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Abstract

This study sought to systematically examine the academic behavior of children with ADHD in different instructional contexts in an analogue classroom setting. A total of 33 children with ADHD participated in a reading comprehension activity followed by a testing period and were randomly assigned within days to either small-group instruction, whole-group instruction, or independent seatwork. The effects of instructional contexts on on-task behavior during instruction and on-task behavior and work productivity during testing were examined. Children with ADHD were found to be more on task during small-group instruction than both whole-group and independent seatwork instructional conditions. In the testing context, children with ADHD were found to be less productive in small-group than in the whole-group and independent seatwork conditions. The findings of this study have implications for future research evaluating the standard educational practices and accommodations made for children with ADHD in the classroom setting.

Keywords

academic accommodations, ADHD, disabilities practices, instructional accommodations, special education

Attention-deficit/hyperactivity disorder (ADHD) is a chronic mental health disorder (American Psychiatric Association [APA], 2000). Children with ADHD have difficulties with attention, impulse control, and activity modulation, resulting in significant academic and social impairments in school settings (APA, 2000). These significant academic and behavioral impairments include poor academic productivity and achievement, disruption of classroom functioning, and negative social interactions with teachers, other school staff, and peers (Barkley, 1998). Disruptive behaviors, in particular, are a cause for serious concern as they often occur at high rates in school settings (Hinshaw, 1992; Walker & Horner, 1996; Zentall, 1993). In addition, such behaviors frequently result in referrals to special education and other school services, disruption of the classroom environment, and a stressful environment for teachers, administrators, and other staff whose responsibility it is to manage such behaviors (Walker & Walker, 1991).

Many children with ADHD receive school-based services or accommodations under the Individuals With Disabilities Education Act (1997; Schnoes, Reid, Wagner, & Marder, 2006) or Section 504 of the American With Disabilities Act (1990). These school-based special education services might include behavioral and learning interventions to assist with academic progress. However, little research has explored the extent to which standard accommodations for students with ADHD include evidence-based interventions for reducing disruptive classroom behavior and increasing academic productivity.

The need to justify the effectiveness of interventions is supported by recent estimates that school systems spend approximately $15 to $22 billion each year to educate children with ADHD. Over the course of 13 years of public education, this equals $200 to $300 billion (Pelham, Foster, & Robb, 2007). Research has shown that children with ADHD are more likely than their peers to have poor academic achievement, a history of learning disabilities, repeated grades, a special education placement, and academic tutoring—all adding to the cost of educating a

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student with ADHD that is beyond that of a typical student (Faraone et al., 1993; Massetti et al., 2008; Pelham et al., 2007). Because of the substantial costs of ADHD for the school system, effective interventions aimed at ameliorating impairments in academic performance (e.g., work productivity, on-task behavior), achievement, and classroom behavior are greatly needed to improve the effectiveness and efficiency of services provided. Furthermore, recent federal legislative mandates such as the No Child Left Behind Act (2002) require that schools emphasize evidence-based programs and services for students. However, very little data are available regarding the effectiveness of typical educational practices as implemented in traditional school settings on improving the behavior and academic performance of children with ADHD.

Researchers have identified several school-based interventions (e.g., behavioral classroom management, stimulant medication, and their combination) as effective in improving functioning and behavior in school for children with ADHD (Abramowitz & O'Leary, 1991; DuPaul & Eckert, 1997, 1998; Pelham & Fabiano, 2008; Raggi & Chronis, 2006). The effectiveness of behavioral classroom management (i.e., teacher implemented contingency management reward programs, point systems, time out) has been particularly well documented in laboratory classroom settings (e.g., Abramowitz, O'Leary, & Rosen, 1987; Pelham et al., 1993; Pfiffner, Rosen, & O'Leary, 1985; Sullivan & O'Leary, 1990). For example, Abramowitz et al. (1987) found that teacher reprimands that were contingent on off-task behaviors were highly successful in suppressing those behaviors, whereas praise that was contingent on off-task behavior was not successful. Sullivan and O'Leary (1990) found that reward and response cost programs were effective in producing immediate and substantial increases in on-task behaviors in children with academic and behavioral difficulties. Recent research in classrooms in therapeutic summer camp settings (i.e., Fabiano et al., 2007) also has shown substantial effects of behavioral classroom management, stimulant medication, and their combination on measures of classroom behavior, work productivity, and teacher ratings of functioning.

