

EXAMINING THE RELATIONSHIP BETWEEN TREATMENT OUTCOMES FOR ACADEMIC ACHIEVEMENT AND SOCIAL SKILLS IN SCHOOL-AGE CHILDREN WITH ATTENTION-DEFICIT HYPERACTIVITY DISORDER

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The purpose of this study was to determine the relationship between treatment-induced changes in academic achievement and social skills in elementary school-age children with attention-deficit hyperactivity disorder. A sample of 123 children in grades 1 through 4 with symptoms of inattention, impulsivity and/or hyperactivity, and significant achievement problems in math or reading were identified for participation. Participants were exposed to academic interventions mediated by their teachers, parents, peers, computers, or the student themselves. Data were collected on academic competence using the Woodcock-Johnson III Test of Achievement and the Academic Competence Evaluation Scales; social skills were assessed using the Social Skills Rating System. Correlations between changes in academic competence and social skills from preintervention to approximately 10 months later were calculated. Results showed that as teacher ratings of reading improved, there were corresponding improvements in social skills. For students in peer-mediated math interventions, increases in math fluency were correlated with improvements in self-control. Results are discussed in the context of possible reasons for these findings and implications for practice and future research. © 2008 Wiley Periodicals, Inc.



Attention-deficit hyperactivity disorder (ADHD) is a psychiatric disorder characterized by developmentally inappropriate levels of inattention and/or impulsivity/hyperactivity (American Psychiatric Association, 2000). Approximately 3% to 5% of elementary school-age children are diagnosed with this disorder (American Psychiatric Association, 2000). Because elementary school classrooms typically include at least 20 children, 1 child in every class will likely have ADHD (DuPaul & Stoner, 2003). Due to the large numbers of children with ADHD in our schools today, teachers increasingly must address the needs of these students in their classrooms.

Children with ADHD often experience profound difficulties with their peers. According to Barkley (2006), approximately 50% of children diagnosed with ADHD have considerable problems in their social relationships with other children. Certain characteristics of ADHD, such as having difficulty taking turns; often interrupting and intruding on others in games, in conversations, and classroom discussion; and the tendency to often appear not to be listening when spoken to (American Psychiatric Association, 2000) contribute to social skills problems. As a result of these problems, children with ADHD are often rejected by their peers (Mrug, Hoza, & Gerdes, 2001), show low levels of social competence (Antshel & Remer, 2003), and often exhibit aggressive behaviors (Nixon, 2001).

Most children with ADHD also struggle academically, both in their work productivity and their academic achievement. Teachers and parents report that children with ADHD underperform relative to their own abilities as well as compared to their classmates (Barkley, 2006). This may be due, in part, to the low academic engagement rates and the inconsistent work productivity evidenced by children with ADHD (DuPaul & Stoner, 2003). In all, up to 80% of children with ADHD have been found to exhibit academic performance problems (Cantwell & Baker, 1991). Due to these difficulties in academic performance and achievement, as many as 56% of children with ADHD require academic tutoring, approximately 30% repeat at least one grade in school, and 30% to 40% are placed in special education (Barkley, 2006).

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To best address both academic competence and social skills in children with ADHD, it is important to first understand the relationship between these two areas. Hinshaw (1992) suggested several causal models to explain this relationship. First, he suggested the possibility that underachievement leads to externalizing behavior. In this model, students who are unable to perform academic tasks may act out toward others in order to escape the task demand. A second possibility is that externalizing behavior leads to underachievement. Children may be so involved in disruptive, nonacademic activities that they are not academically engaged and miss important educational content. A final model suggests that both domains influence each other. The value of these models lies in discovering the appropriate intervention to address both social and academic skills; each causal model suggests a different target behavior for remediation.

Despite some evidence that a deficit in academic skills leads to deficient social skills (e.g., Welsh, Parke, Widaman, & O'Neil, 2001), most studies involving direct interventions with children employ a social skills training model to address social and academic skills. Unfortunately, social skills training has not always been successful. For example, Royer, Desbians, Bitadeau, Maltais, and Gagnon (1999) found that a social skills training program had no effect on behavior problems, academic skills, or social skills. For studies that found positive effects from social skills training, these effects did not always generalize to other environments (Gresham, 2002). For example, Guevremont and Foster (1993) found that improved problem solving in the social skills training environment did not generalize to the classroom or the playground. This lack of generalization may be related to the fact that social skills training programs often address social skills deficits; however, most children with ADHD exhibit performance, rather than skill, deficits (Landau, Milich, & Diener, 1998).

