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Reading Interventions for Students With or At Risk of Attention-Deficit/Hyperactivity Disorder: A Systematic Review

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Abstract

Empirical evidence suggests inattention and attention-deficit/hyperactivity disorder (ADHD) are related to reading fluency, reading comprehension, and academic failure. Students with ADHD are served in both general and special education settings, but limited research explores effective reading interventions for this population. The purpose of this synthesis is to investigate reading studies for participants identified with or at risk of ADHD. We address the following research question: What are the effects of reading interventions on the reading outcomes of students with or at risk of ADHD in Grades 4 to 12? In total, 16 studies met inclusion criteria. Intervention findings are presented in an attempt to document evidence-based practices. Although findings contribute to the evidence base of instructional practices that may be effective for students with ADHD, no interventions meet criteria outlined by the Council for Exceptional Children to be classified as evidence-based practices. However, studies in this review document evidence of positive intervention effects for study participants.

Keywords

comprehension, reading, ADHD, exceptionalities

Attention-deficit/hyperactivity disorder (ADHD) is characterized by persistent high levels of inattention, hyperactivity, and/or impulsivity that interferes with functioning (American Psychiatric Association, 2013). Empirical evidence suggests that inattentive and hyperactive behaviors are related to and predictive of reading fluency, reading comprehension, and academic failure (Currie & Stabile, 2004; Mayes & Calhoun, 2007; Pham, 2016; Rodriguez et al., 2007; Rogers, Hwang, Toplak, Weiss, & Tannock, 2011). Students with ADHD are at greater risk for school dropout or retention as compared with their typically developing peers (Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2007; Fried et al., 2016).

Reading Skills in Students With ADHD

The behavioral characteristics of ADHD (i.e., inattention, hyperactivity, impulsivity) are highly individualized. Although some students display all three behaviors, many only exhibit one or two. Inattentive behavior is highly correlated with deficits in reading fluency and reading comprehension, whereas hyperactivity and impulsivity are not (Pham, 2016; Rogers et al., 2011). Furthermore, Stern and Shalev (2013) posit that students with reduced levels of sustained attention perform significantly lower on reading comprehension assessments than students with increased levels of sustained attention, even when accounting for similar word reading abilities. Studies also suggest that many students with all presentations of ADHD have similar word reading abilities as their typically developing peers, yet they still perform significantly below those without ADHD on reading fluency and reading comprehension measures (Ghelani, Sidhu, Jain, & Tannock, 2004; Martinussen & Mackenzie, 2015). Evidence exists documenting differences in reading at the word level compared with comprehending text, particularly due to the use of additional regions in the brain responsible for higher-order information maintenance and meaning coherence (Aboud, Bailey, Petrill, & Cutting, 2016). Reading comprehension requires continuous updates of mental representations while simultaneously making connections between information obtained through text (i.e., use of working memory). Students with ADHD perform lower on working memory measures than their typically developing peers (Gropper &

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Tannock, 2009); therefore, it is understandable that students with ADHD also underperform on reading comprehension measures (Miller et al., 2013). Although one essential element of the Simple View of Reading model is word-level reading, this skill cannot stand alone. Linguistic comprehension is an equally important component (Hoover & Gough, 1990). Students with ADHD exemplify strong word reading ability, but many struggle to comprehend text, indicating a potential breakdown in linguistic comprehension (Martinussen & Mackenzie, 2015; Purvis & Tannock, 1997). As students progress through grades, an increased emphasis is placed on reading comprehension. As a result, many students with ADHD, specifically those who exhibit inattentive behaviors, fall substantially behind their peers in upper elementary, middle school, and high school (Ghelani et al., 2004).

Previous Reviews of the Literature

Multiple studies focus heavily on the characteristics of students with ADHD in general such as academic functioning, behavioral functioning, and long-term outcomes (e.g., DuPaul et al., 2004; Harpin, Mazzone, Raynaud, Kahle, & Hodgkins, 2016; Martinussen & Mackenzie, 2015; Miller et al., 2013; Pham, 2016; Rogers et al., 2011), but few reading intervention studies are documented for this population. For example, DuPaul and colleagues (2004) documented multiple predictors of academic outcomes (e.g., teacher ratings of ADHD symptoms, social skills, academic-related behaviors, reading achievement, and math achievement) for students with ADHD. Of all the predictors examined, reading and math achievement were the strongest predictors of overall academic outcomes. They posit a need for instruction that targets academic skills rather than solely those that focus on reducing behaviors characteristic of students with ADHD (DuPaul et al., 2004). Rogers and colleagues (2011) documented the relationship between inattention and academic underachievement in the areas of mathematics and reading. In terms of long-term outcomes, Harpin and colleagues (2016) reported lower levels of self-esteem and social function in individuals with untreated ADHD as compared with their typical peers. In addition, there are studies that address the manipulation of medication in conjunction with reading interventions and their effects on student outcomes (e.g., Tannock et al., 2018).

Literature reviews and nonsystematic summaries in the areas of medication interventions, mathematics, working memory, and executive functioning exist for students with ADHD (e.g., Rapport, Orban, Kofler, & Friedman, 2013; Weyandt et al., 2014), yet very few reviews include reading outcomes. Although there are some nonsystematic summaries that discuss academic interventions for students with ADHD (e.g., DuPaul & Eckert, 1998; Jitendra, DuPaul, Someki, & Tresco, 2008; Raggi & Chronis, 2006), only three systematic reviews (DuPaul, Eckert, & Vilardo, 2012; Reid, Hagaman, & Graham, 2014; Trout, Lienemann, Reid, & Epstein, 2007) of the intervention literature for students with ADHD have been conducted. Nonsystematic summaries of the literature document multiple school-based interventions for students with ADHD; however, without the systematic approach of an exhaustive review, it is difficult to draw definitive conclusions from these reviews. Trout and colleagues (2007) focused on nonmedication interventions that included at least one academic outcome. They found that 11 of the 41 studies (27%) included a self-regulation component, which was found to be effective. Included studies also incorporated token economies, which were seen to be effective as well. Although their findings document valuable information at a macro level, specific intervention details related to each academic area are not documented. Reid and colleagues (2014) reviewed self-regulated strategy development (SRSD) for written expression with students with ADHD. Although this is not specifically related to reading outcomes alone, much of the written instruction incorporated summary writing activities, which support reading comprehension. DuPaul and colleagues (2012) conducted a meta-analysis evaluating school-based interventions for students with ADHD. Interventions included behavioral elements (e.g., contingent reinforcement, developing self-control skills, self-management) and academic instruction (e.g., peer tutoring), and all studies had to include at least one outcome measure relevant to school settings (e.g., on-task behavior, work completion, academic grades). Although these reviews provide ample information regarding general academic interventions across mathematics, reading, and writing, there has yet to be a systematic synthesis that specifically focuses on reading interventions for students with or at risk of ADHD. In addition, previous systematic reviews have not investigated reading outcomes as they pertain to ADHD presentation (e.g., inattentive, hyperactive, combined).