Task or instructional modifications (e.g., reducing task length, dividing tasks into subunits, giving explicit instructions, and modifying the delivery or modality of instructions depending on the student's individual learning style) are often included in individualized education programs (IEPs) and are widely used in classrooms for improving the performance of students with emotional and behavioral problems, developmental disabilities, and ADHD (Raggi & Chronis, 2006; Zentall, 2005). However, although there are a number of common educational modifications that are frequently included in the IEPs of students with ADHD, little research has actually explored the effectiveness of these modifications for children with ADHD. One such modification is the use of small-group contexts for instructional and testing settings. The use of small-group instruction has been found to be an effective technique in the general education setting for providing more individualized instruction and active learning for students (Foorman & Torgesen, 2001). In addition, smaller class size has been found to enhance students' academic performance and levels of engagement, and predict better performance in students and less disruptive behavior in the classroom setting (Finn, Gerber, Achilles, & Boyd-Zaharias, 2001; Finn & Pannozzo, 2004; Finn, Pannozzo, & Achilles, 2003). However, there are no systematic evaluations of the impact of small-group contexts on the attention and academic productivity of children with ADHD. Jacob, O'Leary, and Rosenblad (1978) did systematically investigate the effects of formal and informal classroom settings on levels of hyperactive behavior in a sample of 8 hyperactive and 16 non-hyperactive children. In the formal classroom setting, children were required to remain in their seats, do assigned work, or listen to presentations. In the informal classroom setting, children could choose between various child-directed (rather than teacher-directed) tasks that required cooperation with other children. The authors found that both hyperactive and control children had lower rates of hyperactivity in the formal classroom setting. Similarly, Zentall (1980) reported hyperactive children were less off task and less disruptive in classrooms with greater structure. In addition, activities that involved less stimulation, such as independent seatwork, were associated with higher rates of off-task and disruptive behaviors for hyperactive children.

Although the Jacob et al. (1978) and Zentall (1980) studies did not address the specific effects of teacher-directed small-group settings on the behavior of children with ADHD, their findings do support the idea that modifications made to the instructional context have implications for the behavior for children with ADHD. Furthermore, the findings from both studies indicate that children with ADHD benefit from more structured classroom settings and activities. Although no research has examined the utility of small-group instruction for children with ADHD, it appears to reduce the student–teacher ratio, thereby allowing teachers to monitor behavior and provide feedback more readily. Therefore, it is essential that the efficacy of these standard practices is assessed to best meet the educational needs of students with ADHD while making the best use of a school's resources, particularly given the significant amount of resources that are required to educate children with ADHD.

This study sought to systematically examine the academic behavior of children with ADHD in different instructional contexts in a summer camp classroom setting. Students participated in a reading comprehension activity that was introduced via small-group instruction, whole-group instruction, or independent seatwork. Each activity was then followed by a testing period. Therefore, this study aimed to investigate

the effects of instructional group size (i.e., whole group, small group, independent seatwork) on the following:

1. On-task behavior of students with ADHD during instructional tasks
2. On-task behavior and productivity of students with ADHD during a testing context

In the instructional tasks, we hypothesized that children with ADHD would: (a) be more on-task during small-group instruction than during both whole-group instruction and independent seatwork and (b) be more on-task during whole-group instruction than during independent seatwork. During the testing periods, we hypothesized that there would be no differences between testing group contexts in on-task behavior. With regard to work productivity, we hypothesized that children with ADHD would be more productive during the small- and whole-group testing conditions than during the independent seatwork conditions as a result of the conditions of the instructional period (i.e., children in the small- and whole-group conditions were actively learning the skills necessary to more accurately respond to the test questions).

