Relations among academic enablers and academic achievement in children with and without high levels of parent-rated symptoms of inattention, impulsivity, and hyperactivity

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Abstract

This study examined the relationships among academic enablers (i.e., engagement, interpersonal skills, motivation, study skills) and academic achievement in children with and without high levels of parent-rated symptoms of inattention, impulsivity, and hyperactivity (Symptoms of IIH Group). The study included 69 participants (29 [42%] in the IIH Group and 40 [58%] in the Comparison Group), with 33 boys and 36 girls in the third through fifth grades. The researchers found significant differences on the measure of academic enablers, including engagement, interpersonal skills, motivation, and study skills, in which participants in the Comparison Group received higher scores. In addition, several academic enablers mediated the relationship between symptoms of inattention, impulsivity, and hyperactivity and the academic outcomes of reading and teachers' ratings of total academic skills.

The current study examined the relationships among academic enablers and academic achievement for children with and without high levels of parent-rated symptoms of inattention, hyperactivity, and impulsivity. High levels of these symptoms are associated with attention-deficit/hyperactivity disorder (ADHD). However, the current study is not focused on children with a formal diagnosis of ADHD; it concentrates on children with high levels of symptoms associated with ADHD: inattention, hyperactivity, and impulsivity. Professionals in the schools are often confronted with the challenge of working with students who are inattentive or hyperactive; yet, these children do not meet the criteria for a mental health disorder. Children who have problems with inattention, hyperactivity, and impulsivity are at risk for lower academic achievement (DeShazo, Lyman, & Klinger, 2002; DuPaul et al., 2006; Rapport, Scanlan, & Denney, 1999; Zentall, Smith, Lee, & Wieczorek, 1994). It has been reported that up to 80% of children with ADHD symptoms (i.e., inattention, hyperactivity, and impulsivity) exhibit associated academic problems (Cantwell & Baker, 1991).

Regardless of a diagnosis (e.g., ADHD) that may or may not be appropriate, it is important to understand how these behaviors(i.e., inattention, impulsivity, and hyperactivity) are linked to academic achievement. Furthermore, it is important to investigate whether any other behaviors (e.g., motivation) mediate or explain the relationships between academic achievement and inattention, impulsivity, and hyperactivity. Given the large number of children with symptoms of inattention, impulsivity, and hyperactivity who experience academic difficulties, it is important to continue conducting research to learn what variables are associated with academic achievement among these children.

ACADEMIC ENABLERS AND ACADEMIC ACHIEVEMENT

Academic competence refers to all attitudes, behaviors, and skills that a student needs to become successful in the classroom. DiPerna and Elliott (2002) suggest that academic competence is comprised of two components: academic skills and academic enablers. Academic skills are the "basic and complex skills that are a primary focus of academic instruction in elementary and secondary school" (pp. 293–294) and include language-based skills (e.g., early literacy skills and reading), mathematics, and critical thinking. Academic enablers are defined as "attitudes and behaviors that allow a student to participate in and ultimately benefit from academic instruction in the classroom" (p. 294). DiPerna and Elliott (2002) include engagement (attentive and active participation), interpersonal skills (cooperative learning behaviors), motivation (persistence and level of interest in academic subjects), and study skills (strategies that facilitate the processing of new material) as academic enablers.

There is an extensive body of evidence that links academic enablers to academic success. Students who are academically engaged are more likely to have higher test scores (Roderick & Engle, 2001; Willingham, Pollack, & Lewis, 2002), receive higher grades (Goodenow, 1993; Willingham et al., 2002), and have lower dropout rates (Croninger & Lee, 2001). There is research that links positive interpersonal skills and increased academic achievement (Malecki & Elliott, 2002; Wentzel, 1991, 1993; Wentzel & Caldwell, 1997). Moreover, Gresham, Lane, and Beebe-Frankenberger (2005) investigated social skills among different groups of students with disruptive behaviors and found that students with externalizing behaviors (i.e., conduct problems and hyperactive, inattentive, aggressive behaviors) had lower levels of interpersonal skills. Similarly, numerous researchers have examined the positive relationship between motivation and academic achievement (Eccles et al., 1983; Meece, Wigfield, & Eccles, 1990; Schunk, Pintrich, & Meese, 2008; Wentzel & Wigfield, 1998). Students who achieve academically demonstrate effective study skills, whereas poor students do not demonstrate the same skills (Gettinger & Seibert, 2002).

