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Abstract

Children with ADHD encounter difficulties in academic performance and in their ability to succeed in highly-structured environments (e.g., classrooms) where they are expected to behave in developmentally appropriate ways and to produce complete and accurate work. When compared to their same-age peers, children with ADHD seem to produce fewer problems in a fixed amount of time. These differences have been attributed to poor inability to remain on-task and to other distractible behaviors that occur during seatwork (DuPaul & Langberg, 2015). In a review of viable treatment for ADHD in schools, Harrison, Bunford, Evans, and Owens (2013) encouraged the investigation of common accommodations employed in schools to address educational impairments and for which there is currently no evidence of efficacy. The current study attempts to meet this charge by evaluating the efficacy of a presentation accommodation—chunking. Chunking involves presenting small increments of work at a time, instead of presenting the entire assignment at once. Students in first through eighth grade were presented with seatwork in chunked versus standard format during an 8-week Saturday Treatment Program in a cross-over design study. Dependent measures included observations of time on-task and seatwork productivity. Results indicated that chunking seatwork for children with ADHD did not influence their productivity on seatwork. Additionally, rates of rule violations and on-task behavior were not impacted by this presentation accommodation.
Literature Review

Introduction

Children with ADHD encounter difficulties in academic performance and in their ability to succeed in highly-structured environments (e.g., classrooms) where they are expected to behave in developmentally appropriate ways and to produce complete and accurate work (DuPaul, Stoner, & Reid, 2014). Deficits in academic performance are assessed by collecting classroom behavior observation data and by examining samples of seatwork/homework for completion and accuracy (DuPaul et al., 2014). When compared to their same-age peers, children with ADHD produce fewer problems in a fixed amount of time (Pelham et al., 2001). Their rate of accuracy on seatwork has also been shown to be lower than that of their peers on similar tasks (DuPaul et al., 2014). These differences have been attributed to poor ability to remain on-task and to other distractible behaviors that occur during seatwork (DeShazo Barry, Lyman, & Klinger, 2002; DuPaul & Langberg, 2015).

Academic performance is also impacted by difficulties with planning, organization of materials, self-monitoring, and following school rules (DuPaul & Jimerson, 2014). These problems are associated with persistent deficits in academic skills (e.g., reading, math, spelling; Spira & Fischel, 2005; Zentall, Smith, Lee, & Wieczorek, 1994) and low achievement (e.g., standardized tests, persistently low grades; Loe & Feldman, 2007). Children with ADHD are also more likely to repeat a grade and struggle with chronic discipline problems (e.g., repeated suspensions, expulsion; LeFever, Villers, Morrow, & Vaughn, 2002). Frequent disciplining is likely to further decrease exposure to academic learning. Despite the decrease in hyperactivity experienced as children with ADHD age (Hart et al., 1995), they continue to experience
behavioral and academic difficulties that continuously place them at risk for negative outcomes during adolescence and adulthood (e.g., school failure, unemployment; Barkley, Fischer, Smallish, & Fletcher, 2002; Fischer, Barkley, Edelbrock, & Smallish, 1990; Kuriyan et al., 2013).

Academic underachievement and deficits in academic performance for this group of children are frequently addressed through remedial services in schools that are lengthy and costly (Robb et al., 2011; Le et al., 2014). These services, often of a behavioral nature (e.g., token economies, positive reinforcement), aim to reduce undesirable behaviors/symptoms associated with ADHD with the ultimate goal of increasing the overall time students spend engaged in learning activities (McKissick, Hawkins, Lentz, Hailley, & McGuire, 2010). Whereas such programs have been found to yield considerable effect sizes for behavior change, their influence on specific academic difficulties is less pronounced (DuPaul & Langberg, 2015). Research is still needed to identify effective supports targeting the academic challenges faced by children with ADHD.

The Role of Educational Policy in the Remediation of Academic Impairments Associated with ADHD

Current policy and legislation mandates that children with ADHD receive services in accordance with the Individuals with Disabilities Education Act (IDEA 2004) or under Section 504 of the Vocational Rehabilitation Act of 1973, if their condition adversely affects their academic performance or limits their ability to learn. Schnoes, Reid, Wagner, and Marder (2006) noted that children with ADHD receive services under various IDEA categorizations in the schools: Other Health Impaired (OHI), Learning Disability (LD), Emotional Disturbance (ED),
Intellectual Disability (ID), and Speech-Language Impairment (SLI). The majority of students in the national sample examined by Schnoes et al. (2006) and who identified under the OHI or ED categories had ADHD according to parent and teacher ratings. Unlike other disabilities (e.g., LD) for which there exists a well-defined category and corresponding interventions, the absence of an ADHD-specific category complicates the decision-making process in the provision of appropriate interventions and services (Loe & Feldman, 2007). The services children with ADHD receive thus vary in modality and intensity according to their classification (Schnoes et al., 2006). Educators’ lack of familiarity with legal mandates exacerbates the problem of implementing interventions that are well-aligned with the needs of students with ADHD (Reid, 1995; U.S. Department of Education, 2016). In response to allegations of discrimination against students with ADHD, the U.S. Department of Education’s Office of Civil Rights (2016) recently published a resource guide to assist parents and educators in determining appropriate services for children with ADHD. This guide was formulated based on the premise that the identification of appropriate services is essential to limit social, emotional, and educational harm and the ineffective allocation of district and family resources (U.S. Department of Education, 2016).