Method

Participants

A total of 33 children participated in the study, which was conducted during the 2007 Summer Treatment Program (STP) at the State University of New York at Buffalo. All children enrolled in the older two groups (7–12 years old; age $M = 9.57$ years) in the STP were enrolled in the study. Participating children were enrolled in two groups of 16 and 17 children each, arranged by age. The participants were 76% male (25 of 33 children). Parents provided consent for their child to participate in the STP, which involved daily data collection about each child's behavior and academic functioning in the classroom. No children were excluded from the study analyses. This study was approved by the institution's children and youth review board.

Participants in the STP were referred by local professionals or schools, advertisements or reports in the local media, or parent self-referral. All parents completed intake materials, which included parent and teacher rating scales assessing the presence of ADHD symptoms: *Disruptive Behavior Disorder Rating Scale* (DuPaul et al., 1998) and *IOWA Conners Rating Scale* (Goyette, Conners, & Ulrich, 1978; see Table 1 for participant characteristics). To be enrolled in the STP, children had to meet evidence-based diagnostic criteria for ADHD (Pelham, Fabiano, & Massetti, 2005), including at least six symptoms of Inattention or Hyperactivity/Impulsivity and significant impairment in more than one setting as defined by scores above the clinical cutoff on the *Impairment Rating Scale* (Fabiano et al., 2006).

Table 1. Demographic Characteristics of the Sample of Participants with ADHD

Characteristic	*M*	*SD*
Number of participants	33	
Male (%)	76	
Age (years)	9.57	1.51
Ethnicity		
Non-Hispanic White (*n*, %)	29	87.9
Other (*n*, %)	4	12.1
Marital status of parents		
Married (*n*, %)	22	66.7
Divorced (*n*, %)	10	30.3
Cohabitating (*n*, %)	1	3.0
DSM-IV-TR symptoms		
Parent DBD		
Inattention	18.93	4.60
Hyperactivity–impulsivity	16.45	5.79
Oppositional defiant	11.93	4.28
Conduct problems	6.10	4.20
Teacher DBD		
Inattention	16.31	5.75
Hyperactivity–impulsivity	14.28	6.45
Oppositional defiant	9.28	6.35
Conduct problems	3.69	4.75
IOWA Conners Rating Scale		
Parent		
Inattention/overactivity	10.17	2.76
Oppositional/defiant	7.74	3.43
Teacher		
Inattention/overactivity	10.30	3.05
Oppositional/defiant	5.93	4.27
Impairment Rating Scale		
Parent rating of overall severity	4.76	0.95
Teacher rating of overall severity	4.17	1.26

Note: *DSM-IV-TR* = *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text revision; American Psychiatric Association, 2000); DBD = Disruptive Behavior Disorders Scale (Pelham, Gnagy, Greenslade, & Milich, 1992); *IOWA Conners Rating Scale* (Goyette, Conners, & Ulrich, 1978). Values are means and standard deviations unless otherwise noted.

Of the study participants, 64% were medicated for ADHD (i.e., stimulant and nonstimulant medication) throughout the program. Medication was not manipulated during the study, so the effects of the study procedures were examined in the context of steady medication and behavioral treatment for these children. Approximately 45% of children had an existing IEP in the regular school setting. Approximately 12% of children had a 504 accommodation plan in place.

