Review

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Reading in Autism Spectrum Disorders: A Literature Review

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Key Words
Autism spectrum disorders · Reading · Language · Intervention

Abstract
Objective: To review what the literature says about reading abilities of children on the autism spectrum (autism spectrum disorders, ASD) as well as to assess the results of intervention proposals. The broad ASD diagnosis used in the last decades and the resulting changes in the prevalence of these disorders have led to a relevant increase in the number of children diagnosed with ASD in the school system. The purpose of this review is to identify the different profiles of reading abilities shown by children with ASD described in the recent literature and the results of reported intervention methods. ***Methods:*** A review of the literature was conducted in the Web of Sciences and PubMed databases with the keywords 'autism' AND 'read*' and the filter 2010–2015. All articles published in the last 5 years focusing on description of and intervention for reading abilities in individuals with ASD were included. Review articles were excluded. ***Results:*** The selected 58 articles were divided into those that described reading abilities in individuals with ASD (n = 27) and those that reported intervention procedures for reading development (n = 31). ***Conclusions:*** Direct comparisons and associations were prevented due to different inclusion criteria and lack of detailed information about intervention processes. We propose tentative conclusions that should be confirmed by further studies.

Introduction

The increasing number of children with a diagnosis of autism spectrum disorders (ASD) in the school system demands consistent information about the characterization of their reading abilities and the results of different intervention alternatives.

ASD have been the focus of many studies based on several different perspectives. These may vary from genetic and neurologic correlates [1–4] to social and emotional impact [5–7], or educational issues [8, 9], family perspectives [10, 11] and different intervention proposals [12, 13].

The definitions and diagnostic criteria for ASD vary significantly in different studies [14, 15], and therefore the conclusions can hardly be compared or accumulated,

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providing consistent data. The changes in the definition of what should be included within the autism spectrum are just one of the many variations that must be considered [16, 17].

The changes implemented in the DSM-5 classification criteria will probably lead to different groups of individuals receiving the diagnosis of ASD [18, 19]. Therefore, comparing the results of studies conducted before and after these changes may become even more complicated. It can be assumed that the vast majority of the subjects in studies published until 2015 were diagnosed according to the DSM-IV criteria. However, it is virtually impossible to determine a time frame from which all papers refer to subjects diagnosed according to the DSM-5 criteria.

On the other hand, the broad ASD diagnosis used in the last three decades and the resulting changes in the prevalence of these disorders [20, 21] have led to a relevant increase in the number of children diagnosed with ASD in the school system [22].

Regarding reading abilities, studies should describe whether they refer to decoding, such as performance in tasks of word recognition performance, or in a broader sense to word reading comprehension [23]. Children with ASD are often characterized as showing precocious word reading abilities [24], but even though these children may have good decoding skills, comprehension is impaired in most cases.

Considering these aspects, it is relevant to know, at this point, what the recent literature describes about reading abilities in children with ASD and the intervention approaches proposed to improve such skills. Therefore, a literature review was performed with the purpose to address the questions: 'do children with autism have specific reading impairments?' and 'do interventions with focus on reading abilities of children with autism have positive results?'.

