

Review Article

The Promise of Comprehensive Early Reading Instruction for Children With Autism and Recommendations for Future Directions

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Purpose: Children with autism have an increased likelihood of reading difficulties. The reasons for this are numerous and varied, but many children with autism can learn to read when they are provided with evidence-based early reading instruction.

Method: Here, we provide an overview of some of the factors that impact early reading development for children with autism and a rationale for the provision of comprehensive early reading instruction consistent with the recommendations of the National Reading Panel (NRP). We discuss research on NRP instruction for children with autism, including some of our own empirical studies. We also discuss some areas of research that were not emphasized by the NRP but that we view as important. We offer recommendations that extend beyond NRP guidelines in order to advance knowledge and improve practice.

Conclusions: Comprehensive early reading instruction holds great promise for children with autism, but there are gaps in our understanding that need to be addressed. These include the most effective method(s) for tailoring reading instruction to the needs of the individual while optimizing delivery to small groups of children, supporting skills and making other accommodations not outlined by the NRP, and consideration of bilingualism and of reading instruction in languages other than English, among other issues. While our focus in this review article is early reading instruction for children with autism who use oral language, we acknowledge that there is a major gap in the literature concerning reading instruction for those who do not use oral language. We hope that this review article will be helpful to clinicians, educators, and researchers alike, as well as children with autism and their families, friends, and support networks.

Autism spectrum disorder (ASD) is an early-onset neurodevelopmental disorder characterized by social communication deficits and restricted, repetitive patterns of behavior or interests (American Psychiatric Association, 2013). Although we use the terms *autism spectrum disorder* and *ASD* when discussing diagnosis, we have chosen to use the term *children with autism* rather than *children with autism spectrum disorder* or *children with ASD* throughout most of this review article.¹ Beyond these core diagnostic characteristics, the clinical presentation of ASD is highly heterogeneous, although delays in oral language

development are common and approximately 30% of children go on to develop only minimal verbal communication skills² (Anderson et al., 2007; Kasari et al., 2013). Limitations in social communication and oral language development as well as other common comorbidities, including challenging behaviors and intellectual disability, have the potential

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¹There is much discussion in the disability community, as well as in the autism community, about terminology preferences. For example, a study of 3,470 U.K. residents explored preferences for terminology associated with autism (Kenny et al., 2016). Much of the discussion has centered on person-first versus identity-first language. We adhere to the view that it is best to refer to people by the terms they prefer (Shakespeare, 2017). As such, we had wanted to use terms such as *children with autism* and *autistic children* interchangeably throughout our review article in order to accommodate a range of preferences. However, we have been asked to adhere to this journal's requirement that only person-first language be used.

²Children with minimal verbal communication skills are those with a very small repertoire of spoken words or phrases that are used in a limited range of contexts to communicate a limited range of functions.

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to constrain academic participation and achievement for some children with autism (Jones et al., 2009; Randi et al., 2010). With an estimated 1% of children worldwide diagnosed with ASD and the potential for growing numbers due to underdiagnosis of girls,³ there is a pressing need to identify effective methods for improving educational outcomes for this population (Australian Bureau of Statistics, 2018; Baxter et al., 2015; Christensen et al., 2016; Elsabbagh et al., 2012; Kirkovski et al., 2013). It is well known that reading skills are linked with educational and other life outcomes.

Reading can be an area of weakness for some children with autism (Frith & Snowling, 1983; Mawhood et al., 2000; Minsheu et al., 1994; Nation et al., 2006). According to the “simple view of reading,” skilled reading requires the development and coordination of two distinct abilities: decoding and listening comprehension (Gough & Tunmer, 1986). This model captures the well-accepted fact that reading ability is underpinned by multiple componential skills. Many early studies of reading and autism focused on hyperlexia or precocious reading, where decoding skills seemed more advanced relative to comprehension skills or broader intellectual functioning (Burd & Kerbeshian, 1985; Calhoun, 2001; Grigorenko et al., 2003; Huemer & Mann, 2010; Lanter & Watson, 2008; Newman et al., 2007). However, more recent studies have pointed out the discrepancies in definitions of hyperlexia and the great variability seen in both the decoding and comprehension skills of children with autism (Arciuli et al., 2013; Norbury & Nation, 2011; Tong et al., 2019). As such, the topic of hyperlexia is less of a focus in the autism literature than it once was.

More recent research has focused on confirming that similar skill sets contribute to successful reading in children with and without autism (e.g., Dynia et al., 2017; Jacobs & Richdale, 2013; McIntyre et al., 2017; Nash & Arciuli, 2016; Ricketts et al., 2013). However, at least some of the reading difficulties experienced by children with autism can be attributed to more distal factors, including the nature of children’s literacy experiences and the type and quality of reading instruction. For example, school-aged children with autism have been found to engage in relatively brief shared-reading experiences in the home environment relative to their typically developing peers (Lucas & Norbury, 2018). Importantly, teachers and clinicians do not always employ research-based reading instruction methods when working with children with autism (Accardo & Finnegan, 2019). This may be due, in part, to a tendency for children with autism to be underestimated in terms of their ability to learn how to read and ties in with pseudoscientific theories about the underlying causes and effective treatment of reading difficulties (Griffiths et al., 2016; Mirenda, 2003; Wheldall & Beaman, 2000).