Children's Academic Functioning

Academic achievement testing was conducted on all participating children during the first week of the STP. Specific

subtests from the third edition of the *Woodcock–Johnson Tests of Academic Achievement* (WJ-III; Woodcock, McGrew, & Mather, 2000) were used, including Letter-Word Identification, Reading Fluency, Work Attack, Math Calculation, and Math Fluency. These subtests were combined to yield reading and math composite scores. The third edition of the *Peabody Picture Vocabulary Test* (PPVT-III; Dunn & Dunn, 1997) was used as a brief measure of verbal IQ. Overall mean scores on academic and cognitive tests fell within the average range. The mean reading composite score on the WJ-III was 104.36 (*SD* = 11.40). The mean math composite score was 98.97 (*SD* = 9.67). The mean score on the PPVT-III was 108.97 (*SD* = 14.13). One child was an English language learner. Therefore, his PPVT score was not included in the overall mean. Of the study children, 12.5% had PPVT scores below the 30th percentile. Academic functioning information was used to assign appropriate work-level assignments and divide the students into similarly functioning small groups.

STP Procedures Description

The STP is an intensive summer day treatment program for children with ADHD and related disorders (Pelham, Greiner, & Gnagy, 2004). The STP has been developed as a program that offers state-of-the-art treatment to children with ADHD and related problems. The STP has been highly successful in providing treatment for the participating children and their families and has also produced a number of studies that have contributed to the understanding of these disorders and their treatment (see Pelham, Fabiano, Gnagy, et al., 2005, for review). Participants for the STP are recruited through community referrals; the families participating in the STP have enrolled in a clinical program that provides treatment services for children.

Each group of children in the STP spent 2 hr daily in the Academic Learning Center. In the 2007 STP, the learning center was split into morning and afternoon periods, each lasting 1 hr. The morning learning center focused on English language arts activities and involved group reading comprehension activities; data for the present study were gathered in the morning learning center period. Consistent with standard STP learning center periods, academic assignments and placements for group work depended on individual needs and skill levels. Staff members managed behavior using a set of learning center rules that are enforced through a point system and time out (Pelham et al., 2004). Children also received daily report cards (O'Leary, Pelham, Rosenbaum, & Price, 1976) that target individualized daily behavioral and academic goals. Daily and weekly camp and home-based rewards are contingent on the child meeting daily report card goals. In addition, developmental staff members used social reinforcement and appropriate commands to shape children's behavior. It is important to note that all study procedures occurred within the context of this intensive behavior modification program.

Study Procedures

Each group of students was randomly assigned to receive two of three group conditions (i.e., whole group, small group, independent seatwork) on a daily basis for 4 weeks of the STP. The order of conditions was also randomized to control for order effects. The morning activity was divided into two learning segments, and each group was randomly assigned to receive the small-group, whole-group, or individual self-study condition for each segment. Conditions were not repeated in the same day; for example, if a group experienced small group first, it was followed by whole group or independent seatwork. This procedure was used to model procedures in a typical classroom (e.g., small-group work followed by a whole-class lecture).

Each segment was divided into an instructional period and a testing period. The instructional and testing periods each lasted 10 min. The learning center teacher set an electronic timer at the beginning of each period. Instructional and testing material was taken from the *Specific Skills Series for Reading* curriculum (Specific Skills Series for Reading, 2006). One unit was repeated for the entire week; units included Getting the Main Idea, Comparing and Contrasting, Identifying Cause and Effect, and Drawing Conclusions. The instructional period included a teacher-led activity focusing on reading comprehension. The instruction involved describing the concept covered in the unit and covering some examples using the concept and skills through sample questions. During the testing period, children were given reading passages with questions that addressed the skills covered in the unit. Children were given 10 min to complete as many questions as possible. Based on initial testing and through ongoing evaluation of work completion, children were assigned more questions than they could complete during 10 min so as to ensure continuous activity throughout the testing period. The specific procedures for the whole-group, small-group, and individual self-study conditions are described in detail below.