Only one study has investigated academic enablers as mediators in the association between characteristics of ADHD and scholastic achievement (Volpe et al., 2006). This study included 146 students (in first through fourth grade) and utilized structural equation modeling to examine the relationships between the characteristics of ADHD and math and reading standardized test scores. Their theoretical model evaluated prior achievement and academic enablers as mediators in the relationship between the characteristics of ADHD and math and reading achievement. Correlational analyses revealed significant negative relationships between symptoms of ADHD and engagement, interpersonal skills, motivation, and study skills. The four academic enablers were collapsed into a summed score, and this academic enabler variable (as well as prior achievement) was tested as a potential mediator in the relationship between ADHD characteristics and academic

achievement in math and reading. The authors did not obtain support for the total academic enablers serving as mediators for either math or reading achievement. However, when testing a more complex relationship, engagement and interpersonal skills had small effects on current achievement, whereas motivation and study skills had larger effects. This provided some evidence that the individual academic enablers may vary in their indirect effects on the relationship between symptoms of inattention, impulsivity, and hyperactivity and academic achievement.

Other research has focused on important variables, although not termed "academic enablers," that are considered part of this model. For example, when examining group differences between students with and without symptoms of ADHD, there is evidence that children with ADHD have lower levels of academic engagement (Barkley, 1997; Junrod , DuPaul, Jitendra, Volpe, & Cleary, 2006; Nigg, 2006), interpersonal skills (Gadow et al., 2004; Hinshaw, Owens, Sami, & Fargeon, 2006), motivation (Barkley, 1997; Dunn & Shapiro, 1999), and study skills (Barkley, 2003; DuPaul & Stoner, 2003; Robin, 1998). The current study aimed to add to this growing knowledge base by determining whether each variable mediated the relationship between students' symptoms of inattention, impulsivity, and hyperactivity and academic achievement.

Because academic enablers are often associated with higher levels of academic achievement, it is important to understand the potential role these constructs may play in the achievement of children with inattention, impulsivity, and hyperactivity. The current study significantly contributes to the knowledge base in several ways. Most notably, a model of mediation was tested to determine whether each academic enabler (i.e., engagement, interpersonal skills, motivation, and study skills) mediates, or explains, the relationship between symptoms of inattention, impulsivity, and hyperactivity and academic achievement. Academic achievement was measured using curriculum-based measurement and teacher-rated academic skills. Previous studies have not examined each individual variable as a potential mediator in the relationship between symptoms of inattention, impulsivity, and hyperactivity and academic achievement, and prior research has measured academic achievement with standardized test scores (Volpe et al., 2006).

Testing for mediation basically allows one to answer the question: Do academic enablers explain the relationship between symptoms of inattention, impulsivity, and hyperactivity and academic achievement? If the answer is "yes," then these constructs (i.e., engagement, interpersonal skills, motivation, and study skills) may provide important behavioral targets for intervention programs to increase student achievement.

Previous studies have documented gender differences in all of the main constructs in this study. Elliott, DiPerna, Mroch, and Lang (2004) found that female students were rated by their teachers as having higher levels of academic engagement, interpersonal skills, motivation, and study skills. Among other researchers, Waschbusch (2002) reported that boys were more likely to display clinically

significant levels of inattention, impulsivity, and hyperactivity warranting a clinical diagnosis. Finally, it is generally accepted that females have somewhat better verbal abilities, and males have a slight advantage in mathematics. Nowell and Hedges (1998) examined longitudinal trend data from National Assessment of Education Progress and found small mean differences in academic achievement between girls and boys. Thus, the current study included gender as a variable in some of the analyses.

MAIN RESEARCH QUESTIONS AND PREDICTIONS

The goal of the current study was to examine the relationships among academic enablers and academic achievement in children with and without high levels of parent-rated inattention, impulsivity, and hyperactivity. Two main research questions were addressed. First, do academic enablers differ between children with and without high levels of inattention, impulsivity, and hyperactivity and does gender play a role? It was predicted that children with characteristics of inattention, impulsivity, and hyperactivity would have lower scores on all academic enablers (Charney, 1991; DuPaul et al., 2004; Rapport et al., 1999). It was expected that girls would obtain higher scores for all academic enablers (Elliott et al., 2004) and on academic measures of reading (Nowell & Hedges, 1998). Second, do academic enablers mediate the relationship between symptoms of inattention, impulsivity, and hyperactivity and academic achievement? It was predicted that the relationship between symptoms of inattention, impulsivity, and hyperactivity and academic achievement would be mediated by each academic enabler (Rapport et al., 1999; Volpe et al., 2006).

METHODS

Participants

Study participants included 69 students from three rural elementary schools in Illinois from 21 different classrooms. The sample comprised two groups: students with high levels of parent-rated symptoms of inattention, impulsivity, and hyperactivity (Symptoms of IIH Group) and students without these symptoms (Comparison Group). The Procedures section contains details about how the groups were created. Table 1 presents detailed demographic data based on group status. All participants had parental consent and provided student assent to participate in the study. The data for two participants were not included in the analyses because of missing data.