Similarities in the skills underlying reading for children with and without autism have prompted researchers to investigate whether children with autism can benefit from

the same kind of evidence-based reading instruction that is helpful for any beginning, at-risk, or low-progress reader. There has been a great deal of attention paid to instruction for children in the beginning stages of conventional reading development consistent with the recommendations of the National Reading Panel (NRP) from the United States (National Institute of Child Health and Human Development, 2000) and other national reviews in the United Kingdom (Rose, 2006) and Australia (Rowe, 2006).

NRP Instruction

The recommendations of the NRP are based on a large-scale meta-analysis of research on effective reading instruction. Although the NRP review was published almost 2 decades ago, it continues to play a key role in informing contemporary reading instruction policy and practice (Snow, 2016). According to the NRP review, effective early reading instruction includes five elements known as the “Big Five”: phonemic awareness, phonics, vocabulary, reading fluency, and reading comprehension. *Phonemic awareness* refers to the awareness of and ability to segment and manipulate sounds in spoken language. *Phonics* is the understanding of relationships between letters and sounds as well as the ways in which letters can be combined to form words. *Vocabulary* is the understanding of word meaning, and *reading fluency* is the ability to read at speed with accuracy and appropriate expression. *Reading comprehension* refers to a specific set of skills and strategies that allow a person to derive meaning from text, including comprehension monitoring, summarization and question-answering and question-generation skills, and use of graphic and semantic organizers. Comprehensive instruction encompassing all five skills is considered best practice when working with people in the beginning stages of conventional reading development.

Each of the NRP Big Five components was investigated separately by different subcommittees in the 2000 meta-analysis. The subcommittees varied in their inclusion of research involving children with disabilities and instruction conducted in languages other than English. The phonemic awareness and phonics subcommittees considered research involving children described as “normally progressing” and “disabled” readers (i.e., those with delayed reading development). Gains were reported for readers in both groups; however, effect sizes tended to be larger for younger (pre-K–Grade 1) normally progressing children as compared to the older (Grades 2–6) reading-disabled children. The reading fluency subcommittee also considered groups of “normal” and “poor” readers. Fluency instruction was found to improve reading outcomes for typically developing children (Grades 2–4) and children with poor reading skills (Grades 2–9), with similar effect sizes noted for both groups ($d = 0.47$; $d = 0.49$). The vocabulary and reading comprehension subcommittees did not consider research involving students with disabilities but did acknowledge that a student’s age, reading level, learning ability, proficiency in English, and other characteristics may affect success in

³Autism is thought to affect more boys than girls at a ratio of approximately 4:1 (Fombonne, 2009).

vocabulary and comprehension instruction. With regard to research conducted in languages other than English, phonemic awareness instruction was found to assist children learning to read in English and other alphabetic scripts, including Dutch, Finnish, German, Norwegian, Spanish, and Swedish. The subcommittees which investigated the other Big Five reading skills did not separately report instruction outcomes for children learning to read in languages other than English.

While the NRP meta-analysis reported gains for children with disabilities more generally, it is important to acknowledge that none of the NRP subcommittees reported findings specific to children with autism. Such omissions have helped fuel ongoing debate about which methods of reading instruction may be most effective for children in this population. Some in the field have suggested that alternative forms of reading instruction, which capitalize on the supposed strengths of children with autism (e.g., “visual” approaches), may be beneficial (Broun, 2004). However, there is growing evidence that instruction methods consistent with the recommendations of the NRP are effective for all children, including those with autism.

NRP Instruction for Children With Autism

A previous systematic review by Whalon et al. (2009) investigated reading instruction targeting the Big Five specifically for children with autism. The review, which included 11 studies published between 1976 and 2008, found that reading instruction targeting any of the Big Five can be effective for children with autism. However, studies were limited by the inclusion of small samples (one to 20 participants). In addition, some outcome measures only assessed reading-related outcomes, such as vocabulary or phonemic awareness, as opposed to direct measures of reading such as reading fluency or comprehension. Most studies included in the review investigated instruction focused on only one of the Big Five: phonics (Coleman-Martin et al., 2005), vocabulary (Dugan et al., 1995; Kamps et al., 1995), or reading comprehension strategies (O'Connor & Klein, 2004; Whalon & Hanline, 2008). Two studies investigated combined reading fluency and comprehension instruction delivered in cooperative groups (Kamps et al., 1994, 1989). It is a little unclear how the remaining studies, which happen to be conducted in Spanish and Swedish, relate to the NRP recommendations (Basil & Reyes, 2003; Heimann et al., 1995; Rosenbaum & Breiling, 1976; Tjus et al., 1998). Critically, none of the included studies investigated comprehensive reading instruction targeting all Big Five elements.

We conducted an updated systematic review of reading instruction for children with autism targeting the Big Five for the period 2009–2017 (B. Bailey & Arciuli, 2019). A search of the literature identified 10,779 relevant studies, of which 19 met inclusion criteria. The included studies reported on the efficacy of reading instruction targeting one or multiple Big Five skills for children with autism between the ages of 3 and 15 years. Samples in these studies

ranged in size from two to 64 participants and tended to include children representing one specific subgroup, such as “high-functioning” children⁴ (e.g., Barnes & Rehfeldt, 2013). Very few studies involved diverse samples representative of the highly heterogeneous autism population.