Whole-group condition. Whole-group instruction consisted of the classroom teacher leading the students in a whole-group reading comprehension activity. During the 10-min teacher-directed instruction period, teachers first described the concept and skills covered in the units, then led the group in reading sample passages and answering questions assessing that skill. During the instruction period, children were asked basic comprehension questions about the passages they had just read (e.g., What was the main idea of this story? Who was the main character?). A list of sample comprehension questions was generated for each

unit. For these comprehension questions, the teacher asked for student volunteers and called on students from among the volunteers. During the whole-group testing period, students were given 10 min to complete work sheets to test their comprehension of the material presented during the instructional period.

Small-group condition. The small-group condition was different from the other conditions in several respects. During small-group instruction, the groups were divided into small groups of four to six students. One adult led each group in a 10-min reading comprehension activity. The adult first described the concept and skills covered in the units, then led the group in reading sample passages and answering questions about the passage assessing the skills. Each child was also called on in turn to answer no fewer than two and up to four attention questions related to their comprehension of the reading passage (e.g., What was one detail we just read in the passage?) from the same set of sample comprehension questions that was used in the whole-group condition. During the small-group testing period, students were given 10 min to complete work sheets to test their comprehension of the material covered during the instructional period. Students remained in their small groups to complete work sheets about the material covered.

Independent seatwork condition. In the independent seatwork instruction period, students were given self-instruction reading comprehension material to review for 10 min while seated individually at their desks. Students were expected to work independently and quietly, and no comprehension questions were asked during this activity. During the independent seatwork testing period, students were given 10 min to complete work sheets to test their comprehension of the material covered during the instructional period.

Dependent Measures

On-task behavior. An adapted version of the *Classroom Observations of Conduct and Attention Deficit Disorder* (Atkins, Pelham, & Licht, 1985; Pelham et al., 1993) and *Contingencies for Learning and Academic and Social Skills* (Hops & Walker, 1988) were used to systematically code the on-task and off-task behavior of students in the classroom. A research assistant conducted observations in the classroom daily. She was positioned in the front of the classroom away from classroom activity to remain unobtrusive and avoid disrupting the classroom context. Children were seated in four rows of either four or five children in each row. The research assistant observed each row of children for 15 s. At the end of the 15-s observation period, a 3-s recording interval occurred, when the observer noted if children were off task for any portion of the 15-s period. Off task was defined as any behavior in which the child was not paying attention to the teacher or specified activity, not participating in the assigned activity, or not working on the assigned tasks. In addition, off-task behavior was coded if the child broke one of the classroom rules (e.g., be respectful of others, use materials and possessions appropriately). A 3-s reorienting period followed the 3-s recording period, to allow the observer to gain focus on the next row of students. A new 15-s observation period would follow, with a 3-s recording period, during which the next row of students was observed. The 21-s observe–record cycle continued until the end of the instructional period and resumed during the 10-min testing period. A "beeper" tape was created to facilitate accurate 15- and 3-s observation, recording, and reorienting intervals. The observer listened to this tape using earphones so as not to disturb the classroom.

On average, each child was observed for 13 intervals across the classroom period. For each child, a percentage of time on task was calculated using the total number of intervals on task divided by the total number of intervals observed for the instruction and testing periods. Therefore, an on-task score was generated for the instruction period and for the testing period. Reliability observations were conducted on approximately 20% of the observations in the classroom by having a separate individual observe the children alongside the everyday observer. Kappa (k) indices were calculated for each observation interval to determine agreement between the two observers codes across the three conditions. Overall k averaged .60 and ranged from .423 to .784. This is considered good agreement by conventional standards (Cicchetti, 1994; Fleiss, 1981).

Work productivity. Productivity during the testing period was calculated by dividing the number of problems a child accurately completed by the total number of problems assigned, generating a percentage of problems completed accurately.