Measures

The study consisted of three primary constructs: inattentive, impulsive, and hyperactive behaviors, academic enablers, and academic achievement. Inattentive,

impulsive, and hyperactive behaviors were measured via the ADHD-IV Rating Scale (DuPaul, Power, Anastopoulos, & Reid, 1998). The ADHD-IV is an 18-item scale that measures ADHD-characteristic behaviors. The items are based on Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) diagnostic criteria for ADHD, and all items are rated on a 4-point Likert scale ranging from 0 (never or rarely) to 3 (very often). The current study utilized the parent-rated version of the scale. Normative data were gathered from 4,000 teachers and 4,500 parents of children in kindergarten through 12th grade. The parent-rated version demonstrated reliability through (a) strong internal consistency (coefficient alpha of .94), (b) strong test–retest reliability (.90), and (c) moderate inter-rater agreement (.41). Validity for the measure is demonstrated through significant correlations with similar measures. In addition, factor analysis of the ADHD-IV Rating Scale shows a clear two-factor structure, which corresponds to two subtypes of ADHD in the DSM-IV (DuPaul, Power, et al., 1998). A summed score of all items was used in the analyses.

Table 1. Demographic Characteristics of Participants by Group

	Total *n* = 69		Symptoms of IIH *n* = 29		Comparison *n* = 40	
	n	%	*n*	%	*n*	%
Gender						
Boy	33	47.8	14	48.3	19	47.5
Girl	36	52.2	15	51.7	21	52.5
Race/Ethnicity						
African American	2	.9	1	3.4	1	2.5
Hispanic American	1	1.4	1	3.4	0	0
White	66	95.7	27	93.1	39	97.5
Grade						
Third	30	43.5	14	48.3	16	40.0
Fourth	9	13	5	17.2	4	10.0
Fifth	30	43.5	10	34.5	20	50.0

Academic enablers were assessed with the Academic Competence Evaluation Scales (ACES; DiPerna & Elliott, 2000), which is a norm-referenced scale for evaluating academic functioning of students in kindergarten through college. The ACES measures two domains of academic functioning: academic enablers (Engagement, Interpersonal Skills, Motivation, and Study Skills) and academic skills based on teachers' judgment (Reading/Language Arts, Math, and Critical Thinking) (DiPerna & Elliott, 2000). Academic enabler items are rated on a 5-point Likert scale ranging from 1 (never) to 5 (almost always). The current study utilized the teacher-rated version of the measure. The ACES was standardized on a large, national sample of teachers and students. Reliability for the Academic Enablers scale is demonstrated through (a) strong internal consistency with high coefficient alphas for all grade clusters, (b) good test-retest correlations, and (c) adequate inter-rater correlations when rated by two different teachers. Validity for the ACES was demonstrated through factor analysis and correlations with similar measures, such as Iowa Test of

Basic Skills (ITBS; Hoover, Hieronymus, Frisbie, & Dunbar, 1993), the Social Skills Rating System (Gresham & Elliott, 1990), and grade-point averages (DiPerna & Elliott, 2000).

Academic achievement data were collected through two methods: assessment of basic skills using curriculum-based measurement (CBM) and teacher judgments of academic skills. The authors felt that it was important to include both types of academic achievement data to assess the relationships among impulsivity, inattention, and hyperactivity and direct, quantitative measures of basic skills (CBM), as well as more qualitative measures of academic skills based on teacher judgments.

CBM probes were used to assess academic skills in reading and math. CBM is a set of standardized, short, timed tests, or probes, and can be given on a regular basis to monitor a student's academic progress in basic skills (Shinn, 2002). General reading ability was assessed via Reading-CBM (R-CBM). Participants were given three reading passages at their respective grade levels and asked to read aloud for 1 minute. The number of words read correctly was recorded, and these scores were averaged across the three probes for the R-CBM score. Reading probes were taken from AIMSweb (2005). Reliability for curriculum-based measurement in reading is demonstrated through strong test-retest correlations (.92–.97) and alternate forms reliability (.89–.94; Tindal, Germann, & Deno, 1983; Tindal, Marston & Deno, 1983). Evidence of validity is demonstrated through strong convergent construct validity correlations of .91 with the Woodcock Reading Mastery Test and .82–.86 with the Gates-MacGinite Reading Test (Fuchs & Deno 1992; Jenkins & Jewell, 1993). Participants were also asked to complete math problems for 2 minutes on three different probes at their respective grade levels. The number of correct digits was scored for each probe. The CBM Math score was the average score across the three probes. The math probes were taken from Monitoring Basic Skills Progress (Fuchs, Hamlett, & Fuchs, 1998). Reliability and validity for CBM Math probes are demonstrated through strong alternate forms reliability (.90–.92) and convergent construct validity of .36–.59 with the Stanford Diagnostic Mathematics Test and .80–.83 with basic math fact probes (Thurber, Shinn & Smolkowski, 2002).

