
SPECIAL TOPIC: RESEARCH BRIEF

Consultation-Based Academic Interventions for Children With Attention Deficit Hyperactivity Disorder: Effects on Reading and Mathematics Outcomes at 1-Year Follow-up

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Abstract. The purpose of this follow-up study was to evaluate the effectiveness of two consultation-based models to enhance the educational functioning of children with attention deficit hyperactivity disorder (ADHD) after 1 year of no treatment. Children ($N = 167$) meeting *Diagnostic Statistical Manual* (4th ed., text revision; 2000) criteria for attention deficit hyperactivity disorder were randomly assigned to one of two consultation groups: traditional data-based academic intervention, which consisted of interventions based on consultant-teacher collaboration, representing “consultation as usual,” or intensive data-based academic intervention, which consisted of interventions using a data-based decision-making model involving ongoing feedback to teachers. Teachers implemented academic interventions over 15 months, and all children were assessed 1 year following the suspension of treatment. A variety of academic outcomes were assessed on five occasions (baseline, 3 months, 12 months, 15 months, and 1-year follow-up). Although previously published reports of this sample using hierarchical linear modeling analyses indicated comparable significant positive growth for the majority of these dependent variables for both intervention groups, the findings of this follow-up study using hierarchical linear modeling found significant growth trajectories for only 2 of 16 dependent variables. These findings highlight the need for sustained intervention efforts to ameliorate the educational functioning of children with attention deficit hyperactivity disorder.

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Students diagnosed with attention deficit hyperactivity disorder (ADHD) typically exhibit developmentally inappropriate levels of inattention, impulsivity, and motor activity (American Psychiatric Association, 2000). As a function of these symptomatic behaviors, children and adolescents with ADHD are at higher than average risk to experience significant academic difficulties throughout their school years (DuPaul & Stoner, 2003). In fact, the standardized mean difference in achievement between students with and without ADHD is in the moderate to large range ($d = 0.71$; Frazier, Youngstrom, Glutting, & Watkins, 2007). It is not surprising then that children with ADHD are at significant risk for grade retention and school dropout (Barbareis, Katusic, Colligan, Weaver, & Jacobson, 2007). Thus, it is critical for school psychologists and other education professionals to develop and implement interventions that are effective in ameliorating these students' academic difficulties.

Unfortunately, the most common treatments (i.e., psychostimulant medication and behavior management strategies) for ADHD are limited in their effect on academic performance (Multimodal Treatment Study of ADHD [MTA] Cooperative Group, 1999, 2004). Initial support for interventions directly addressing the academic deficits experienced by students with ADHD has come from single-subject and small-sample research design studies examining strategies such as classwide peer tutoring (DuPaul, Ervin, Hook, & McGoey, 1998), computer-assisted instruction (Clarfield & Stoner, 2005), self-regulated strategy for written expression (Reid & Liemann, 2006), and homework support (Power, Karustis, & Habboushe, 2001). Although findings from these short-term intervention studies have been promising, the need for longitudinal investigation of academic interventions with this population is particularly acute given the chronicity of symptomatic behaviors and academic deficits associated with ADHD.

Recently, DuPaul et al. (2006) and Jitendra et al. (2007) reported the results of a longitudinal investigation comparing two different models of school-based consultation on

the academic achievement of 167 elementary school children (Grades 1–4) with ADHD who were also experiencing significant difficulties in reading, mathematics, or both. Students were randomly assigned to one of two consultation groups—Intensive Data-Based Academic Intervention (IDAI) and Traditional Data-Based Academic Intervention (TDAI)—and received intervention in reading, mathematics, or both from their classroom teachers. The two groups differed in that consultants for the IDAI group collaborated with classroom teachers to design academic interventions based on assessment data, closely monitored treatment integrity, and provided feedback to teachers regarding integrity and student progress. In contrast, consultants for the TDAI group collaborated with classroom teachers to design academic interventions based on teacher choice, monitored treatment integrity, but did not provide feedback to teachers regarding integrity or outcomes, and did not collect data on student progress. Students in both groups received academic interventions over 15 months across 2 school years.

Trajectories for a variety of academic indices including norm-referenced achievement test scores, curriculum-based measurement probes, teacher ratings of academic performance, report card grades, and progress toward goal measures were examined using hierarchical linear modeling analyses. Although statistically significant ($p < .001$) positive growth was obtained for 18 of the 24 dependent variables, slopes did not differ between the two groups, indicating no clear advantage for the IDAI consultation model (DuPaul et al., 2006; Jitendra et al., 2007).