When compared to students without ADHD, children with ADHD are more likely to receive academic services (i.e., classroom aide, monitoring of progress by a special education teacher) and accommodations (i.e., additional time for tests, shorter assignments) (Schnoes et al., 2006). In an analysis of the lifetime educational costs of a group of children with ADHD from Kindergarten through 12th grade, Robb et al. (2011) found that children with ADHD spent a higher average number of years utilizing special education services than did their peers without ADHD. Additionally, the yearly expenditures on special placement was relatively higher for
these students when compared to their peers. Similarly, the rate of grade repetition and time spent engaged in disciplinary action, along with their associated costs, tended to be more elevated for children with ADHD (Robb et al., 2011). Thus, children with ADHD require considerable school resources and supports due to their challenging behaviors.

**Decisions in the provision of evidence-based academic services.** Recent amendments made to educational mandates (e.g., IDEIA 2004, regulations of 2006) hold educators and administrators accountable for the academic progress and success of children with disabilities (Yell, Katsiyannis, Ryan, McDuffie, & Mattocks, 2008). Following changes in law that occurred in 2008, new interpretive standards of Section 504 have included a more detailed definition of major life activities (i.e., thinking, concentrating) as well as the elimination of mitigating measures, such as behavioral modifications or medication, in determining the extent of students’ disabilities (ADA Amendment Acts of 2008; Zirkel, 2009). The expansion of eligibility standards under Section 504 has implications for the identification of reasonable accommodations (Zirkel, 2009). These amendments re-emphasize the role of educators in determining the eligibility of students and in devising adequate plans to ensure a free appropriate education for these students (U.S. Department of Education, 2016; Zirkel, 2009).

Researchers argue that this state of accountability makes it necessary for educators to understand the resources they are using to address students’ needs (Harrison, Bunford, Evans, & Owens, 2013). Harrison et al. (2013) distinguish between three types of services in schools: interventions, modifications, and accommodations, and advocate for the use of clear definitions that will enhance the use of appropriate, evidence-based strategies. Because the terms accommodations, modifications, and interventions tend to be used interchangeably
(Harrison et al., 2013), distinguishing them is important for the purpose of this paper. When assignments are modified or changed to reflect the ability of a student, we refer to a modification. For example, a mathematics assignment’s content may be modified to only include addition and subtraction for a student whose mathematics learning skills are below those of his same age peers who can multiply. An intervention involves “a systematic process to develop or improve [...] skills,” such as those provided during pull-out reading services (Harrison et al., 2013). The reader is referred to Harrison et al. (2013) for a more detailed discussion of interventions and modifications.

Accommodations for children with ADHD hold them to the same standards as their typically developing peers, while attempting to “level the playing field” for this group (Harrison et al., 2013). A typical example of an accommodation would be that of a student with a disability who is required to complete 50 mathematics problems in an hour and a half instead of the hour given to typically developing peers if it is believed that attention problems will interfere with the student’s productivity. Despite its popularity in remediating attention problems for children with ADHD, the effectiveness of extended time as an accommodation varies in the literature. In their study of extended time on reading ability, Brown, Reichen, and Quinlan (2011) reported increased productivity when students were provided extended time. In another study investigating the efficacy of the popular accommodation, Pariseau, Fabiano, Massetti, Hart, & Pelham (2010) did not find significant change in assignment productivity behavior when children were provided extended time. Other recommended accommodations include: preferential seating, simplification of instructions, and frequent breaks (Harrison et al., 2006; Schnoes et al., 2006; Spiel, Evans, & Langberg, 2014). The strong correlation that exists
between time engaged and student learning (Woolfolk, 1995) may justify the use of these accommodations in the classroom. Meaningful time engaged, often referred to as academic learning time or time on-task, is expected to increase student learning. However, there is consensus in the field that despite the numerous accommodations recommended by experts, minimal evidence is available to inform the use of accommodations for children with ADHD (Harrison et al., 2013; Spiel et al., 2014). While chunking is commonly employed in schools as a presentation accommodation for children with ADHD, there is a lack of research to support its use to address the behavioral difficulties associated with ADHD. Given the high cost of educating children with ADHD and the need for educators to provide them with adequate support and instruction, it is important to first understand and evaluate the impact and practicality of accommodations for students with ADHD (Harrison et al., 2013; U.S. Department of Education, 2016).

In their review of viable treatment for ADHD, four types of commonly used accommodations were identified: presentation, response, time/scheduling, and setting accommodations. The current paper will focus on the application of the accommodation of chunking in schools, a commonly employed accommodation. Chunking—assigning work in smaller segments—is a practical, presentation accommodation used to address educational impairments for this group of students. Presentation accommodations involve manipulating the appearance of an academic activity to increase its manageability (Harrison et al., 2013). Chunked seatwork is commonly recommended for children with ADHD with the thought that providing shorter tasks will decrease the likelihood of engagement in disruptive behaviors to escape seatwork (Duquette, 2001; Sink, 2011). Thus, chunking seatwork is expected to increase
academic learning time or on-task time, and to contribute to the longer-lasting effect of increased academic productivity over time. Chunking’s practicality and low cost make it a preferred accommodation in schools.

