Teaching "Technologies" to Support Early Literacy Instruction

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With the premise that technology encompasses both tools and techniques, this presentation will focus on best practices in helping learners (especially those with autism spectrum and related disorders) acquire foundational literacy skills. Often educators and parents struggle to effectively teach functional reading skills to these learners who exhibit significantly limited language skills, narrow vocabulary, rapidly shifting attention, difficulties with delay, a tendency to focus on irrelevant stimuli and other behaviors that can interfere with learning. Teaching any complex repertoire requires a thorough analysis of the behaviors that make up that repertoire. While most experts agree that reading involves deriving meaning from print, understanding a reading repertoire requires a component/composite analysis of essential antecedent-behavior-consequence relations (e.g., how speech sounds and print are related, deriving sound and meaning from print, fluently recognizing and comprehending increasing larger units of print comprehend print). The presenter will share specific strategies for teaching literacy to individuals with autism or similar behavioral characteristics, including strategies to effectively teach the components and assess for the composite. The effective use technology as a tool for increasing early literacy will also be incorporated.

Learning objectives include:

1. Participants will become familiar the sometimes unique difficulties associated with teaching reading to learners in with autism spectrum disorders.
2. Participants will become familiar with a component-composite analysis of early reading skills.
3. Participants will become familiar with strategies and practices that have been empirically demonstrated effective in increasing reading repertoires.
4. Participants will become familiar with how to adapt or present those strategies and practices to learners with autism spectrum disorders.
5. Participants will become familiar with various technologies and materials that build or support early literacy skills for learners with autism spectrum disorders.

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(Semi) Annotated Bibliography

Basil, C. & Reyes, S. (2003). Acquisition of literacy skills by children with severe disability. *Child Language Teaching and Therapy, 19, 27-48.*

> This study investigated the effectiveness of *Delta Messages*, a computer-based reading program on the reading of six children with developmental disabilities (two were diagnosed with autism). Mental ages ranged from 2.3 (years.months) to 7.6. Receptive vocabulary level ranged from 2.11 to 7.1; Expressive vocabulary ranged from 2.10 to 5.1. The learning activities in the program consisted of creating sentences, in which the students selected words or groups of words that result in a sentence. The program then reads the sentence and the student saw an animation illustrating the sentence. All possible word selections produced meaningful sentences. Testing activities required the student to produce a sentence describing a presented animation. Mastery was achieved when 80% of sentences independently produced by student were correct. Students were assessed at 4 times: initially at end of familiarization period, end of 3-month period, three months after training was terminated, and 6 months after training was terminated. Students improved on post and follow-up; it is unclear whether the program produced changes or whether other interventions occurring at the same time were responsible for changes (the latter may be assumed, as there was no control and most significant increases occurred after the program had been discontinued).

Broun, L. T. (2004). Teaching students with autistic spectrum disorders to read: A visual approach. *Teaching Exceptional Children, 36, 36-40.*

> Principles of the methodology:
> 1. Whole word sight recognition: learners for whom the auditory processing is compromised find it easier to learn whole words; learners don't need a thorough understanding of the alphabet to read, and letter-sound combinations may be too abstract for learners with ASD. Phonics are introduced after learners have a repertoire of 25-50 sight words, and phonics are then taught in the context of those words.
> 2. Begin with words that are significant to the child (e.g., pet names, preservative interests)/ Then, introduce adverbs, pronouns, etc., that allow sentence building.

The methodology is mostly visual because the spoken word is paired with the printed word; there's also a kinesthetic component when the learner points to stimuli in order to match them, and a spoken (or hand-sign) component because learners are required to produce the word in the presence of the picture.

Browder, D. M. & Cooper-Duffy, K. (2003). Evidence-based practices for students with severe disabilities and the requirement for accountability in "No Child Left Behind". *The Journal of Special Education, 37*(3), 157-163.

> The authors consider two provisions of the NCLB act: (a) the reading, math, and science assessment requirement and (b) the yearly progress expectation. They note that most research on skill acquisition for student with disabilities has focused on functional life skills rather than academic skills. Where academic skills are studied, the research focuses on teaching functional reading and math, such as learning functional sight words, dealing with money and telling time. Documenting progress also poses a challenge, as the response needs to be defined and a time frame established. Although research has demonstrated this in special classrooms, it is not clear how this would work in general education settings. A final issue concerns the lack of implementation for research-based practices. The authors conclude that these provisions provide a challenge due to the lack of prior research on teaching academic skills to students with disabilities.

Browder, D. M. & Lalli, J. S. (1991). Review of research on sight word instruction. *Research in Developmental Disabilities, 12*(3), 203-228.

> Abstract: This review of 20 years of literature on sight word instruction for individuals with handicaps identifies several effective procedures. These procedures are described for the two types of learning required in sight word instruction — word recognition and comprehension. Criteria for procedural selection are recommended. Research limitations are critiqued with suggestions provided for further evaluation of sight word instruction.

Browder, D. M., Wakeman, S. Y., Spooner, F., Ahlgrim-Delzell, L., & Algozzine, B. (2006). Research on reading instruction for individuals with significant cognitive disabilities. *Exceptional Children, 72*(4), 392-408.

> The authors reviewed 128 studies on reading instruction for students with disabilities to determine the extent of evidence-based practices used for each of the critical components of reading identified by the National Reading Panel. They found that most studies focused on acquiring functional sight words (vocabulary). About one-third focused on picture identification that was sometimes taught with comprehension, but less than one-third of the studies contained a comprehension measure. For those that did, 18 studied functional applications such as reading a recipe while 13 focused on academic applications such as reading a story passage. A few studies (13 or 10%) focused on phonics instruction. Thirty-six studies (28%) focused on fluency, but most indicators were error percentages. No longitudinal studies were conducted; all studies spanned just a few months and targeted one or two components of reading. Of the total number of participants (1,123) in the reviewed studies, 62 (6%) were diagnosed with autism. The author's conclude that there are a sufficient number of studies that focus on sight words, but research on teaching the other components of reading to students with disabilities is lacking. They also note that certain skills, particularly phonics and phonemic awareness, may be difficult to teach to nonverbal students, although studies have been conducted in this area (see Coleman-Martin, Heller, Cihak, & Irvine, 2005).