The second measure of academic achievement was collected from classroom teachers who completed ACES (DiPerna & Elliott, 2000). In addition to measuring academic enablers, as described above, the ACES measures academic skills based on teachers' judgment (Reading/Language Arts, Math, and Critical Thinking) (DiPerna & Elliott, 2000). Academic skill items are rated on a 5-point Likert scale ranging from 1 (far below) to 5 (far above). The ACES was standardized on a large, national sample of teachers and students. Reliability for the Academic Skills scale is demonstrated through (a) strong internal consistency with high coefficient alphas for all grade clusters, (b) good test-retest correlations, and (c) adequate inter-rater correlations when rated by two different teachers. Validity for the ACES was demonstrated through factor analysis and correlations with similar measures. For example, correlations with the ITBS ranged from .38 to .87 for composite scores, and

correlations between the ACES and grade-point averages ranged from .56 to .90 (DiPerna & Elliott, 2000).

Procedures

Data used in the study were previously collected as part of another larger study. Teachers who volunteered to participate in the study sent a consent form and the ADHD-IV Parent Form rating scale home with all of the students in their classrooms. If the parents agreed to participate, they returned the consent form and the completed rating scale. Students also provided assent for their participation in the study. Participants in the Symptoms of IIH Group included all students with a score at or above the 90th percentile on the parent-rated form. DuPaul, Anastopoulos, and colleagues (1998) recommend using the 98th percentile as a conservative cutoff in research when trying to identify individuals who have a high probability of having ADHD. However, they recommend a somewhat less stringent cutoff of the 90th or 93rd percentile when the ADHD-IV is used in conjunction with multiple sources of data. Given that the goal of the current study was to investigate outcomes associated with the symptoms of inattention, impulsivity, and hyperactivity, not necessarily children with formal diagnoses of ADHD, the authors decided to use the 90th percentile as the criterion for being included in the Symptoms of IIH group. Participants in the Comparison Group consisted of students with consent who were not above the 90th percentile on the parent-rated ADHD-IV. To maximize the number of participants in both groups, the authors chose to keep all individuals below the 90th percentile in the Comparison Group, instead of choosing a lower criterion, such as the 80th percentile, for inclusion in the Comparison Group. This also retained all participants in the dataset instead of procedures that may require deleting participants from analyses. Comparison Group participants were chosen at random out of each participating classroom among students with consent with a maximum of four students per classroom. Teachers rated between one and four students (M = 3.29).

Participants were given CBM Math probes in small groups, and R-CBM was administered individually by a trained graduate student and research assistants. Teachers were asked to fill out the ACES. Grades could not be collected directly from the schools; therefore, following data collection, a letter was mailed to parents requesting third-quarter grades. However, because there was a low return rate, these data were not used. CBM data were collected for each student at their respective grade level. Given that the probes were at different difficulty levels, it was necessary to standardize these scores to be able to compare scores across all grade levels. Raw scores for R-CBM and CBM Math were standardized toz-scores by subtracting the respective grade-level mean from the raw score and dividing by the respective standard deviation. Z-scores were then converted to a T-scale by multiplying each score by 10 (the standard deviation of a T-scale) and adding 50 (the mean of a T-scale).

RESULTS

Refer to Table 2 for means and standard deviations of the main study variables for the total sample, by group status (Symptoms of IIH and Comparison) and gender.

Table 2. Means and Standard Deviations of Main Study Variables by Group and Gender