In an effort to further investigate the efficacy of reading interventions specifically related to reading fluency, vocabulary, and reading comprehension for students with or at risk of ADHD, a systematic research review was conducted to answer the following question:

> **Research Question 1:** What are the effects of reading interventions on reading outcomes of students with or at risk of ADHD in Grades 4 to 12?

Method

Data Collection

To locate all applicable research studies, we conducted an exhaustive, systematic search of the literature following criteria outlined by Cooper (2017). The electronic search

utilized the following electronic databases: (a) Education Source, (b) ERIC, and (c) PsychINFO. The search was limited to peer-reviewed studies published before June 2017. In an effort to maintain replicability, we did not include a search of gray literature (e.g., unpublished studies, dissertation studies). Because we aimed to include only peer-reviewed studies, gray literature did not meet our inclusion criteria. To find studies including students deemed at risk or those diagnosed with ADHD, Line 1 of the search included key terms (ADHD or ADD or "attention defic* or "attention problem* or hyperactive*) associated with this population. To find studies that included reading interventions across multiple text types, terms associated with reading interventions (reading or fluency or decod* or vocabulary or literacy or "social studies" or "social science* study" or "history study" or "history teaching" or "history instruction") were entered in Line 2 of the search. Line 3 consisted of terms related to populations excluded in the current study (NOT college or undergraduates or "higher education" or preschool or "early childhood").

This systematic review included studies that met the following criteria:

(a) Studies utilized experimental, quasi-experimental, treatment/comparison, or single-case study designs. Single group designs and case studies were excluded. In addition, we excluded studies that did not report data taken at pre- or postintervention.
(b) Studies included participants with or at risk of ADHD as defined by clear criteria such as a medical diagnosis or cut score on a validated screener (e.g., Conners 3; Conners, 2008). Studies that did not disaggregate data for the population of focus were excluded. For example, if multiple disabilities were included in group studies, only those that disaggregated findings for students with or at risk of ADHD were included. If not disaggregated, at least 50% of the total participants in the study sample had to be identified as having or as being at risk of ADHD. Only participants classified as at risk of or as having ADHD were included in single-case design studies. If some participants in the study did not meet these inclusion criteria, they were excluded, and their data were not used in the synthesis.
(c) Studies were only included if they focused on students in Grades 4 to 12. If studies included participants from grades other than Grades 4 to 12, we included only those that disaggregated findings for the target grade levels (i.e., Grades 4–12) or those that included at least 50% of the total sample from the target grade levels. If data were not disaggregated for the target grades or it was unclear if a minimum of 50% of the sample encompassed students in Grades 4 to 12, the study was not included in the synthesis.
(d) Studies included interventions that took place in a classroom or school environment such as a traditional school, a self-contained school for students with disabilities, or a residential facility that provided instruction in classrooms within the facility. Studies were excluded if interventions were delivered outside the classroom environment such as a tutoring center or in a child's home.
(e) Reading interventions were required to use an alphabetic language that focused on reading fluency, vocabulary, or reading comprehension to be included in the synthesis. Multicomponent interventions were included if at least 50% of the intervention focused on fluency, vocabulary, or reading comprehension instruction. Specifically, if behavioral interventions were paired with reading interventions, at least 50% of the intervention had to include targeted reading instruction. In addition, studies including the manipulation of medication in conjunction with reading interventions were excluded. These were excluded to account for effects that may be due to the presence of medication and/or the effects related to the believed presence of medication (e.g., placebo effects) rather than effects related to reading interventions alone.
(f) Studies included interventions that measured reading outcomes in fluency, vocabulary, or comprehension as a dependent variable.

The initial search yielded 5,272 articles. After importing all abstracts using Zotero and accounting for duplicates, 4,332 studies remained. From this list of studies, titles and abstracts were read and sorted into three categories: yes, maybe, or no, leaving 194 articles for a full-text review. Overall, 10% of the 4,332 abstracts (433 abstracts) were randomly selected, and two independent reviewers read each abstract and identified them as "yes," "maybe," or "no." An interrater reliability of 97% was achieved for abstract sorting. Discrepancies were resolved by discussing differences and the final sort reached 100% agreement. Full texts of all studies were obtained for all abstracts identified as "yes" and "maybe" ($n = 194$). Two researchers independently completed a full-text review of 20 randomly selected articles (10% of the remaining 194 articles) to establish interrater reliability; authors reached 100% reliability on the first attempt. Of the 194 possible articles, a total of 14 articles met inclusion criteria.

In an effort to find additional studies, we conducted a hand search to examine studies published from January 2015 to August 2017. *Remedial and Special Education, Education and Treatment of Children*, and *Reading Improvement* were included in the hand search due to the high incidence of articles found within these journals identified in the initial computer search. Two additional articles were located during the hand search, resulting in a total of