Brown H. M., Oram-Cardy J., Johnson A. (2013). A meta-analysis of the reading comprehension skills of individuals on the autism spectrum. *Journal of Autism and Developmental Disabilities, 43*, 932–955.

Abstract: This meta-analysis examined 36 studies comparing autism spectrum disorder (ASD) and control groups in reading comprehension. Three moderators (semantic knowledge, decoding skill, PIQ) and two text types (high vs. low social knowledge) were examined as predictors of reading comprehension in ASD. The overall standardized mean difference for reading comprehension was $g = -0.7$ SD. The strongest individual predictors of reading comprehension were semantic knowledge (explaining 57 % of variance) and decoding skill (explaining 55 % of variance). Individuals with ASD were significantly worse at comprehending highly social than less social texts. Having ASD alone does not predict reading comprehension deficits. Instead, individual skills, especially language ability, must be considered before one can accurately predict whether a given individual with ASD will experience difficulties in reading comprehension.

Carnahan C. R., Williamson P. S. (2013). Does compare–contrast text structure help students with autism spectrum disorder comprehend science text. *Exceptional Children, 79*, 347–363. [Google Scholar](#)

Abstract: Using a single-subject reversal design, this study evaluated the use of a compare-contrast strategy on the ability of students with autism spectrum disorder to comprehend science text. Three middle school students with high-functioning autism and their teacher participated in this study. A content analysis comparing the number of meaning units in passages to the number of meaning units in student-completed Venn diagrams was conducted for both the treatment and maintenance phases. Results indicated that instruction in the compare-contrast text pattern was effective in increasing participants' comprehension. A content analysis of Venn diagrams revealed a decrease in number of recorded meaning units during the maintenance phase while passage comprehension remained high. Future research and implications for classroom interventions are discussed.

Carnahan, C. R., & Williamson, P. (2016). Systematically teaching students with autism spectrum disorder about expository text structures. *Intervention in School and Clinic*, 51(5), 293-300.

Abstract: Using a multiple baseline single-subject design, this study evaluated the effects of a text structure intervention package on the ability of students with autism to comprehend traditional science texts. Three high school students with high-functioning autism and their teacher participated in this study. The intervention package included instruction in types of text structures using a text structure organization sheet before reading, and completing an analysis and summary sheet during and after reading. Results indicated that the instruction was highly effective during intervention and maintenance phase for all three participants. The first-year special education teacher was able to implement the intervention with fidelity. All participants agreed that the intervention was helpful for reading science texts. Future research and implications for classroom intervention is discussed.

Carnahan, C., Williamson, P., Hollingshead, A. & Israel, M. (2012). Using technology to support balanced literacy for students with significant disabilities. *Teaching Exceptional Children, 45 (1),* 20-29. Retrieved from: http://journals.sagepub.com/doi/pdf/10.1177/004005991204500104

Chiang, H. & Lin, Y. (2007). Reading comprehension instruction for students with autism spectrum disorders: A review of the literature. *Focus on Autism and Other Developmental Disabilities, 22(4),* 259-267.

> The authors reviewed 11 studies (out of potential of 754) to determine to what extent evidence-based practices exist for teaching. These eleven studies met the review criteria of (a) at least one participant with autism, (b) data on reading comprehension, and (c) use of an experimental design, including single subject designs. These studies include a total of 49 students with autism, with the majority of studies (7) also including students with mental retardation. Three of the studies included students with normal IQ scores or high-functioning autism, although none included students with Asperger syndrome. Most studies (9) included students between 6 and 11 years old. Seven studies focused on sight word comprehension, while four studies focused on text comprehension. A range of instructional strategies were used, including (1) flashcards of key words, (2) discrete-trial training procedures, (3) peer tutoring, (4) cooperative learning groups, (5) incidental teaching for functional sight words, (6) computer-based instruction for functional words, (7) pre-reading, cloze tasks, and cueing for text comprehension, (8) stimulus class technology and observational learning, and (9) computer assisted instruction. However, it the low number of studies and the variety make it difficult to determine optimal strategies.

Coleman-Martin, M. B., Heller, K. W., Cihak, D. F., & Irvine, K. L. (2005). Using computer-assisted instruction and the nonverbal reading approach to teach word identification. *Focus on Autism and Other Developmental Disabilities, 20(2),* 80-90.

> This study examined the use of computer-assisted instruction for teaching sight words to students with speech impairments. Three students participated, including one 12-year-old female with autism. She communicated with an augmented communication device and word recognition skills were estimated to be at a second-grade level. A PowerPoint program was used to teach decoding (sounding out word slowly, then saying it fast) according to the nonverbal reading approach (NRA). In this approach, the student is instructed to say the sounds/words 'internally'. The program progressed from teacher instruction, CAI plus teacher, and finally CAI only. All students reached criterion (80% for two consecutive sessions) in each condition.

Collins, B. C., Evans, A., Creech-Galloway, C., Karl, J., & Miller, A. (2007). Comparison of the acquisition and maintenance of teaching functional and core content sight words in special and general education settings. *Focus on Autism and Other Developmental Disabilities, 22(4),* 220-244.

> The authors investigated acquisition and maintenance of functional and content sight words presented in (a) systematic massed trial practice in resource room, (b)

systematic distributed trial practice in general education classroom, and (c) embedded instruction in general education classroom. Four students with functional intellectual disabilities participated. Ages ranged from 9 to 19, with IQs ranging from 40 to 50. Massed and distributed trials were done with flash cards while the embedded trails used general education materials such as worksheets. All students reached criterion on both functional and core content sight words in all conditions, although results varied across students.

Conners, F. A., Rosenquist, C. J., Sligh, A. C., Atwell, J. A., & Kiser, T. (2006). Phonological reading skills acquisition by children with mental retardation. *Research in Developmental Disabilities, 27*, 121-137.