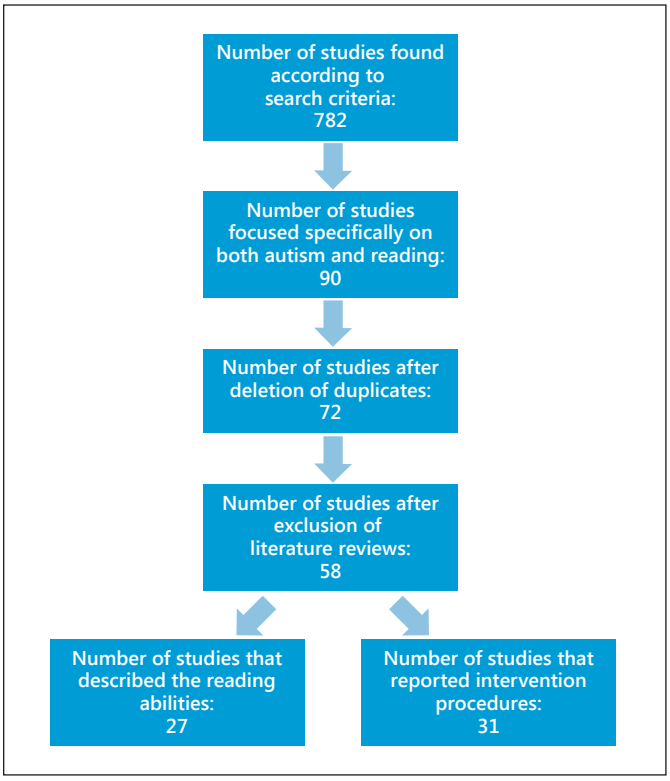

Fig. 1. Search and selection process.

Objectives

The purpose of this review was to identify the different profiles of reading abilities of children with ASD and the results of different intervention methods reported in the literature.

Search Strategy

A review of the literature was conducted to answer the questions stated above. The Web of Sciences (WoS) and PubMed (PM) databases were searched with the keywords 'autism' AND 'read*' with the filter 2010–2015.

Inclusion criteria were: articles published in the last 5 years in peer-reviewed journals indexed in WoS and PM databases with the focus on a description of reading abilities and intervention with individuals with ASD. Review articles were excluded.

In order to obtain an overview of the available information about the characterization of reading abilities and intervention proposals no further criteria were applied in the selection of the reviewed papers.

Results

The first search resulted in 782 articles; 604 in WoS and 178 in PM. The initial analysis aimed to determine which of them focused specifically on both autism and reading. This process resulted in 58 papers in WoS and 32 in PM, a total of 90 articles. They were further analyzed to eliminate duplicates (i.e. articles that were included both in WoS and PM) and publications that did not have enough data; this search resulted in 72 articles that were analyzed according to their content. Among these, 14 articles were reports on literature reviews and were, there-

fore, excluded. The remaining 58 were divided into two categories: (a) those that described the reading abilities of individuals with ASD (n = 27) and (b) those that reported intervention procedures towards reading development (n = 31) (fig. 1). Further inspection of the articles helped specifying the details of each study, number of participants, measures of literacy skills used, and main conclusions. The results are presented in tables 1 and 2.

It can be observed that the number of participants in each study varied significantly. There are several papers describing studies with a relatively large numbers (59% of them report studies with more than 20 participants), some single-case studies (7%), and 4 studies that did not report the number of subjects (14%). Only 11% of 27 articles described studies with adults.

Regarding the type of measures used to evaluate literacy skills, most studies (44%) focused on single-word reading and text comprehension measures, some (29%) assessed cognitive abilities that are related to reading such as memory and oral language skills, whereas only 2 studies investigated spelling skills in this specific population.

Although the inclusion criteria for the participants in each study are not equivalent across the different papers, thus preventing a true meta-analysis, some tentative conclusions can be drawn.

- Performance in single-word reading tasks is better than reading comprehension.
- The oral language level is associated with reading comprehension.
- Persons with ASD have difficulties with reading comprehension despite eventually good or intact decoding skills.
- There is no confirmation of the weak central coherence hypothesis; it seems that the lack of association between meaning and word recognition is based on other factors.
- Nonverbal social and cognitive abilities are associated with reading comprehension and reading performance.
- Phonological processing seems to be less associated with reading comprehension performance than semantics and syntactic knowledge.

Contrary to what could be observed in articles describing reading abilities of persons with ASD, most of the papers describing intervention procedures had a small number of subjects [22 papers (70%) had 6 participants or less]. In total, these papers reported on 62 children and 5 adults. Six articles reported interventions with more than 18 participants, leading to a total of 143 children in these larger-number studies.

The intervention procedures described can be divided in two groups: those aiming to improve single-word reading and those directed to reading comprehension. Behavioral techniques are the basis for the strategies used in studies that focused on improving single-word reading. The conclusions of these articles imply that not all progress was generalized or maintained after the end of the training programs. The papers reporting programs for enhancing reading comprehension describe different approaches such as computer-assisted instruction, direct instruction, talking about a book, graphic organizers, story maps and prompting. Generalization to other abilities and stability of improvement were reported by these studies.