Studies included in our recent systematic review showed that reading instruction targeting one or more of the Big Five elements was effective for children with autism. It is worth noting here that the terms *code-based instruction* (phonemic awareness, alphabets, fluency, and phonics) and *meaning-based instruction* (vocabulary and comprehension) are sometimes used in the literature. The studies on code-based instruction tended to utilize small samples of children ($N < 10$) who had limited verbal communication skills and were in the early stages of learning to read (3–5 years of age; Benedek-Wood et al., 2016; Johnston et al., 2009) or who were older and had delayed reading development (11–15 years of age; Ainsworth et al., 2016; R. L. Bailey et al., 2011; Leytham et al., 2015). Results from these studies provide preliminary evidence that code-based instruction can be effective in improving early decoding skills for children with autism, including those who have limited verbal abilities and learning difficulties. The studies on meaning-based instruction focused on children with at least some basic word reading skills. For example, in one study with a relatively large sample, Turner et al. (2017) investigated the efficacy of an adapted version of the reciprocal teaching instruction program, which encourages the use of prediction, question-answering, and question-generation strategies in the context of group-based learning activities with 29 children with autism aged 11–15 years. Results for this study showed statistically significant improvements in reading comprehension for children who received reciprocal teaching instruction as compared to children in a control group, with a medium-to-large effect size ($r = .49$). Together, these studies demonstrate that code- and meaning-based NRP instruction can be effective in improving some aspects of reading for children with autism.⁴

Three studies included in our review evaluated comprehensive reading instruction targeting all Big Five elements (B. Bailey et al., 2017b; Grindle et al., 2013; Whitcomb et al., 2011). Kamps et al. (2016) investigated the Reading Mastery curriculum for English, which targets phonemic awareness, phonics, reading fluency, and comprehension skills but does not explicitly target vocabulary. In all three studies of comprehensive instruction, learning activities were delivered via computer-assisted programs. B. Bailey et al. (2017b) utilized the freely available ABRACADABRA, hereafter referred to as ABRA, program (Centre for the Study of Learning and Performance, 2009). Whitcomb et al. (2011) used the commercially available Headsprout program, which was later rebranded as MimioSprout Early

⁴The terms *high-functioning* and *higher-functioning* are used throughout much of the literature to describe children with autism whose daily living and/or cognitive skills are within the normal range. Others have used these terms without providing definitions.

Reading and was also used in the study of Grindle et al. (2013; see Learning A–Z, 2013). These three studies showed that comprehensive evidence-based instruction facilitated improvements in both the code-based (decoding) and meaning-based (reading comprehension) skills of children with autism.

A novel aspect of our systematic review was our use of the Evaluative Method for Determining Evidence-Based Practices in Autism (hereafter referred to as Evaluative Method) framework to determine the strength of the evidence in relation to each of the included studies (Reichow et al., 2008). We chose this framework over other evaluative methods, such as that proposed by the Scottish Intercollegiate Guidelines Network (2007), as it emphasizes quality indicators specific to research involving children with autism. This includes the importance of confirming children’s ASD diagnosis using acceptable methods of assessment, among other issues. Table 1 provides an overview of the research quality indicators in the Evaluative Method framework for group and single-subject design studies. Primary quality indicators (i.e., those elements thought to be essential in methodologically rigorous research) are shown first, followed by secondary quality indicators (i.e., features that are also important but not critical to research design).

According to this Evaluative Method framework (Reichow et al., 2008), of all the studies on comprehensive instruction methods, our own initial investigation of one-to-one instruction using the ABRA program was the only study to achieve a quality rating of “adequate” and included the largest sample ($N = 20$; B. Bailey et al., 2017b). This study

would have achieved a higher quality rating if participants’ autism diagnoses had been confirmed, if control conditions were more completely described, if measures of reading outcomes were obtained via blind ratings, and if participants had been randomly assigned to intervention and control groups. The other studies on comprehensive instruction methods were rated as lower in quality according to the Evaluative Method framework.

Comprehensive Reading Instruction Using ABRA

ABRA (Centre for the Study of Learning and Performance, 2009) is designed to improve early reading skills in English through of game-based activities targeting the Big Five. It incorporates reading activities and some spelling activities as well as complying with current recommendations regarding technology-based reading instruction for beginning and at-risk learners (Cheung et al., 2016; Lysenko & Abrami, 2014). Rather than being a fully self-directed and stand-alone program, ABRA is intended as a teaching resource to be used in conjunction with other noncomputerized materials found in any classroom (e.g., alphabet puzzles and books). There is no set “dosage” for administration of ABRA. Rather, administration of ABRA requires a trained facilitator who can assess the child’s existing skills and work with knowledge of the ABRA program to develop appropriate learning objectives, identify appropriate learning activities, and monitor children’s ongoing reading development. Guidelines for developing learning objectives and

Table 1. Evaluative Method for Determining Evidence-Based Practices in Autism quality indicators (Reichow et al., 2008).