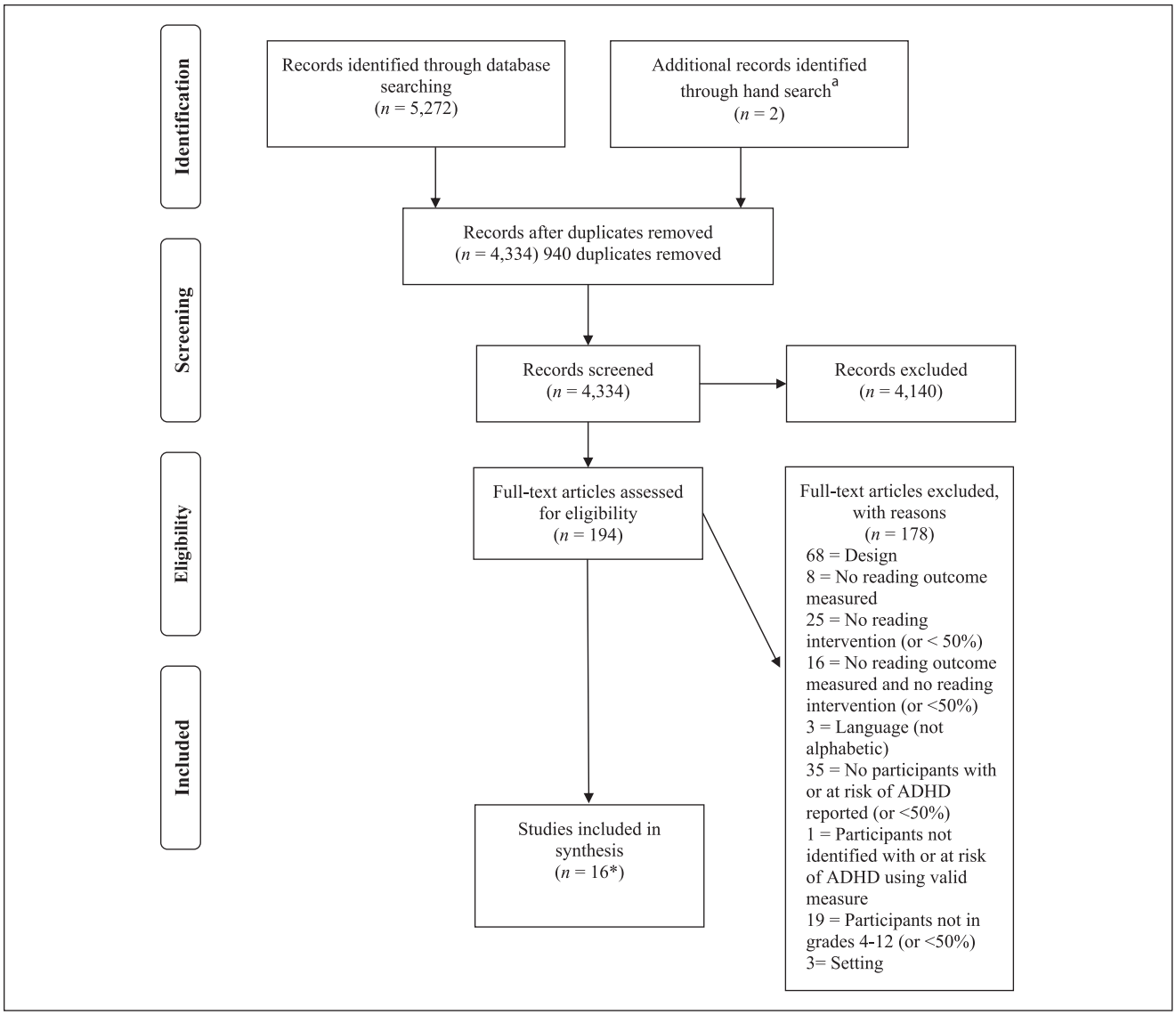

Figure 1. PRISMA diagram depicting the search process.
[a] = Remedial and Special Education, Education and Treatment of Children, Reading Improvement; ADHD = attention deficit hyperactivity disorder.

16 studies. The PRISMA diagram in Figure 1 provides details regarding the search and sorting procedures based on the recommendations of Moher, Liberati, Tetzlaff, and Altman (2009).

Data Analysis

Coding procedures. Two researchers coded studies that met inclusion criteria using a researcher-developed code sheet which focused on general study characteristics such as study design, sample size, participant demographics, treatment and comparison groups for group designs, baseline, treatment, and maintenance phases for single-case design, general findings, and measures. In addition, coders documented treatment fidelity and interobserver agreement reported in all studies.

All studies were initially coded by the first author and double coded by the second author. Before coding began, the second author was trained in all coding procedures. The first author led the training and acted as the gold standard (Gwet, 2001). After the training, coders established initial interrater reliability. One article was blind-coded by both researchers, and initial interrater reliability exceeded 90%. Throughout the double coding process, both researchers noted any disagreements and agreed upon a final code as needed, resulting in 100% agreement. In an effort to account for observer drift, both coders referred to a coding manual consisting of clear explanations of coding processes as well

as specific examples of potential coding decisions. Examples provided decision trees to assist coders in making consistent decisions.

Effect size calculation. Emerging research supported by the Campbell Collaboration suggests using the between-case standardized mean difference (BC-SMD) to calculate and interpret effects of single-case studies, particularly those that utilize a reversal design and an across-participant multiple-baseline design, that include at least three participants and variability in baseline data across participants (Valentine, Tanner-Smith, Pustejovsky, & Lau, 2016). The BC-SMD estimates effects measured on the same scale as between-group experimental designs, such as Cohen's *d* and Hedges's *g*. In the current corpus of studies, none included the minimum number of participants (i.e., three), they did not document variability of baseline data both across or within participants, and they did not meet the necessary criteria for design (i.e., reversal or across-participant multiple-baseline); therefore, the BC-SMD effect size estimates could not be calculated. Although some studies included three participants, they utilized designs investigating multiple baseline across settings and/or academic tasks (e.g., word sets) rather than across participants. Due to the limitations involving the calculation of effect sizes comparable with those reported for group designs, effects sizes are presented for each individual study participant and cannot be generalized to the general population. In an effort to provide descriptive information representative solely of the participants' reading outcomes as a result of their individual exposure to treatment, we calculated Tau-*U* effect sizes for each single-case participant. Tau-*U* accounts for trend within baseline phases and is commonly used with small datasets (Vannest & Ninci, 2015). To calculate Tau-*U*, which requires raw data, we utilized digital software to upload graphs from each single-case participant. WebPlotDigitizer is cited by previous reviews as a reliable program for extracting single-case data to calculate effect sizes such as Tau-*U* (Moeyaert, Maggin, & Verkuilen, 2016; Williams, Austin, & Vaughn, 2018). Using this software, we converted data points from single-case graphs into numerical values that were then entered into a Single-Case Effect Size Calculator (Pustejovsky, 2017). Effect size values from 0 to 0.20 represent small changes, 0.20 to 0.60 represent moderate changes, 0.60 to 0.80 represent large changes, and 0.80 and above represent very large changes (Parker, Vannest, Davis, & Sauber, 2011; Vannest & Ninci, 2015). For group designs, we calculated Hedges' *g* by taking the difference between the posttest mean of the intervention group and posttest mean of the comparison group, divided by the pooled weighted standard deviation (Hedges, 1985). Hedges' *g* effect sizes are reported to provide a less biased estimate of effect sizes given the small sample sizes in both group studies (Hedges, 1985).

Results

Fourteen single-case studies and two group design studies (Cassar & Jang, 2010; Rogevich & Perin, 2008) were identified for inclusion in the current systematic review, totaling 16 studies. Table 1 provides an overview of each study. Table 2 provides a summary of conditions, measures, and effect sizes. Results are summarized by (a) participants, (b) general study characteristics, (c) quality indicators (QIs) and evidence-based practices (EBPs), and (d) common intervention characteristics.