The purpose of the present study was to investigate the degree to which positive growth in academic performance was maintained at 1-year follow-up for the participants in the DuPaul et al. (2006) and Jitendra et al. (2007) studies. No prior studies with this population have examined long-term achievement outcomes as a function of academic intervention. Given the significant gain in academic skills shown by participants in both consultation groups over 15 months, it was hypothesized that trajectories for all measures would

remain significantly positive through 1-year follow-up and that there would be no significant difference between the two consultation groups with respect to slope.

Method

Detailed descriptions of study participants, dependent measures, and intervention and assessment procedures are presented elsewhere (DuPaul et al., 2006; Jitendra et al., 2007). In this section, only a brief summary of these features is provided.

Participants

Participants included 175 children (133 boys, 42 girls; M age = 104.3 months; SD = 14.7) attending first through fourth grade in public elementary schools located in urban, rural, and suburban settings in eastern Pennsylvania who were experiencing significant difficulties with ADHD symptoms and academic achievement. All student participants met strict research diagnostic criteria for ADHD via parent and teacher ratings on the ADHD Rating Scale—IV (DuPaul, Power, Anastopoulos, & Reid, 1998) and parent interviews using the National Institute of Mental Health Diagnostic Interview Schedule for Children—IV (Shaffer, Fisher, & Lucas, 1998). This investigation employed an intent to treat methodology. Participants were included if they received at least one semester of consultation for either math or reading.

The final sample, however, comprised 167 students (127 boys and 40 girls). These 167 students were randomly assigned to one of two educational consultation groups: TDAI (n = 86; 66 boys) or IDAI (n = 81; 61 boys) and received intervention in reading (TDAI = 68, IDAI = 58), mathematics (TDAI = 50, IDAI = 45), or both (TDAI = 32, IDAI = 22). Because of missing data, results for only 107 (TDAI = 58, IDAI = 49) of the 126 students receiving reading interventions and 80 (TDAI = 39, IDAI = 41) of 95 students receiving math interventions were examined in the current study.

Dependent Measures

Dependent measures included curriculum-based measurement oral reading fluency probes and mathematics computation probes, report card grades, selected scales from the Academic Competency Evaluation Scale (DiPerna & Elliott, 2000), and raw and standard scores from selected scales of the Woodcock-Johnson III Tests of Achievement (WJ-III; Woodcock, McGrew, & Mather, 2001). Reading subtests included Reading Fluency and Reading Comprehension. Measures of mathematic achievement included Math Fluency and Calculation. Forms A and B of the WJ-III were alternated for each assessment, and aged-based norms were used to generate standard scores for each subtest.

Procedures

All dependent measures were collected on five occasions (baseline, 3 months, 12 months, 15 months, and a 1-year follow-up) across 3 school years. Trained graduate students in school psychology, special education, and counseling psychology served as research assistants and administered all measures using standardized procedures. The research assistants were blind to the purpose of the study and to the group membership of participating children. Student report card grades were collected from schools at the end of each academic year. Parents signed separate release of information forms allowing project staff to collect this information.

Intervention

Interventions for students in both treatment groups were selected from a list of interventions organized by skill area, although the method of intervention selection differed by group. For the TDAI group, the design of academic interventions was based on teacher choice (i.e., “consultation as usual” control condition), whereas the design of academic interventions for the IDAI group was based on assessment data using a consultative problem-solving model (Bergan & Kratochwill, 1990). That is, the IDAI model differed from TDAI

Table 1
Means and Standard Deviations at 1-Year Follow-up

Outcome Domain	Measure	TDAI	IDAI
		Mean (SD)	Mean (SD)
Math achievement	WJ-III Calculation (S)	92.67 (10.62)	93.72 (10.81)
	WJ-III Calculation (R)	15.41 (3.96)	16.52 (4.02)
	WJ-III Math Fluency (S)	84.93 (22.03)	89.84 (15.02)
	WJ-III Math Fluency (R)	48.74 (20.87)	55.92 (21.11)
	CBM	2.19 (.87)	2.43 (1.12)
	Report Card	3.35 (1.04)	3.00 (.86)
Teacher perceptions of math performance	ACES Math Skills	16.27 (4.77)	17.33 (6.08)
	ACES Critical Thinking	30.5 (9.4)	30.86 (9.27)
Reading achievement	WJ-III Reading Fluency (S)	91.91 (14.15)	89.77 (13.13)
	WJ-III Reading Fluency (R)	33.27 (15.77)	31.23 (15.01)
	WJ-III Passage Comp. (S)	90.06 (10.30)	88.00 (6.77)
	WJ-III Passage Comp. (R)	25.24 (5.85)	24.00 (4.67)
	CBM	3.63 (1.66)	3.63 (1.74)
	Report Card	3.39 (.93)	2.85 (.88)
Teacher perceptions of reading performance	ACES Reading Skills	23.86 (7.45)	24.19 (5.56)
	ACES Critical Thinking	30.26 (8.41)	30.68 (8.06)

