect of the problem behavior subscale on the outcome variables between ESC and SDI groups. Positive values for γ_{81} indicated that the negative influence of problem behavior on reading outcomes was less in the ESC group relative to the SDI group.

^b γ_{SDI} was the effect of the problem behavior subscale measure on the outcome variables in the SDI group.

^c γ_{ESC} was the effect of the problem behavior subscale measure on the outcome variables in the ESC group.

^dBased on the *Comprehensive Test of Phonological Processing*.

^eBased on the *Woodcock Reading Mastery Test-Revised/Normative Update*.

[†] $p < .10$. ^{*} $p < .05$. ^{**} $p < .01$. ^{***} $p < .005$ (one-tailed). One-tailed tests were adopted because of the known direction of the hypotheses; that is, we hypothesized that problem behaviors would have a stronger negative influence on all outcome variables for students within the SDI condition group to their effects within ESC.

Figure 1 to gain a better understanding of the moderating effects of ESC.

Although some interaction effects for problem behaviors by intervention condition were nonsignificant, the same pattern of findings was observed on all but the phonemic sound matching measure (i.e., problem behaviors had a stronger negative influence on reading outcomes in the SDI condition), including the influence of externalizing behaviors on word attack ($\gamma_{SDI} = -1.06$, $\gamma_{ESC} = -0.26$) and the influence of hyperactivity on letter sound knowledge ($\gamma_{SDI} = -0.81$, $\gamma_{ESC} = -0.39$), word attack ($\gamma_{SDI} = -0.73$, $\gamma_{ESC} = -0.43$), and word ID ($\gamma_{SDI} = -0.79$, $\gamma_{ESC} = -0.40$). A larger sample size may have been necessary to detect more moderation effects on those variables (Aiken & West, 1991; Cohen, Cohen, West, & Aiken, 2003).

Discussion

Converging evidence associates reading risk and problem behaviors among children who fail to adequately benefit from early reading intervention. This study's findings extend prior research by using multilevel models with student-level predictors and instructional factors to investigate whether and to what extent a systematic, code-based reading intervention moderates the influences of problem behaviors on kindergarten reading outcomes.

Problem Behaviors' Negative Influence on Kindergarten Reading Outcomes

When interpreting outcomes, note that students in this study were selected at the beginning of the intervention on the basis of reading risk with no regard to problem behavior, resulting in a behaviorally heterogeneous sample of children with problem behavior ratings ranging from below the 16th percentile to above the 98th, with an average rating at the 50th percentile on the SSRS-T *Problem Behavior Scale*. Our observations are consistent with prior research examining characteristics of young children with reading problems; that is, we observed a portion of children at risk of reading difficulty who had comorbid behavior problems that may have impeded their ability to profit from instruction.

Torgesen et al. (1999) found classroom behaviors to be one of the most consistently important variables for predicting nonresponse or weak response to early reading intervention. Nelson and colleagues' meta-analysis (2003) further documented problem behavior as one of the strongest predictors of poor reading outcomes (weighted $Z_r = .46$). Likewise, Al Otaiba and Fuchs's study (2006) of children who were responsive versus nonresponsive to reading intervention found substantial differences between the two groups on measures of classroom problem behavior ($d = -1.20$, $p < .001$). These and the majority of prior studies