		Comparison			IIH			Total		
		M	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
Total ACES Academic Skills	Boys	119.58	16.58	17	86.15	19.94	13	105.13	24.52	30
	Girls	115.33	21.89	21	84.53	26.42	15	102.50	28.11	36
	Total	117.26	19.56	38	85.28	23.22	28	103.70	26.37	66
ACES Reading	Boys	40.23	5.48	17	27.23	7.41	13	34.60	9.07	30
	Girls	40.48	7.67	21	29.53	8.85	15	35.92	9.74	36
	Total	40.37	6.70	38	28.46	8.15	28	35.32	9.39	66
ACES Math	Boys	29.53	4.58	17	22.61	6.08	13	26.53	6.25	30
	Girls	27.33	6.33	21	19.20	6.99	15	23.94	7.68	36
	Total	28.32	5.66	38	20.79	6.69	28	25.12	7.13	66
ACES Critical Thinking	Boys	49.88	7.16	17	36.31	8.62	13	44.00	10.28	30
	Girls	47.52	9.22	21	35.80	12.39	15	42.64	12.01	36
	Total	48.58	8.34	38	36.04	10.61	28	43.26	11.20	66
ACES Engagement	Boys	32.95	5.11	19	25.69	6.67	13	30.00	6.76	32
	Girls	31.62	7.28	21	25.40	8.04	15	29.03	8.11	36
	Total	32.25	6.30	40	25.54	7.31	28	29.48	7.46	68
ACES Interpersonal Skills	Boys	45.68	4.93	19	33.77	6.56	13	40.84	8.13	32
	Girls	46.71	6.29	21	36.80	10.28	15	42.58	9.46	36
	Total	46.22	5.64	40	35.39	8.73	28	41.76	8.84	68
ACES Motivation	Boys	44.63	8.34	19	28.77	7.84	13	38.19	11.26	32
	Girls	45.00	8.55	21	29.27	12.02	15	38.44	12.71	36
	Total	44.82	8.34	40	29.03	10.12	28	38.32	11.96	68
ACES Study Skills	Boys	48.63	5.88	19	36.15	8.03	13	43.56	9.15	32
	Girls	51.14	4.34	21	36.93	10.91	15	45.22	10.43	36
	Total	49.95	5.22	40	36.57	9.51	28	44.44	9.81	69
CBM Math	Boys	3.98	2.22	19	3.71	2.87	21	3.83	2.55	40
	Girls	3.48	1.54	14	2.82	2.00	15	3.14	1.80	29
	Total	3.76	1.95	33	3.34	2.55	36	3.54	2.28	69
R-CBM Fluency	Boys	128.32	36.00	19	81.74	22.36	14	108.56	38.45	33
	Girls	132.51	31.05	21	103.71	35.79	15	120.51	35.64	36
	Total	130.52	33.12	40	93.10	31.58	29	114.79	37.23	69

Preliminary Analyses

Inattention, Impulsivity, and Hyperactivity Symptoms

To ensure that the Symptoms of IIH Group and the Comparison Group differed significantly on the ADHD-IV scores, an analysis of variance (ANOVA) was

conducted. As expected, the Symptoms of IIH Group scored significantly higher on ratings of IIH behaviors (M = 56.28) than the Comparison Group (M = 8.95), F (1, 67) = 236.09, p < .001.

Group (Symptoms of IIH and Comparison) and Gender differences were investigated on the academic dependent variables (i.e., ACES Academic Skills score, R-CBM, CBM Math). For R-CBM there was a Group main effect, with the Symptoms of IIH Group scoring lower than the Comparison Group and F (1, 68) = 22.39, p < .001, Cohen's (1988) d=1.16, Large. For CBM Math, there was also a Group main effect, with the Symptoms of IIH Group scoring lower than the Comparison Group and F (1, 68) = 6.86, p < .05, Cohen's d = .19, Small. The overall teacher-rated Academic Skills score differed by Group Status, F (1, 62) = 35.94, p < .001, Cohen's d = .51, Medium, with the Symptoms of IIH Group scoring lower than the Comparison Group. To further investigate differences in teacher-rated academic skills, a Group by Gender multivariate analysis of variance (MANOVA) was conducted on the Academic Skills Subscales (Reading, Math, and Critical Thinking). The MANOVA was significant for Group Status, Wilks' Lambda = .597, p<.001, and Gender, Wilks' Lambda = .825, p = .009, with girls having higher scores. The follow-up univariate ANOVA revealed that the Symptoms of IIH Group scored lower on the Reading, Math, and Critical Thinking subscales, F (1, 65) = 41.65, 24.77, 28.55, ps < .001, respectively. For each of these differences, Cohen's d was in the Large range, and d = 1.60, 1.22, and 1.31, for Reading, Math, and Critical Thinking, respectively. Although the overall MANOVA was significant for a Gender main effect with girls having higher scores than boys, none of the follow-up univariate ANOVAs on the Math, Reading, and Critical Thinking Subscales was significant for Gender differences.

Prediction 1

It was predicted that children with characteristics of inattention, impulsivity, and hyperactivity would have lower scores on all academic enablers. To investigate whether the participants in the two groups (Symptoms of IIH and Comparison) differed in academic enablers, a Group by Gender ANOVA was conducted on the ACES Total Academic Enablers score. There was a significant main effect for Group, F(1, 67) = 51.78, p < .001, Cohen's d = 1.73, Large,with the Comparison Group obtaining higher scores than the Symptoms of IIH Group. There was no main effect of Gender, F (1, 67) = .24, nonsignificant, or Group by Gender interaction, F (1, 67) = .00, nonsignificant.