Primary quality indicators	Secondary quality indicators
Group designs <ul style="list-style-type: none"> Participant characteristics—complete participant information (age, gender, and diagnosis) Independent variable—treatment described with replicable precision Dependent variable—measures described with replicable precision Comparison condition—comparison condition(s) described with replicable precision Link between research question and statistical analysis—analyses strongly reflect the research question(s) Statistical analysis—appropriate, adequately powered analyses Single-subject designs <ul style="list-style-type: none"> Participant characteristics—as above Independent variable—as above Dependent variable—as above Baseline condition—operationally defined, encompassed three measurement points and stable visual analysis with no positive or negative trend Visual analysis—stable visual analysis with < 25% overlap of data and a large shift in performance across adjacent conditions Experimental control—three demonstrations of experimental effect across three points in time 	<ul style="list-style-type: none"> Random assignment Blind raters Interobserver agreement Fidelity Attrition Generalization or maintenance Effect size Social validity Interobserver agreement Blind raters Kappa Fidelity Generalization or maintenance Social validity

Note. Primary quality indicators are rated as high, acceptable, or unacceptable. Secondary indicators are considered evident or not. Group design studies with all primary quality indicators rated as high and evidence of at least four secondary indicators are considered high quality overall. Group studies with four or more high primary indicators rated and evidence of two secondary indicators are of adequate quality. Group studies with fewer than four primary or two secondary indicators are of weak quality. Single-subject design studies with all high primary quality indicators and evidence of at least three secondary indicators are of high quality. Single-subject studies with four high primary indicators and evidence of two secondary indicators are of adequate quality. Single-subject studies with fewer than four primary or two secondary indicators are of weak quality.

the implementation of the ABRA activities can be found in the ABRA manual (Abrami et al., 2010). To date, our own research has investigated the use of ABRA in one-to-one and small-group instruction.

One-to-One ABRA Instruction

In the first study of its kind, we demonstrated the efficacy of ABRA for enhancing reading skills in children with autism when the program was delivered individually to participants in their homes by a trained ABRA facilitator. As reported by B. Bailey et al. (2017b), an instruction group received 26 hr of ABRA instruction over a 13-week period, whereas children in a control group received “business as usual” reading instruction. ABRA was delivered outside of school hours. Participants were children with autism aged 5–12 years. To be included in the study, participants were required to have a formal clinical diagnosis of ASD, have no hearing or vision impairments, have measurable oral language skills, and be able to demonstrate sustained attention to tasks for 15 min. Baseline measures showed that participants varied widely in their oral language and broader adaptive abilities. Intervention outcomes were evaluated using standardized measures independent of the ABRA program. These included the Word Reading subtest of the Wide Range Achievement Test–Fourth Edition (Wilkinson & Robertson, 2006), which assessed word-level reading accuracy, and the Neale Analysis of Reading Ability–Third Edition (Neale, 1999), which assessed passage-level reading accuracy and comprehension. We conducted analyses using 2 (time: pre- vs. post-instruction) \times 2 (group: instruction vs. control) analyses of variance (ANOVAs). Analyses were reported in the article. Additional analyses of raw scores from the standardized reading measures showed statistically significant interactions between time and group, with essentially the same large effect sizes for word reading accuracy ($\eta^2 = .41$, 90% CI [.11, .59]) and passage reading accuracy ($\eta^2 = .41$, 90% CI [.11, .59]) as well as a similarly large effect size for passage reading comprehension ($\eta^2 = .32$, 90% CI [.05, .53]). These results suggest that ABRA facilitates generalized gains in reading accuracy and comprehension for children with autism when administered on a one-to-one basis.

Interestingly, reading instruction using ABRA also had some effect on children’s spelling skills. Spelling data from the same study as B. Bailey et al. (2017b) were the focus of a second paper (B. Bailey et al., 2017a). Here, we explored the effects of ABRA instruction on children’s spelling abilities, first using a measure of conventional spelling accuracy and then using two separate measures derived using the Computerized Spelling Sensitivity System (CSSS; Masterson & Hrbec, 2011). Using the CSSS, correct and incorrect spelling attempts were segmented into elements (i.e., letters representing either a phoneme or a morpheme), with each element awarded a score from 0 to 3 based on the level of phonological, orthographic, and morphological information that was encoded. Conventionally accurate elements comprising a correctly spelled word were

awarded a score of 3. Orthographically legal elements that encode the correct phoneme but not using a conventionally accurate letter or letter combination were awarded a score of 2 (e.g., “toock” for “took”). Orthographically illegal elements attracted a score of 1 (e.g., “toot” for “took”), and omitted elements were scored 0 (e.g., “too” for “took”); see Table 2 for additional examples). Element scores were used to calculate two measures of linguistic spelling ability: (a) Spelling Sensitivity Score–Elements or the overall average element score and (b) Spelling Sensitivity Score–Words or the average score based on the lowest scoring element in each spelling attempt.

We again conducted a series of 2 (time: pre- vs. post-instruction) \times 2 (group: instruction vs. control) ANOVAs, this time to investigate children’s spelling outcomes. Our analysis of conventional spelling accuracy scores did not show any statistically significant improvements for the instruction group relative to the control group. However, our analyses using the linguistic spelling ability measures showed that participants in the instruction group did improve in their ability to encode linguistic information in their spelling attempts relative to the control group as a result of the ABRA intervention (Spelling Sensitivity Score–Words: $\eta_p^2 = .20$, 90% CI [.00, .43]; Spelling Sensitivity Score–Elements: $\eta_p^2 = .22$, 90% CI [.00, .44]). The same linguistic abilities measured using the CSSS are thought to support other aspects of literacy, including decoding (Moats, 2019). Thus, improvements in CSSS scores suggest that ABRA was effective in improving the linguistic abilities underlying multiple aspects of literacy for children with autism.