**Support for the use of seatwork chunking.** A single case study that investigated the practicality of this presentation accommodation of chunking work was found. Wallace, Cox, and Skinner (2003) sought to answer whether providing smaller assignments to a student receiving special education with math difficulties carries benefits. An A-B-A-B design was used to evaluate the presentation accommodation. The student was described as having mild intellectual disability and presenting with disruptive behavior problems (e.g., inattention, hyperactivity). The experimental condition consisted of presenting the student with modified sheets containing 5 to 6 problems. Alternatively, the student received a whole sheet with 30 subtraction problems in the standard condition. The teacher provided specific praise contingent on the completion of every seatwork segment. The number of seatwork problems completed was compared within-subject. Results indicated that the student completed a greater number of problems when presented with the modified sheets. His accuracy level also appeared to increase with this accommodation. This study suggests the promise of chunked seatwork for children with ADHD, but it is limited in that it was conducted with a single student who had intellectual disability. The manner in which this accommodation would work with children with ADHD with average intellectual ability is not known.
Summary and Rationale

Children with ADHD demonstrate chronic academic impairments. These problems persist throughout their schooling. While many strategies are known to help parents and teachers manage the behaviors of children with ADHD, very little is known about the effectiveness of widely used methods to address their academic performance in classrooms. Educators attempt to create equal opportunities and offer adequate instruction to these children through the use of interventions, modifications, and accommodations. However, the paucity of studies investigating the usefulness of accommodations like chunking remains a problem. In fact, in their review of school-based treatment strategies for children with ADHD, DuPaul and Weyandt (2006) note that although the utility of this accommodation seems intuitive, educators’ decision to utilize it is based solely on anecdotal evidence. The current study was designed to address the existing concerns about the validity of accommodations that are intended to level the playing field for children with ADHD, with cost-effectiveness and practicality for educators in mind. This paper describes the evaluation of the efficacy of seatwork chunking for a group of students with ADHD.

Aims and Hypotheses

This research sought to evaluate the impact of the accommodation of chunking on the academic performance of children with ADHD. Specifically, the research question of interest was: would children’s productivity and behavior differ when presented with chunked versus standard seatwork format? It was hypothesized that students would benefit from the accommodation in exhibiting improved academic productivity and on-task behavior, as its
intent is to reduce the impact of ADHD symptoms (Harrison et al., 2013). Specifically, (1) it was expected that students’ seatwork output in the chunking condition, as measured by their rates of completion and accuracy, would be greater when compared to their output in the standard condition; (2) children would spend more time engaged in seatwork in the chunking condition; and (3) it was expected that children would exhibit fewer classroom rule violations when seatwork was presented in chunked format.

METHOD

Data for the current study were collected as part of a larger behavioral program conducted over two consecutive semesters (i.e., Fall and Spring) at a university research center. The Academic Competency Enabling (ACE) program is a multimodal program combining academic and behavioral elements from other well-established interventions for children with ADHD and their families (e.g., Summer Treatment Program; Pelham, Fabiano, Gnagy, Greiner, & Hoza, 2005; Pelham, Grieener, & Gnagy, 1998). The program was designed following a format similar to that of the STP, including individual seatwork, organizational skills training, and recreational activities. Children spent 30 minutes weekly engaged in independent seatwork. A contingency management program was used to address behavioral goals only. Specifically, a set of rules was reviewed with all children at the beginning of the day. A Daily Report Card (DRC) was established for each child as an individualized contract to promote positive behaviors and to facilitate communication with families (Volpe & Fabiano, 2013). Daily program-based rewards were contingent on meeting goals listed on the DRC. Additionally, praise was administered throughout conditions to increase the occurrence of positive behaviors during the seatwork period. These procedures were maintained consistently through all weeks of the program.
Participants

The research study targeted children entering grades 1<sup>st</sup> through 8<sup>th</sup> at the beginning of the 2015-2016 academic year. Participants were recruited in schools, mental health centers, hospital clinics, and through physician referrals in the community prior to each semester. Recruitment strategies included distribution of flyers to schools and interaction with parents at pick-up time or at school-based events (e.g., parent night). At the beginning of each semester, families were screened for eligibility for the study via phone. Exclusionary criteria included: a) the child with an IQ less than 70), b) a diagnosis of autism, and/or c) a severe illness or medical condition (e.g., seizures, cardiac problems).

A clinic interview was scheduled with families of the 34 children (24 boys) who qualified to participate in the study. The interview was conducted by graduate-level students who described the study to the family, obtained consent and assent, and gathered behavioral ratings scales. Children who exhibited academic and behavioral problems were invited to participate in the study. Cognitive and academic achievement testing were conducted with prospective participants. The two-subtests form of the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II) was administered as a brief measure of cognitive ability (Wechsler & Hsiao-pin, 2011). Selective subtests from the Woodcock-Johnson Test of Academic Achievement, Third Edition (WJ III), were administered to determine basic math and reading abilities (Woodcock, McGrew, Mather, & Schrank, 2001). Parents and teachers of participants completed a battery of measures, including behavioral and academic questionnaires about their child. Behavioral measures included the Disruptive Behavior Disorder Rating Scale (DBD-RS; Pelham, Gnagy,
Greenslade, & Milich, 1992), which uses DSM-IV criteria for the diagnoses of ADHD, Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD).

The 34 participants were assigned to one of two classrooms based on the current school grade they attended. On this basis, during the Fall Semester, 10 students were assigned to the middle school group and five to the elementary group. During the Spring Semester, there were 13 students assigned to the middle school group and seven to the elementary group. One student dropped out of the study. Mean age of participants was 9.24 (2.49) years. Additional participant characteristics are listed in Table 1.