A Group by Gender MANOVA was conducted on the ACES Academic Enablers subscales to investigate differences among the different types of academic enablers. The overall MANOVA for Group was significant, Wilks' Lambda = .482, F (4, 61) = 16.76, p < .001, and follow-up ANOVAs revealed significant differences on the four subscales F (1, 67) = 16.02, p < .001, F (1, 67) = 38.78, p < .001, F (1, 67) = 49.85, p < .001, F (1, 67) = 55.35, p < .001, for Engagement, Interpersonal Skills, Motivation, and Study Skills, respectively. For all subscales, the Comparison Group obtained higher scores than the Symptoms of IIH Group. All of the group differences were

Large and Cohen's d = .98, 1.47, 1.70, and 1.74 for Engagement, Interpersonal Skills, Motivation, and Study Skills, respectively. There were no significant Gender differences, Wilks' Lambda = .983, or Group by Gender interactions, Wilks' Lambda = .376.

Prediction 2

It was hypothesized that each of the four academic enablers (Engagement, Interpersonal Skills, Motivation, and Study Skills) would mediate the relationship between symptoms of inattention, impulsivity, and hyperactivity and each measure of academic achievement. Using the steps proposed by Baron and Kenny (1986), the mediation model was tested for each measure of academic achievement, including Reading, Math, and teacher-rated Academic Skills (ACES). The first step was to regress the mediator (Engagement, Interpersonal Skills, Motivation, Study Skills) on the independent variable (parent-rated ADHD-IV Total Score), which indicated a significant negative relation in the expected direction, $\beta = -.49$, $p < .001$; $\beta = -.67$, $p < .00$; $\beta = -.65$, $p < .001$; and $\beta = -.70$, $p < .001$, respectively. Second, for each academic outcome, four hierarchical regressions were conducted with the ADHD-IV Total Score as the independent variable in Step 1, and each academic enabler score (Engagement, Interpersonal Skills, Motivation, Study Skills) added in Step 2. The dependent variables were R-CBM, CBM Math, and Academic Skills. See Table 3 for specific regression results. As a reminder, mediation is said to occur when the mediator (i.e., academic enablers) has a significant effect on the dependent variable (i.e., academic outcomes) and the effect of the independent variable (i.e., symptoms of IIH) shrinks on the addition of the mediator (i.e., each academic enabler). Thus, looking at Step 2 of the hierarchical regressions, mediation is said to occur when the mediator variable (i.e., each academic enabler) is significant, and the beta for the ADHD score is reduced or no longer significant. The Sobel test was used to test the significance of the indirect effect to reduce type I and type II error (Baron & Kenny, 1986; Preacher & Hayes, 2004). The Sobel test is a commonly used test of the significance of the indirect effect and is conservative (MacKinnon, Warsi, & Dwyer, 1995). Table 3 also identifies the associated Sobel Z values and the level of mediation (none, full, or partial) and whether they were significant. Sobel values were calculated using an online Internet program (Jose, 2003).

All academic measures (R-CBM, CBM Math, and Academic Skills) were significantly and inversely related to parent-rated symptoms of IIH in Step 1. In Step 2, with the addition of each academic enabler, the change in R2 was significant for Reading and Academic Skills. For Reading, Step 1 was significant ($\beta = -.45$, $p < .001$), and in Step 2, the pathway between Symptoms of IIH and Reading became nonsignificant with the addition of Interpersonal Skills ($\beta = -.24$, $p = .09$), Motivation ($\beta = -.11$, $p = .40$), and Study Skills ($\beta = -.13$, $p = .36$); with the addition of Engagement ($\beta = -.33$, $p < .01$), however, the pathway between Symptoms of IIH and Reading remained significant. When a previously significant relationship between the independent and dependent variable becomes nonsignificant with the addition of a third variable, it suggests that the third variable is functioning as a full mediator of the relationship;

however, if the pathways between the independent variable and dependent variable as well as the mediator and dependent variable are significant, partial mediation is suggested. Therefore, Interpersonal Skills, Motivation, and Study Skills fully mediated the relationship between Symptoms of IIH and R-CBM, and Engagement partially mediated this relationship.