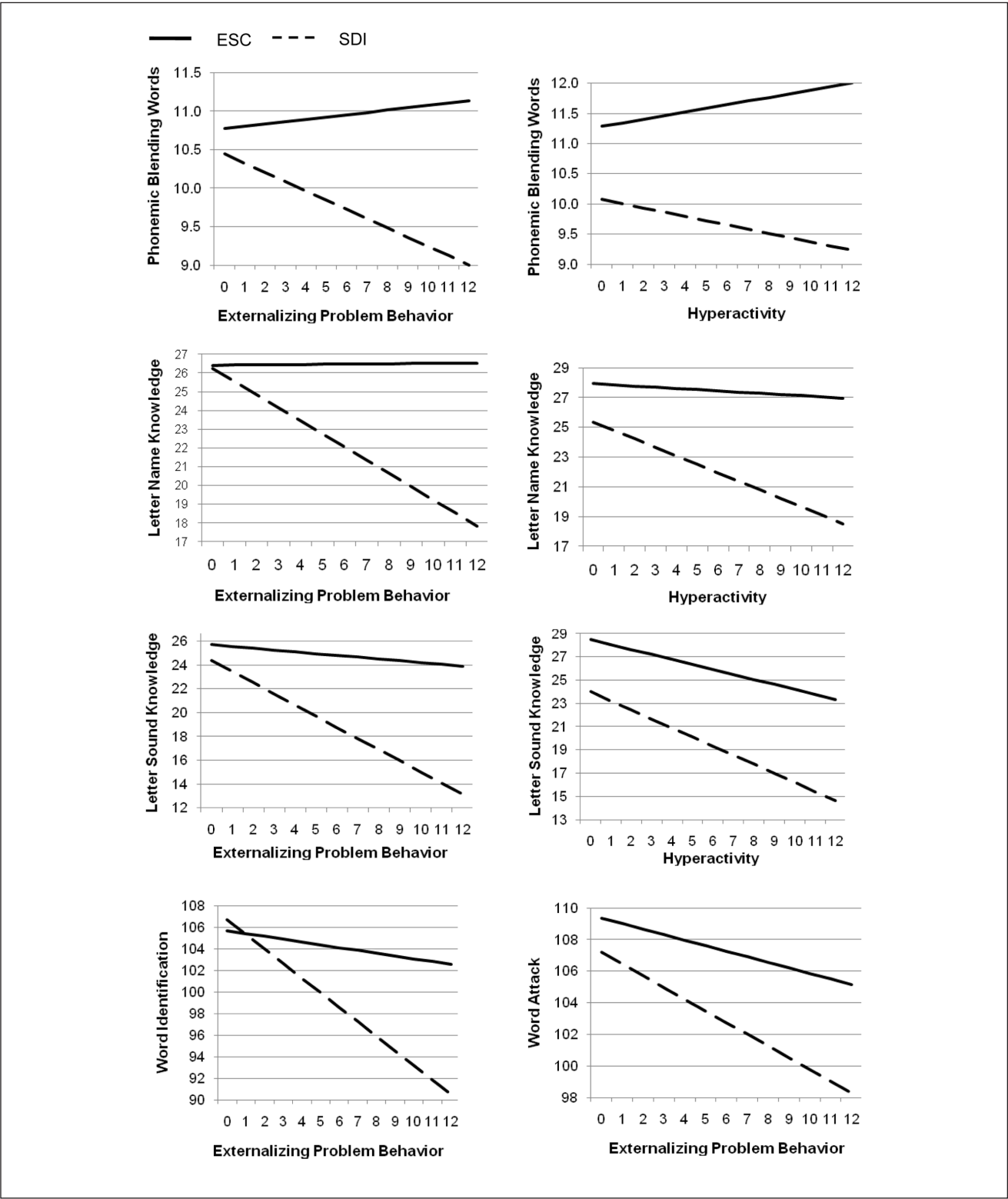


Figure 1. Interaction plots illustrating the differential effects of problem behavior on end of kindergarten reading performance by type of intervention (ESC versus SDI).
Abbreviations: ESC, explicit, systematic, code-based instruction; SDI, school-determined intervention.

examining the influence of problem behavior on early reading outcomes used more global measures of problem behavior and/or relied on composite or word-level reading outcomes (i.e., Al Otaiba & Fuchs, 2006; Morgan et al., 2008; Rabiner et al., 2000; Torgesen et al., 1999). Our study extends earlier work by examining relations between different types of problem behaviors and kindergarten phonemic, alphabetic, and word reading outcomes.

The influence of externalizing problem behaviors varied by type of outcomes measure (i.e., alphabetic/decoding skills versus phonemic awareness). Children with higher ratings of externalizing behaviors performed significantly lower on all print-based reading outcomes than did children with lower problem behavior ratings. Externalizing problem behaviors had a stronger negative influence among more complex tasks (i.e., word attack and word identification) than simpler alphabetic tasks, such as letter name knowledge and letter sound knowledge. The weakest association of externalizing behaviors was with phonemic awareness, with a small, statistically marginal influence on sound matching and no statistically significant relation with phonemic blending words. Rabiner et al. (2000) also observed a negative correlation between externalizing behaviors and word reading skills ($-.20, p < .01$). Conversely, Morgan et al. (2008) found that first-grade reading problems increased a child's odds of having externalizing problem behaviors in third grade (odds ratio = 1.33, $p < .05$), but their tested relation between first-grade externalizing problem behaviors and third-grade reading was not statistically significant.

The influence of hyperactivity on reading outcomes was similar to that of externalizing problem behaviors. Its relation with end-of-kindergarten performance was also statistically significant for all measures except phonemic blending words; its association was stronger with print-based reading tasks and weakest with phonemic sound matching. Rabiner et al. (2000) likewise noted a negative correlation between hyperactivity and end-of-kindergarten reading outcomes ($-.24, p < .01$).