Note. TDAI = traditional data-based academic intervention; IDAI = intensive data-based academic intervention; WJ-III = Woodcock-Johnson III Tests of Achievement; S = standard score; R = raw score; CBM = curriculum-based measurement; Passage Comp = Passage Comprehension; ACES = Academic Competency Evaluation Scale.

in that interventions were selected on the basis of functional and academic assessment data. Also, in the IDAI model teachers were provided with modeling, prompting, and feedback to guide the implementation of interventions (see DuPaul et al., 2006; Jitendra et al., 2007).

Results

Means and standard deviations from the follow-up assessment phase are presented in Table 1. The remaining means and standard deviations across all dependent measures have been published previously (DuPaul et al., 2006; Jitendra et al., 2007). Multilevel modeling analyses for each dependent variable were used to assess trajectories within consultation groups and to assess possible differences in academic growth between groups. Models for the analyses are as follows:

Level 1

$$Y = B_0 + B_1(\text{linear slope}) + TB_2(\text{quadratic slope}) + e$$

Level 2

$$B_0 = \gamma_{00} + \gamma_{01}(\text{treatment group}) + \gamma_{02}(\text{age or SES}) + u_{0i}$$

$$B_1 = \gamma_{10} + \gamma_{11}(\text{treatment group}) + \gamma_{12}(\text{age or SES}) + u_{1i}$$

$$B_2 = \gamma_{20} + \gamma_{21}(\text{treatment group}) + \gamma_{22}(\text{age or SES}) + u_{2i}$$

At Level 1 of each model, intercept (baseline level), linear slope, and quadratic slope were calculated for each participant. At Level 2, group-level parameters of individual

change were examined, including mean initial performance for TDAI (γ_{00}), difference in mean initial performance between TDAI and IDAI (γ_{01}), mean growth rate (per assessment period) for TDAI (γ_{10}), and difference in mean growth rate between TDAI and IDAI (γ_{11}). To examine possible declines in performance associated with the withdrawal of intervention, a change in trajectory was examined for TDAI (γ_{20}), as was a differential change in direction between TDAI and IDAI (γ_{21}). An alpha level of .05 was used for all statistical tests.

Analyses were performed separately for students receiving interventions in math and reading. Because participants in the IDAI math sample were significantly older than the children in the TDAI math sample [$t(93) = 2.92, p < .01$], age in months was used as a Level 2 covariate for math sample analyses. In the reading sample, SES (socioeconomic status) was higher for IDAI than the TDAI group [$t(105) = 2.65, p < .01$], and so SES was entered as a Level 2 covariate for analyses of the reading sample.

Results of the multilevel modeling analyses are summarized in Table 2. For all dependent measures, with the exception of raw scores for WJ-III Math Fluency and WJ-III Reading Fluency and the two curriculum-based measurement indices, γ_{00} was statistically significant ($p < 0.01$), indicating that the TDAI group started out at a nonzero level of performance. For no dependent measure was γ_{01} statistically significant, indicating that there was no significant difference in performance between IDAI and TDAI groups with regard to initial level of performance. Significant linear slopes were not found for the majority of dependent variables. The only outcome measures to indicate statistically significant linear growth (γ_{10}) were raw and standard scores on WJ-III Reading Fluency ($p < 0.01$ for both variables). No γ_{11} values were statistically significant, indicating that linear growth trajectories did not differ across groups. None of the outcome measures demonstrated statistically significant curvilinear growth (γ_{20}) and no statistically significant

differences were found in curvilinear growth rate between groups (γ_{21}).

For each dependent measure, effect sizes were calculated as the difference between the mean follow-up and mean baseline scores divided by the pooled standard deviation (Table 3). Resultant indices represent estimates of the magnitude of change from baseline to follow-up in standard deviation units (Cohen, 1988). Effect sizes (ES) were small ($ES \leq 0.50$) for standard scores on all WJ-III outcome measures, with the exception of Reading Fluency (for IDAI only), which reached the moderate range ($ES = 0.53$). The effect size for Reading Fluency standard scores for the TDAI group was similar ($ES = 0.46$). Other outcome measures that showed moderate effects were Academic Competency Evaluation Scale Critical Thinking (TDAI math sample and IDAI reading sample only). Effect sizes for WJ-III raw scores and curriculum-based measurement indices were in the large range ($ES > 0.80$). Finally, effect sizes for report card grades were small and in the negative direction for the IDAI group.