Procedures

Setting. The seatwork period lasted 30 minutes at the beginning of the day, following the morning discussion. The intent of seatwork assignments was to give children independent practice in successfully completing assigned seatwork in the areas of math and reading at their level. Appropriate math and reading levels for assigned seatwork were determined based on the reading and math abilities of the child at the time of the intake visit. Additionally, during the first week of the program, children were given a diagnostic test of reading derived from the Specific Skills Series for Reading curriculum to determine the level of reading seatwork that would be assigned during the following weeks. The choice of curriculum was inspired by previous research in which children with ADHD participated, such as Pariseau et al.’s (2010). Moreover, the rationale was that this curriculum would allow for opportunity for meaningful practice of skills that children are likely developing in school. It includes strategies to bolster reading proficiency approved by the National Reading Panel ("The Research for SRA"). Children received three reading tasks each week from the Specific Skills Series and math problems emphasizing additions, subtractions,
multiplications, and/or divisions. The minimum total number of problems assigned was 50 problems and the maximum was 190 to ensure that students had enough work to stay on-task during the entire the seatwork period. The data from each Saturday program day were used to continuously evaluate the appropriateness of the level of seatwork for each child and adjustments were made as needed to ensure children were assigned work that they could complete independently with at least 80% accuracy. For example, one student’s seatwork consisted of copying letters due to difficulty completing seatwork at her grade level during the first week of the program. If the 80% accuracy benchmark was not met or exceeded, children’s seatwork was adjusted accordingly (i.e., difficulty increased or decreased).

Undergraduate level research assistants prepared children’s seatwork folders prior to the Saturday Program day. Each classroom was staffed by two graduate level students trained to implement the program. Each was assigned the role of teacher or teacher aide. Teachers gave students directions to transition into the seatwork period (e.g., take out a pencil, put your books away). Once students were prepared and attentive, teachers reviewed the classroom rules, then provided general instructions for the seatwork activity (e.g., “when I start the timer, open your folder and begin working”). Teachers and classroom aides then distributed folders containing the seatwork assignment to each student and instructed students to keep their folders closed until instructed to begin their seatwork. Once all students received their folders, students were instructed to begin working. A timer was placed in a visible location. Instructions were clarified for children when necessary during the activity. Teachers and aides were instructed not to provide students with direct help with academic tasks (e.g., modeling). Their role was limited to implementing the program in a consistent manner and monitoring children’s
behaviors during the seatwork period. They were encouraged to provide behavioral feedback to children in a ratio of three labeled praise statements for every instance of negative feedback. At the end of the seatwork period, teachers gave students the command to stop working and collected children’s folders.

**Design.** A repeated measures cross-over design was used in this study to present standard seatwork and chunked seatwork to students in a counterbalanced fashion during 8 weeks in the Fall and again in the Spring. The order of the seatwork subjects, however, remained the same throughout the program during each semester (i.e., reading followed by math).

**Standard seatwork.** In this condition, children received a packet of reading and math problems. Every week, reading tasks consisted of comprehension and/or fill-in-the blank questions commensurate with children’s abilities and drawn from the *Specific Skills Series for Reading* curriculum (*Specific Skills Series for Reading*, 2006). Children always received the following reading tasks which highlighted three skills: identifying cause and effect, identifying fact and opinion, and using phonics/using word study. Examples of reading problems included completing sentences using a set of multiple choice responses or reading a passage and answering multiple choice questions about the passage. The number of problems to be assigned to children was determined based on their initial performance on the diagnostic test and varied among children. One student’s seatwork was changed to copying letters which were not drawn from a specific curriculum due to limitations in reading skills. Math seatwork consisted of math fluency problems created by the principal investigator (e.g., additions, subtractions, 2 x 1 multiplications, etc.). Each child received math fluency problems at their
level; the appropriate level was determined from a diagnostic math fluency task at the time of intake. The number of problems assigned was adjusted based on rates of completion and accuracy. Teachers and aides verified children’s work during the seatwork period to prevent students from rushing through assignments.

**Chunked seatwork.** The general procedure remained the same in this condition. However, children were given seatwork in chunks of 5 problems at a time. Children were instructed to raise their hand to signal that they had completed a chunk. Teachers/aides brought the next slip and collected the completed slip of seatwork. As teachers circulated about the classroom, they also verified completed seatwork for accuracy. Children who appeared to be rushing through assignments (e.g., high number of errors) were prompted to read over their work or to re-attempt the incorrect problems.

**Treatment Fidelity.** Observations were conducted during the seatwork period of every ACE program day to ensure fidelity of treatment. A fidelity checklist was developed using the described procedures for the seatwork period. Doctoral-level students were assigned to each classroom to complete observations and coded whether each treatment element was implemented during each session (Appendix B). The average rating for program fidelity across both semesters was 98.6%.

**Measures**

Measures collected for both groups during 6 weeks of intervention were used for analysis. The first and last weeks of the program (weeks 1 and 8) were not included with the
assumption that students’ effort would be different during the first and last weeks of the program.