This study investigated the relationship between verbal working memory, phonemic awareness, general intellectual ability and language ability and acquisition of phonological reading skills in children with mental retardation. Forty students between the ages of 7 and 12 participated. All had an IQ of at least 40, could identify letters, and were not reading phonologically. Students ranged in developmental level from 4 to 8 years. Students were matched in pairs as closely as possible on age and IQ, nonword reading accuracy, phonemic awareness, and language comprehension. The two groups were similar in the types of reading instruction they were receiving in school as reported by teachers, with 89 and 88 percent receiving phonics-based instruction, 74 and 76 receiving functional reading instruction (e.g., focus on environmental print), 21 and 18 percent receiving whole language instruction, and 1 and 12 percent receiving another type of reading instruction. Students in the both groups received a pre-assessment on (a) letter names, (b) letter sounds, (c) nonword reading, (d) sight word reading, (e) intelligence, (f) language comprehension, (g) phonemic awareness, (h) verbal working memory, and (i) articulation speed, with the experimental group receiving instruction between assessments. Instruction included oral practice in sound blending (six lessons); letter-sound association (7 lessons), and sounding out (9 lessons). Post-instruction assessment included (a) sounding out instruction set, (b) sounding out transfer set, (c) sounding out composite and (d) nonword reading and sight word reading. On sounding out measures, there was a main effect for group (with instruction group performing higher than non-instruction group) and for set (instruction set higher than transfer set). However, there was great variability between students. A regression analysis showed that for students who received instruction, beginning reading skills and language ability were related to sounding out skills. For students who did not receive instruction, beginning reading skill, phonemic awareness, and articulation speed were related to sounding out skill. The groups did not differ on nonword and sight word reading, with both groups improving between pre and post assessment. The authors conclude that intensive and targeted phonics instruction can be effective in increasing sounding-out skills of students with MR and emphasize the need for additional research on effectiveness of specific sequences and elements of instruction, student characteristics, and how to offer effective, intense, individualized instruction that's less labor-intensive.

Davidson, M. M., & Weismer, S. E. (2014). Characterization and Prediction of Early Reading Abilities in Children on the Autism Spectrum. *Journal of Autism and Developmental Disorders*, *44*(4), 828–845. http://doi.org/10.1007/s10803-013-1936-2

Abstract: Many children with autism spectrum disorder (ASD) have reading profiles characterized by higher decoding skills and lower reading comprehension. This study assessed whether this profile was apparent in young children with ASD and examined concurrent and longitudinal predictors of early reading. A discrepant profile of reading (higher alphabet and lower meaning) was found in 62% of this sample. Concurrent analyses revealed that reading proficiency was associated with higher nonverbal cognition and expressive language, and that social ability was negatively related to alphabet knowledge. Nonverbal cognition and expressive language at mean age 2½ years predicted later reading performance at mean age 5½ years. These results support the importance of early language skills as a foundation for reading in children with ASD.

Eskes, G. A., Bryson, S. E., & McCormick, T. A. (1990). Comprehension of concrete and abstract words in autistic children. *Journal of Autism and Developmental Disorders, 20*, 61-73.

Abstract: This study employed the Stroop paradigm to examine comprehension of single words in autistic children. The words of interest varied along a concrete-abstract dimension. In the Stroop paradigm, subjects are asked to name the color of ink in which color words are printed. Comprehension is indexed by the degree to which the automatic processing of words interferes with the color-naming task. For both concrete and abstract words, autistic children showed the same degree of interference as reading matched controls. The findings corroborate and extend previous work suggesting that autistic children understand, and by implication, can mentally represent, at least some word meanings.

Frith, U., & Snowling, M. (1983). Reading for meaning and reading for sound in autistic and dyslexic children. *British Journal of Developmental Psychology*, *1*, 329–342.

Flores, M. & Ganz, J. B. (2007). Effectiveness of direct instruction for teaching statement inference, use of facts, and analogies to students with developmental disabilities and reading delays. *Focus on Autism and Other Developmental Disabilities, 22*(4), 244-251.

This study investigated the effects of a Direct Instruction reading comprehension program on the comprehension skills of students with autism and other developmental disabilities. Four elementary students participated, ranging in age from 10 to 14 years. Two students were diagnosed with autism, one with mild mental retardation, and one with ADHD. Comprehension as measured by the Passage Comprehension subtest of the Woodcock-Johnson III ranged from 28 to 84 (all below averages scores). Students received instruction for 20 minutes each day during regularly scheduled instructional periods. Instruction included statement inference, use of facts, and analogies. The intervention was conducted by the researchers who followed the DI program's prescribed scripts. A multiple-probe-across-behaviors design was used. All students met criterion across all conditions, and maintained performance one month after instruction was completed.

Fossett, B. & Mirenda, P. (2006). Sight word reading in children with developmental disabilities: A comparison of paired associate and picture-to-text matching instruction. *Research in Developmental Disabilities, 27*, 411-429.

> The authors compared paired associate instruction and picture-to-text matching instruction for teaching sight words. Participants included two boys ages 10 years 7 months and 11 years, 9 months. The first was diagnosed with autism and was functionally nonverbal. The second was diagnosed with Soto Syndrome and scored an age equivalent of 3 years 3 months on the Peabody Picture Vocabulary Test-III. Two sets of five words from picture communication symbols were chosen for the study. Instruction included flashcards, matching worksheets, and pasting worksheets. Participants mastered the words in picture-to-text matching but not in paired association condition.

Frith, U. & Snowling, M. (1983). Reading for meaning and reading for sound in autistic and dyslexic children. *British Journal of Developmental Psychology, 1,* 329-342.

> The authors compared reading of autistic and dyslexic children who were had same reading age. Participants included eight children with autism with a reading age of 8-10 years (four had normal IQs), a control group of typically developing children matched for reading age, and a group of eight children with dyslexia at the same level of reading ability. Children with dyslexia did significantly worse in non-word reading – typically developing children and children with autism did not differ on the non-word reading measure. There was no difference between groups on real-word reading. These results showed that children with autism used phonological and lexical strategies appropriate for their reading age. There was also no difference between groups on measures of abstract/concrete word reading or Stroop interference, which suggests that children with autism do not differ in accessing word meaning. However, children with autism performed more poorly on a sentence completion task that required them to use context cues to choose the semantically appropriate word in the absence of syntactic clues.

Grigorenko, E.L., Klin, A., Pauls, D.L., Senft, R., Hooper, C., & Volkmar, F. (2002). A descriptive study of hyperlexia in a clinically referred sample of children with developmental delays. *Journal of Autism and Developmental Disorders, 32*, 3—12.

Heimann, M., Nelson, K. E., Tjus, T., & Gillberg, C. (1995). Increasing reading and communication skills in children with autism through an interactive multimedia computer program. *Journal of Autism and Developmental Disorders, 25*(5), 459-480.