Discussion

This study investigated the degree to which positive growth in academic performance was maintained at 1-year follow-up for participants in the DuPaul et al. (2006) and Jitendra et al. (2007) studies. Statistically significant growth was indicated only for raw and standard scores on WJ-III Reading Fluency. An examination of mean scores at follow-up (Table 1) in relation to those at postintervention (DuPaul et al., 2006; Jitendra et al., 2007) showed that on the majority of outcome variables, students in both groups tended to maintain, although not necessarily improve upon, intervention gains. Effect sizes for raw scores were large, indicating that students continued to learn relative to past performance. However, based on the small effect sizes for standard scores for both groups, it appears that the long-term effects in terms of participants' relative standing among peers were minimal. One

Table 2
Hierarchical Linear Modeling Analyses of Achievement Outcomes

Outcome Domain	Measure	Mean Intercept TDAI (γ_{00})	Mean Δ in Intercept IDAI (γ_{01})	Mean Growth TDAI (γ_{10})	Mean Δ in Growth IDAI (γ_{11})	Mean Curvilinear Growth TDAI (γ_{20})	Mean Δ in Curvilinear Growth IDAI (γ_{21})
Math achievement	WJ-III Calculation (S)	90.4**	-1.0 (NS)	-0.1 (NS)	2.2 (NS)	-0.1 (NS)	-0.3 (NS)
	WJ-III Calculation (R)	9.4**	-0.5 (NS)	1.0 (NS)	0.6 (NS)	-0.0 (NS)	-0.7 (NS)
	WJ-III Math Fluency (S)	79.2**	4.3 (NS)	4.2 (NS)	-0.2 (NS)	-1.0 (NS)	0.6 (NS)
	WJ-III Math Fluency (R)	17.9 (NS)	5.5 (NS)	8.9 (NS)	-0.4 (NS)	-0.9 (NS)	0.8 (NS)
	CBM	0.5 (NS)	0.3 (NS)	0.4 (NS)	-0.2 (NS)	-0.0 (NS)	0.0 (NS)
Teacher perceptions of math performance	Report Card	3.8**	-0.7 (NS)	-0.3 (NS)	0.5 (NS)	0.2 (NS)	-0.6 (NS)
	ACES Math Skills	17.2**	-0.3 (NS)	-1.4 (NS)	1.1 (NS)	0.2 (NS)	-0.2 (NS)
	ACES Critical Thinking	28.3**	-1.7 (NS)	-1.9 (NS)	1.8 (NS)	0.4 (NS)	-0.2 (NS)
	WJ-III Reading Fluency (S)	76.0**	-6.0 (NS)	11.5*	-3.7 (NS)	-1.6 (NS)	0.7 (NS)
	WJ-III Reading Fluency (R)	6.3 (NS)	3.5 (NS)	10.7**	-3.9 (NS)	-1.1 (NS)	0.7 (NS)
Reading achievement	WJ-III Passage Comp. (S)	90.2**	-2.2 (NS)	1.6 (NS)	0.4 (NS)	-0.2 (NS)	-0.1 (NS)
	WJ-III Passage Comp. (R)	17.6**	-1.0 (NS)	1.1 (NS)	0.9 (NS)	0.1 (NS)	-0.2 (NS)
	CBM	0.8 (NS)	-0.2 (NS)	0.7 (NS)	0.3 (NS)	-0.0 (NS)	-0.1 (NS)
	Report Card	3.43**	-0.3 (NS)	0.1 (NS)	0.2 (NS)	0.0 (NS)	-0.0 (NS)
	ACES Reading Skills	20.7**	0.1 (NS)	0.1 (NS)	1.3 (NS)	0.1 (NS)	-0.2 (NS)
Teacher perception of reading performance	ACES Critical Thinking	24.1**	-0.2 (NS)	-2.9 (NS)	2.4 (NS)	0.8 (NS)	-0.4 (NS)

Note. TDAI = traditional data-based academic intervention; IDAI = intensive data-based academic intervention; WJ-III = Woodcock-Johnson III Tests of Achievement; S = standard score; R = raw score; CBM = curriculum-based measurement; Passage Comp. = Passage Comprehension; ACES = Academic Competency Evaluation Scale.
* $p < .05$.
** $p < .01$.