The association between internalizing problem behaviors and kindergarten reading outcomes differed somewhat from those of externalizing and hyperactive behaviors. There were no statistically significant relations between internalizing behaviors and letter name or letter sound knowledge. The negative influence of internalizing behaviors on word reading outcomes, however, was similar to those of externalizing and hyperactive problem behaviors. Another difference was the significant negative relation between internalizing problem behaviors and CTOPP blending words, a measure uninfluenced by the other problem behavior subscales. Halonen et al. (2006) found that high levels of internalizing behaviors at age 6 negatively influenced reading outcomes at age 7. Rabiner et al. (2000) reported a marginally significant

correlation ($R^2 = .27, p < .10$) between internalizing behaviors and word identification. There is limited information among existing studies to assess whether internalizing behaviors exact differential influence on alphabetic and phonemic measures; nonetheless, trends indicate that internalizing problem behaviors negatively affect phonemic and word-level reading outcomes.

To summarize, we observed statistically significant relations between all three subtypes of problem behavior and the majority of phonemic awareness, alphabet knowledge, and word reading outcomes. Nonetheless, the variations are difficult to put into context, and there is limited prior research examining associations between more specific problem behaviors and different reading outcomes to aid interpretation. Future investigations of different types of problem behavior and their effects on phonemic versus print-based outcomes are needed to better understand and substantiate these findings.

The Interaction Between Problem Behavior and Types of Intervention

The study's second objective was to investigate whether type of reading intervention could moderate the negative effects of problem behaviors on reading and reading-related outcomes. Analyses revealed that explicit, code-based reading instruction influenced the three types of problem behavior differently. Type of reading intervention had no moderating effect on the relation between internalizing behaviors and any of the outcome measures. Within both types of reading intervention, higher ratings of internalizing problem behaviors predicted lower reading outcomes on all but the letter name knowledge measure. Conversely, ESC moderated the negative influences of externalizing and hyperactive problem behaviors on many reading and reading-related outcome measures. However, ESC's moderating effects for hyperactivity were statistically significant for only one phonemic and both alphabetic outcomes but not the word-level reading measures.

Phonemic awareness. There were no significant interactions between type of reading intervention and any measure of problem behavior on phonemic sound-matching outcomes. Within both intervention conditions, sound matching was largely uninfluenced by externalizing and hyperactive problem behaviors. Externalizing behaviors had a small, marginally significant effect on sound matching in the ESC condition and no statistically significant influence within SDI. The association between hyperactivity and phonemic sound matching was also relatively small within both intervention conditions.

On the more complex phonemic outcome measure, the pattern of findings differed. Type of intervention moderated the effects of both externalizing and hyperactive problem

behaviors on phonemic blending words. Higher ratings of externalizing or hyperactive behaviors predicted lower phonemic word-blending outcomes for children in the SDI condition, yet neither of these problem behaviors influenced word-blending outcomes for children in ESC.

Fall and spring observations revealed that many SDI teachers included phonemic-awareness content in their instruction. During fall, approximately half the activities observed across SDI groups incorporated phonemic awareness and 13% included blending or segmenting words. By spring, 29% of observed activities incorporated phoneme-level instruction, and 29% focused on blending or segmenting words. Nonetheless, findings suggest that neither the type nor the amount of phonemic awareness instruction within SDI was sufficient to override the impact of hyperactive and externalizing problem behavior.

Alphabet knowledge. ESC moderated negative influences of externalizing and hyperactive problem behaviors on both letter name and letter sound outcomes. Within ESC, neither hyperactivity nor externalizing behaviors influenced letter name outcomes. Conversely, for children in the SDI condition, both externalizing and hyperactive problem behaviors were strong predictors of suppressed letter name performance. ESC's moderating effects on letter sound outcomes was similar, with externalizing problem behaviors having no significant influence on letter sound outcomes in ESC but a significant negative association within SDI. Hyperactive problem behaviors negatively influenced outcomes in both conditions, with the magnitude of its influence considerably less within ERI. Despite limited prior research using alphabet-level outcome measures for comparative purposes, it is plausible that an explicit, code-based intervention designed to provide plentiful opportunities for student response and frequent yet systematic shifts in instructional activities enabled the children to maintain task engagement and thereby benefit more from instruction.