**Average percent accuracy of completed work.** Children were assigned a combination of reading and math problems. Reading tasks included reading a selection of short passages that were accompanied by four to five multiple choice comprehension questions, and a number of fill-in-the blank phonics questions appropriate for each child’s academic level as determined by the diagnostic test drawn from the *Specific Skills for Reading* curriculum (Specific Skills Series for Reading, 2006). Reading passages focused on developing skills to identify cause and effect or fact and opinion. Phonics tasks were also presented in multiple choice format. Reading was followed by worksheets of mathematics calculation problems. Levels of difficulty for these problems were determined using one-minute fluency probes of varying difficulty. Children received a high number of combined reading and mathematics problems to complete consistent across weeks. Seatwork was scored by three undergraduate-level research assistants at the end of each program day. Seatwork was scored objectively using a key for both reading and math. Each child’s rate of accuracy was calculated for combined math and reading seatwork for each program day. Rate of accuracy was determined based on the number of problems completed correctly divided by the number of problems attempted, and multiplied by 100. The reliability of this weekly measure was verified by correlating the percent seatwork completed correctly during the second and third week. A Pearson correlation indicated a strongly positive association between these variables $r = 0.896$, $p = 0.01$. This suggests a strong test-retest reliability of the measure. Information on the validity of this measure is not available, however, prior studies investigating changes in classroom behavior and academic
performance of children with ADHD have employed similar seatwork measures (Hart, Massetti, Fabiano, Pariseau, and Pelham, 2011; Pariseau et al., 2010) An average of the percent seatwork completed correctly was calculated for each child across each condition by summing the percent seatwork completed correctly for each week and dividing by the number of weeks spent in that condition.

**Appropriate classroom behavior.** During the seatwork period, four trained undergraduate level students conducted classroom behavior observations. Prior to the beginning of the program, the observers were asked to learn a set of behavioral definitions verbatim. These definitions reflected the classroom rules (i.e., Be Respectful, Obey Adults, Work Quietly, Stay in Assigned Seat/Area, Use Materials Appropriately, and Raise Hand to Speak) reviewed at the beginning of the day with children. Observers were then asked to code a set of videos with mock classroom seatwork periods. Before conducting observations during the ACE program, they were required to code all training videos with at least 80% reliability. Children were seated in three rows of four children each. Observers recorded appropriate classroom behaviors using Partial Interval Recording and on-task behavior using Momentary Time Sampling. Observers listened to a recording that signaled the beginning and ending of ten-seconds-long intervals. At the ten-second mark, observers recorded whether any rule violations had been observed. Two observers were assigned to each class and cycled through three rows of four children each.

**On-task behavior.** Additionally, observers were required to reliably code the On-Task behavior of children. Momentary time sampling was used to record on-task behavior separately. Research assistants recorded whether children were on-task at the 10-second mark
of each interval observed. Percentage of time on-task was derived from the number of intervals during which children did not exhibit off-task behaviors, divided by the total number of intervals observed. This number was then multiplied by 100 to yield a percentage.

**RESULTS**

**Data Analysis**

An a priori power analysis yielded a suggested sample of $N = 10$ (Faul, Erdfelder, Lang, & Buchner, 2007). Data collected during the Fall and Spring semesters was combined for analysis of a single sample ($N=34$). First, we investigated whether the presentation accommodation of chunking work influenced the academic performance of children with ADHD. During three of the six weeks included in the analyses, seatwork was presented in chunked format and during the alternate three weeks, seatwork was presented in standard format. A repeated measures, one-way multivariate analysis of variance (MANOVA) was conducted to examine whether differences existed in seatwork output (i.e., average percentage of seatwork completed accurately), disruptive behavior (number of rule violations), and time on-task within participants as a function of experimental condition (chunked vs. standard seatwork). Effect sizes were calculated for each dependent measure by subtracting the standard mean from the chunked mean, and dividing by the pooled standard deviation.

Means for seatwork productivity (percent problems completed correctly) were calculated for the chunked condition and for the standard conditions. Similarly, means were calculated for percent violations exhibited by each child and for percent time spent on task. At least 2 data points were required to compute the mean of a dependent variable, to ensure
multiple observations of behavior in each condition. A median split was then performed to determine whether differences existed between age groups of children on the dependent variables. Listwise exclusion was used to handle missing data in the dependent variables (N = 9).

Dependent variables were moderately correlated. The Greenhouse-Geisser correction was used to correct for the violation of the sphericity assumption. The normality of the data was tested. The distribution for the variable of seatwork productivity (percent problems completed correctly) approximated a normal distribution. A repeated measures MANOVA was performed to determine whether differences existed in average percent seatwork completed correctly when seatwork was presented in chunked versus standard format for that group. Means of dependent variables in each condition can be found in Table 2. The difference in means of percent problems completed correctly was not found to be significant, $F(1, 24) = 0.571, p = 0.457$. This approach was repeated to determine whether seatwork format influenced engagement in disruptive behavior (percent violations) and on-task behavior (percent time on-task). The disruptive behavior variable was substantially positively skewed. A logarithm transformation was performed to normalize the percent violations distributions under the experimental and standard conditions. The difference in average percent rule violations was not significant, $F(1, 24) = 0.842, p = 0.368$. The time on-task variable was negatively skewed in both groups. One outlier was retained because it represented a true observation and results were unchanged with or without its inclusion. A reflect and square root transformation was performed to normalize the distributions. The untransformed data were used because the distribution was not improved by the reflect and square root transformation. Children were on task 85 % of the time on average under the business as usual condition and
children were on task 87% of the time on average under the experimental condition. This difference was not significant, $F (1, 24) = 1.93, p = 0.177$.

A moderator analysis was performed to determine whether seatwork productivity, disruptive behavior, and time engaged varied based on student’s age. The age variable was recoded using a median split method. The sample was separated into two different groups. The younger children’s group was comprised of children ages 9 and below (N = 16) and the older children’s group made up of children ages 10 and above (N = 9). Age was entered as a between subject variable. There were no significant differences noted in dependent variables between younger and older children in time engaged, $p = 0.645$, disruptive behavior, $p = 0.272$, or seatwork productivity, $p = 0.333$. Given the small sample size and disproportionately male sample, differences in dependent variables based on sex were not analyzed as initially planned.