Table 3
Effect Sizes Comparing Baseline and Follow-up Data Across Achievement Outcomes

Outcome Domain	Measure	Effect Sizes	
		TDAI	IDAI
Math achievement	WJ-III Calculation (S)	-0.01	0.19
	WJ-III Calculation (R)	1.17	1.1
	WJ-III Math Fluency (S)	-0.11	0.27
	WJ-III Math Fluency (R)	1.05	1.13
	CBM	1.27	1.17
	Report Card	0.21	-0.07
Teacher perceptions of math performance	ACES Math Skills	0.08	0.09
	ACES Critical Thinking	0.68	0.38
Reading achievement	WJ-III Reading Fluency (S)	0.46	0.53
	WJ-III Reading Fluency (R)	0.99	0.87
	WJ-III Passage Comp. (S)	0.08	0.07
	WJ-III Passage Comp. (R)	0.89	0.83
	CBM Reading	0.93	1.03
	Report Card	0.15	-0.40
Teacher perceptions of reading achievement	ACES Reading Skills	0.27	0.25
	ACES Critical Thinking	0.88	0.65

Note. TDAI = traditional data-based academic intervention; IDAI = intensive data-based academic intervention; WJ-III = Woodcock-Johnson III Tests of Achievement; S = standard score; R = raw score; CBM = curriculum-based measurement; Passage Comp. = Passage Comprehension; ACES = Academic Competency Evaluation Scale.

exception was standard scores for WJ-III Reading fluency, which demonstrated a moderate effect size for the IDAI group ($ES = 0.53$) and a somewhat smaller effect size for the TDAI group ($ES = 0.46$).

The findings in the mathematics domain are sobering. Although Jitendra et al. (2007) found that students made progress on skills targeted for intervention, these gains were not adequate to affect students' relative standing on WJ-III math achievement indices as indicated in (DuPaul et al. 2006). Our findings indicate a continuation of this trend.

Findings in the reading domain are more encouraging and informative. Reading fluency was by far the most common target for intervention in the reading domain. Although the effects of intervention on reading fluency were statistically significant, the effects were small or moderate. It should be noted that these effects would not have

reached the level of statistical significance if alpha was adjusted to reduce the threat of Type I error. Nevertheless, it is important to note that students in the reading sample met stringent research diagnostic criteria for ADHD and were identified by teachers as struggling readers. Extant studies indicate that students with both reading and attention problems are particularly resistant to reading interventions (Nelson, Benner, & Gonzalez, 2003; Rabiner, Malone, & the Conduct Problems Prevention Research Group, 2004). Moreover, approximately 50% of the students in this sample were third- and fourth-graders, for whom it may be more challenging to demonstrate improvement in response to reading interventions as compared to younger students (e.g., Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996).

At initial assessment, the mean reading fluency standard scores for students in

the TDAI and IDAI groups were more than 1 *SD* below the mean (83.1 and 79.5, respectively) relative to typically developing students. At follow-up, mean scores for these groups were 91.9 and 89.8, respectively, which is comparable to scores (91.9 and 90.4, respectively) at the end of intervention. Although relative standing in reading fluency did not diminish after intervention was withdrawn, the positive trend did not persist. It would be difficult to predict the effect of these gains on future student achievement outcomes. However, it is important to note that, as a group, these below-average students transitioned into the average range of reading fluency achievement. Unfortunately, gains in reading fluency were not met with gains in reading comprehension. Indeed, very small gains were noted on standard scores for WJ-III Passage Comprehension. Likewise, report card grades do not reflect the gains made in reading fluency.

Conclusions

These findings have clear implications for future intervention efforts for students with ADHD. First, although reading fluency is essential in developing reading comprehension, it is important to simultaneously target comprehension skills in order to have a meaningful effect on student reading achievement (see Gajria, Jitendra, Sood, & Sacks, 2007). The limited gains achieved in this project suggest that academic supports for students with ADHD should not only be initiated, but maintained over time to lessen the academic achievement gap between students with ADHD and their peers. The need for ongoing academic intervention supports is not surprising given the chronicity of ADHD symptoms and similar findings for other interventions for this population (cf. Jensen et al., 2007). Finally, results of this study indicate that although evidence-based academic interventions appear to have an effect (regardless of consultation model), ongoing interventions may be necessary to achieve further improvements in academic performance.

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