Table 3. Summary of Hierarchical Regression Analyses of Academic Enablers Mediating the Relationship between Symptoms of Inattention, Impulsivity, and Hyperactivity and Academic Outcomes

Academic Achievement Measure	Step	Independent Variable	*B*	*SE B*	β	Adjusted R^2	ΔR^2	Sobel *Z*
R-CBM	1	Symptoms of IIH ***	−.29	.07	−.45	.19***		1.77
	2	Symptoms of IIH*	−.21	.08	−.33	.23***	.05*	none
		Engagement †	.32	.16	.25			
	1	Symptoms of IIH***	−.29	.07	−.45	.19***		2.05*
	2	Symptoms of IIH	−.15	.09	−.24	.24***	.06*	Full
		Interpersonal Skills*	.36	.15	.33			
	1	Symptoms of IIH***	−.29	.07	−.45	.19***		3.40***
	2	Symptoms of IIH	−.07	.08	−.11	.35***	.16***	Full
		Motivation***	.42	.10	.53			
	1	Symptoms of IIH***	−.29	.07	−.45	.19***		2.72**
	2	Symptoms of IIH	−.08	.09	−.13	.29***	.10**	Full
		Study Skills**	.44	.14	.45			
CBM Math	1	Symptoms of IIH *	−.19	.08	−.29	.07*		NA
	2	Symptoms of IIH	−.14	.09	−.21	.08*	.02	
		Engagement	.22	.18	.17			
	1	Symptoms of IIH*	−.19	.08	−.29	.07*		NA
	2	Symptoms of IIH	−.14	.10	−.21	.07*	.01	
		Interpersonal Skills	.15	.17	.13			
	1	Symptoms of IIH*	−.19	.08	−.29	.07*		NA
	2	Symptoms of IIH	−.08	.10	−.13	.10*	.04	
		Motivation	.21	.12	.25			
	1	Symptoms of IIH*	−.19	.08	−.29	.07*		NA
	2	Symptoms of IIH	−.11	.11	−.17	.08*	.02	
		Study Skills	.18	.16	.18			
Academic Skills	1	Symptoms of IIH ***	−1.07	.17	−.62	.38***		4.06***
	2	Symptoms of IIH***	−.65	.17	−.38	.54***	.17***	Partial
		Engagement***	1.68	.34	.48			
	1	Symptoms of IIH***	−1.07	.17	−.62	.37***		2.55*
	2	Symptoms of IIH**	−.67	.21	−.39	.44***	.07**	Partial
		Interpersonal Skills**	1.03	.37	.35			
	1	Symptoms of IIH***	−1.07	.17	−.62	.38***		6.32***
	2	Symptoms of IIH	−.25	.16	−.14	.67***	.29***	Full
		Motivation***	1.57	.21	.72			
	1	Symptoms of IIH ***	−1.07	.17	−.62	.37***		4.92***
	2	Symptoms of IIH	−.25	.20	−.14	.58***	.21***	Full
		Study Skills ***	1.77	.31	.66			

Note. NA = not available. *$p < .05$, **$p < .01$, ***$p < .001$, †$p = .051$.

For Math, Step 1 was significant ($\beta = -.29$, $p < .05$); however, in Step 2, the pathway between Symptoms of IIH and Math remained significant with the addition of each potential mediator, Engagement ($\beta = -.21$, $p = .12$), Interpersonal Skills, ($\beta = -.21$, $p = .19$), Motivation ($\beta = -.13$, $p = .39$), and Study Skills ($\beta = -.17$, $p = .31$). This pattern suggests that none of the academic enablers are functioning as a partial or full mediator in the relationship between Symptoms of IIH and CBM Math Scores.

For the ACES Academic Skills, Step 1 was significant ($\beta = -.62$, $p < .001$), and in Step 2, the pathway between Symptoms of IIH and Academic Skills became nonsignificant with the addition of Motivation ($\beta = -.11$, $p = .21$) and Study Skills ($\beta = -.13$, $p = .36$). With the addition of Engagement ($\beta = -.38$, $p < .001$) and Interpersonal Skills ($\beta = -.39$, $p < .01$), the pathway between Symptoms of IIH and Academic Skills remained significant. These results suggest that Motivation and Study Skills are fully mediating the relationship between Symptoms of IIH and Academic Skills, and Engagement and Interpersonal Skills are partial mediators of this relationship.

DISCUSSION

This study examined the relationships among academic enablers and academic achievement in children with and without high levels of inattention, impulsivity, and hyperactivity. As expected, children with significantly high levels of inattention, impulsivity, and hyperactivity had lower levels of academic enablers. Additionally, children with high levels of inattention, impulsivity, and hyperactivity scored significantly lower on each measure of academic achievement. This supports prior research that has demonstrated that children with ADHD are at risk for lower academic performance and underachievement (DuPaul et al., 2004; Rapport et al., 1999). Surprisingly, very few studies have investigated the performance on CBM of children with characteristics of inattention, impulsivity, and hyperactivity or formal ADHD diagnoses.