Three other articles refer to suggestions of intervention strategies such as *scaffolding* and the use of software designed to improve reading comprehension. These approaches are described as flexible, allowing one-to-one adaptations.

Conclusion

Characteristics of the reading process of persons with ASD were described in 27 articles that included 1,490 individuals. Direct comparisons and associations are prevented by the different inclusion criteria used in the different studies. However, it is possible to propose some preliminary conclusions that should be confirmed by further studies. Reading comprehension seems to be more associated with semantic and syntactic abilities in oral language than with phonological development. Decoding skills, apparently, are not directly associated with reading comprehension, thus leading to better performance in single-word reading tests than in reading comprehension. Nonverbal social and cognitive abilities seem to be associated with reading comprehension and reading performance, especially in what refers to the association of meaning to a word.

Intervention proposals regarding reading abilities of persons with ASD are reported in 31 articles that refer to a total of 210 subjects, including just 5 adults. Not all studies provide the detailed descriptions of the intervention procedures that would be necessary to make comparisons and associations between them. Very few studies include information about the duration of the intervention and the prior training of the therapists. Therefore, any conclusion about the reasons for the reported results would be premature. Better and more stable results are described by the articles that report interventions focused towards

Table 1. Articles about reading characteristics of persons with ASD

Authors	Title	Reference	Participants	Conclusions
Au-Yeung SK, Kaakinen JK, Liversedge SP, et al.	Processing written irony in autism spectrum disorder: an eye-movement study	Autism Res 2015, DOI: 10.1002/aur.1490	Adults[a]	Participants with ASD and controls had the same performance while reading ironic nonironic texts. Participants of both groups required more time to read ironic statements.
Wei X, Christiano E, Yu W, et al.	Reading and math achievement profiles and longitudinal growth trajectories of children with autism spectrum disorder	Autism 2015;19:200–210	130 children	Children with hyperlexia had slower improvement in conversational skills when compared with children with hypercalculia.
Davidson M, Weismer S	Characterization and prediction of early reading abilities in children on the autism spectrum	J Autism Dev Disord 2014;44:828–845	94 children	Children had reading levels within the normal range. Nonverbal cognition and expressive language abilities predicted reading performance.
Lucas R, Norbury C	Levels of text comprehension in children with autism spectrum disorders (ASD): the influence of language phenotype	J Autism Dev Disord 2014;44:2756–2768	80 children	Literacy competence cannot be predicted just by word reading. Children with oral language impairment are more likely to present difficulties in learning to read text (despite their abilities to read single words).
Adlof S, Klusek J, Shinkareva S, et al.	Phonological awareness and reading in boys with fragile X syndrome	J Child Psychol Psychiatry 2015;56:30–39	54 children	Phonological and nonverbal cognitive skills were similar and had similar relationships with reading.
Troyb E, Orinstein A, Tyson K, et al.	Academic abilities in children and adolescents with a history of autism spectrum disorders who have achieved optimal outcomes	Autism 2014;18:233–243	41 children	Children with high-functioning autism presented lower scores in reading comprehension and mathematical problem solving.
Cronin K	The relationship among oral language, decoding skills, and reading comprehension in children with autism	Exceptionality 2014;22:141–157	13 children	Identified a significant relationship between reading ability and semantics but none with phonology. Semantics and syntax are also related to reading comprehension.
Inoue K, Wada M, Natsuyama T, et al.	The feature of high reading ability in high-functioning pervasive develop mental disorders of childhood: analysis of the K-ABC and WISC-3rd assessment	Res Autism Spectr Disord 2014;8:25–30	60 children (35 ASD)	Results suggest that children with high functioning ASD have high reading abilities but read words like symbols but do not use semantics or context to extract meaning to infer and comprehend.
Cardoso-Martins C, Gonçalves D, de Magalhães C	What are the mechanisms behind exceptional word reading ability in hyperlexia? Evidence from a 4-year-old hyperlexic boy's invented spellings	J Autism Dev Disord 2013;43:3001–3003	1 ch	Analysis of the spelling errors of children with hyperlexia and ASD can provide important information about how they learn to read and process graphophonemic correspondence.
Jacobs D, Richdale A	Predicting literacy in children with a high-functioning autism spectrum disorder	Res Dev Disabil 2013;34:2379–2390	84 children (42 ASD)	For young children with high-functioning ASD, phonological processing and oral language may predict literacy performance.
Arciuli J, Stevens K, Trembath D, et al.	The relationship between parent report of adaptive behavior and direct assessment of reading ability in children with autism spectrum disorder	J Speech Lang Hear Res 2013;56:1837–1844	21 children	As other characteristics of children with ASD, literacy levels vary among them and some have clear difficulties with reading. Adaptive behavior, as reported by parents, is associated with reading abilities.
Brock J, Bzishvili S	Deconstructing Frith and Snowling's homograph-reading task: implications for autism spectrum disorders	Q J Exp Psychol (Hove) 2013;66:1764–1773	Adults[a]	Several factors that affect the reading performance of adults with ASD were identified. They do not confirm the weak central coherence hypothesis.
Ricketts J, Jones C, Happé F, et al.	Reading comprehension in autism spectrum disorders: the role of oral language and social functioning	J Autism Dev Disord 2013;43:807–816	100 children	Word recognition and oral language may explain the variances in reading comprehension. Social behavior and social cognition predict reading comprehension.