It is noteworthy that the vast majority of work in the area of literacy and autism has examined decoding and other reading skills. Far fewer studies have examined encoding (i.e., spelling) and writing skills. Clearly, encoding and broader writing skills are important for reciprocal communication in text-based mediums and functional literacy. For example, many social media tools rely on text-based communication, and several studies indicate that individuals with autism use these tools enthusiastically and can become proficient users (e.g., Mazurek, 2013; van der Aa et al., 2016; van Schalkwyk et al., 2017; Ward et al., 2018). We recommend that researchers, educators, and clinicians incorporate spelling and writing activities when delivering literacy instruction for children with autism.

A number of studies have provided one-to-one instruction (B. Bailey et al., 2017a, 2017b; Grindle et al., 2013; Whitcomb et al., 2011). While valuable in supporting the academic development of children with autism, one-to-one instruction has limitations. From a practical standpoint, one-to-one instruction can be expensive and difficult to accommodate in traditional educational settings. Also, it can have the effect of minimizing children’s opportunities to participate in social aspects of schooling, such as working as a group and getting along with others. It is advantageous if children with autism, and all children, can be taught to read in group settings (Watkins et al., 2015). An example of group-based instruction is the study by Kamps et al.

Table 2. Additional Spelling Sensitivity Score segmentation and scoring examples.

Target	Segmentation	Example attempt	Element scores	SSS-E	SSS-W
run	r-u-n	r-u-n	3-3-3	3	3
beach	b-ea-ch	b-ee-ch	3-2-3	2.67	2
rust	r-u-s-t	r-u-s-p	3-3-3-1	2.5	1
swim	s-w-i-m	-w-i-m	0-3-3-3	2.25	0
flipped	f-l-i-p-p-ed	f-l-i-p-p-ed	3-3-3-3-3-3	3	3
swimming	s-w-i-m-m-ing	s-w-i-m-#-ing	3-3-3-3-0-3	2.5	0

Note. # denotes an omitted element. SSS-E = Spelling Sensitivity Score–Elements; SSS-W = Spelling Sensitivity Score–Words.

(2016). Another example is our study of ABRA delivered in small groups in a school setting.

Group ABRA Instruction

There is a growing body of research showing that group-based ABRA can be effective, although most of these studies have focused on children without autism. Some of this research is summarized in a review by Abrami et al. (2015), which included studies of English reading instruction for typically developing children in Canada, Singapore, Kenya, and Australia’s Northern Territory. These promising findings and the fact that ABRA is freely available have given rise to a great deal of research interest in the program. Recently, U.K. researchers have undertaken a large-scale project, funded by the Education Endowment Foundation, which assessed the efficacy of group-based ABRA delivered in schools for mostly typically developing children (15% of participants described as having special educational needs). In Phase 1 of the project, ABRA was administered in 50 schools across England. Results showed that children who received ABRA instruction advanced in their literacy development by several months compared to children who received “business as usual” reading instruction (McNally et al., 2016). Gains were most evident for children from low socioeconomic backgrounds (20% of participants). There was no consideration of the potential uses of ABRA specifically for children with autism in this Education Endowment Foundation–funded research.

We conducted the first ever study of group-based ABRA for children with autism—delivered in a school setting—and found some promising results but also identified key challenges (Arciuli & Bailey, 2019). That study included 23 children aged 5–12 years. As in our earlier ABRA research, inclusion criteria included a formal clinical diagnosis of ASD, no hearing or vision impairments, measurable language ability, and the ability to demonstrate sustained attention to tasks for 15 min. In addition, participants were required to be able to say the name or sound associated with at least one letter of the alphabet. As in our earlier one-to-one ABRA research, baseline measures showed that participants varied from upper to lower extremes on measures of oral language and broader adaptive abilities. Children in an instruction group received a minimum of 20 hr of ABRA instruction over 9 weeks during school hours in place

of their regular literacy lessons (duration limited to fit within a single term at the request of the school).⁵ ABRA instruction was delivered in small groups by teachers at the school who had been trained to administer the program. An ABRA facilitator, external to the school, was on-site during all ABRA instruction sessions to assist both teachers and students. A control group received “business as usual” reading instruction.

Intervention outcomes were assessed using the same measures of generalized word- and passage-level reading accuracy and comprehension as in our original ABRA study. As in our earlier study, results of 2 (time: pre- vs. post-instruction) × 2 (group: instruction vs. control) ANOVAs showed that children who received ABRA instruction achieved statistically significant gains by comparison with a control group. Analysis of raw scores revealed statistically significant interactions between time and group, with large effect sizes for word reading accuracy ($\eta_p^2 = .30$, 90% CI [.06, .50]) and passage reading accuracy ($\eta_p^2 = .18$, 90% CI [.00, .39]). However, unlike the earlier study, we found no statistically significant interaction, and only a small effect size, for passage reading comprehension ($\eta_p^2 = .08$, 90% CI [.00, .29]). These results suggest that, while effect sizes are reduced by comparison with one-to-one ABRA instruction, group-based ABRA is associated with improved reading accuracy for children with autism. Our finding of a lack of improvement in reading comprehension during group-based ABRA needs to be further investigated.