Participants

Studies included a total of 65 students (55 males and 10 females). All participants were identified as having a medical diagnosis of ADHD. Although we considered students at risk of ADHD eligible for this synthesis, none of the studies documented any at-risk participants. In addition, all participants received special education services and many were identified as having co-occurring diagnoses such as learning disabilities (LDs), emotional and behavioral disorders (EBD), speech and language impairments (SLI), or autism spectrum disorders (ASDs). In total, 12 studies included explicit reading criterion to determine whether students qualified to participate in the study. Two studies included explicit writing criterion to determine eligibility to participate, and three studies did not report any reading or writing criterion. The age of included participants ranged from 10 to 18 years. Eight studies included students in upper-elementary grades (Grades 4 and 5), and eight studies included students in middle and high school (Grades 6–12). Overall, 23% of the sample was African American, 22% was Caucasian, 18% was Hispanic, and 37% of participants' race and ethnicity were not reported. Socioeconomic status (SES) was not reported for the majority of studies; however, five studies reported participants of low SES. Low SES was defined by studies including 50% or more participants qualifying for free and reduced priced lunch (Cullen, Keesey, Alber-Morgan, & Wheaton, 2013; Cullen, Alber-Morgan, Schnell, & Wheaton, 2014; Johnson, Reid, & Mason, 2012; Jozwik & Douglas, 2016; Rogevich & Perin, 2008).

General Study Characteristics

Both group design studies employed a quasi-experimental design in which they matched participants on specified characteristics. The majority of single-case studies followed a multiple-baseline design either across participants ($n = 8$) or across settings, word lists, academic areas, or behaviors ($n = 4$). Two single-case design studies implemented a baseline and intervention without including a reversal (AB). Three studies focused on fluency, 10 focused on reading comprehension, and three focused on more than one reading component

Table 1. Study Characteristics.

Study (year)	Study design	*n*, grade, and age	Text type	Reading component focused on intervention
Belfiore, Grskovic, Murphy, and Zentall (1996)	AB	*n* = 3 Grade: 4 and 5 Age: 10 and 11 years	Expository (history and science)	Fluency
Cassar and Jang (2010)	Quasi-experimental	*n* = 6 Grade: 6 Age: 11 years	NR	Fluency
Crabtree, Alber-Morgan, and Konrad (2010)	Multiple baseline across participants	*n* = 2 Grade: 12 Age: 17 and 18 years	Narrative	Comprehension
Cullen, Alber-Morgan, Schnell, and Wheaton (2014)	Multiple baseline across participants	*n* = 1 Grade: 5 Age: NR	Narrative and expository	Comprehension
Cullen, Keesey, Alber-Morgan, and Wheaton (2013)	Multiple baseline (multiple probe) across word sets	*n* = 1 Grade: 4 Age: NR	N/A (sight words)	Fluency
Ennis (2016)	Multiple baseline (multiple probe) across participants	*n* = 1 Grade: 9 Age: NR	Expository (history)	Comprehension
Fishley, Konrad, Hessler, and Keesey (2012)	Multiple baseline (multiple probe) across morpheme decks	*n* = 1 Grade: 18 Age: 12 years	N/A (morphemes)	Fluency and vocabulary
Flores and Ganz (2007)	Multiple baseline (multiple probe) across behaviors	*n* = 1 Grade: 5 Age: 10 years	NR	Comprehension
Flores and Ganz (2009)	Multiple probe across behaviors	*n* = 2 Grade: 5 Age: 10 and 13 years	NR	Comprehension
Hedin, Mason, and Gaffney (2011)	AB	*n* = 2 Grade: 4 and 5 Age: 10 and 11 years	Expository (science)	Comprehension
Hilsmier, Wehby, and Falk (2016)	Multiple baseline across participants	*n* = 2 Grade: 7 and 8 Age: 12 and 13 years	NR	Fluency and comprehension
Johnson, Reid, and Mason (2012)	Multiple baseline across participants	*n* = 3 Grade: 9 Age: 14 and 15 years	Expository (history)	Comprehension
Jozwik and Douglas (2016)	Multiple baseline (multiple probe) across participants	*n* = 3 Grade: 4 Age: 10 years	Narrative	Vocabulary and comprehension
Rogevich and Perin (2008)	Quasi-experimental	*n* = 31 Grade: 7–10 Age: *M* = 14.7 years	Expository (history and science)	Comprehension
Saddler, Asaro-Saddler, Moeyaert, and Ellis-Robinson (2017)	Multiple baseline across participants	*n* = 2 Grade: NR Age: 10 years	Expository (history)	Comprehension
Shimabukuro, Prater, Jenkins, and Edelen-Smith (1999)	Multiple baseline across three academic areas	*n* = 3 Grade: 6 and 7 Age: 12 and 13 years	NR	Comprehension

Note. AB = design consisting of a baseline and intervention phase with no reversal present; *n* = sample size; NR = not reported; N/A = not applicable.

(i.e., fluency and vocabulary, fluency and comprehension, vocabulary and comprehension). Of the studies that included reading passages, six included expository text, two included narrative text, one included both narrative and expository, and five did not report the type of text included in the intervention. The majority of studies ($n = 15$) consisted of small group or

Table 2. Summary of Intervention Findings.

Author	Intervention description	Measure	Intervention dosage					Effect size			
			Instructional grouping (no. of students)	Duration of lessons (min)	Lesson frequency (sessions per week)	Total intervention sessions	Hedges's *g*		Tau-*U*		
									P1	P2	P3
Belfiore, Grskovic, Murphy, and Zentall (1996)	B: Students read 90 words (80 known and 10 unknown) T1: Students read five unknown words three consecutive times on black and white cards. T2: Students read five words in black and white followed by two sets of colored versions of the same words (total of 3 times reading each word)	Words read correctly out of total words read	NR	1	5	27–29		T1 T2	0.84 0.84	0.88 0.88	0.94 0.94
Cassar and Jang (2010)	C: Students sorted and matched spelling patterns (e.g., oa, ow), combined patterns to make new words, came up with as many real or nonsense words as possible in 1 min, and were given direct and explicit instruction (and guided practice) followed by individual practice T: Individual sessions—Students practiced segmenting and blending words (real and nonsense) and word parts, read word sets and tried to beat their previous times, and engaged in direct and explicit instruction followed by independent practice (crossword puzzles, word lists) Group interaction sessions—Students played two board games allowing for practice of skills; teachers gave feedback on how to improve skills while students played board games	WRAT-3	3	30	4	24	$g = 0.41$				
Crabtree, Alber-Morgan, and Konrad (2010)	B: Students read 3-page fictional passages with no stopping points and answered questions about the plot of the story T: Students read 3-page fictional passages with stopping points after each page, used a 3-column handout (one column per page read) to support self-monitoring, and were prompted to answer questions at each stopping point	Immediate recall worksheet Comprehension quizzes:	3	30	4	7			0.94 1.06	1.07 1.19	
Cullen, Alber-Morgan, Schnell, and Wheaton (2014)	B: Students read passages and completed vocabulary and spelling activities T: Students completed the Headstart comprehension computer-based program with built in feedback	OAA AIMS web MAZE	5	15–30	4	12			1.06 0.73		
Cullen, Keesey, Alber-Morgan, and Wheaton (2013)	B: Students completed baseline probes consisting of sight words on PowerPoint slides; no feedback was given for sight word accuracy T: Students were explicitly taught how to complete computer activities selected for each session, completed independent work on computers, read along with the computer, highlighted words spoken by the computer program, read words to the computer (which the computer then dictated on the screen), typed words, dragged words into cloze sentences, spelled words, unscrambled words, and matched spoken words to their written form	Words read correctly within 3 s out of the total words attempted (three word sets)	Small group: 4; computer practice: 1	20–25	3–5	14		Set 1 Set 2 Set 3	0.50 0.39 0.94		
Ennis (2016)	B: BAU social studies instruction with class discussion, vocabulary lessons, and response to comprehension questioning T: TWA + PLANS+ SRSD with explicit modeling, guided practice, and independent practice; students answered questions verbally and in written form	Written summaries	1	40–50	2–3	6			1.11		