Given the fact that social skills training has been unsuccessful in improving academic competence, and sometimes ineffective in increasing social skills, it is surprising how few studies have investigated the use of academic treatments to address both academic achievement and social skills. There is some evidence in the literature, however, that the use of academic interventions can lead to increases in academic performance and social skills. Coie and Krehbiel (1984) conducted the first study comparing academic interventions with social skills interventions. In this study, 40 socially rejected, low-achieving African American fourth graders were randomly assigned to one of four treatment groups: academic skills training, social skills training, combination academic and social skills training, and a control group. Results suggested that academic skills training was most effective because children in this group showed significant improvements in reading, math, and social preference scores; reduced off-task behavior and more on-task behavior; less disruptive behavior; and more positive teacher attention. The social skills training only resulted in significant reading comprehension progress. Although these results seem promising, the academic skills training group received three times as much intervention time as the social skills group, making it impossible to conclude that one intervention was more effective than the other.

In a similar study, Lane, O'Shaughnessy, Lambros, Gresham, and Beebe-Frankenberger (2001) investigated the effects of a reading intervention program on reading fluency, word attack skills, and behavior problems using single-subject case methodology. Seven first-grade children with externalizing behavior patterns and poor reading skills were provided with phonological awareness training. All children experienced significant growth in word attack skills and oral reading fluency, and for some of the participants, the reading intervention had positive effects on behavior. In general, as beginning reading skills increased, maladaptive behaviors in the classroom and on the playground decreased.

Although these studies indicate the effectiveness of academic programs to target academic and social skills or problem behavior concerns, other studies have not been able to replicate these effects. Lane (1999) attempted to replicate the Coie and Krehbiel (1984) investigation by conducting a study

using equal intervention times. The results of this study were not statistically significant due to low power; however, group means suggested that the academic intervention group made progress in academic skills and social competence. Wehby, Falk, Barton-Arwood, Lane, and Cooley (2003) investigated the effectiveness of a reading program on the phonological awareness skills, general reading ability, and inappropriate behavior of eight children identified as having emotional and behavioral disorders using a multiple baseline design across groups. Results showed improvement in sound naming, blending, and nonsense words; however, increases in these specific skills did not generalize to general reading ability. In addition, there was no improvement in the rate of inappropriate behavior exhibited by participating students during reading instruction.

In a more recent study, Barton-Arwood, Wehby, and Falk (2005) investigated the effects of a reading intervention on reading achievement and social behavior in six children with emotional or behavioral disorders. Participating students were placed in an accelerated direct instruction reading program in lieu of typical reading instruction. Results indicated moderate, yet variable, improvements in basic reading skills but limited gains in oral reading fluency. Inappropriate behavior was observed at near zero levels during academic periods, but improvements in behavior during baseline indicate these levels may have been unrelated to the academic intervention. Therefore, the effectiveness of the reading intervention in reducing problematic behaviors could not be established in this study.

The previously mentioned studies provide some evidence that academic interventions may result in improvements in both social skills and academic performance. However, these studies have not examined this possibility specifically in children with ADHD. Research in the area of peer tutoring, however, has had some promising results for this population of students. DuPaul and Henningson (1993) and DuPaul, Ervin, Hook, and McGoey (1998) examined the effects of classwide peer tutoring (CWPT) on the academic performance and behavior of elementary-age students with ADHD. Both studies showed significant positive effects on academic measures and decreases in problem behavior. Although social skills were not measured directly, the authors suggest decreases in behavior problems may result in benefits to peer social relations. More recently, Plumer and Stoner (2005) used a multiple baseline across participants design in order to investigate the effects of CWPT and peer coaching on peer social behaviors in three children with ADHD. When CWPT was implemented, all three students showed significant increases in positive social behaviors with peers during academic settings, although these effects did not generalize to social situations. These results indicate that for children with ADHD, increases in appropriate social behavior may result from an academic intervention.

Overall, there has been surprisingly little research investigating the effects of academic interventions on social skills, and findings have been inconsistent. In addition, several studies have examined the impact on reducing behavior problems, as opposed to increases in social skills. Although the research in this area has shown promise, methodological flaws, small sample sizes, and short intervention periods have limited the extent of the research that exists. In addition, studies have not yet examined the relationship between treatment-induced changes in academic and social skills with respect to children with ADHD.