**DISCUSSION**

Children with ADHD are more likely than their typically developing peers to receive accommodations (Schnoes et al., 2006), including this presentation accommodation (Harrison et al., 2013) with the intent of leveling the playing field for these students. The reasoning for the use of accommodations is that increasing time engaged will increase student learning (Woolfolk, 1995). As such, it was expected that presenting fewer chunks of work to students would increase the time they spent on-task during the seatwork period, further impacting their academic productivity positively. Yet, results indicated that chunking seatwork did not impact the proximal target of academic productivity. Furthermore, chunking seatwork was not found to influence the distal targets of on-task behavior or disruptive behaviors.
Differences in the academic productivity of children with ADHD are often related to poor on-task behavior and to other distractible behaviors that occur during seatwork (DuPaul et al., 2015). It should be noted that the background behavioral intervention in this study may have reduced variability in disruptive and off-task behavior potentially resulting in a ceiling effect. The disconnect between the frequent use of this accommodation in schools and current findings of a lack of efficacy supports the need to further research this accommodation to inform its utility for increasing the academic productivity of children with ADHD (Harrison et al., 2013). This also demonstrates the urgency to increase educators’ understanding of the resources they are using to address students’ needs (Harrison et al., 2013) rather than basing their decisions of accommodations’ utility on anecdotal evidence (DuPaul et al., 2006). This is particularly important at a time when new legislation calls for the identification of reasonable accommodations (Zirkel, 2009) and accountability is at its peak (Yell et al., 2008).

The lack of statistical evidence to support the use of chunking also leads to questions regarding the cost-effectiveness of implementing it in schools. Evaluating the practicality of chunking is important given the cost of educating children with ADHD (Robb et al., 2011). Should teachers dedicate additional time and resources (i.e., help provided by aide) to present seatwork in chunked format to children with ADHD at the risk that students’ academic productivity will remain unchanged from the business as usual method of presenting seatwork. This time and attention would be better dedicated to developing and implementing strategies that will result in improved academic and behavioral functioning.
Limitations

A first limitation of this study is its small sample size. Students in the chunking condition appeared to have fewer rule violations and to spend more time on-task while producing less seatwork. These results were not significant, but may be related to a small sample size lacking power to detect an effect. A larger sample size would be necessary to detect effects in seatwork productivity, disruptive and on-task behaviors. Another limitation involves the seatwork material utilized for the study. Seatwork was assigned from the Specific Skills Series and generally addressed 3 skills: identifying fact and opinion, identifying cause and effect, and using phonics. Despite measuring students’ skill level and attempting to assign seatwork that corresponded to students’ level, students did not receive instruction on these skills prior to completing seatwork. As students often need review throughout a school year, students’ familiarity with these skills may have impacted their ability to complete seatwork in an accurate manner. However, because the work level and type was maintained across conditions, any impact of this factor on performance would be distributed across both experimental conditions. One suggestion for future studies would be to include seatwork that reflects skills students are developing in school simultaneously to ensure familiarity with the task. Another possible solution to this would be to study rates of accuracy immediately following instruction on the skill that will be emphasized during seatwork to better approximate an authentic classroom setting. Variability may have also been introduced by providing seatwork at different levels of difficulty for children with different abilities. This may be a threat to the internal validity of the study. It may also be that no differences in students’ productivity were detected because the accommodation was presented during a lengthy 30-minutes or massed practice period versus
being distributed over time. The learning and memory research suggests that distributing
learning and practice over time has a significant effect, as demonstrated in Schutte et al.’s
(2015) study of math fluency growth rates, for example. This also raises the question of
whether the duration of the seatwork period may have been unfavorable. The duration of
seatwork for this study was inspired by previous studies researching the efficacy of behavioral
interventions (Pelham et al., 2005). Future studies should investigate the efficacy of chunking
when administered during briefer periods of seatwork (e.g., 15 minutes) and of distributing
seatwork chunks over time. Another limitation related to the design of the study involves a
possible confound variable introduced in both the standard condition and in the experimental
condition. Students were made aware of the time limit for completing seatwork in both
conditions. It is thus possible that timing alone had an effect on seatwork productivity and that
chunking was not powerful enough for a noticeable increase in productivity. As demonstrated
in prior studies, use of a timing device is an effective method to increase academic engagement
(Carr & Punzo, 1993). In the present study, there was little to no information available
regarding students’ comorbidities. ADHD and learning disability (i.e., dyslexia) often co-occur.
Given the high comorbidity between ADHD and learning disorders (Massetti, 2008), it will be
important to investigate the role, if any, that learning disabilities play into the academic
productivity of children with ADHD who receive accommodations or other services, in future
studies. Another limitation involves the generalizability of the study because students are
typically assigned a manageable number of problems in their school setting. In the present
study, we aimed to assign enough seatwork to students to evaluate their on-task behavior and
productivity in a consistent manner across program weeks (during 30 minutes each time) and
across students to reduce introduction of bias. Unlike the typical classroom, all children in this study had a Daily Report Card (DRC) and worked toward meeting behavioral goals during a program day that were tied to incentives (e.g., toy store) (Volpe & Fabiano, 2013). This may have influenced children’s motivation to engage in positive behaviors, including completing seatwork at a higher rate than would be typical. The current study did not evaluate the effect of public praise provided to students on their productivity or behaviors, but tried to account for effects by consistently providing public praise throughout the weeks of the program in a 3:1 ratio and across classrooms. As noted earlier, children with ADHD have been found to be less productive during seatwork time than their typically developing peers (DuPaul et al., 2014; Pelham et al., 2001). There were no comparison groups available in this study. It would be beneficial to include a comparison group in future studies to determine whether children with ADHD benefit from this accommodation in a way that allows them to reach similar levels of productivity as their typically developing peers, which is the premise for the use of this accommodation.