(continued)

Table 2. (continued)

Author	Intervention description	Measure	Intervention dosage					Effect size			
			Instructional grouping (no. of students)	Duration of lessons (min)	Lesson frequency (sessions per week)	Total intervention sessions	Hedges's *g*		Tau-*U*		
									P1	P2	P3
Fishley, Konrad, Hessler, and Keesey (2012)	B: BAU ELA instruction where students looked up vocabulary words in the dictionary and discussed words as they read novels together in class T: Morphemes were explicitly taught to students with the use of a graphic organizer; students asked to define as many morphemes as they could in 30 s and then told to try to beat their previous time (GO FASTER program); students graphed their progress independently; sprint training was implemented if student did not reach mastery of two consecutive sessions of 25 correctly defined morphemes	Number of correctly stated morpheme definitions in 30 s (three word sets)	1	15	NR	13		Set 1 Set 2 Set 3	1.00 0.63 1.10		
Flores and Ganz (2007)	B: NR T: DI program, *Corrective Reading Thinking Basics: Comprehension level A*; program consisted of scripted lessons, provided opportunities for students to respond chorally, and included explicit modeling, guided practice, and independent practice activities	Statement Inference Using Facts Analogies	4	20	5	28			0.99 0.99 1.00		
Flores and Ganz (2009)	B: NR T: DI program consisting of picture analogies, deductions based on a series of pictures, inductions based on a series of given events, and opposites where students verbally restated a statement using the opposite of one word within the original statement	Deductions Inductions Opposites Picture Analogies	4	20	5	NR			1.00 0.867 n/a 0.89	1.04 n/a 0.75 0.67	
Hedin, Mason, and Gaffney (2011)	B: NR T: TWA + SRSD instruction consisted of teacher modeling, guided practice, and the gradual transfer of strategy use from teacher to student	Number of main ideas recalled Quality of retell	1	30	NR	10			0.80 1.20	0.94 0.83	
Hilsmier, Wehby, and Falk (2016)	B: BAU ELA instruction using the *Language!* in self-contained special education classroom; during data collection, the researcher read to participants from a newspaper, book, or magazine (students' choice) for 10 min and then asked questions about the reading, but no instruction or feedback was provided T1: RMR instruction required students to read passages from the QuickReads program four times: (a) read silently and independently, (b) followed along while researcher read to student, (c) read passage aloud to researcher, and (d) timed while reading passage aloud T2: RMR + CR/PF instruction was identical to RMR instruction except for the addition of students graphing their progress and earning reinforcers after meeting set goals	SRA Multiple Skills Series (WCPM)	1	20	4	20–26		T1 T2	0.65 0.70	0.33 −0.06	
Johnson, Reid, and Mason (2012)	B: Students prompted to read a total of five passages and orally retell everything they could remember about each passage; students were given a yellow and blue highlighter and a piece of scratch paper while reading T: TWA + SRSD instruction consisted of explicit instruction and guided practice with graphic organizers and highlighters to identify main ideas and supporting details; students eventually practiced independently and asked to summarize passages orally	Number of main ideas recalled Percentage of supporting details recalled	1	30	NR	7–9			0.66 0.80	0.93 0.88	0.88 1.13

(continued)

Table 2. (continued)

Author	Intervention description	Measure	Intervention dosage					Effect size		
			Instructional grouping (no. of students)	Duration of lessons (min)	Lesson frequency (sessions per week)	Total intervention sessions	Hedges's *g*	Tau-*U*		
								P1	P2	P3
Jozwik and Douglas (2016)	B: students led through guided reading lessons using instructional-level text T: Semantic ambiguity detection training lessons were modified to support Els with learning difficulties and consisted of real-life objects to support background knowledge, additional opportunities for oral language practice, structured learning activities, explicit connections between the participants' native language and English, texts including words known by participants, and visual icons to support language input	SADA AIMS web MAZE	2–3	25	5	17		0.87 0.97		
Rogevich and Perin (2008)	C: BAU ELA instruction focused on reading and discussing narrative text T: TWA + WS + SRSD instruction consisted of opportunities to find the author's purpose, to consider what they already know about the topics, set goals, increase reading rates, reread sections of passages as needed, identify main idea and supporting details, orally summarize text, and reflect on what was learned	Written summaries	3–4	45	4–5	5	$g = 2.63$*			
Saddler, Asaro-Saddler, Moeyaert, and Ellis-Robinson (2017)	B: Students were asked to plan and write a minimum of three summaries independently T: SRSD + WIN instruction consisted of goal setting and self-reinforcement; lessons focused on using the WIN strategy to compose a summary of a passage; the process was explicitly modeled, students were led through guided practice, and students eventually used the strategy independently	Written summaries	2	30–40	3	6		1.17	1.13	
Shimabukuro, Prater, Jenkins, and Edelen-Smith (1999)	B: BAU ELA instruction (specific instructional characteristics not reported) T: Instruction and practice focused on reading comprehension skills across multiple topics, using materials from Jamestown Publishers' Skills Series; students corrected their own work and engaged in discussion as a group	Comprehension questions	7	45	NR	30		0.98	1.04	0.96

Note. P = participant; B = baseline phase; NR = not reported; T = treatment; WRAT-3 = Wide Range Achievement Test–third edition; OAA = Ohio Achievement Assessment—Passage Comprehension; BAU = business as usual; TWA = think before reading, think while reading, and think after reading; PLANS = pick goals, list ways to meet goals, and make notes, sequence notes; SRSD = self-regulated strategy development; ELA = English language arts; DI = Direct Instruction; n/a = not applicable; SRA = Science Research Associates; WCPM = words correct per minute; RMR = Read-Model-Read; CR/PF = contingent reinforcement/performance feedback; SADA = semantic ambiguity detection assessment; ELs = English language learners; WS = written summarization; WIN = write a topic sentence, identify important information, and number the facts, reasons, and ideas from the author before writing a summary.
*$p < .01$.

one-to-one instruction led by a researcher. Two included researcher-lead interventions paired with computer-based programs. The majority of studies used researcher-developed measures to investigate intervention effects; however, two studies used both standardized and researcher-developed assessments (Flores & Ganz, 2009; Jozwik & Douglas, 2016), three used standardized assessments (Cassar & Jang, 2010; Cullen et al., 2014; Hilsmier, Wehby, & Falk, 2016). One study did not report whether or not the measure was researcher-developed or standardized (Shimabukuro, Prater, Jenkins, Edelen-Smith, 1999).