Table 1 (continued)

Authors	Title	Reference	Participants	Conclusions
Tsai A, Savostyanov A, Wu A, et al.	Recognizing syntactic errors in Chinese and English sentences: brain electrical activity in Asperger's syndrome	Res Autism Spectr Disord 2013;7:889–905	31 adults (10 ASD)	In ASD and control groups matched for reading competence, it seems that ASD individuals have more difficulty in brain organization of the semantic and syntactic processes.
Baliousis M, Vollm B, Banerjee P, et al.	Autistic spectrum disorder, personality disorder and reading disability: a complex case that falls between the cracks?	J Forens Psychiatry Psychol 2013;24:286–292	1 adult	Describes the case of an individual convicted for violent offense that had extreme difficulties in receiving adequate service due to autism, personality disorder and dyslexia.
Hellinckx T, Roeyers H, Van Waelvelde H	Predictors of handwriting in children with autism spectrum disorder	Res Autism Spectr Disord 2013;7:176–186	131 children (70 ASD)	Reading abilities and fine motor skills were associated with handwriting speed while gender and visual motor integration impacted handwriting quality.
Williamson P, Carnahan C, Jacobs J	Reading comprehension profiles of high-functioning students on the autism spectrum: a grounded theory	Except Child 2012;78:449–469	13 children	Approach based on the constructivist theory to study influences on reading comprehension of children with ASD.
Treffert D	Hyperlexia III: separating 'autistic-like' behaviors from autistic disorder; assessing children who read early or speak late	WMJ 2011;110:281–286; quiz 287	Children[a]	Describes different conditions within the autism spectrum and the characteristics as hyperlexia and language delay.
Whalon K, Hart J	Children with autism spectrum disorder and literacy instruction: an exploratory study of elementary inclusive settings	Remedial Spec Educ 2011;32:243–255	3 children	The study shows the challenges faced by children with ASD in literacy instruction: few experiences of comprehension instruction is one of the most relevant.
Norbury C, Nation K	Understanding variability in reading comprehension in adolescents with autism spectrum disorders: interactions with language status and decoding skill	Sci Stud Read 2011;15:191–210	27 children	Poor structural language skills were associated with difficulties in comprehension. Performance in single-word reading was better. Decoding and comprehension seem to interfere with reading abilities.
Asberg J, Kopp S, Berg-Kelly K, et al.	Reading comprehension, word decoding and spelling in girls with autism spectrum disorders (ASD) or attention-deficit/ hyperactivity disorder (ADHD): performance and predictors	Int J Lang Commun Disord 2010;45:61–71	110 children (20 ASD)	Girls with typical development, with attention-deficit/ hyperactivity disorder and with ASD performed similarly in the literacy tests, but girls with autism had important difficulties in reading comprehension despite decoding and vocabulary training.
Cardoso-Martins C, da Silva J	Cognitive and language correlates of hyperlexia: evidence from children with autism spectrum disorders	Read Writ 2010;23:129–145	18 children	Reading by hyperlexic children with ASD apparently result from computing letter-sound relations implicitly and using statistical learning. These children had poor performance on phonological awareness and on phoneme-grapheme tasks.
Huemer S, Mann V	A comprehensive profile of decoding and comprehension in autism spectrum disorders	J Autism Dev Disord 2010;40:485–493	384 children	Results indicate no association between decoding and comprehension. Relatively intact decoding skills occurred along with low comprehension.
St Clair M, Durkin K, Conti-Ramsden G, et al.	Growth of reading skills in children with a history of specific language impairment: the role of autistic symptomatology and language-related abilities	Br J Dev Psychol 2010;28(pt 1):109–131	Children[a]	Reading skills are associated with language abilities. Individuals with SLI and ASD had adequate reading performance. There is a significant gap between what ASD children can read and what they can understand.
Caruana N, Brock J	No association between autistic traits and contextual influences on eye-movements during reading	PeerJ 2014;2:e466	71 adults	No support to the weak central coherence hypothesis nor to the 'comprehension monitoring' alternative.