It is noteworthy that participants in many of our own studies, like other studies that have been conducted with individuals with autism to date, were all boys. In the case of our group-based ABRA study, this was because most of the participants in the school for children with autism that we collaborated with were boys, and every family that consented to taking part included a male child with autism. The NRP guidelines do not make recommendations based on gender. However, some research suggests that there may be gender differences in the social communication skills of children with autism (e.g., Dean et al., 2017). As discussed later in this review article, it is thought that children’s social skills play a role during reading instruction. The possible effects

⁵There are currently no formal guidelines regarding how long ABRA should be used. In our two published studies, participants received either 20 hr of ABRA instruction over 9 weeks or 26 hr of ABRA instruction over 13 weeks.

of gender during ABRA instruction, or any other type of comprehensive NRP-guided instruction program, should be addressed in future research with children with autism. We anticipate that we will start to see more gender diversity in all studies conducted with people with autism, not just those concerned with reading, as a result of increasing awareness of underdiagnosis of girls with autism and the reasons for that underdiagnosis.

How Should We Tailor Comprehensive Reading Instruction?

Generally speaking, instruction should be individualized in line with profiles of weaknesses, strengths, and interests in children with autism in order to be optimally effective (e.g., Trembath & Vivanti, 2014). In the case of reading instruction, for instance, foundational phonemic awareness and phonics skills should be targeted as a matter of priority for children with autism who have very limited decoding skills, although opportunities to develop reading comprehension, vocabulary, and fluency skills should also be made available to each individual at some point and tailored (e.g., questions in reading comprehension activities could be tailored to match children’s oral language abilities). The potential for customizability is a key strength of the ABRA program. ABRA includes 32 learning activities organized into four modules that broadly reflect the NRP Big Five: alphabetics (phonemic awareness and phonics), reading fluency, reading comprehension (including vocabulary), and writing. Examples of some of the ABRA activities are presented by module in Table 3. Each module

offers a range of learning activities targeting specific aspects of the NRP domains, with many including customizable difficulty levels. For example, the ABRA alphabetics module contains a series of phonemic awareness activities used to target skills including phoneme matching, word segmentation, and word blending. Word length can be adjusted for these latter two activities, meaning that they can be made suitable for children with an emerging ability to segment and blend words to those with more advanced skills.

ABRA is also designed to capitalize on children’s strengths and interests. For example, passage-level reading activities involve reading materials from ABRA’s 35 full-length stories. These stories represent a wide range of topics and genres and include 15 books with Canadian, Australian, and Kenyan accented narration (all in English). Stories feature a diverse cast of male and female protagonists as well as a mix of historical and fictional settings. This feature enables the user to tailor instruction activities for the individual in line with well-known topics, or perhaps recently taught topics.

Accommodating interests is important when working with any child but is perhaps most important for children with autism—who have restricted interests. A systematic review by Ninci et al. (2018) identified 20 studies on the effects of embedded preservative interests on social communication skills and task completion for 79 children with autism. One study included in the review focused on reading comprehension (El Zein et al., 2014). This study was found to meet quality design standards using the What Works Clearinghouse Standards for Single-Case Design and Evidence (Kratochwill et al., 2010, 2013) and presented the case

Table 3. Example ABRA activities by module.

Module Example activity	Description
Alphabetics (<i>n</i> = 17)	
Alphabet song	Sign along to the alphabet song with or without the computer
Same phoneme	Label pairs of phonemes as same or different
Word matching	Match words with the same beginning or ending phonemes
Letter–sound search	Find the letter corresponding to a sound from the computer
Auditory blending	Blend sounds from the computer to form a whole word
Basic decoding	“Sound out” written words and match them to pictures
Reading fluency (<i>n</i> = 6)	
High-frequency words	Read high-frequency words before the timer runs out
Reading with expression	Take turns reading text with correct and incorrect expressions
Accuracy	Get feedback on any reading mistakes and try them again
Speed reading	Get feedback on whether you are reading too fast or too slow
Reading comprehension (<i>n</i> = 7)	
Prediction	Predict what is coming next in the story
Sequencing	After reading, place story events in the correct order
Vocabulary	Match words to the correct definitions
Story response	Answer open-ended questions about the story
Story elements	Answer questions about key events in the story
Writing (<i>n</i> = 2)	
Spelling words	Type regular and irregular words using the keyboard
Spelling sentences	Type sentences as dictated by the computer

Note. Data in parentheses are the number of activities in each module. ABRA = ABRACADABRA program.

of Jim, an 8-year-old boy with autism and reading comprehension difficulties who was interested in cars. Stories were adapted to include cars (e.g., changing the main character in a story from a fox to a car). Descriptive stats showed that Jim's ability to answer reading comprehension questions relating to adapted car texts was higher than baseline (i.e., when reading texts without mention of cars). Jim also produced more expansive retells in the adapted-text condition as compared to baseline. In another study not included in the review, Mancil and Pearl (2008) presented the case of Denise, a girl with autism in the second grade who was enthralled with Thomas the Train. Denise's teacher embedded Thomas the Train into her school curriculum (e.g., using images of Thomas the Train to teach subtraction), including reading instruction. At baseline, Denise would take a long time to complete readings and be unable to recall any information. With Thomas the Train embedded, her teacher reported that reading activities were completed much faster, with improved fluency and comprehension. Such findings provide preliminary support for the use of perseverative interests as a means of supporting reading motivation and comprehension for children with autism, perhaps especially important during the initial stages of learning to read.