> The authors investigated the effectiveness of Alpha, a computer-based reading instructional program. Participants included 11 (9 boys, 2 girls) diagnosed with autism (chronological age between 6:9 to 13:8 years; mental age between 3:00 and 9:5 years; receptive language age between 2:9 and 7:0 years), 9 children (4 boys) diagnosed with mixed handicaps mean chronological age of 13:1 years; estimated mental age between 5:0 and 6:6 years; receptive language age between 2:8 and 7 years; all had IQ of 70 or less, and 10 (2 boys) normal preschool children (mean chronological age of 6:4 years; mean mental age of 6:3 years; language between 6:3 and 7 years). The Alpha program includes 112

lessons with four modes: Individual Words, Creating Sentences, Testing Words, and Testing Sentences. The Individual Words mode taught vocabulary (nouns), and the Creating Sentences mode involved the student selecting noun-verb-noun sequences that result in an animation of the sentence. The testing mode required children to select words to describe an animation. Mastery was defined as at least 80% correct in the testing mode. Group A received average of 25.6 sessions over 16.9 weeks; Group MH received average of 21.8 sessions over 17.7 weeks; Group NP received 7.8 sessions over 6.3 weeks; sessions lasted between 21.1 and 32 minutes. Measures included three tests of reading (flashcard sentences, flashcard words, letter identification and word reading; sentence imitation; phonological awareness; and communication recorded on video during initial and final lesson). Students with autism showed statistically significant gains between pre- and post-test for reading and phonological awareness. Children with autism also showed an increase in "verbal expression", "enjoyment" and "seeks help".

Hume K. A. (2010). Effective instructional strategies for students with ASD: Keys to enhancing literacy instruction. In Carnahan C., Williamson P. (Eds.), Quality literacy instruction for students with autism spectrum disorders (pp. 21–44). Shawnee Mission, KS: Autism Asperger.

Iovannone, R., Dunlap, G., Huber, H., & Kincaid, D. (2003). Effective educational practices for students with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 18,* 150-165.

> The authors review general aspects of ASD as a disorder (e.g., prevalence, treatment options), then compare several reviews of ASD interventions (not exclusively academic ones) and discuss the common aspects that those reviews found effective. The common aspects were: individualized support and services, systematic instruction, comprehensible learning environments, specific curriculum content, family involvement, and a functional approach to problem behavior. Some of these common areas are summarized as follows:
> 1. Systematic instruction involves "identifying valid educational goals, carefully outlining instructional procedures for teaching [...] evaluating the effectiveness of the teaching procedures, and adjusting instruction based on data" (p. 157), planning for skill transfer and maintenance, and planning for higher levels of engagement.
> 2. A comprehensible learning environment is one that allows learners with ASD and others to predict what is happening and what will happen next in the learning process.

Joseph, L. M., & Seery, M. E. (2004). Where is the phonics? *Remedial and Special Education, 25,* 88-94.

> This article focuses on learners with mental retardation (MR), not necessarily or exclusively ASD. It is a review of a small group of previous articles on teaching phonics to learners with MR. Key points:
> • The authors report that many efforts to teach literacy to learners with MR use a sight-word or whole-word method without teaching phonics.

- Learners with MR are underrepresented in studies exploring the effectiveness of phonics.
- The authors found that the number of articles on teaching phonics to learners with MR had barely grown from 1992 to 2004.

The articles reviewed found that children with MR can learn and use phonetic analysis strategies and can transfer those strategies to new words, thereby helping to dispel the belief that learners with MR have limited transfer skills. However, the strategies used across the studies cited are very varied (ranging from picture fading to kinesthetic letter tracing). The authors report that none of the studies reviewed used direct, explicit teaching of letter-sound correspondences, and no studies measured reading fluency as a dependent variable.

Justice, L. M., & Pence, K. L. (2004). Addressing the language and literacy needs of vulnerable children: innovative strategies in the context of evidence-based practice. *Communication Disorders Quarterly, 25,* 173- 178.

From the authors: "In the current context of evidence-based practice, some researchers and practitioners may be uncomfortable using or endorsing innovative practices, particularly when there is little scientific support for that practice. Nonetheless, it can take many dollars and years of research to document the efficacy and effectiveness of a new technique or strategy. Furthermore, many innovative interventions are conceptually and theoretically well grounded. The current push to use only those interventions for which there is adequate scientific support can undermine the use of innovative approaches" (p. 175).

Kaderavek, J. N., & Rabidoux, P. (2004). Interactive to independent literacy: a model for designing literacy goals for children with atypical communication. *Reading & Writing Quarterly, 20,* 237-260.

The interest in the literacy of children with communication impairments was spurred by the inclusion of these learners in general education, advocacy groups, and national mandates asserting that "every child should be a reader". Similarly, the definition of "being literate" has expanded to include behaviors such as engaging in shared story reading, labeling and pointing to pictures in books, and oral storytelling as aspects of emergent literacy. The authors then describe different approaches to literacy from a purely conceptual standpoint (e.g., the social interaction model, the participation model), and favor what they call the interactive-to-independent model, which consists of a series of phases from just engaging in "interactive" literacy-related activities to the independent ones, much like the emergent literacy model.

Kamps, D., Heitzman-Powell, L., Rosenberg, N., Mason, R., Schwartz, I., & Romine, R. S. (2016). Effects of reading mastery as a small group intervention for young children with ASD. *Journal of Developmental and Physical Disabilities*, 28(5), 703-722.

Katims, D. S. (2000). Literacy instruction for people with mental retardation: historical highlights and contemporary analysis. *Education and Training in Mental Retardation and Developmental Disabilities, 35,* 3-15.

This article provides a brief historical description of trends and procedures to teach reading to learners with mental retardation (not necessarily with autism). There's no evaluation of what has been effective, but some interesting historical data on the first applications to learners with special needs of phonics-based programs, computer-based instruction, emergent literacy, whole language approach, etc. The authors cite a note observing that "in regular education, the focus of reading instruction is on gaining meaning from print, while the research on reading instruction for students with mental retardation focuses almost exclusively on the identification of individual words".