Table 1 (continued)

Authors	Title	Reference	Participants	Conclusions
Asberg J, Sandberg D	Dyslexic, delayed, precocious or just normal? Word reading skills of children with autism spectrum disorders	J Res Read 2012;35:20–31	10 children	Reading difficulties are accompanied by other reading-related difficulties in children with ASD, but it is premature to determine any causal relation between them.
Miniscalco C, Sandberg A	Basic reading skills in Swedish children with late developing language and with or without autism spectrum disorder or ADHD	Res Dev Disabil 2010;31:1054–1061	21 children (5 ASD)	There were significant differences in phonological and grammatical awareness, color naming and word memory between children with ASD and normal-developing children.

[a] Number of subjects not indicated.

Table 2. Articles describing intervention proposals regarding reading abilities of persons with ASD

Authors	Title	Reference	Participants	Proposals and Conclusions
Knight V, Wood C, Spooner F, et al.	An exploratory study using science eTexts with students with autism spectrum disorders	Focus Autism Other Dev Disabl 2015;30:86–99	Children[a]	Book Builder is a tool to facilitate reading for children with autism. Teachers and students reported satisfaction.
Williamson P, Carnahan C, Birri N, et al.	Improving comprehension of narrative using character event maps for high school students with autism spectrum disorder	J Spec Educ 2015;49:28–38	3 children	Studied the effectiveness of an intervention package that included scaffolded completion to improve text comprehension. There were changes in scores.
Ricketts J, Dockrell J, Charman T, et al.	Do children with specific language impairment and autism spectrum disorders benefit from the presence of orthography when learning new spoken words?	J Exp Child Psychol 2015;134:43–61	54 children	The study provides evidence that the presence of orthographic cues can support interventions that emphasize the orthographic form.
Murdaugh D, Deshpande H, Kana R	The impact of reading intervention on brain responses underlying language in children with autism	Autism Res 2015, DOI: 10.1002/aur.1503	15 children	The findings of this study suggest the potential of a strength-based reading intervention in changing brain responses and facilitating better reading comprehension in ASD children.
Morlock L, Reynolds J, Fischer S, et al.	Video modeling and word identification in adolescents with Autism Spectrum Disorder	Child Lang Teach Ther 2015;31:101–111	3 children	Evidence-based intervention using video modeling was effective in improving word recognition and reading.
Zhang D, Spencer V	Addressing the needs of students with autism and other disabilities in China: perspectives from the field	Intl J Disabil Dev Educ 2015;62:168–181	2 children	The qualitative study identified main areas of attention: teacher recruitment and training, curriculum methodology and parental involvement.
Leytham P, Pierce T, Baker J, et al.	Evaluation of the nonverbal approach for two 12 to 13-year-old students with ASD	Res Autism Spectr Disord 2015;9:68–76	2 children	Ten words were trained in 20 sessions with the Nonverbal Reading Approach method. Results are reported effective.
Reutebuch C, El Zein F, Kim M, et al.	Investigating a reading comprehension intervention for high school children with autism spectrum disorder: a pilot study	Res Autism Spectr Disord 2015;9:96–111	6 children (3 ASD)	The Collaborative Strategic Reading – High School was adapted and used in 41 sessions. Increases in comprehension and interactions were noted.
Harper-Hill K, Copland D, Arnott W	Pathways to meaning: written and spoken word priming in children with ASD versus typically developing peers	Res Autism Spectr Disord 2014;8:1351–1363	18 children	ASD children with 'no language impairment'. Semantic prime to written word paradigm. Priming occurred only in the younger participants.