Quality of Design and EBPs

To classify an instructional practice as an EBP, specific evidence from methodologically sound studies must be documented (Cook et al., 2015). Two distinct steps are involved in identifying practices as evidence based. First, studies must meet specific QIs defined by the Council for Exceptional Children (CEC). Next, a combination of studies that meet the necessary QIs must document positive effects.

QIs. To determine the evidence base behind the instructional practices utilized across studies, we coded studies for CEC's QIs described by Cook and colleagues (2015). We evaluated areas of Context and Setting, Participants, Intervention Agents, Description of Practice, Implementation Fidelity, Internal Validity, Outcome Measures/Dependent Variables, and Data Analysis. We applied a total of 24 QIs to group design studies, which include those that apply to both group design and single-case design studies (18) as well as those that only apply to group design studies (6). We applied a total of 22 QIs to single-case studies, which include those that apply to both group design and single-case studies (18) and those that only apply to single-case studies (4).

Of the two group design studies, none met all QIs necessary to the focus of the synthesis. Five out of 14 single-case studies met all QIs (Cullen et al., 2013; Fishley, Konrad, Hessler, & Keesey, 2012; Flores & Ganz, 2007, 2009; Johnson et al., 2012). Many studies included only one or two participants with or at risk of ADHD. As a result, QI 6.5, which requires at least three demonstrations of an effect, was not met. If we included all participants in the study (e.g., participants not identified with or at risk of ADHD), multiple studies would have met QI 6.5 (e.g., Crabtree, Alber-Morgan, & Konrad, 2010; Cullen et al., 2014; Ennis, 2016; Jozwik & Douglas, 2016; Saddler, Asaro-Saddler, Moeyaert, & Ellis-Robinson, 2017), resulting in a potential evidence base for instructional practices utilized in these studies. However, none of these studies met QIs for the target population of students with or at risk of ADHD; therefore, none of the practices utilized within the studies can be classified as EBPs for this population of students. These studies met all other QIs, indicating they utilized rigorous design procedures with the total participants included. Our inability to classify the interventions utilized within these studies was not due to a lack of design rigor, but rather due to the limited presence of students with or at risk of ADHD.

Some studies (single-case and group comparison) did not meet QIs related to design because they did not report a measure of treatment fidelity (Belfiore, Grskovic, Murphy, & Zentall, 1996; Cassar & Jang, 2010; Rogevich & Perin, 2008; Shimabukuro et al., 1999). Although one of these studies reported the presence of procedural safeguards to ensure treatment adherence (e.g., Rogevich & Perin, 2008), authors did not report the use of a measure to assess treatment fidelity. Two single-case studies did not control for threats to internal validity due to the use of an AB design with no reversal (Belfiore et al., 1996; Hedin, Mason, & Gaffney, 2011).

EBPs. According to Cook et al. (2015), practices used in single-case design studies are classified as an EBP if (a) five methodically sound studies (must meet all QIs) with at least 20 total participants document positive effects or (b) at least 50% of criteria for two or more methodologically sound single-case studies report a 3:1 ratio of studies with positive effects to those with neutral/mixed effects and none can report negative effects. None of the interventions in this systematic review met this criterion; however, two studies utilizing Direct Instruction (DI) met the requirements necessary to classify DI as potentially an EBP for students with or at risk of ADHD (Flores & Ganz, 2007, 2009). This classification is based on two methodologically sound single-case design studies with positive effects. Two studies utilized DI to target students' ability to comprehend text (Flores & Ganz, 2007, 2009). In both studies, researchers taught DI using *Corrective Reading Thinking Basics: Comprehension Level A* (Engelmann, Haddox, Hanner, & Osborn, 2002). The program included scripted lessons, opportunities for students to respond chorally, the use of signals to stimulate student response, corrective feedback procedures, explicit modeling of skills, guided practice, and independent practice. Researcher-developed and standardized measures were administered to investigate effects of the intervention. Tau-*U* calculations for both studies ranged from 0.75 to 1.04.

Three interventions documented in the corpus of studies met the QIs necessary to be classified as EBPs, yet they stand alone and can only be classified as providing insufficient evidence of an EBP (Cullen et al., 2013; Fishley et al., 2012; Johnson et al., 2012). The first is a computer-based program supporting word reading (Cullen et al., 2013). Students engaged in multiple activities with target words such as reading highlighted words on the screen aloud, dragging words into cloze-type sentences, and reading

words to the computer which would dictate the words on the screen. Tau-*U* calculations for the intervention ranged from 0.39 to 0.94 suggesting moderate to very large changes in reading outcomes after the introduction of the intervention. The second intervention with insufficient evidence, GO FASTER, focused on morpheme meaning instruction with the use of a semantic graphic organizer (Fishley et al., 2012). Students were drilled on the meaning of morphemes and then told to try to beat their previous time using the GO FASTER program, which promoted accuracy and speed of content. Tau-*U* effect sizes for the GO FASTER intervention range from 0.63 to 1.10. The third included SRSD instruction with the addition of TWA, which stands for *think before reading, think while reading*, and *think after reading* (Johnson et al., 2012). The *before reading* step prompts students to consider the author's purpose, any background knowledge they already have, and to think about what they want to learn. The *while reading* step instructs students to think about the rate in which they read, to make connections with the text (e.g., linking knowledge), and to reread sections when needed. *After reading* steps include thinking about the main idea of the text, how to summarize the information, and about what students learned. Tau-*U* effect sizes for SRSD + TWA range from 0.66 to 1.13.

Common Intervention Characteristics Across Studies

As previously noted, only one intervention included in the current review met the criterion necessary to be classified as a potential EBP (i.e., DI) according to Cook and colleagues (2015). There is a dearth of reading interventions documented for students with or at risk of ADHD; therefore, we present a summary of what has been investigated in this area in addition to the interventions described previously. We recognize that the following interventions are not defined as EBPs according to CEC standards; however, they shed light on the literature that exists in this area and provide researchers with direction for future research. We grouped these common intervention characteristics into four categories to summarize the interventions documented across all studies in the current review: (a) computer-based instruction, (b) SRSD, (c) self-monitoring and goal setting, and (d) additional intervention components.