The authors also reviewed college textbooks on special education and on mental retardation, surveying them for the information they provided on teaching literacy to this population. They found that these sources provided very little information about assessment and instructional procedures in literacy for learners with mental retardation or learning disabilities, although the procedures reported in those sources come from many different approaches (whole language, phonic analysis, multisensory approaches, fluency, paraphrasing, etc. Then they go on to stating: "Powerful and effective behavioral techniques used for teaching reading, writing, and spelling to people with mental retardation have a long history in special education (Conners, 1992). The strength of this orientation is evident today based upon the large body of journal articles, books, and other reviews influenced, or altogether dominated by a reductionist approach […]Given these historical and present day facts, the questions that remain for many teachers and researchers relate to other orientations toward literacy that might inform more effective teaching approaches for people with mental retardation. (!!! This is especially negative because Katims is widely cited in other articles about literacy and children with DD/LD.)

Kimball, J. W., & Smith, K. (2007). Crossing the bridge: from best practices to software packages. *Focus on Autism and Other Developmental Disabilities, 22,* 131-134.

"When it comes to the structured, incremental, and tightly managed instruction known to be beneficial for children with autism, computers may fulfill certain teaching functions quite efficiently and successfully. This is especially important, given the shortage of personnel qualified to teach children with autism (Simpson, 2004)" (Kimball & Smith, 2007, p. 131).
The article lists some problems with the instructional programs as they apply to learners with ASD:
1. Few programs have been developed for or tested with children with ASD.
2. Many programs have significant pedagogical flaws such as: bells and whistles that inadvertently reinforce correct responses or cause distraction; reinforcement schedules that can't be adjusted; little variety in reinforcers; limited number of egs and little attention to alternative stimulus control topographies (e.g., non-critical attributes appear to be spuriously paired with critical ones); limited capacity for prompting and prompt fading; few instructional steps or levels; requirement of high-level entry skills.

Good instructional programs for learners with ASD should allow learner to: meet the learning objectives, and do so independently; grow with the program with respect to its contents and its degree of support; transfer and maintain skills. Good programs also reliably measure and record performance.

Kluth, P, & Darmody-Latham, J. (2003). Beyond sight words: Literacy opportunities for students with autism. *The Reading Teacher, 56*, 532-534.

The authors address the issue of the lack of literacy instruction for students with autism and the need to recognize that students with disabilities can benefit from instruction. They stress that teachers should not limit their expectations for students with disabilities.

Koppenhaver, D. A., & Erickson, K. A. (2002). Natural emergent literacy supports for preschoolers with autism and severe communication impairments. *Topics on Language Disorders, 23,* 283-292.

The authors arranged the environment to facilitate the natural development of emergent literacy in three preschool learners with autism. The intervention included: making a wide arrange of children's books and writing tools available in the play areas, putting Velcro stickers with words on them on top of buttons used during different tasks. The authors found increases in self-initiated behaviors related to emergent literacy in the participants, such as browsing or silently studying books, running a finger over each line of text in books. By the end of the study, participants were engaging in print- or writing-related activities about 1/3 of the time when other play activities were available.

Kuehn, B. M. (2007). CDC: Autism Spectrum Disorders. *Journal of the American Medical Association, 297*(9), 940-940.

Lanter, E., & Watson, L. R. (2008). Promoting literacy in students with ASD: the basics for the SLP. *Language, Speech, and Hearing Services in Schools, 39,* 33-43.

Teaching reading skills helps learners with ASD improve their oral language skills as well as their reading skills (Colasent & Griffith, 1998; Craig & Sexton Telfer, 2005; Koppenhaver & Erickson, 2003; Wolfberg, 1999 [cited in Lanter & Watson, 2008]).

The authors provide summary of what can be typically expected of learners with and without ASD across the different literacy stages (emergent literacy, conventional reading, and skilled reading). A summary of their intervention suggestions for learners with ASD across these three stages follows:
1. Emergent literacy
    •   Avoid reading readiness models: the belief that learners must master skills like colors, shapes, and letter identification before they are ready to begin literacy instruction has excluded learners with ASD from formal reading instruction. Spoken language should not be considered a prerequisite for reading.

- Shared reading: conduct frequent and repeated readings of narrative and expository texts to promote learner's recognition of familiar schemas (also to increase oral language and decrease stereotypic behaviors).
- Story retelling
- Create dialogues around storybooks in which teacher models "think alouds" (i.e. model how to answer questions and derive meaning from text). The effectiveness of thinking aloud has been assessed with learners with LD, but not with ASD so far.
- Teach literacy in natural contexts: some learners with ASD may have trouble understanding the function of literacy. The authors recommend incorporating functional reading as part of other classroom routines (e.g., signing in, singing) and use it as an opportunity to teach literacy.
- Label objects and pictures to promote sight word reading.

2. Conventional reading
At this stage, many learners with autism show a discrepancy between appropriate decoding skills and poor comprehension, especially among learners with high IQs. However, in samples of ASD learners with heterogeneous IQs, a significant portion of them have decoding problems in addition to comprehension problems. Recommended procedures:
- Promote phonological awareness: learners with ASD are not that different from their peers in their development of phonological awareness or in the phonological cues they use to read words. The authors also recommend taking advantage of the strong visual learners shown by learners with ASD to teach word reading.
- Use computer software: initial data suggests that computer-assisted reading instruction increases phonological awareness, word reading, language expression, and enjoyment in learners with ASD.
- Help learners construct meaning through dialogue: using questions and thinking aloud.
- Match the text with the language strategy:

3. Skilled reading
Skilled reading is defined as the stage where learners can "derive meaning from printed text accurately and efficiently" (Scarborough, 2003, p. 97, cited in Lanter & Watson, 2008). Lanter and Watson state that only a minority of learners with ASD reach the skilled reading stage, because many of them struggle with inferences, tend to interpret language literally, and have trouble deriving meaning from context, especially for words referring to motives and internal states.

Recommended procedures:
- Match text with ability: this may imply going a couple of years below the learner's *decoding* ability.
- Focus on deep rather than surface questions: use factual questions to teach facts and motivate learners, but emphasize inferential questions.