Table 2 (continued)

Authors	Title	Reference	Participants	Proposals and Conclusions
Pennington R, Collins B, Stenhoff D, et al.	Using simultaneous prompting and computer-assisted instruction to teach narrative writing skills to students with autism	Educ Train Autism Dev Disabil 2014;49:396–414	5 children	Simultaneous prompting and computer-assisted instruction were effective in improving the participant's performance in story reading skills. Non-targeted reading skills were also improved.
Lucas R, Norbury C	Orthography facilitates vocabulary learning for children with autism spectrum disorders	Q J of Exp Psychol (Hove) 2014;67:1317–1334	20 children	Vocabulary learning associated with reading the single low-frequency words. Orthography facilitated vocabulary learning.
Gonzalez-Navarro A, Freire-Prudencio S, Gil D, et al.	FIRST: a tool for facilitating reading comprehension in high-functioning autism spectrum disorder (in Spanish)	Rev Neurol 2014;58:S129–S135	None	Software was developed not just designed for people with ASD but with people with ASD. The tool must be flexible and facilitate customized use.
Grindle C, Hughes J, Saville M, et al.	Teaching early reading skills to children with autism using Mimio-Sprout early reading	Behav Interv 2014;28:203–224	4 children	The ABA program in a school setting has shown improvement in word recognition even in children with 14 months.
El Zein F, Solis M, Lang R, et al.	Embedding perseverative interest of a child with autism in text may result in improved reading comprehension: a pilot study	Dev Neurorehabil 2015, Epub ahead of print	1 child	Embedding the perseverative interest of a child with ASD with readings may lead to more adequate answers in reading comprehension.
Goh S, Whitaker A, Feldman J, et al.	Teaching non-verbal children with autistic disorder to read and write: a pilot study	Int J Dev Disabil 2013;59:95–107	18 children	Innovative curriculum with one-to-one instruction in reading and writing. Participants were tested before and after intervention. All participants showed improvement in the skills they were trained.
Bethune K, Wood CL	Effects of wh-question graphic organizers on reading comprehension skills of students with autism spectrum disorders	Educ Train Autism Dev Disabil 2013;48:236–244	3 children	Used graphic organizers to improve wh-questions comprehension in reading tasks. Accuracy of answers was improved.
Akcin N	Comparison of two instructional strategies for students with autism to read sight words	Eurasian J Educ Res 2013;13:85–106	3 children	Five-word set for each teaching strategy (constant time delay and stimulus fading). All target words were acquired. Constant time delay was more effective in terms of number of trials.
Flores M, Nelson C, Hinton V, et al.	Teaching reading comprehension and language skills to students with autism spectrum disorders and developmental disabilities using direct instruction	Educ Train Autism Dev Disabil 2013;48:41–48	18 children	The study demonstrated that direct instruction is an effective model of intervention in reading comprehension for students with ASD.
Tanji T, Takahashi K, Noro F	Teaching generalized reading and spelling to children with autism	Res Autism Spectr Disord 2013;7:276–287	3 children	Training on generalization of reading and spelling skills with matching-to-sample strategy. Two participants improved.
Mucchetti C	Adapted shared reading at school for minimally verbal students with autism	Autism 2013;17:358–372	4 children	Teachers and students read a book and talked about it. All students showed improvement in reading comprehension.
Crowley K, McLaughlin T, Kahn R	Using direct instruction flashcards and reading racetracks to improve sight word recognition of two elementary students with autism	J Dev Phys Disabil 2013;25:297–311	2 children	Direct Instruction flashcards and reading racetracks were used to improve reading of sight words in 2 children with ASD. They showed to be effective for both participants.
Taylor B, DeQuinzio J, Stine J	Increasing observational learning of children with autism: a preliminary analysis	J Appl Behav Anal 2012;45:815–820	3 children	Monitoring responses on the acquisition of sight words with vocal imitation. Participants read the words with more efficiency in monitoring sessions.