This study was designed to answer the question “What is the relationship between changes in academic competence, as a result of an academic intervention, and social skills in school-age children with ADHD?” It was hypothesized that academic competence and social skills would be positively correlated, and that as academic competence improved, there would be a corresponding improvement in social skills. In addition, it was hypothesized that for participants who received peer-mediated academic interventions, increases in academic performance would have an even greater correspondence with changes in social skills.

METHOD

Participants

Participants were part of a larger National Institute of Mental Health-funded research study investigating the effectiveness of a consultative problem-solving model on the academic achievement of children with ADHD (see DuPaul et al., 2006; Jitendra et al., 2007). Children were recruited from several school districts in eastern Pennsylvania and included those with all three subtypes of ADHD (inattentive, hyperactive/impulsive, and combined type). Children had to meet several criteria to participate in the project. First, the child's teacher must have reported that the child experienced significant problems with inattention, impulsivity, and/or hyperactivity. Both parent and teacher ratings on the ADHD Rating Scale-IV (DuPaul, Power, Anastopoulos, & Reid, 1998) must have been at or beyond the 90th percentile compared to children of similar age and gender for either inattention or hyperactivity/impulsivity.

For children who met the requirements, informed consent was obtained, and a parent was asked to report on the Diagnostic Interview Schedule for Child-Parent Report (DISC; Shaffer, Fisher, Dulcan, & Davies, 1996). The number of symptoms reported must have met *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; American Psychiatric Association, 2000) criteria for any of the three subtypes of ADHD. Other requirements included verbal teacher report of significant achievement problems in math or reading, placement in grades 1 through 4 of either a general education or special education classroom in a public school, and no plans to move out of the area in the next 24 months. Children who had significant deficits in intellectual functioning, significant visual or hearing impairments, a history of brain damage, or developmental delay were not included in the study.

A total of 204 teachers in 52 schools participated in this study. A final sample of 123 children participated in this study, representing 74% of students who participated in the larger study. The sample consisted of 72% boys ($n = 89$) and 28% girls ($n = 34$). Sixty-eight percent of the sample was Caucasian ($n = 83$), 20% Hispanic ($n = 25$), 9% African American, and 2% American Indian or Alaskan Native. At the onset of the study, the reported mean age of students was 8.5 years ($SD = 1.24$), and the percentage of students in grades 1, 2, 3, and 4 were 23% ($n = 28$), 23% ($n = 28$), 33% ($n = 41$), and 21% ($n = 26$), respectively. Results from the DISC revealed that 67% of the participants met DSM-IV criteria for ADHD Combined type ($n = 82$), 26% for Inattentive type ($n = 32$), and 7% for Hyperactive/Impulsive type ($n = 9$).

Participants in the larger study were randomly assigned to one of two educational consultation groups—Individualized Academic Intervention (IAI; $n = 65$; 53%) and Generic Academic Intervention (GAI; $n = 58$; 47%)—and received intervention in reading and/or mathematics (for additional details, see DuPaul et al., 2006). During the two semesters of intervention, 78% of all participants received reading interventions ($n = 96$), and 58% received math interventions ($n = 71$). Students exposed to reading and math interventions did not differ with respect to gender, ethnicity, age, grade, or ADHD diagnosis. In addition, there were no differences in these variables between students who received peer-mediated interventions and those who did not.

Dependent Measures

Academic competence was assessed using the Woodcock-Johnson III Tests of Achievement (WJ-III; Woodcock, McGrew, & Mather, 2001) and the Academic Competence Evaluation Scales (ACES; DiPerna & Elliott, 2000). Social skills were assessed using the Social Skills Rating System (SSRS; Gresham & Elliott, 1990).

Woodcock-Johnson III Test of Achievement. The WJ-III is a comprehensive, individually administered battery for assessing the academic achievement of children, adolescents, and adults. The standard battery of the WJ-III consists of 12 subtests measuring total achievement, as well as broad reading, math, and written language skills. For the purposes of this study, the Reading Fluency, Passage Comprehension, Math Fluency, and Calculation subtests were dependent measures. These subtests were chosen because they most closely matched the areas targeted by the academic interventions. Standard scores on these subtests were used for analysis. The reliability and validity of these subtests are well established (Woodcock et al., 2001).