Important Considerations Beyond the Big Five

It is worth noting that the NRP did make some recommendations that extended beyond the Big Five. One relevant recommendation is for the use of cooperative learning groups to aid reading comprehension development. Here, cooperative learning is defined as any pattern of classroom organization that allows students to work together to achieve their individual goals (Harris & Hodges, 1995). Cooperative learning reading comprehension activities involve children working in groups, listening to their peers as they read, and helping one another to use strategies shown to promote reading comprehension. The NRP found 10 studies on cooperative learning involving children aged 3–6 years. These studies found that reading comprehension strategies could be effectively learned in cooperative activities. Three studies found significant improvements in reading comprehension as measured by standardized tests. These studies did not involve children with autism, but peer-mediated interventions have been shown to be effective for promoting reading comprehension for children with autism elsewhere (Kamps et al., 1994, 1995; Whalon et al., 2009).

Several studies, including some of our own, have indicated that skills beyond the Big Five might assist children with autism in their reading development. Modeling by Ricketts et al. (2013) based on the “simple view of reading” (Hoover & Gough, 1990) has shown that social behaviors, measured using the Autism Diagnostic Observation Schedule—Generic (Lord et al., 2000), and social cognition, measured using the Strange Stories test (Happé, 1994), contribute to reading comprehension over and above decoding and listening comprehension skills in children with

autism. This is consistent with more recent modeling by McIntyre et al. (2018), which showed that social cognition predicts unique variance in the reading comprehension skills of children with autism after controlling for IQ, decoding, and oral language. Furthermore, children with autism have been found to have greater difficulties comprehending texts requiring greater social cognition relative to other less socially demanding texts (Brown et al., 2013).

Beyond studies of children with autism, there seems to be a growing consensus that social skills play a role in reading acquisition, especially when instruction is delivered in groups. For example, deficits in social skills have been linked to decreased task engagement and poorer reading learning outcomes for preschool children with disruptive behavior problems (Vitiello & Williford, 2016). Associations between social skills and reading achievement have been shown to continue over the beginning years of formal education in research involving children from lower socioeconomic backgrounds (Miles & Stipek, 2006) and children with mixed socioeconomic backgrounds (Sparapani et al., 2018). Furthermore, there is preliminary evidence that integrated social-emotional and reading instruction may enhance reading outcomes for children at risk of emotional and behavioral disorders (Daunic et al., 2013).

Thus, the focus on social skills in research involving children with autism arises from several factors: (a) social communication deficits are a diagnostic feature of ASD; (b) certain aspects of reading such as reading comprehension draw on social knowledge and experiences; and (c) many reading instruction contexts draw upon social skills such as cooperation, especially in formal educational settings. Of course, social skills can be defined in a number of different ways and encompass a range of skills, including the ability to orient to social stimuli, understand facial expressions, initiate interactions, and appreciate others' points of view.

According to Dore et al. (2018), it has been suggested that theory of mind draws on a range of linguistic, cognitive, and social skills that may affect reading skills. Interestingly, a recent study of 42 children with autism and 55 typically developing children living in Hong Kong showed a link between performance on some theory of mind tasks and performance on some nonliteral reading comprehension tasks involving inference, evaluation, and mentalization (Tong et al., 2019). This study did not conclude that individuals with autism lack theory of mind. Rather, it suggested that tasks designed to tap into theory of mind skills reveal variability in samples of children with and without autism, and such variability may be a contributing factor in variability in reading comprehension. This study is one of the few to explore reading skills in children with autism in a language other than English. Other studies on the reading skills of Chinese children with autism include those by Hao and Layton (2018) and Zhao et al. (2019).

Interdisciplinary teams play an important role in supporting the reading development of children with autism. For example, input from teams including psychologists,

educators, school counselors, occupational therapists, and speech pathologists can be useful in addressing comorbidities that impact participation and literacy learning, including behavior difficulties. The role of speech pathologists in supporting oral language development is particularly important for reading comprehension, as emphasized in the well-accepted “simple view of reading” framework (Hoover & Gough, 1990). In addition to addressing the language difficulties underlying reading development, speech pathologists should be involved in addressing any communication barriers in the classroom and beyond, which impact children’s ability to access literacy learning opportunities. An example is by incorporating the use of visuals or alternative and augmentative communication systems in reading activities.

It is worth noting that a number of previously published reviews have explored other aspects of reading instruction for children with autism. These include the use of computer-assisted instruction (e.g., Grynspan et al., 2014; Knight et al., 2013; Pennington, 2010; Ramdoss et al., 2011; Root et al., 2017) and methods for improving reading comprehension—an area of weakness for many children with autism—that go well beyond those strategies discussed in the report of the NRP (e.g., Chiang & Lin, 2007; El Zein et al., 2014). Others have investigated instruction methods for preschool children with autism (e.g., Fleury & Schwartz, 2017).