Table 2 (continued)

Authors	Title	Reference	Participants	Proposals and Conclusions
Hua Y, Hendrickson J, Therrien W, et al.	Effects of combined reading and question generation on reading fluency and comprehension of three young adults with autism and intellectual disability	Focus Autism Other Dev Disabl 2012;27:135–146	3 adults	Reread – Adapt and Answer – Comprehend (RAAC). All participants improved their performance in factual and inferential comprehension during the intervention.
Mims P, Hudson M, Browder D	Using read-alouds of grade-level biographies and systematic prompting to promote comprehension for students with moderate and severe developmental disabilities	Focus Autism Other Dev Disabl 2012;27:67–80	4 children	A modified system of least intrusive prompts on text-dependent listening comprehension. All students improved listening comprehension.
Stringfield S, Luscre D, Gast DL	Effects of a Story Map on Accelerated Reader postreading test scores in students with high-functioning autism	Focus Autism Other Dev Disabl 2011;26:218–229	3 children	Children were taught to use a Story Map as a postreading organizing tool. Positive effects were quick and maintained during the study.
Tanji T, Noro F	Matrix training for generative spelling in children with autism spectrum disorder	Behav Interv 2011;26:326–339	2 children	Matching-to-sample strategy. Both subjects improved their spelling performance.
Travers J, Higgins K, Pierce T, et al.	Emergent literacy skills of preschool students with autism: a comparison of teacher-led and computer-assisted instruction	Educ Train Autism Dev Disabil 2011;46:326–338	4 children	Teaching literacy skills to young children with ASD. Comparing traditional teaching and multimedia computer assisted instruction. In both groups children showed improvement.
Dogoe M, Banda D, Lock R, et al.	Teaching generalized reading of product warning labels to young adults with autism using the constant time delay procedure	Educ Train Autism Dev Disabil 2011;46:204–213	2 adults	Constant time delayed to improve reading skills in learning how to read warning labels. Both participants acquired the trained skills but didn't generalize across settings.
Axe J, Sainato D	Matrix training of preliteracy skills with preschoolers with autism	J Appl Behav Anal 2010;43:635–652	4 children	Matrix model with some multiword phrases are taught and other emerge. Three participants performed the trained actions.
Whitcomb S, Bass J, Luiselli J	Effects of a computer-based early reading program (Headsprout®) on word list and text reading skills in a student with autism	J Dev Phys Disabil 2011;23:491–499	1 child	Effects of a computer-based early reading program that allows work at home and registers the child's activities. It was useful to improve reading comprehension.
Whalon K, Hart J	Adapting an evidence-based reading comprehension strategy for learners with autism spectrum disorder	Interv Sch Clin 2011;46:195–203	None	Scaffolding strategies are a good way to improve reading comprehension and this study suggests ways of keeping record of the progresses.

[a] Number of subjects not indicated.

the improvement of reading comprehension, as opposed to the studies regarding the use of behavioral techniques to increase single-word reading abilities. However, there is not enough data about the duration of the intervention processes, specific characteristics of the participants before the intervention, training of the therapists in the area, specific material or resources used to allow hypotheses about better or more successful intervention methods.

Literacy acquisition in children and adults with ASD demand further assessment. The large individual variations of the autism spectrum may be reflected in the reading performance of persons with ASD, therefore resulting either in hyperlexia or in different forms of reading deficits. The identification of different reading strategies and specific profiles of abilities and impairments depends on efficient assessment tools that are essential to the design of more efficient intervention procedures.

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