- Group reading: small interactive groups with teacher supervision has proven effective for learners with LD, so they may work for learners with ASD as well.
- Build background knowledge: especially through diagrams, semantic maps, etc., that rely on the visual strength of learners with ASD.
- Link texts with prior knowledge: presenting ASD learners with abstracts and titles related to the text they are about to read improves their recall of information. Presenting prereading questions may actually be harmful because these questions can distract learners from the focus of the text.
- Use visual aids: such as Venn diagrams, story maps, framed outlines, etc. Using thought bubbles has helped learners with ASD answer questions about characters' thoughts.
- Promote text monitoring: learners with ASD tend to read quickly, with little pausing or rereading. The authors suggest to promote text monitoring by presenting questions throughout the text, not simply at the end.

Mancil G. R., Pearl C. E. (2008). Restricted interests as motivators: Improving academic engagement and outcomes of children on the autism spectrum. *Teaching Exceptional Children Plus*, 4, 2–15. PDF

> The article presents one way improve engagement and ensure motivation for students with autism spectrum disorders (ASD) during academics: use restricted interests in instruction and activities. Embedding these interests into the curriculum can motivate the student with ASD to attempt tasks that were previously less preferred or difficult. This article demonstrates how elementary, middle, and high school teachers improved academic engagement and outcomes for three students with ASD. Guidelines are provided along with numerous examples of creative ways for embedding retricted interests across subject areas and grade levels

Massaro, D. W., & Bosseler, A. (2006). Read my lips: the importance of the face in a computer-animated tutor for vocabulary learning by children with autism. *Autism, 10*, 495-510.

> This article features vocabulary learning, and the study used a picture-matching task (in the receptive component, the program presents as array of pictures, and learners have to click on the picture that depicts the vocabulary word spoken by the program; in the productive component, the program highlights a picture and learners have to say the word). The independent variable was the presence vs. absence of a character's face on screen during the task. The study found that some learners with ASD learned more vocabulary with the face than without it.

Mirenda, P. (2003). "He's not really a reader…": Perspectives on supporting literacy development in individuals with autism. *Topics in Language Disorders, 23,* 271-282.

> Many learners with autism have literacy-related skills such as print awareness and sight-word recognition, but are deemed by their teachers as "not ready" for reading instruction. Major limitations of common approaches to reading as they relate to learners with autism:

1. The Readiness Model: this model of reading instruction states that phonemic awareness and phonics are prerequisite skills for reading. However, traditional phonics programs are so decontextualized that learners with autism have considerable trouble mastering this skill.
2. Functional Reading: this approach was used to teach learners some sight words considered crucial (e.g., "exit", "enter", etc.). Often, however, the reading of these words did not extend to non-instructional situations.
3. Facilitated Communication: learners are taught to type words on a portable keyboard or whiteboard, first by a facilitator who prompts their every keystroke. Then, facilitation is faded to just wrist support, then elbow support, and so forth. Some learners with autism that did not demonstrate speech were able to learn to communicate this way.

Morrow, L., & Carnahan, C. (2010). Exemplary and balanced literacy instruction. *Quality literacy instruction for students with autism spectrum disorders*, 189-216.

Moore, M., & Calvert, S. (2000). Brief report: Vocabulary acquisition for children with autism: Teacher or computer instruction. *Journal of Autism and Developmental Disorders, 30,* 359—362.

Nation, K. (1999). Reading skills in hyperlexia: A developmental perspective. *Psychological Bulletin, 125*(3), 338-355.

The authors review studies of hyperlexia, a disorder characterized by advanced word recognition skills in learners who have cognitive and language deficits, and associated with learners diagnosed with autism. They argue that hyperlexia is on the continuum of normal reading skills and results from differences in reading-related skills such as phonological processing skills, print exposure, and memory coupled with a preoccupation with reading.

Nation, K., & Norbury, C. (2005). Why reading comprehension fails: Insights from developmental disorders. *Topics in Language Disorders, 25*(1), 21-32.

The authors review literature on the reading deficits of children with problems with specific comprehension impairment, children diagnosed with autism and children with specific language impairment (SLI). Children with specific comprehension impairment tend to have trouble making inferences and are less likely to engage in processes such as monitoring comprehension. These deficits also occur in spoken language comprehension.
Few studies have systematically examined reading comprehension in children with autism. The data available indicates that children with autism exhibit a wide-range of skills, and problems with reading comprehension is often associated with deficits in language skills. However, studies have not examined what specific underlying skill deficits contribute to poor reading comprehension in this population. Reading skills of children with SLI are also variable, and linked to language impairments, although this relationship is complex. The authors conclude by stating the need for more research to pinpoint specific aspects reading comprehension, as the process is extremely complex and reasons for poor comprehension are also likely to be very

complex. Once these are identified, specific, targeted interventions can be developed.

Nation, K., Clarke, P., Wright, B., & Williams, C. (2006). Patterns of reading ability in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 36,* 911-919.

> The authors state that the widely-held belief that learners with ASD have higher decoding abilities than their peers is based on studies that included only ASD learners who were advanced readers. In reality, there is a wide range in the decoding skills of learners with ASD (e.g., some of them read nonsense words poorly even though they are skilled at reading words). This "suggests that for some autistic children at least, reading accuracy may not be underpinned by adequate phonological decoding skills, as is the case in normal reading development" (p. 912). The issue of hyperlexia (good decoding with poor comprehension) is also reviewed and linked to ASD.

> The authors evaluated the decoding and comprehension skills of 41 ASD learners across a broader population than in previous studies. The participants' reading accuracy ranged from floor to ceiling levels, and the mean reading accuracy was within the norms for typically-developing children. Reading comprehension, on average, was 1 SD below norm, but also ranged from floor to ceiling levels.

> One interesting finding was that many of their participants had poor decoding skills as measured by their performance on reading nonsense words, yet performed well when reading real words. In non-ASD samples, there is a strong correlation between word reading and nonsense word reading, but in this sample, the correlation between the two skills was lower, suggesting that word recognition and decoding are not so correlated in learners with ASD. The difficulty of these learners to read nonsense words may indicate that they have trouble applying decoding strategies, or that difficulties in oral language common in this population are responsible for impairments in phonological processing (relatedly, ASD learners also struggle when repeating nonsense words orally). Another possibility is that the high word-reading performance is due to learners memorizing words or using visual association strategies when reading. This pattern may actually be encouraged by reading programs targeting learners with ASD that explicitly focus on repetition of familiar texts instead of phonics.

National Early Literacy Panel. (2008). *Developing early literacy: Report of the National Early Literacy Panel.* Washington, DC: National Institute for Literacy.