Word reading. The most pronounced and significant finding involved the interaction between type of intervention and the effects of externalizing problem behaviors on word-level outcomes. Externalizing problem behaviors had a strong negative influence on both word attack and word identification within SDI but no influence on these word-level outcomes in the ESC condition. A plausible explanation rests in the consistent use of code-based instruction in the ESC condition. By spring, only 38% of the observed SDI activities focused on decodable words, whereas ESC classrooms provided frequent systematic instruction using decodable text in every lesson. Conversely, the influence of hyperactivity on word-reading outcomes was not moderated by intervention condition. Although the hyperactivity's negative relation with word-reading outcomes was stronger within SDI, ERI children's hyperactive problem behaviors had a marginally significant negative influence on word reading outcomes.

Limitations

Findings of this study must be considered in light of its limitations, the first of which is its relatively small sample for detecting moderation effects. Some of the statistically insignificant interactions may have been influenced by sample size. In general, interaction/moderation effects have relatively low statistical power, and a larger sample size is required to detect this type of effect (Aiken & West, 1991; Cohen et al., 2003). Future studies that randomize at the student level (instead of teacher) or involve a greater number of student participants may be informative.

The study's measures pose potential limitations as well. We measured phonemic awareness using two subtests from the CTOPP (Wagner et al., 1999). If the entire battery of CTOPP kindergarten measures had been administered, the resulting composite scores may have provided a more complete account of participants' phonemic awareness. In addition, we relied on ratings from children's classroom teachers to measure externalizing, internalizing, and hyperactive problem behaviors. Although issues of feasibility make rating scales appealing for larger studies, additional behavioral data employing direct observation may have enhanced our understanding of children's behaviors and the contexts in which they typically occurred.

The multiple dimensions of ECS and the breadth of instructional approaches within SDI complicated efforts to compare and contrast the two interventions. Conditions differed by emphasis of what was taught and how instruction was delivered. Future studies using more thorough approaches to describe and evaluate comparison conditions may shed light on those specific features of intervention that diminish the influence of problem behavior on reading outcomes.

A final potential limitation is the study's sampling and length. We included only children who were identified to be at greatest risk of reading difficulty with no knowledge or regard to problem behavior, resulting in a fairly heterogeneous range of problem behaviors. Although this selection process was most appropriate for answering our research questions, investigations designed to target only children with problem behaviors would be informative. In addition, following children longitudinally as others have done (e.g., Morgan et al., 2008; Rabiner et al., 2000) may provide a better indication of reading outcome and stability of problem behaviors over time.

Implications and Conclusions

This study's findings provide encouraging, albeit preliminary, evidence of the potential of a systematic, explicit intervention integrating phonemic awareness, alphabetic knowledge, and phonetic decoding to moderate the negative influences of externalizing and hyperactive problem

behaviors on many end-of-kindergarten literacy outcomes. Nonetheless, more research is needed to understand why ESC moderated the negative influences of hyperactive and externalizing behaviors on alphabet and word reading outcomes but had little influence on phonemic awareness.

However, ESC was not sufficient to interrupt the negative influence of internalizing problem behaviors on any of the reading or reading-related outcomes in this study. Regardless of intervention type, higher ratings of internalizing behaviors predicted lower outcomes on all but the simplest print-based task (letter name knowledge). Future studies should continue to investigate internalizing problem behaviors and their negative impact on early reading development.

The current findings implicate a range of instructional features, including what is taught and how information is delivered and practiced. Abundant research documents multiple factors that compose an instructional package of effective early reading instruction for at-risk learners, including intensive intervention delivered in small groups with abundant opportunities for student response; systematic, code-focused instruction on target phonemic and alphabetic skills; and adjustable instructional pacing that facilitates student attention and acquisition of skills. Investigations that more thoroughly analyze the sameness and difference between intervention and comparison conditions (Denton, Kurz, Shih, & Mathes, 2008) may help discern specific aspects that diminish the negative influences of problem behaviors on reading development.

Declaration of Conflicting Interests

The author(s) declared a potential conflict of interest (e.g., a financial relationship with the commercial organizations or products discussed in this article) as follows: The intervention used in this study was the *Early Reading Intervention* (Pearson/Scott Foresman). Because the fifth and sixth authors of this article (Simmons and Coyne) are also coauthors of this curriculum, the following steps were implemented to ensure objectivity of findings: All data analyses were conducted by statisticians who had no financial interest with the *Early Reading Intervention*. An external consultant with no financial affiliation with the *Early Reading Intervention* program independently reviewed the article to ensure that (a) data analyses were appropriate, accurate, and objective; (b) reported findings and discussion were accurate; and (c) interpretations were consistent with data analysis.

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