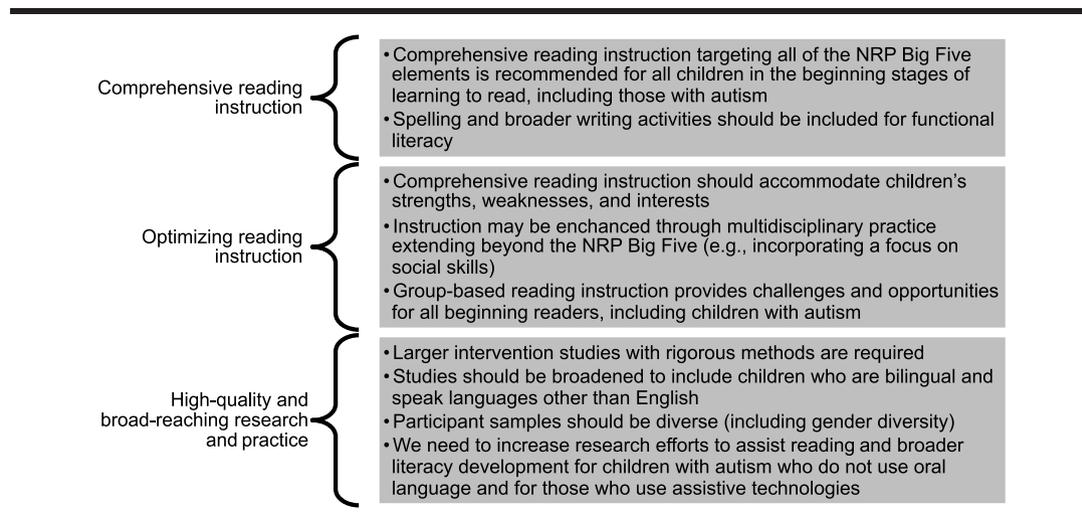
Reading Instruction in Languages Other Than English

In the field of autism research, there are few studies on English reading instruction for bilingual children and even fewer on reading instruction in languages other than English (e.g., Drysdale et al., 2015). The NRP guidelines relate primarily to English-speaking children learning to

read in English. Aside from the phonemic awareness subcommittee, findings in the NRP review are not reported separately for children who are bilingual or biliterate. Bilingualism is an important issue to consider; monolingualism may be considered the exception rather than the rule in a global context. A preliminary study by Vanegas (2019) investigated whether English reading skills varied as a result of monolingualism ($n = 18$ with a mean age of 8.4 years) versus bilingualism ($n = 13$ with a mean age of 7.6 years) in children with autism living in the United States. The bilingual children with autism spoke English in addition to Spanish ($n = 11$), Slovak ($n = 1$), or Italian ($n = 1$). Results revealed that, although there were no differences in IQ, English vocabulary, or broader communication skills, the monolingual children with autism had better word reading skills. The author noted that reading skills can take longer to develop in some bilingual children and that such a difference might not be observed in older children or in a larger, more representative sample of children with autism. Interestingly, there was no statistically significant difference in spelling skills across the two groups. A narrative review of multiple studies, which considered both simultaneous and sequential bilingual learners, concluded that there was little evidence of differences in the language and reading skills of monolinguals with autism versus bilinguals with autism (Bird et al., 2016).

A recent study by Serret et al. (2017) used a game-based approach to improve French reading skills in minimally verbal school-aged children with autism. The serious game, SEMA-TIC, incorporates 100 words and 50 sentences that include these words. All of the target words are between two and 10 letters and are one to four syllables in length, and all are picturable. SEMA-TIC is not comprehensive in that it does not incorporate all of the Big Five. Rather, it focuses primarily on phonics and principles of whole-word association, alphabet knowledge, decoding, and encoding. SEMA-TIC was delivered over 23 weeks

Figure 1. Recommendations summary. NRP = National Reading Panel.



(4 hr per week) to an intervention group ($n = 12$), whereas a control group received no intervention ($n = 13$). Only the intervention group improved in literacy skills, with three of the 12 children developing decoding skills as measured by independent tests administered before and after treatment.

A recent multinational study examined an adult reading comprehension tool, Open Book, in three languages: English, Spanish, and Bulgarian (Cerga-Pashoja et al., 2019). This tool is described as a noncommercial electronic platform used to improve the accessibility of documents for people with autism through various functions, including “detection of language obstacles in the text; adding definition to terms or infrequent (rare) words; adding images in order to aid word visualization; providing options to change text format (e.g., background color, text color); and ‘magnify’ feature...” (p. 2). Open Book is assistive technology rather than a program of comprehensive literacy instruction for beginning readers. However, this study highlights the utility of some general reading aids that have been applied cross-linguistically.

There is a need for increased research effort in the areas of bilingualism, biliteracy, and reading instruction as well as assistive technology in languages other than English, especially with regard to children with developmental disabilities. Autism researchers, as well as clinicians and educators, need to be aware that multilingualism is common in the global context. Our theories and practices must take this into account and extend beyond consideration of reading instruction in English for monolingual speakers of English.

Conclusions

Early research on reading and autism focused on topics such as hyperlexia and whether the subskills underpinning reading abilities are similar across children with and without autism. There is now greater emphasis on effective reading instruction for children with autism.

There is a growing consensus that comprehensive instruction that incorporates the Big Five, as recommended by the NRP, is not only appropriate for children with autism but also effective. Surprisingly few instruction programs, be they commercial products or freely available, have incorporated all of the Big Five elements. Researchers, clinicians, and educators should increase efforts to develop and assess these kinds of programs. In our view, the ABRA program is a fine example of a computer-assisted comprehensive reading instruction program that has shown some promising results in initial small-scale studies with children with autism. Larger studies that follow rigorous methods are required.

Figure 1 for a summary of our overarching recommendations. We recommend that research efforts focus on three main areas: comprehensive reading instruction, optimizing reading instruction, and high-quality and broad-reaching research and practice. We emphasize optimization of group-based delivery in a way that accommodates tailoring of reading instruction to individual children’s needs and interests. We strongly recommend that research efforts be

broadened to include some skills not specifically targeted by the NRP (e.g., social skills), children who are bilingual, and reading instruction in languages other than English. We hope that we will see more gender diversity and greater emphasis on spelling and writing abilities for functional literacy in future studies of literacy instruction for children with autism.

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