Finally, it was predicted that each academic enabler would function as a mediator for the relationship between significantly high levels of inattention, impulsivity, and hyperactivity and each measure of academic achievement. Analyses revealed that several academic enablers mediated the relationship between symptoms of inattention, impulsivity, and hyperactivity and the academic outcomes of reading and teachers' ratings of total academic skills. Motivation and study skills were full mediators for both reading and academic skills, engagement was a partial mediator for reading and academic skills, and interpersonal skills were a full mediator for reading and a partial mediator for academic skills. Academic enablers did not function as a mediator in the relationship between inattention, impulsivity, and hyperactivity and math in the current study. It is not known why academic enablers did not explain the relationship between symptoms of inattention, impulsivity, and hyperactivity and math skills; the authors speculate that either (a) inattentive, impulsive, and hyperactive symptoms are directly impacting math skills (i.e., not

indirectly through academic enablers), or (b) the link between these symptoms and math is accounted for by variables not measured in this study.

Volpe and colleagues (2006) tested a similar mediation model with a total academic enablers score serving as a mediator in the relationship between ADHD-type behaviors and math and reading achievement measured via a published, norm-referenced achievement test. Although Volpe et al. found inconclusive results for their mediation model, the current study showed evidence that academic enablers served as a mediator in the relationship between significantly high levels of inattention, impulsivity, and hyperactivity and reading and teacher-rated academic skills. In addition, the current study used teacher-rated academic skills as well as curriculum-based measurement as academic outcomes, compared with the standardized achievement tests used in the Volpe et al. study.

Limitations

The findings of the current study should be interpreted with some caution because of the presence of several limitations. First, the study was limited in the constructs utilized to explain the relationship between the symptoms of inattention, impulsivity, and hyperactivity and achievement. For example, other previously identified variables that may influence achievement, such as cognitive and metacognitive variables, were not included in the current study (Wang, Haertel, & Walberg, 1993). Second, the number of participants in the study was small. This small sample size may have hidden some possible effects that may have been evident with a larger sample. Third, the majority of the participants (95.7%) were White/Caucasian. Thus, when generalizing to other racial/ethnic groups, not all findings may be applicable. Fourth, the group of children with significantly high levels of inattention, impulsivity, and hyperactivity was determined by a parent-rated ADHD scale. Although a stringent cut point and a solid rating scale were utilized, results should be interpreted in light of the presence of inattention, impulsivity, and hyperactivity, but not necessarily generalized to all children diagnosed with ADHD. Lastly, teachers' ratings of academic skills and academic enablers were utilized versus direct observation of these skills. These teacher rating data are subject to bias and may be less accurate than more direct assessments.

Implications

The results of the current study could be used to inform prevention strategies at the primary, secondary, and tertiary level. In terms of secondary or tertiary prevention strategies, school professionals should consider selecting interventions that not only address the problem behaviors and academic difficulties that are associated with inattention, impulsivity, and hyperactivity, but also teach strategies that support learning. For example, an intervention to address reading fluency could incorporate goal setting to increase motivation and include explicit instruction on how to practice reading fluently, such as repeated reading (i.e., study skills). Similarly, teachers can facilitate interpersonal skills by providing opportunities to interact

with peers during portions of the instructional time and using strategies to increase engagement during instruction (e.g., choral responding). For tertiary prevention efforts, if a student displays high levels of inattention, impulsivity, and hyperactivity and is not responding to academic skill instruction, educators could strongly consider adding instruction about study skills and use instructional strategies that maximize engagement and increase motivation.

Beyond intervention efforts, the study could help inform primary prevention strategies as well. A prevention framework that considers academic skills and academic enablers as complementary may provide a stronger curricular foundation and promote effective instruction for all students. Rather than focusing only on academic skill instruction, providing instruction about and practice using academic enablers may increase overall academic success for all students.

CONCLUSION

The current study documented lower levels of achievement in children with symptoms of inattention, impulsivity, and hyperactivity on indirect measures of academic skills (i.e., teacher-rated academic skills), direct measures of academic skills (i.e., CBM probes), and behaviors that enable academic success (i.e., engagement, interpersonal skills, motivation, study skills). Results also suggest that the relationship between symptoms of inattention, hyperactivity, and impulsivity and some academic outcomes (i.e., reading and teacher-rated global academic skills) is explained by academic enablers. Thus, it might not be enough to intervene directly with academic skills for children with symptoms of inattention, impulsivity, and hyperactivity; they also may need to build up their nonacademic behaviors to support their progress in school. Consistent with DiPerna and Elliott's (2002) model of academic competence, both academic skills and academic enablers contribute to academic success. Given that children and adolescents with symptoms of inattention, impulsivity, and hyperactivity are at risk for academic difficulties, it may be important to intervene with both academic skill and academic enabler deficits. The results of this study highlight the need to not only focus on the behavioral symptoms of inattention, impulsivity, and hyperactivity, but to also focus on the social behaviors that support learning in the classroom (e.g., engagement, interpersonal skills) when the goal is to improve academic outcomes.

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