Academic Competence Evaluation Scales. The Teacher form of the ACES is a rating scale used to assess academic skills and academic enabling behaviors for students in grades K–12 or college. Included in the ACES are 33 questions regarding academic skills in three domains: Reading/Language Arts, Mathematics, and Critical Thinking. Questions are rated on a 5-point Likert scale, ranging from far below (1), below (2), grade level (3), above (4), and far above (5). For the purposes of this investigation, raw scores on the Reading/Language Arts and Mathematics subscales were used. The reliability and validity of the ACES are well established (DiPerna & Elliott, 2000).

Social Skills Rating System. The Elementary version of the SSRS consists of teacher ratings of social skills, problem behaviors, and academic competence. Included in the SSRS are 30 questions regarding social skills in three domains: Cooperation (e.g., “Follows your directions”), Assertion (e.g., “Invites others to join in activities”), and Self-Control (e.g., “Controls temper in conflict situations with peers”). Questions are rated on a 3-point Likert scale ranging from never (0), to sometimes (1), to very often (2). For the purposes of this study, raw scores on all three social skills domains were examined. The reliability and validity of the SSRS is well established (Gresham & Elliott, 1990).

Procedures

For both IAI and GAI conditions, consultation was provided for a period of 15 months. Several similarities exist across the two groups that included providing information and resources to teachers regarding ADHD, collaborating with classroom teachers to design interventions, presenting detailed instructions on implementation of selected interventions, ensuring access to the same intervention materials, and monitoring intervention integrity at least three times per intervention phase. A key difference between the two groups was the selection and facilitation of specific, empirically supported intervention strategies. That is, the selection of instructional strategies was based on the target behavior for the GAI group, whereas it was based on both the target behavior and information derived from direct observation and assessment data for the IAI group. In addition, ongoing progress monitoring data were used in the IAI group to determine progress and make appropriate instructional changes. For a complete description of each group, see DuPaul et al. (2006) and Jitendra et al. (2007).

Interventions for both groups were varied and focused on math and/or reading skills, based on individual areas of difficulty. Teacher-mediated interventions included several instructional strategies, such as story mapping (Idol, 1987), listening passage preview (Rathvon, 1999), collaborative strategic reading (Vaughn & Klingner, 1999), and schema-based word problem solving (Jitendra & Hoff, 1996; Jitendra, Hoff, & Beck, 1999). Parent-mediated interventions comprised completing home-school communication forms, supervising homework, and parent tutoring. Peer-mediated interventions typically involved models of CWPT (Greenwood, Maheady, & Delquardi, 2002), such as reciprocal peer tutoring (Fantuzzo, King, & Heller, 1992) or peer-assisted learning strategies (e.g., Fuchs, Fuchs, Yazdian, & Powell, 2002). Other interventions were computer-assisted instruction and

student-mediated interventions that emphasized metacognitive skills such as self-regulated learning strategies (e.g., self-monitoring, self-evaluation, or self-reinforcement).

For both treatment groups, all interventions, with the exception of self-mediated intervention, were implemented beginning in the spring of the participants' first year in the study. These interventions continued until the end of the school year and resumed in October of year 2. The interventions were then maintained until the end of the second school year, with student-mediated interventions typically added later in the year based on a collaborative decision between the consultant and the teacher. Interventions, with the exception of parent-mediated intervention, were delivered in the child's assigned classroom, which occurred primarily in a general education setting ($n = 109$) and, to a lesser extent, in special education classrooms ($n = 12$).

Due to the fact that all students with ADHD received some form of academic intervention in this program and that similar positive effects on academic performance were obtained for both groups (see DuPaul et al., 2006; Jitendra et al., 2007), children in both the IAI and GAI conditions were combined for analysis. Participants in the larger study were evaluated on dependent measures on five occasions: in the winter of year 1, which was prior to the onset of the intervention; the spring of year 1; the winter and spring of year 2; and the spring of year 3. For the purposes of this investigation, only the scores at pretreatment and winter of year 2 were used for analysis to allow sufficient time for the observation of treatment-induced changes in academic and social performance. Direct testing of children was conducted by trained graduate students in school psychology and special education, who were blind to the purpose and hypotheses of the study. Rating scales were distributed directly to teachers and completed within a few weeks of achievement testing.