Computer-based instruction. Two studies included computer-based instruction in addition to instruction delivered by a researcher (Cullen et al., 2013; Cullen et al., 2014). One of which was previously described as meeting all QIs (Cullen et al., 2013). Both programs included built-in corrective feedback opportunities. If students answered any questions incorrectly, the computer erased the incorrect answer, highlighted the correct response, provided an explanation of why the initial answer was not acceptable, and informed students why the highlighted correct answer was the appropriate choice. In addition, if students continuously made the same error, the computer program responded by providing additional practice of the weak target skill. Tau-*U* effect sizes for Cullen and colleagues (2014) ranged from 0.73 to 1.01, suggesting large to very large intervention effects.

SRSD. Five studies incorporated SRSD with additional strategies such as TWA, PLANS, and WIN (Ennis, 2016; Hedin et al., 2011; Johnson et al., 2012; Rogevich & Perin, 2008; Saddler et al., 2017). SRSD is a strategy with well-documented positive effects, specifically related to writing outcomes among students with EBD (e.g., Ennis & Jolivette, 2014; Mason, Snyder, Sukhram, & Kedem, 2006). SRSD is considered of high utility because it can be used across multiple academic settings (Ennis & Jolivette, 2014). It promotes student self-monitoring and incorporates opportunities for students to set individual goals during strategy use (Harris & Graham, 1996). The SRSD model consists of 6 stages: (a) developing background knowledge about the topic of instruction, (b) discussing the importance of the strategy along with self-monitoring and goal-setting, (c) explicit modeling of the strategy by the teacher, (d) memorizing the steps of the strategy, (e) teacher support and guidance while students practice the use of the strategy, and (f) independent practice of the strategy with minimal teacher assistance. Tau-*U* effect size calculations for single-case design studies investigating SRSD interventions ranged from 0.46 to 1.13. Rogevich and Perin (2008) investigated the intervention using a group design and a researcher-developed measure. The estimated effect size for the intervention was $g = 2.63$ and was statistically significant compared with the outcomes measured in the comparison group.

Four studies combined SRSD with TWA (Ennis, 2016; Hedin et al., 2011; Johnson et al., 2012; Rogevich & Perin, 2008). One study added the mnemonic PLANS in addition to TWA and SRSD instruction (Ennis, 2016). PLANS provides a framework for instructing students to pick goals, list ways to meet goals, and make notes. Finally, it prompts them to sequence their notes. Similarly, another study paired SRSD with the mnemonic WIN, which supports the process of writing topic sentences, identifying important information, and numbering information and writing a summary (Saddler et al., 2017). Regardless of the additional mnemonics, all interventions including SRSD in the current synthesis focused on verbal or written summarization, which supports the comprehension of text.

Although only one SRSD study can be classified according to the criterion outlined by Cook and colleagues (2015) as exhibiting insufficient evidence of an EBP due to a lack of additional studies that met all QIs, it is crucial to note that two additional studies could not be combined with it to classify SRSD as potentially evidence based simply due to the

lack of participants with or at risk of ADHD (Ennis, 2016; Saddler et al., 2017). Although both studies utilized rigorous single-case designs to investigate the effects of SRSD, they did not document three demonstrations of a positive effect required to meet QI 6.5 for students targeted in our review.

Self-monitoring and goal setting. Three studies incorporated elements of self-monitoring and goal setting in addition to reading instruction yet did not include SRSD (Crabtree et al., 2010; Fishley et al., 2012; Hilsmier et al., 2016; Shimabukuro et al., 1999). All of these studies provided opportunities for students to set their own goals and graph their progress. Shimabukuro and colleagues (1999) incorporated self-monitoring into reading comprehension instruction. Students corrected their own work with teacher support, engaged in discussion, and monitored their progress with the use of reading comprehension questions. Hilsmier and colleagues (2016) utilized the *Read-Model-Read* (RMR) program in which students read a passage silently, then followed along as the researcher read the same passage aloud, and then read the passage aloud to the researcher. Next, students were taught to set fluency and comprehension goals. If students met their goals, they received contingent reinforcers. Tau-*U* calculations for two of the studies using a researcher-developed measure (Fishley et al., 2012; Shimabukuro et al., 1999) ranged from 0.63 to 1.10; however, one study, which used a standardized measure (Hilsmier et al., 2016), yielded highly variable Tau-*U* calculations. The majority of effect sizes across participants was positive and ranged from 0.33 to 0.70. One of the participants, however, did not experience positive effects when given contingent reinforcers (Tau-$U = -0.06$).

Additional intervention components. One study included explicit spelling instruction that focused on patterns found within words, segmenting and blending, and word reading followed by small group instruction that included board games that specifically focused on the skills taught in the intervention (Cassar & Jang, 2010). The intervention yielded an effect size of $g = 0.41$ based on students' scores on a standardized measure that evaluated word reading skills; however these effects were not statistically significant. In addition to board games, two studies included the use of graphic organizers (Crabtree et al., 2010; Fishley et al., 2012). Tau-*U* effect size calculations across both studies ranged from 0.63 to 1.19 based on researcher-developed measures. Belfiore and colleagues (1996) focused on word reading using cards that contained black and white ink and colored ink. Tau-*U* effect size calculation ranged from 0.83 to 0.94 across all participants.

Discussion

The purpose of this synthesis was to identify and describe reading interventions for students with or at risk of ADHD. A systematic review of the literature yielded 16 studies, two of which were group designs and 14 of which were single-case designs. Even though the current synthesis aimed at including all students with or at risk of ADHD, no studies included students who were considered at risk with the use of teacher ratings or teacher recommendation. Instead, studies only included participants identified with a medical diagnosis of ADHD. In addition, all students in the corpus of studies received special education services, many of which were also identified as having co-occurring disabilities such as LD, EBD, and ASD. Only one study reported that all instruction was received in the general education setting with special education services provided via push-in supports (Jozwik & Douglas, 2016). All others reported that students received special education services for reading in a separate classroom. This suggests a lack of findings surrounding students identified as having ADHD in general education settings.

Although evidence exists reporting higher levels of academic struggles among students with inattentive behaviors (e.g., Pham, 2016; Rogers et al., 2011), the majority of studies identified students as having ADHD, in general, without specifying particular presentations. We coded all studies for ADHD presentations across participants to see whether we could connect previous findings of descriptive studies to intervention work in this area; however, only three studies specifically reported inattentive behaviors or a diagnosis of an inattentive presentation among participants (Belfiore et al., 1996; Hilsmier et al., 2016; Johnson et al., 2012). Furthermore, of these three studies, none of the authors discussed reading outcomes for these students as they pertained to inattentive behavior.