Nguyen, N. N., Leytham, P., Schaefer Whitby, P., & Gelfer, J. I. (2015). Reading comprehension and autism in the primary general education classroom. *The Reading Teacher, 69*(1), 71-76.

O'Connor, I. M., & Klein, P. D. (2004). Exploration of strategies for facilitating the reading comprehension of high-functioning students with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 34,* 115-127.

Like typically-developing learners, children with autism use phonetic strategies: they can decode novel nonsense words, they read regular words more easily than irregular ones, and they treat words such as "the" as single units.

The reading comprehension in this population often falls below their decoding skills and age-level norms, but not all aspects of reading comprehension are equally affected. For example, some comprehension areas are intact in this population, such as single-word reading comprehension and completing cloze tasks with a syntactically appropriate word (although not always a semantically appropriate word). However, two areas in which learners with autism struggle are pronouns and using prior knowledge to understand text.

This study used three interventions to increase the reading comprehension of learners with autism who had adequate decoding skills. The interventions were anaphoric cuing, pre-reading questions, and cloze tasks. Anaphoric cuing consisted of targeting pronouns within each story and asking learners to identify the referent of each pronoun. Pre-reading questions consisted of learners answering questions posed by the experimenter before reading the passage; the questions were intended to activate prior knowledge. Only the anaphoric cuing resulted in increased reading comprehension as measured by post-reading questions.

Panyan, M. V. (1984). Computer technology for autistic students. *Journal of Autism and Developmental Disorders, 14*(4), 375-382.

[Article abstract – don't have full text] Reviews the literature related to the use of computers with autistic individuals, noting that although only a limited number of applications have been reported, the potential of the computer to facilitate the progress of autistic persons is promising. Specific learning problems or styles associated with autism are identified and linked with the unique aspects of computer-based instruction. For example, the computer's role in improving the motivation of autistic individuals is related to its capacity to analyze the reinforcing qualities of a particular event interactively and immediately for each user. Recommendations that may enable computers to be maximally beneficial in assessing the learning process and remediating learning problems are offered, 2 of which include selecting appropriate software and integrating computer instruction within the classroom environment.

Pinto, P. Y. (2014). *Teachers' Perspectives of Research-Based Instructional Strategies and Implementation to Promote Literacy Skills for Students with Autism Spectrum Disorders: A Collection of Case Studies.* ProQuest: Ann Arbor, MI

Quill, K. A. (1997). Instructional considerations for young children with autism: the rationale for visually cued instruction. *Journal of Autism and Developmental Disorders, 27,* 697-714.

These paper summarizes characteristics of children with ASD across different domains (cognition, memory, communication, etc.), and explains why visually cued instruction (via pictographs or written words) helps these learners (explanation in terms of attention and perception). The author does not address the use of visually cued instruction in reading specifically.

Rehfeldt, R.A., Latimore, D., & Stromer, R. (2003). Observational learning and the formation of classes of reading skills by individuals with autism and other developmental disabilities . *Research in Developmental Disabilities, 24*, 333—358.

> The authors investigated whether individuals with developmental disabilities demonstrated stimulus classes after observing another individual demonstrate the prerequisite conditional discriminations, finding that stimulus class technology, coupled with the opportunity to observe another individual perform a skill, may be an economical and efficient means of teaching persons with developmental disabilities.

Sugasawara, H., & Yamamoto, J. (2007). Computer-based teaching of word construction and reading in two students with developmental disabilities. *Behavioral Interventions, 22,* 263-277.

> The participants in this study had mental retardation (ASD status not reported). The authors used a MTS task in which a picture was presented as the sample and the 2-3 (Japanese) characters that formed the corresponding words were used as comparisons. The feedback given after the selection of each character was a synthesized voice saying the sound of that character. The feedback after selecting the last character for the word depicted by the picture was a synthesized voice saying the whole word plus a visual starburst of the sample (this program seems to work very similarly to HER's ML segment, only learners build words using characters instead of building sentences using words, and, unlike the ML segment, this program only presents the characters that are needed to form the word and no other characters).

Tjus, T., Heimann, M., & Nelson, K. E. (2001). Interaction patterns between children and their teachers when using a specific multi-media and communication strategy. *Autism, 5,* 175-187.

> This study assessed the effectiveness of *Alpha* (a computer-based reading program) with children with autism in Sweden. The study did not focus on reading performance, but instead looked at children's behavior during the task (e.g., compliance, seeking help, off-task behavior) and teacher's behavior as well (comments, prompts, etc.), while comparing these variables for children with autism and children with mixed intellectual disabilities. There were no significant differences between groups. The authors elaborate on the relation between children's language level and the type of changes seen after the program (low-language children had an increase in oral expressiveness; high-language children had an increase in motivation).

Tjus, T., Mikael, H., & Keith, N. (2004). Reading acquisition by implementing a multimedia intervention strategy for fifty children with autism or other learning and communication disabilities. *Journal of Cognitive and Behavioral Psychotherapies, 4*(2), 203-221.

> [article abstract – don't have full text] This study reports on the effect of teaching fifty children using a specially developed multimedia program for computers

combined with verbal and social interactions with the children's teachers. Five groups of children (mean chronological age = 9:6 years, mental age = 7:10; and language age = 5:7) participated, children who had or were at risk for learning and language difficulties: dyslexia, hearing impairment, *autism*, deficits in attention, motor control and perception, and cerebral palsy with mental retardation. The aim was to maximise the opportunities for exploring literacy and language structures through different modes. All children used the program in addition to their ordinary *reading* and language training. A quasi-experimental design that included measures of *reading* during baseline, treatment, and follow-up periods was used throughout the study. Most children significantly increased their *reading* gain from baseline to treatment but the clearest gain was noted for the group of children with *autism*. It is concluded that a strategy that combines a motivating multimedia program with focused interactions with the teacher might improve the *reading* development in children with various learning disabilities.

Wahlberg, T., & Magliano, J. P. (2004). The ability of high function individuals with autism to comprehend written discourse. *Discourse Processes, 38,* 119-144.

This article assessed reading comprehension in adults with autism with good reading skills (they had a high school degree or higher). It provides a summary of the areas in which learners with ASD struggle in the areas of language, syntax, semantics, etc.