Data Analysis

Prior to primary analyses, effect sizes were calculated to determine the magnitude of treatment-induced change on each dependent variable. Next, to test the primary hypotheses, scores on the dependent measures were transformed to z -scores. Then, the differences between pretreatment and winter year 2 (i.e., posttreatment) scores on each dependent measure were computed. Finally, correlations between the changes in academic skills and social skills on the dependent measures were calculated using Pearson r coefficients.

RESULTS

Table 1 presents means, standard deviations, and effect sizes for each dependent variable. Means and standard deviations for the SSRS and the ACES subscales are reported by raw score; for the WJ-III subtests, these scores are based on standard scores. Results indicate that for the SSRS Cooperation subscale, there was a **medium effect size ($d = 0.43$)**, indicating moderate increases in teacher-rated cooperation from baseline to outcome. For the SSRS Assertion and Self-Control subscales, effect sizes were small (Assertion: $d = 0.23$, Self-Control: $d = 0.21$).

Effect sizes were also calculated for academic measures. Results indicated a small effect size for the ACES Reading subscale ($d = 0.25$), but negligible effect sizes for the ACES Math ($d = 0.02$), indicating some growth in teacher-reported reading skills, but none in math. Moderate gains were shown on the WJ-III Reading Fluency ($d = 0.48$), but much smaller gains were seen for the WJ-III Calculation ($d = 0.19$), Math Fluency ($d = 0.05$), and Passage Comprehension ($d = 0.03$) subtests.

Correlations Between Academic and Social Measures in Total Sample

Table 2 presents Pearson correlations between changes in social skills from baseline to winter of year 2, measured by the SSRS, and changes in academic skills, measured by the WJ-III and the ACES. Results indicated several significant associations between changes in academic scores and

Table 1
Means, Standard Deviations, and Effect Sizes for Academic and Social Skills Variables

	Mean (SD) Pretreatment	Mean (SD) Outcome	Effect Size
SSRS Cooperation	7.60 (3.07)	9.96 (5.56)	0.43
SSRS Assertion	9.04 (3.38)	10.07 (4.09)	0.23
SSRS Self-Control	10.57 (3.75)	11.44 (4.26)	0.21
ACES Reading	23.66 (6.94)	25.31 (7.63)	0.25
ACES Math	17.81 (5.01)	17.92 (5.64)	0.02
WJ Reading Fluency	84.73 (21.52)	93.22 (14.83)	0.48
WJ Calculation	94.15 (14.28)	96.83 (13.65)	0.19
WJ Math Fluency	89.55 (13.58)	90.29 (15.05)	0.05
WJ Passage Comprehension	91.09 (11.26)	91.42 (10.34)	0.03

Table 2
Pearson Correlations of Academic and Social Competence Measures in Total Sample

Subscale	SSRS Assertion	SSRS Self-Control	ACES Reading	ACES Math	WJ-III Reading Fluency	WJ-III Calculation	WJ-III Math Fluency	WJ-III Passage Comp.
Cooperation	0.288**	0.424**	0.225*	-0.071	-0.070	-0.005	0.013	0.024
Assertion		0.500**	0.282**	0.168	-0.088	0.003	-0.066	-0.065
Self-Control			0.083	-0.043	0.011	-0.030	0.068	-0.112
ACES Read				0.526**	0.113	0.134	0.106	0.129
ACES Math					0.131	0.149	0.294*	0.114
Read Fluency						0.120	0.385**	0.293**
Calculation							0.266**	0.133
Math Fluency								0.246**

Note. SSRS = Social Skills Rating System; ACES = Academic Competence Evaluation Scales; WJ-III = Woodcock-Johnson III Test of Achievement.

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

changes in social skills ratings. Significant positive correlations were found between changes on the ACES Reading subscale and the SSRS Cooperation subscale ($r = 0.225, p < .05$). In addition, changes on the ACES Reading subscale were also significantly, positively correlated with the SSRS Assertion subscale ($r = 0.282, p < .01$). These results indicate that increases in reading, as rated by teachers, were associated with increases in Cooperation and Assertion, also as rated by teachers. However, no significant correlations were found between changes in the ACES Math subscale and SSRS subscales, nor were there any significant associations between changes in the WJ-III subtests and the SSRS subscales.