Treatment and Procedure Integrity and Fidelity

Treatment integrity and fidelity for the point system and behavioral procedures during the learning center were measured through observations. Fidelity observations were conducted during approximately 20% of the classroom periods to ensure adherence to the behavioral treatment as well as to the condition protocols. Observations were conducted by an STP doctoral-level supervisor with extensive experience in STP procedures as well as the study protocols. A detailed list of stepwise classroom procedures was outlined for each condition. The observer marked a + or – next to each procedure listed and recorded all group commands and social reinforcement for the entire period. In addition, the observer independently observed three randomly selected children and recorded all rule violations,

individual commands, and individual social reinforcement for those three children during the entire period. At least one observation was conducted in each condition. The average observation rating for appropriately administered treatment components was 98.7%. The average percentage of appropriate commands was 89.2%.

Results

Three separate repeated measures ANOVAs were conducted to evaluate the effects of instructional group size on children's: (a) on-task behavior during instruction (b) on-task behavior during testing (c) work productivity during testing.

Data for each child were aggregated across the 4 weeks of the STP to yield a mean group percentage of on-task behavior and work productivity for the each condition (i.e., small group, whole group, independent seatwork) respectively. Post hoc contrast analyses were used to evaluate differences among the whole-group, small-group, and individual-instruction conditions if the omnibus tests were significant. Effect sizes were calculated to evaluate the size of differences between on-task behavior and work productivity in each instructional group.

Table 2. Means and Standard Deviations for Children's On-Task Behavior and Work Productivity During Instructional and Testing Periods

Behavior/Productivity	*M*	*SD*	Effect Size[a]
Instructional period			
On-task behavior			
Independent seatwork (IS)	0.686	0.154	IS < SG, *d* = .68
Whole group (WG)	0.71	0.163	WG < SG, *d* = .49
Small group (SG)	0.781	0.122	
Testing Period			
On-task behavior			
IS	0.856	0.132	
WG	0.867	0.109	
SG	0.837	0.115	
Work productivity			
IS	0.443	0.168	IS > SG, *d* = .22
WG	0.457	0.167	WG > SG, *d* = .29
SG	0.407	0.165	

a. Effect sizes calculated only for significant contrasts. Direction of contrasts noted by < or >.

On-Task Behavior During Instructional and Testing Periods

Two separate within-group repeated measures ANOVAs were conducted to evaluate the effects of group size conditions on on-task behavior during the instruction and testing periods (see Table 2 for results). The omnibus test of the effect of condition on on-task behavior was significant, $F(2, 31) = 10.44$, $p < .001$, for the instructional periods. Post hoc contrasts showed a significant difference, $F(1, 32) = 20.0$, $p < .001$, between on-task behavior in the independent-seatwork and small-group conditions and in the whole-group and small-group conditions, $F(1, 32) = 6.01$, $p = .020$, indicating that children with ADHD display more on-task behavior during the small-group condition than during the independent-seatwork and whole-group instruction conditions. There was not a significant difference in on-task behavior between the independent-seatwork and the whole-group instruction conditions, $F(1, 32) = 0.641$, $p = .429$. Cohen's *d* effect sizes were calculated between significant contrasts; effect sizes were .68 between the independent-seatwork and small-group conditions and .49 between whole-group and small-group conditions.

The omnibus test of the effect of condition on on-task behavior during testing was not significant, $F(2, 31) = 1.695$, $p = .200$. As such, post hoc analyses were not interpreted to evaluate differences between the conditions. This finding suggests that the on-task behavior of children with ADHD does not differ between testing contexts.

Work Productivity During Testing

A repeated measures ANOVA was also conducted on the percentage of seatwork completed accurately, with group size condition as the independent variable (see Table 2 for results). The omnibus test of the effect of condition on work productivity during testing was significant, $F(2, 31) = 7.501$, $p = .002$. Post hoc contrasts revealed significant differences between productivity in independent-seatwork and small-group conditions, $F(1, 32) = 8.845$, $p = .006$, suggesting that children with ADHD complete a greater proportion of their work accurately during independent seatwork than in small group. Significant differences in productivity were also found between the whole-group and small-group conditions, $F(1, 32) = 14.785$, $p = .001$, suggesting that children with ADHD complete more work accurately in whole-group setting than in the small-group setting. There was not a significant difference between independent seatwork and whole-group seatwork on children's productivity, $F(1, 32) = 1.518$, $p = .227$. Cohen's *d* effect sizes for significant contrasts were .22 between independent-seatwork and small-group conditions and .29 between whole-group and small-group conditions.