**Future Directions in Research**

This study is one of the first of its kind. Only one case study by Wallace et al. (2003) investigating the impact of this particular accommodation on student academic productivity and behavior has been examined in the literature prior. Despite the numerous studies for children with ADHD prescribing behavioral treatments, little is known about their effect on the academic productivity of children. And of the commonly prescribed services in school to remediate academic difficulties, there is little to no research that has been conducted to evaluate their effectiveness in schools. The theory of increased academic learning time
contributing to academic productivity would suggest that increasing the time children with ADHD spend engaged in meaningful seatwork would also increase their output. One way of determining the efficacy of services provided to children with ADHD is thus based on measurable increases in academic learning time and its relation to academic output and reduced disruptive behaviors. This was the aim of the present paper. The lack of change in academic productivity, disruptive behavior, and on-task behavior, when chunking was administered suggests that this presentation accommodation may not be as effective as its rate of use in schools would let believe. This raises the question of whether providing seatwork in chunked format creates an additional distraction in the classroom or encourages children to engage in disruptive behaviors as they wait for teachers to provide the following segment of work. If seatwork chunking is contributing to distraction in the classroom, it would be counterintuitive to provide this accommodation for children with ADHD who struggle to inhibit their behaviors. Would this be the case if children self-administered segments of seatwork using a more discrete approach for praise upon completion of a seatwork segment. Future research continues to be needed to suggest effective accommodations that both increase students’ academic learning time and decrease their disruptive behaviors (McKissick et al., 2010). While children’s academic productivity, as measured by the percentage of problems they completed accurately, did not appear to increase with chunking in the current study, it will be important for future studies to determine whether children with ADHD benefit from this accommodation in other ways. For example, when compared to typically developing peers, does providing children with ADHD chunked seatwork level the playing field for them in terms of their rates of work accuracy and work completion, as these rates have been reported to be
weaknesses for children with ADHD in past studies (DuPaul et al., 2014; Pelham et al. 2001). Studies are also needed to determine whether children would benefit from chunking if seatwork were linked to previous instruction, which would allow for a better ecological evaluation of the accommodation. Future research should aim not only to better understand the effects of behavioral treatment on academic variables but also to increase our understanding of the effectiveness of commonly prescribed accommodations (e.g., preferential seating, seatwork chunking) in schools (Harrison et al., 2013). This is particularly important at this time following the U.S. Department of Education’s (2016) guide for more effective allocation of district resources. Teachers and administrators are charged with the challenging task of providing accommodations that are effective for students and are held accountable for the academic growth of students with disabilities.

Practical Recommendations for School Psychologists and Educators

Accommodations, which are often prescribed to children with ADHD, aim to give them a booster and ensure that these students have equal opportunities compared to their typically developing peers to succeed (Harrison et al., 2013). School psychologists and other educators usually play an important role in determining which accommodations might be beneficial to students. Decisions about accommodations and other services are typically informed by measuring academic productivity (seatwork correct/completed) and behaviors (time on-task, disruptiveness) similar to those used in this study. School psychologists may be inclined to suggest chunking seatwork for children who present with these problems. However, this study would encourage administrators and other educators to be cautious in recommending an accommodation that appears unlikely to change the initial problems discussed and that may be
soaking up resources inefficiently. Instead school psychologists and other educators should consider measuring academic productivity and disruptive behavior changes when prescribing this accommodation. As accountability for teachers and educators continues to increase, there is an increased need for knowledge of services that are time and cost-effective, while providing students with a fair and equal chance of succeeding. School psychologists should also take charge in identifying well-researched accommodations that may be promising in increasing the academic productivity of students with ADHD and in decreasing their distractible behaviors.

The current study examined the impact of the accommodation of chunking on the academic performance of children with ADHD. Results suggested that children’s productivity and behavior did not differ significantly when presented with chunked versus standard seatwork format. As such, the current results suggest that there is not enough evidence in research to suggest that this presentation accommodation provides an advantage to children with ADHD to level the playing field as is often expected when prescribed in schools. Additionally, there were no differences between younger and older students in seatwork productivity, disruptive behavior, or time engaged in seatwork across conditions. Chunking remains an appealing choice due to its simplicity and low cost in schools, but research will need to further evaluate its potential and to identify ways to administer it that meet standards for increasing the immediate and long-term success of children with ADHD.
References


large assignments into smaller assignments and teaching a student with retardation to recruit reinforcement. *School Psychology Review, 32*(1), 132-142.