Correlations Between Academic and Social Measures in Peer-Mediated Intervention Group

Table 3 presents Pearson correlations between changes in academic skills, as measured by the ACES and the WJ-III, and changes in social skills, as measured by the SSRS for those students who received peer-mediated academic interventions. A different pattern of results emerged for this subset of the study sample as compared with the total sample. In contrast to the findings from the total sample, there were no significant correlations between the ACES Reading and the SSRS subscales for the peer-mediated intervention group. However, an association between changes in math and social skills was revealed for this group. Specifically, there was a significant, positive correlation

Table 3
Pearson Correlations of Academic and Social Competence Measures in Peer-Mediated Intervention Group

Subscale	SSRS Assertion	SSRS Self-Control	ACES Reading	ACES Math	WJ-III Reading Fluency	WJ-III Calculation	WJ-III Math Fluency	WJ-III Passage Comp.
Cooperation	0.230	0.436**	0.267	-0.004	-0.115	0.063	0.097	0.015
Assertion		0.551**	0.243	0.196	-0.149	0.164	0.050	-0.084
Self-Control			0.182	0.127	0.025	0.132	0.326*	-0.023
ACES Read				0.523**	0.117	0.168	0.163	0.147
ACES Math					0.004	0.031	0.232	0.002
Read Fluency						0.064	0.442**	0.243*
Calculation							0.144	-0.002
Math Fluency								0.128

Note. SSRS = Social Skills Rating System; ACES = Academic Competence Evaluation Scales; WJ-III = Woodcock-Johnson III Test of Achievement.

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

between changes on the WJ-III Math Fluency subtest and the SSRS Self-Control subtest ($r = 0.326$, $p < .05$). This indicates for the peer-mediated intervention group, as Math Fluency scores increased on the WJ-III, there were corresponding increases in teacher ratings on the SSRS Self-Control scale.

DISCUSSION

This study examines the relationship between changes in academic competence, as a result of academic interventions, and social skills in school-age children with ADHD. The results suggested that changes in academic competence were related to positive changes in social skills. Specifically, results showed that overall, an increase in reading as rated by teachers on the ACES was associated with an increase in assertion and cooperation, also rated by teachers on the SSRS. **Therefore, it appears that reading interventions may have had a positive impact on both teacher ratings of reading performance and social skills for participating children with ADHD.**

In addition, this study tested the hypothesis that for school-age children with ADHD who received peer-mediated academic interventions, increases in academic performance would have an even greater correspondence with changes in social skills. A different pattern of results emerged for this subset of the sample as compared with the total sample. For children in the peer-mediated intervention group, treatment-related increases in math fluency as measured by the WJ-III were positively correlated with increases in self-control, as rated by teachers on the SSRS. This indicates that the reciprocal peer tutoring math intervention may have influenced both math fluency and self-control in these children with ADHD. This correlation was not found for peer-mediated intervention in reading.

The results from this study add to a growing literature investigating the use of academic interventions to target both academic performance and social skills in school-age children. Although some research in this area has found academic interventions effective for increasing both academic and social skills (Coie & Krehbiel, 1984; Lane et al., 2001; Plumer & Stoner, 2005), other studies have not produced statistically significant effects (Barton-Arwood et al., 2005; Lane, 1999; Wehby et al., 2003). Due to inconsistent findings across investigations, this study provides additional evidence that intervening in the academic domain may produce modest increases in social skills without the use of direct social skills intervention.

This study further extends the extant research literature to show the effects of academic interventions on academic and social skills specifically in children with ADHD, as opposed to the more

general category of children with emotional or behavioral disorders, as has been studied in most prior investigations. Although Plumer and Stoner (2005) found some partial improvements in social skills in children with ADHD as a result of CWPT, these results are limited by small sample size and short intervention period. In addition, Plumer and Stoner did not measure academic outcomes; therefore, increases in social skills may have been unrelated to increases in academic performance. This study addresses these weaknesses by providing some tentative evidence that improvements in academic ratings are related to increases in social skills ratings in a large sample of children with ADHD.