To examine the extent to which the total amount of problems completed differed from the total number of problems completed with accuracy across the three conditions, a follow-up repeated measures ANOVA was conducted with the

percentage of total number of problems completed out of the total number of problems assigned as the dependent variable. The omnibus test of the effect of condition on work completed during testing was not significant, $F(2, 31) = 2.667$, $p = .085$. As such, post hoc analyses were not interpreted to evaluate differences between the conditions. This finding suggests that children with ADHD do not differentially complete more problems across conditions.

Discussion

The present study examined the effects of instructional group size on the on-task behavior and productivity of children with ADHD in an analogue classroom setting. A total of 33 children with ADHD participated in reading comprehension activities in small-group, whole-group, or independent-seatwork conditions. Children participated in a 10-min instructional period and a 10-min testing period, and on-task behavior during instruction and testing and productivity during testing were evaluated through observations and work sheets.

Our findings suggest that group size is an important factor for ADHD children's on-task behavior during instructional periods. Specifically, significant differences were found between children's on-task behavior during small-group instruction and independent seatwork and whole-group instruction, with the small-group condition demonstrating the greatest proportion of on-task behavior during instruction. Our analyses therefore suggest that children with ADHD exhibit more on-task behavior during small-group instruction when compared to their on-task behavior during both whole-group instruction and independent seatwork. These findings were moderately strong, as indicated by the effect sizes. Our results do not show a significant difference in children's on-task behavior during whole-group and individual-seatwork instruction conditions. This may be because of the similarities between the whole-group and independent-seatwork instructional conditions (e.g., same seating arrangements, same student to teacher ratio).

Although children exhibited more on-task behavior in the small-group condition during the instructional period, no significant differences between group size conditions were found in on-task behavior during the testing period. This finding is underscored by the fact that the task demands for the testing situation were highly similar across the conditions, unlike the instructional situation. Children were provided with the same number of problems with the same difficulty and asked to perform the same activity during the testing period for the small-group, individual-seatwork, and whole-group conditions. Also, the discrepancy in findings between the instructional and testing periods suggests that although children with ADHD might benefit from small-group conditions during instructional activities in classrooms, these benefits may not extend to testing contexts.

During testing periods, our results show that children with ADHD completed a lower proportion of questions accurately during the small-group condition compared to both the individual-seatwork and the whole-group conditions. Specifically, we found significant differences between children's mean percentage of work completed accurately during small-group testing than both independent seatwork and whole-group testing. These findings therefore suggest that testing children with ADHD in a small-group context may worsen their work productivity. It is important to note that the effect size for this finding is modest. Nevertheless, this is a finding in need of replication and follow-up, as small-group testing is a common accommodation made on the IEPs of children with ADHD.

When taken together, the on-task and productivity findings for the testing period indicate that children did not appear less on task during the small-group condition, but they were less productive during this condition as compared to the whole-group and independent-seatwork conditions. Furthermore, from our follow-up analyses of the total number of completed problems, it appears that children with ADHD did complete the same amount of work across conditions. However, the accuracy of their work is significantly affected by the condition context. This might be because of the fact that the instructional period for the small-group context was highly structured in that teachers provided a great deal of scaffolding for children's attention and their increased proximity to students produced increased monitoring and feedback regarding students' behavior. There might have been a great deal of contrast between these periods and the testing situation, where students' attention and productivity was much more self-directed, with teachers providing only reactive strategies (e.g., praise and reprimands) to address on-task behavior. It is also possible that the increased structure and teacher proximity of the small-group instructional condition may have resulted in children focusing more on behavioral engagement in the instructional context. This may have actually competed with their understanding and retention of instructional content, thereby worsening their work productivity in the small-group testing condition. In contrast, the difference between instruction and testing was not so significant for the whole-group and individual seatwork conditions. Therefore, future research is needed to explore the specific mechanisms at play on the attentional capacities of children with ADHD in testing situations.