Westerveld, M. F., Paynter, J., Trembath, D., Webster, A. A., Hodge, A. M., & Roberts, J. (2016). The emergent literacy skills of preschool children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, np. doi:10.1007/s10803-016-2964-5

Abstract: A high percentage of school-age students with autism spectrum disorder (ASD) have reading comprehension difficulties leading to academic disadvantage. These difficulties may be related to differences in children's emergent literacy development in the preschool years. In this study, we examined the relationship between emergent literacy skills, broader cognitive and language ability, autism severity, and home literacy environment factors in 57 preschoolers with ASD. The children showed strengths in code-related emergent literacy skills such as alphabet knowledge, but significant difficulties with meaning-related emergent literacy skills. There was a significant relationship between meaning-related skills, autism severity, general oral language skills, and nonverbal cognition. Identification of these meaning-related precursors will guide the targets for early intervention to help ensure reading success for students with ASD.

Westerveld, M. F., Trembath, D., Shellshear, L., & Paynter, J. (2016). A systematic review of the literature on emergent literacy skills of preschool children with autism Spectrum disorder. *The Journal of Special Education, 50*(1), 37-48.

Abstract: A wealth of research has been conducted into emergent literacy (i.e., precursors to formal reading) skills and development in typically developing (TD) children. However, despite research suggesting children with autism spectrum disorder (ASD) are at risk of reading challenges, limited research exists on their emergent literacy. Thus, we aimed to systematically review emergent literacy

research with this population. Database searches from 1995 to 2015 yielded three articles that met inclusion criteria. Results suggested both strengths and challenges in emergent literacy skills in children with ASD. Significant links between emergent literacy skills and both oral language and nonverbal cognition were also found. The findings highlight the need for further research; future directions and implications are discussed.

Whalon, K. J., Al Otaiba, S., & Delano, M. E. (2009). Evidence-based reading instruction for individuals with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 24*(1), 3-16.

Whalon, K., Martinez, J. R., Shannon, D., Butcher, C., & Hanline, M. F. (2015). The impact of reading to engage children with autism in language and learning (RECALL). *Topics in Early Childhood Special Education, 35*(2), 102-115.

Williams, C., Wright, B., Callaghan, G., & Coughlan, B. (2002). Do children with autism learn to read more readily by computer assisted instruction or traditional book methods? *Autism, 6,* 71-91.

The authors state that the majority of children with autism need one-to-one instruction in order to show adequate learning gains. Traditional instruction methods have encountered problems with this population, such as low motivation, off-task behavior, and interfering stereotypical responses. They provide theoretical reasons why computer-delivered instruction in reading may be beneficial for children with autism, and recommend instructional environments that combine text, graphics, and voice:

1. Having to focus on a computer screen with minimal information presented may help solve the discrimination issues present in some children with autism.
2. Children with autism are more responsive to stimuli that are consistent and predictable, something that is difficult to achieve in social instructional interactions but feasible in computer-delivered instruction.
3. The immediate feedback, highly visual environment, and feasibility of extensive repetition provided by computer-delivered instruction are more compatible with these children's arousal and attention patterns.

Williams et al. (2002) evaluated the reading gains of eight three- to five-year old children with autism in book-based and computer-based instruction. The investigators used a cross-over design, switching the experimental conditions after ten weeks. They found that children spent more time on task and spoke more words during the computer condition. However, the independent variable in this study was the medium of instruction, not the program itself or its components. The computer-based instruction consisted of a digitized version of the book-based instruction. The differences between the two conditions were: in book-based instruction, learners used actual books, with pictures and artifacts that produced sounds (e.g., bells and horns attached to the pictures); they also played instructional games with cards. The computer-delivered instruction featured the same sounds (activated by clicking), plus voice-over of the story and drag-and-drop games similar to the card games of the book-based condition. Reading gains were assessed by measuring how many words (out of a list) learners could read

(i.e. used a whole-word approach). Differences in reading gains between the two conditions were negligible. The investigators found, however, that children spent more time on task and during the computer-based instruction than during the book-based instruction.

Williamson P., Carnahan C., Jacobs J. (2012). Reading comprehension profiles of high functioning students on the spectrum: A grounded theory. *Exceptional Children, 78*, 449–469. Retrieved from http://search.proquest.com/docview/1022655102?accountid=2909

Yamamoto, J., & Miya, T. (1999). Acquisition and transfer of sentence construction in autistic students: analysis by computer-based teaching. *Research in Developmental Disabilities, 20*, 355-377.

> This study used a computer program to teach Japanese learners with autism to construct sentences using verbs, subjects, objects, and grammatical particles (which in Japanese determine the syntactic role of a word). The program showed a sample picture onscreen depicting a character performing an action (which would be described using a transitive verb). Before the intervention, researchers ensured that learners could match isolated written words to pictures depicting those words (i.e. learners knew the "meaning" of each word even though they had not used them in written sentences. Learners were taught to construct a sentence that matched the picture by clicking on boxes that contained words for subjects, verbs, and objects (much like the second phase of our ML segment). The computer presented differential feedback based on the accuracy of the sentence. After using the program, learners were able to build novel sentences that described pictures with subject-verb-object combinations that had not been trained directly.

> This study used a whole-word approach whereby learners selected whole words in order to build sentences, and was more focused on teaching correct sentence structure than reading per se.

Zascavage, V. T., & Keefe, C. H. (2004). Students with severe speech and physical impairments: opportunity barriers to literacy. *Focus on Autism and Other Developmental Disabilities, 19*, 223-234.

> This article relates to learners with severe speech and physical impairments (SSPI), but has some potentially useful notes that may also be the case for learners with autism:
> - Students with multiple disabilities receive less reading instruction than their peers without disabilities, and that their reading instruction is frequently interrupted by non-instructional activities (Koppenhaver & Yoder, 1993).
> - Participants (college faculty, administrators, and parents of children with SSPI) noted several barriers to the literacy of learners with SSPI, such as
>   - segregated classrooms —learners need to be included in regular
>   - classrooms where there is more literacy diversity
>   - the readiness model that requires a minimum entry repertoire before formally teaching reading —this is an arbitrary criterion that limits the instruction received by learners

- emphasis on life/functional/social skills to the detriment of academic skills
- availability of technology to improve reading instruction, but lack of teacher preparation or need for excessive teacher training to take advantage of that technology.