In addition, this study examines the use of academic interventions over an extended period of time. Although much of the research in this area employed intensive academic interventions, few studies have implemented these programs over long periods of time. Lane (1999), for example, investigated the use of a reading intervention for a 6-week period. In a follow-up study, Lane et al. (2001) investigated the effects of a 10-week phonological awareness intervention on academic and social skills. In these studies and others (Barton-Arwood et al., 2005; Wehby et al., 2003), authors acknowledge that results may be significantly limited by a brief academic intervention period. In fact, Coie and Krehbiel (1984) showed the most promising results with an academic intervention spanning the course of nearly an entire school year. Similarly, this study examines academic interventions over two full semesters of school, providing one of the most extensive intervention periods in the literature. Due to the fact that academic and social problems can be extremely resistant to intervention, a longer intervention period is more likely to produce significant and lasting change.

Based on teacher ratings in this total sample, it appears that employing reading interventions may be a promising approach to targeting both academic and social skills problems in children with ADHD. Effect sizes revealed a moderate effect for the SSRS Cooperation subscale and small effects on the Assertion and Self-Control subscales. This suggests that changes in academic performance are related to small to moderate changes in social skills. It is possible, however, that although the social skills of participating children improved somewhat, overall impairments remained.

In addition, results of this investigation reveal that changes in math performance, as rated by teachers, are not significantly associated with changes in social skills when the entire range of academic interventions is considered. Because most of the research in the field examines the effectiveness of reading interventions, it may be that math interventions do not produce desired changes in social skills. This finding, however, may actually be related to the number of students receiving math interventions, as opposed to the effectiveness of the interventions themselves. An examination of the sample reveals that there were significantly more participants enrolled in reading interventions than in math interventions. A smaller sample of students who were exposed to math interventions results in less statistical power to detect statistically significant results. It is possible that with a larger sample of participants enrolled in math interventions, significant correlations between changes in math performance and social skills may be revealed. However, it should be considered that peer tutoring in math appears to lead to both changes in academic performance and social skills.

It is also important to note that for the total sample, no significant correlations between changes on WJ-III subtests and changes on the SSRS were obtained. This is similar to a lack of results found for standardized test measures in other similar studies (Barton-Arwood et al., 2005; Lane, 1999; Wehby et al., 2003). The combination of these results and findings from previous investigations may indicate that certain standardized test measures, such as the WJ-III, may not be sensitive enough to identify changes that occurred during the intervention period. It may be that teachers, who observe and work with students on a daily basis, are more sensitive to changes in academic performance than are standardized, norm-referenced tests.

Despite the lack of a correlation between changes on the WJ-III and on SSRS scores for the total sample, it is interesting to note that students enrolled in peer-mediated math intervention showed

related increases in both math fluency on the WJ-III and the SSRS Self-Control subscale. This significant finding from the WJ-III, although in contrast to some of the existing literature, may be related to the nature of the Math Fluency subtest itself. Unlike many other subtests on the WJ-III, the Math Fluency subtest is similar to curriculum-based measurement in that it is closely aligned with the target of the intervention and requires quick and accurate responding. The similarity of this subtest to the content of the intervention may help explain statistically significant findings, despite the standardized nature of the assessment.

Based on previous research, it is not surprising that peer tutoring interventions had positive impacts on both academic and social skills (Fuchs et al., 2002; Plumer & Stoner, 2005). The fact that these results were found for math, and not reading, interventions differs somewhat from the literature. On closer inspection of the individual types of peer-mediated interventions used in this study, however, these results become more similar to other findings in the research literature. The peer-mediated, math intervention chosen for this study was reciprocal peer tutoring, which is characterized by frequent interactions with peers, the opportunity to provide and accept corrective and positive feedback, and taking turns as tutor and tutee. The nature of reciprocal peer tutoring, which necessitates cooperation, turn taking, and responding to criticism, is closely related to self-control as measured by the SSRS. In fact, many studies that found positive effects of peer tutoring on social skills employed this form of peer tutoring (Fuchs et al., 2002; Plumer & Stoner, 2005). Alternatively, the peer-mediated reading strategy employed in this study involved repeated reading with a peer. This intervention consisted of a peer tutor modeling a reading passage and the target peer tutee repeating the same passage. This form of peer-mediated intervention does not provide the target child the opportunity to serve as a tutor, take turns, or give appropriate feedback to a peer. Therefore, it is not surprising that this intervention did not result in changes in self-control. Based on the literature, it is likely that had a reciprocal peer tutoring reading intervention been used in this study, increases in ratings of self-control might have been related to improvements in reading.