Limitations and Implications for Research and Practice

The results of the present study highlight the need for further research investigating standard accommodations made for children with ADHD, as the replication of these findings

may have implications for the standard accommodations made as well as the standard educational practices implemented for children with ADHD, albeit with some limitations. First, the highly structured, intense behavioral system implemented in the STP classroom setting may have influenced our findings, especially with regard to our results during the testing periods. Specifically, in the STP classroom, children earn and lose points and privileges (e.g., recess) based on their behavior. Therefore, if children do not remain on task, there are direct consequences in place for their behavior. Children who are on task also are socially reinforced for their positive behaviors. Previous research illustrates these procedures have considerable positive effects on children's deportment and academic productivity in the classroom setting (e.g., Fabiano et al., 2007). Thus, future studies should examine whether these findings are observed within the context of less behaviorally structured classrooms. Second, the academic learning center of the STP used small classrooms of 16 or 17 children. Future studies would need to extend findings to larger class sizes to determine generalizability of findings to regular classroom contexts. This is particularly important because research has shown that children with ADHD spend the majority of their time in the general education setting (Reid, Maag, Vasa, & Wright, 1994; Schnoes et al., 2006). Third, the present study used a relatively small sample and thus requires replication. Fourth, the study tested only children with ADHD. It is important to replicate findings with children with ADHD in mixed classroom settings and possibly with a heterogeneous population of children with ADHD, typical children, and children with other learning disabilities (e.g., learning disability, emotional and behavioral disorders). Furthermore, the length of our study did not allow us to adequately examine whether these group size effects would translate into improved academic functioning for children with ADHD. With notable exceptions (e.g., DuPaul, Ervin, Hook, & McGoey, 1998; DuPaul et al., 2006; Habboushe et al., 2001; Mautone, DuPaul, & Jitendra, 2005), work related to academic interventions for children with ADHD has lagged (Raggi & Chronis, 2006). This is an important limitation of the literature because children with ADHD often have lower achievement scores and academic grades relative to typical children (e.g., DuPaul et al., 2004). As such, future studies should examine whether accommodations made to the instructional group size would subsequently improve the long-term academic functioning of children with ADHD. Moreover, given that we used relatively short instruction and testing time periods (10 min) and tested two conditions per day, future studies should examine longer instruction and testing intervals, one per day, to examine the extent to which students may have experienced possible cognitive overload.

Because 64% of the participants were steadily medicated for ADHD throughout the STP, the effects of the study procedures must be examined against a background of steady medication and behavioral treatment for these children. This does not necessarily limit the generalizability of our results, as stimulant medication is commonly used as a treatment for ADHD in the general education setting. However, future investigations should evaluate and compare the effects of instructional and testing group contexts with and without steady stimulant medication.

Overall, however, our findings have important implications for future research evaluating the standard educational accommodations and educational practices implemented for children with ADHD. Given the substantial incremental costs involved in educating children with ADHD in regular and special education settings, it is imperative that evidence-based services and accommodations are used for children with ADHD in school settings. Unfortunately, many of the accommodations and practices used for children with ADHD have not been systematically evaluated. Our study is the first to demonstrate that small-group instruction appears to result in significantly higher percentages of on-task behavior during instruction for children with ADHD, when compared to instruction delivered during whole-group or independent activities or settings. Although replication is needed, our findings serve as a first step toward further systematic evaluations of this accommodation and practice and again highlight the need for further systematic research evaluating the evidence base of standard educational accommodations and practices used for children with ADHD.

Authors' Notes

Greta M. Massetti is now at the Division of Violence Prevention at the Centers for Disease Control and Prevention.

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