Appendix A

Table 1

*Characteristics of Participants*

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>M (SD)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24</td>
<td>70.58</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>29.41</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>34</td>
<td>9.24 (2.49)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
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<td>11.76</td>
<td></td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
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<td>73.53</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Black or African American</td>
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<td>26.47</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>21</td>
<td>61.76</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>17.65</td>
<td></td>
</tr>
<tr>
<td><strong>Academic Skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WJ Broad Reading</td>
<td>30</td>
<td>102.47 (15.05)</td>
<td></td>
</tr>
<tr>
<td>WJ Broad Math</td>
<td>32</td>
<td>97.97 (13.46)</td>
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</tr>
<tr>
<td><strong>IQ</strong></td>
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<td></td>
<td></td>
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<tr>
<td>WASI-2 Subtests</td>
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<td>96.38 (12.27)</td>
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<tr>
<td><strong>Special Education Services</strong></td>
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<td>IEP</td>
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<td>32.35</td>
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</tr>
<tr>
<td>504</td>
<td>4</td>
<td>11.76</td>
<td></td>
</tr>
<tr>
<td>Neither</td>
<td>10</td>
<td>29.41</td>
<td></td>
</tr>
<tr>
<td>Parent DBD Rating</td>
<td>28</td>
<td>87.5</td>
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</tr>
<tr>
<td>ODD</td>
<td></td>
<td>1.09 (0.56)</td>
<td></td>
</tr>
<tr>
<td>Inattention</td>
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<td>1.97 (0.66)</td>
<td></td>
</tr>
<tr>
<td>Impulsivity</td>
<td></td>
<td>1.64 (0.81)</td>
<td></td>
</tr>
<tr>
<td>IRS Overall Severity score</td>
<td>8</td>
<td>4.25 (1.75)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Variable n across characteristics due to missing data. DBD = Disruptive Behavior Disorder, ODD = Oppositional
Appendix B

Table 2

*Summary of Within Subjects Dependent Variables Across Conditions*

<table>
<thead>
<tr>
<th></th>
<th>STANDARD</th>
<th>CHUNKING</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seatwork completed correctly</td>
<td>42.25 (17.89)</td>
<td>40.72 (16.90)</td>
<td>-0.09</td>
</tr>
<tr>
<td>Rule Violations</td>
<td>0.62 (0.57)</td>
<td>0.54 (0.47)</td>
<td>-0.15</td>
</tr>
<tr>
<td>Time On-Task</td>
<td>84.85 (17.11)</td>
<td>87.41 (11.05)</td>
<td>0.18</td>
</tr>
</tbody>
</table>

*Note. N = 25; means represent calculated average percentages across time*
### APPENDIX C

Table 3  
*Summary of Between Subjects Variables Across Conditions*

<table>
<thead>
<tr>
<th>Variable</th>
<th>STANDARD</th>
<th>CHUNKING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YOUNGER GROUP</td>
<td>OLDER GROUP</td>
</tr>
<tr>
<td>Seatwork Correct</td>
<td>41.08 (19.43)</td>
<td>44.31 (15.65)</td>
</tr>
<tr>
<td>Time On-Task</td>
<td>83.67 (19.57)</td>
<td>86.95 (12.33)</td>
</tr>
<tr>
<td>Rule Violations</td>
<td>0.62 (0.43)</td>
<td>0.40 (0.55)</td>
</tr>
</tbody>
</table>

N = 25
APPENDIX D

Treatment Fidelity Checklist

Circle **YES** if the item was performed by either the teacher or the lead counselor during the seatwork period, and **NO** if it was not observed:

1. Rules reviewed before seatwork
   - YES
   - NO

2. General instructions provided to the group of students before seatwork
   - YES
   - NO

3. Folders remained closed until instructions were given to begin seatwork
   - YES
   - NO

4. Classroom rules, instructions, and passing out materials completed within 5 minutes of seatwork period
   - YES
   - NO

5. Teacher or lead counselor set the timer as she gave direction to begin working on seatwork
   - YES
   - NO

6. Timer was set in a visible location
   - YES
   - NO

7. Teacher and lead circulated through classroom to provide feedback as needed
   - YES
   - NO

8. Assigned chunk was clearly completed (e.g., student raised hand, all items answered as student sat back) before teacher or lead provided the next slip, if applicable.
   - YES
   - NO

9. Chunked: Teachers provided standard feedback: “Nice work completing this one! Here is the next one” while handing the student the next slip.
   - YES
   - NO

10. Seatwork lasted 30 minutes
    - YES
    - NO

11. When time elapsed, children were instructed to put their pencils down (or to stop writing)
    - YES
    - NO

12. Praise and feedback were provided in a **3:1** ratio throughout seatwork
    - YES
    - NO

Please monitor instances of feedback and praise given to an individual child, a group of children, or to the whole class.

<table>
<thead>
<tr>
<th>Behavioral/Corrective Feedback</th>
<th>Praise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Any other points you deem necessary to review with or give staff feedback about:

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Event sampling will be used for coding Rule Violations. Event sampling asks the question, “Did any misbehavior occur within the last ten seconds?” If the answer is “Yes,” a “1” should be recorded on the observation sheet. If the answer is “No,” a “0” should be recorded. Momentary sampling will be used to code On-Task. Momentary sampling asks the question, “When the recording says ‘On-task’ is the child on-task at that exact moment?”
### Appendix F

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
<th>Error</th>
<th>Result</th>
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</thead>
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<td>Value 1</td>
<td>Error 1</td>
<td>Result 1</td>
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<tr>
<td>Measure 2</td>
<td>Value 2</td>
<td>Error 2</td>
<td>Result 2</td>
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<tr>
<td>Measure 3</td>
<td>Value 3</td>
<td>Error 3</td>
<td>Result 3</td>
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<td>Measure 4</td>
<td>Value 4</td>
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<td>Result 4</td>
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<td>Measure 5</td>
<td>Value 5</td>
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<td>Measure 6</td>
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<td>Measure 7</td>
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<tr>
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<td>Measure 10</td>
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APPENDIX G

Table 1

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<th>4</th>
<th>5</th>
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<td>3</td>
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