Implications for Practice

The findings of this study, and the growing body of literature examining the effectiveness of academic interventions to address academic and social skills, have important implications for practice. As many children with ADHD experience disruptive behaviors and impaired interactions with peers, it is important to address these difficulties in a proactive manner. This is particularly important given findings that adolescents and adults with ADHD continue to experience social skills deficits and impairments in social interactions and friendships (Mannuzza & Klein, 2000). Social skills training, however, is costly, time-consuming, and often ineffective in ameliorating children's social skills deficits in natural settings (Gresham, 2002; Guevremont & Foster, 1993; Royer et al., 1999). Alternate interventions must thus be considered in order to address these needs early and in an effective manner.

Results from this and other research provide some evidence that conducting academic interventions with children with ADHD who are struggling both academically and socially may increase academic and social skills. Social skills improvements may occur as a result of an increase in academic competence, without the need for explicit social skills interventions. This may be especially true for students with ADHD, whose social problems are often a result of performance, rather than skill deficits (Landau et al., 1998). Reciprocal peer tutoring, which contains features that promote positive social interactions, may provide these students with increased opportunities to practice social skills already in their repertoire. The findings of this investigation suggest that for some students with ADHD, academic interventions may be used as an initial tool for addressing academic and social skills problems. This is especially salient in schools today, which are increasingly focused on

improving academic performance as driven by federal and state legislation. In addition, academic interventions may serve as an adjunct to other interventions that are designed to directly target social behavior and peer interactions, including peer coaching and social skills training.

Limitations

It should be noted that this study is not without its limitations, and results should be considered with caution. First, because this study was designed to answer questions about the relationship between social and academic skills in children with ADHD, it does not provide any information regarding causation. Therefore, it cannot be inferred that increases in academic skills caused increases in social skills. Second, changes in both academic and social skills may not be a direct result of the academic intervention. It is possible that increases in academic competence and social skills were due to maturation or attention from the mediator of the intervention. Given a lack of a control group, it cannot be certain that the active ingredient in the academic intervention is responsible for increases in social skills.

Although subjective teacher report of significant achievement problems in math or reading was required for inclusion in the study, no objective measure of learning problems was required. As a result, baseline standardized test scores were in the low average to average range. An additional limitation relates to the dependent measures chosen for analysis. Of the three dependent measures, two are teacher rating scales, which present a problem of shared method and source variance. In addition, it is possible that the teacher ratings are not as accurate in describing the actual state of the child's social skills or academic performance as compared with direct measures of these behaviors. To further complicate matters, because this is a longitudinal study with a duration of 1.5 years, participants had different teachers completing the rating scales from pretreatment in year 1 to the data collection in year 2. Therefore, any changes in social skills or academic competence could be a result of differential standards held by classroom teachers as opposed to actual changes in child behavior.

Conclusions and Directions for Future Research

Due to the modest results and inconsistent findings in the literature, more research in this area is warranted, especially for children with ADHD. Future research should continue to examine the relative outcomes of academic interventions, social skills interventions, and combined academic and social skills interventions to determine the most effective strategy to address both academic and social skills problems. It may be that a combination of academic and social skills interventions is necessary for children who prove to be more resistant to intervention. In addition, the use of multiple methods of data collection for social skills would allow researchers to obtain information from multiple sources and cross-validate teacher ratings. This is especially important because teachers are not always aware of the peer culture, nor do all teachers have the opportunity to observe students in social settings. Future studies should employ the use of direct observations of students' social behavior, in addition to teacher rating scales, to allow for a more accurate assessment of social behavior and interactions. This would also help reduce concerns with shared source and method variance.

Research in this area has suggested that norm-referenced, standardized measures may not be sensitive enough to identify treatment-induced changes. To capture treatment effects, future research may use more frequent measurement tied directly to classroom content (e.g., curriculum-based measurement). In addition, future research should examine the effectiveness of reciprocal peer tutoring in reading over a longer intervention period. The use of this intervention strategy over an extended intervention period may show desired increases in reading and social skills, and could be easily incorporated into a classroom's weekly curriculum.

In summary, this study provides initial evidence that academic interventions have a positive effect on both academic and social skills in school-age children with ADHD. Although future research is clearly necessary, this study suggests an efficient and practical initial or adjunct strategy for intervening with academic and social skills.

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