Effect Size Interpretations

As previously noted, Tau-*U* effect sizes reported for single-case participants should not be directly compared with group design effects, such as Hedges's *g*. We report Tau-*U* effect sizes to present a description of how single participants responded to treatment. Overall, all interventions improved reading fluency, vocabulary, and reading comprehension for all included participants with the exception of one study, in which findings were highly variable (Hilsmier et al., 2016). Three of the four effect size calculations were positive and represented moderate to large changes from baseline to intervention (0.33–0.70), but one effect size did not represent a positive effect (−0.06).

When examining the high effect size calculations across the majority of studies, it is important to consider various items while interpreting such findings. Although students made notable gains after receiving intervention, it is also important to consider potential explanations for the magnitude of effects. Cheung and Slavin (2016) discussed methodological features that may affect effect sizes in educational intervention studies. One feature they noted pertains to the

development of measures. Researcher-developed measures are associated with higher effect sizes than standardized measures. This does not necessarily negate the presence of an effect from researcher-developed measures, but it should be considered when interpreting effect sizes. Because researcher-developed assessments are highly aligned to the content found within the intervention, it is not surprising that higher mean scores are often observed. Conversely, standardized assessments are independent of treatment, providing students an opportunity to apply their knowledge to a more generalized assessment. Significantly higher mean scores after treatment using both measures is evidence of a treatment effect; however, the magnitude of such effects must be interpreted with caution. Across all studies, only four (one group design study and three single-case studies) reported the use of standardized measures (Cassar & Jang, 2010; Cullen et al., 2014; Hilsmier et al., 2016; Jozwik & Douglas, 2016). A direct comparison of effects can only be made for group designs (i.e., Cassar & Jang, 2010; Rogevich & Perin, 2008) given the nature of the Tau-*U* as a representation of outcomes for single participants in single-case designs. However, only one of the two group designs reported significant positive effects in this review (i.e., Rogevich and Perin, 2008); therefore, a direct comparison of effects in both group design studies is not warranted. Tau-*U* effect size calculations for single-case studies should be interpreted independently from one another in that outcomes are specific to the participants in each study. All studies exhibited an upward trend after the introduction of an intervention with the exception of one single effect size (Hilsmier et al., 2016), suggesting a functional relationship between dependent and independent variables.

Intervention Components

Similar to the previous synthesis conducted by Trout et al. (2007), one third of the studies in the synthesis incorporated SRSD within an academic intervention. Vocabulary interventions were not observed in isolation and were always paired with fluency or reading comprehension interventions. Although previous literature notes a general strength in word reading ability among students with ADHD (Ghelani et al., 2004; Martinussen & Mackenzie, 2015), three studies in the current synthesis incorporated word reading within fluency interventions, yet did not target reading comprehension. Main idea and summarization skills were of high focus among reading comprehension studies, many of which were taught using strategy instruction including mnemonic devices.

Limitations and Future Research

The findings of this review are limited by the research designs and methodological underpinnings of the primary studies that met search criteria. All of the studies, even those classified as group designs, had fairly small sample sizes, none of which exceeded 31 students. Although some may contend that smaller sample sizes often give way to more strictly controlled studies as compared with those implemented on a large-scale (e.g., Cheung & Slavin, 2016), there is also more room for statistical error among smaller sample sizes. For example, it is difficult to encompass a sample that is representative of the general population when working with very small numbers, simply due to the lack of variability within small samples. This lack of variability makes it difficult to generalize any of the findings to a larger population, making the external validity fairly weak (Onwuegbuzie, 2000). Because many of the studies (e.g., Crabtree et al., 2010; Cullen et al., 2014; Ennis, 2016; Jozwik & Douglas, 2016; Saddler et al., 2017) may have met the criterion to be classified an EBP given the presence of additional participants with or at risk of ADHD and three demonstrations of an effect, we could only identify DI as a potential EBP for these students. Future studies utilizing interventions included in this review (e.g., computer-based instruction, SRSD + TWA + PLANS, GO FASTER) with rigorous study design and a minimum of three students with or at risk of ADHD (if using a single-case design) are necessary to document sufficient evidence of EBPs in reading for this population.

In addition, all studies in this synthesis included participants who received special education services and a diagnosis of ADHD at the time of the study, whereas we know a large population of students in the general education setting may also have or be at risk of having ADHD (Rowland et al., 2015). Because these participants are not represented in the current sample, it is difficult to state whether or not the interventions described are as effective for these students.

Due to the lack of studies that included participants in the general education setting, the field may benefit from future studies that seek out these students and investigate similar interventions to see whether they are as effective with students with ADHD who either do not receive special education services or those who receive services in the general education classroom. In addition, rating scales determining whether or not students are at risk of ADHD exist (e.g., Conners 3; Conners, 2008). Many students may exhibit inattentive, hyperactive, or impulsive behaviors as indicated by standardized rating scales without a formal diagnosis of ADHD; therefore, research is needed to support effective reading interventions for these students in all classrooms.

As indicated by the minimal number of group studies included in this synthesis ($n = 2$), more research is needed to explore the group effects of the interventions found to be effective for individual participants in single-case design studies. Large-scale randomized control trials may further

support the use of such interventions providing opportunities to generalize findings to larger populations of students with ADHD.

Finally, none of the included studies investigated the intervention effects on specific ADHD presentations (i.e., hyperactivity, inattentive, combined). Although three studies noted differences in presentation among participants, conclusions were not connected to specific presentations when reporting results. Future research is needed to determine which interventions may be more effective for specific ADHD presentations, particularly those that are strongly associated with lower academic outcomes: inattentive and combined presentations.

Overall, results from this synthesis demonstrate positive effects of reading interventions implemented with students with ADHD served in special education settings. These findings are important, as students with or at risk of ADHD often demonstrate lower reading outcomes than their typically developing peers. Quite possibly the most compelling finding in this review is the lack of studies focusing on reading interventions as well as the lack of EBPs documented to improve reading outcomes for this population. Identifying interventions to remediate reading difficulties in this population may have a positive impact on the reading and life outcomes of students with or at risk of ADHD.

Conclusion

Although findings in this review contribute to the evidence base of instructional practices that may be effective for students with ADHD, no interventions met criteria outlined by the CEC to be classified as EBPs for these students. However, these studies provide evidence of positive intervention effects for study participants. Findings are encouraging, and they form an initial base of evidence that, through future research, may one day be classified as EBPs. We are aware that despite the lack of EBPs, teachers are obligated to appropriately serve students with or at risk of ADHD in their classrooms. This review documents the findings available thus far, which consists of self-regulated strategy use to generate and compose main idea statements and summaries, explicit instruction utilized in DI lessons, computer-based interventions that include built-in feedback, self-monitoring and goal setting, structured games that involve peer interactions, use of graphic organizers, and presenting text in various ways (e.g., black and white vs. colored font). Although evidence is not fully developed for these practices, initial research demonstrates they hold promise for serving students with or at risk of ADHD.

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