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Teaching Children with Autism to Read for Meaning: Challenges and Possibilities

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Abstract

The purpose of this literature review is to examine what makes reading for understanding especially challenging for children on the autism spectrum, most of whom are skilled at decoding and less skilled at comprehension. This paper first summarizes the research on reading comprehension with a focus on the cognitive skills and processes that are involved in gaining meaning from text and then reviews studies of reading comprehension deficits in children on the spectrum. The paper concludes with a review of reading comprehension interventions for children on the spectrum. These children can especially benefit from interventions addressing particular cognitive processes, such as locating antecedent events, generating and answering questions, locating referents, and rereading to repair understanding.

Keywords

Autism spectrum disorders; Cognitive processes; Decoding skills; Reading comprehension; Reading comprehension interventions; Reading difficulties

Learning to read for understanding can be a challenging task even for typically developing children. In the general population, children are typically taught to read by “code-based” instruction or phonics instruction that helps children decode words by recognizing and manipulating sound-symbol correspondence and attending to orthographic patterns in written words (Stahl 2001). The ultimate goal is to move children beyond these word-reading processes that use up limited processing capacity so that readers can shift cognitive resources to meaning-making. For many children, this shift to reading for understanding marks the beginning of another stage in learning to read. In this stage, even fluent readers are challenged by the complex cognitive demands of reading comprehension, as texts increase in difficulty and length.

Reading for understanding is especially challenging for individuals with autism spectrum disorders (ASDs). ASDs are a cluster of developmental disorders characterized by deficits in communication and social interactions as well as cognitive processing deficits. Individuals within the spectrum exhibit a range of strengths and weaknesses, with a full range of intellectual abilities from above to below average. Those with average to above average intelligence are

sometimes referred to as “high-functioning” (Howlin 2000). Some researchers include Asperger’s Syndrome (AS) at the “high” end of the spectrum. Individuals with AS typically exhibit less severe deficits, particularly in the domain of language, than others on the spectrum (Ozonoff et al. 2000). There is considerable controversy about whether or not high-functioning autism is a separate condition from AS (Macintosh and Dissanayke 2004). In this article, we refer to the cluster of these disorders collectively as ASDs, unless there is a specific reason for differentiating these disorders.

No matter where children fall on the spectrum, children with ASDs generally demonstrate well-developed word recognition skills, but their reading comprehension is severely impaired (Nation et al. 2006). An extreme profile of word recognition skills developing in advance of reading comprehension, termed hyperlexia, is associated with autism (Grigorenko et al. 2002, 2003). Yet, such a decoding-comprehension discrepancy also occurs among struggling readers without identified disabilities (Nation et al. 2002). Grigorenko et al. (2003) recommended that the term hyperlexia be reserved for individuals with developmental disorders characterized by an unusual and early preoccupation with words as well as other cognitive and social deficits, such as those seen in children on the spectrum. This precocious ability to decode words apparently has a neural basis. One study of brain activity using functional magnetic resonance imaging (fMRI) found that hyperlexic reading is brought about by simultaneously drawing upon both the left hemisphere’s phonological and the right hemisphere’s visual processing systems (Turkeltaub et al. 2004). Yet, it is of note that the way hyperlexia was defined in this study might not be viewed as conventional; further comparable investigations are needed to support findings from this study.

Newman et al. (2007) found that children with ASD decode words by relying on the same phonological and orthographic mapping processes as typical readers. Unlike in typically developing readers, however, in children with hyperlexia, the more abstract skills of reading comprehension do not develop along with their word recognition skills. The authors and others (e.g., Nation 1999) suggest that word recognition may develop in children with ASD at an early age because of these children’s preoccupation and hence intensive practice with reading words.

Thus, children with ASDs tend to demonstrate well-developed word recognition skills in absence of corresponding skills in constructing meaning. There is evidence that poor comprehenders in both the typically developing and atypically developing populations have difficulty shifting their attention from word-level reading to text comprehension. Oakhill and her colleagues (Oakhill et al. 2003; Yuill and Oakhill 1991) have conducted an extensive research program on poor comprehenders in the typical population. In examining the factors that contribute to poor comprehension in the typically developing population, they have identified processes required for comprehension. In addition to decoding skills, skills such as text integration, metacognitive monitoring, inference making, and working memory have all been found to contribute to variability in reading comprehension ability. Other research has shown, by studying reading in children diagnosed with different developmental disorders, that word recognition skills and comprehension skills, although highly correlated, develop independently. For example, some children with dyslexia who have difficulty decoding are good comprehenders and conversely, some children who have well-developed decoding skills are poor at comprehending (Cain and Oakhill 2004; Nation 2001). Most children with ASD fall into this latter category (O’Connor and Klein 2004). For example, Nation et al. (2006) have found comprehension difficulties in more than 65% of children with ASD who had measurable reading skills. This research supports the view that reading consists of component skills and that children with developmental disorders are likely to show strengths in some areas and weaknesses in other areas.

In this paper, we briefly review the research on reading comprehension, with a focus on the cognitive skills and processes effective readers use to make sense of text. We next turn our attention to studies of reading comprehension deficits in children with ASD. We ask what makes reading for understanding difficult for these children, most of whom are skilled at decoding and less skilled at comprehension. Finally, we review interventions that have been effective in helping children with ASD gain meaning from text. We are especially interested in how successful interventions address individual differences to capitalize on strengths and compensate for weaknesses.

Componential Nature of Reading

Understanding the component skills and processes involved in reading for understanding, apart from decoding, has important implications for designing instruction in reading comprehension for all children as well as for designing interventions to strengthen reading comprehension skills in children with ASD and other developmental disorders.

In short, the development of phonological and orthographic knowledge about single words is an important foundation for reading, but word recognition alone is not sufficient for reading comprehension (Nation 2001). Skilled text comprehension is a complex process that depends on knowing the meanings of words, in addition to such skills as analyzing the syntactic and semantic structures of word combinations, drawing upon one's background knowledge to interact with the topic of discourse, applying logical inferential abilities, and relying on metacognitive structures, such as self-monitoring.

How Do Readers Understand What They Read?

Contemporary views of reading comprehension construe reading as an ongoing process in which readers interact with written text to extract and construct meaning (Snow 2002). Grounded in social cognitive theory, this interactive view of reading contrasts with the "simple view of reading" proposed by Gough and Tunmer (1986). In this earlier model, reading was defined as a product of decoding and listening comprehension. According to this theory, automaticity in word recognition and the degree of success on listening comprehension tasks should predict reading comprehension. As readers become increasingly adept at word recognition, their cognitive resources are shifted to attend to comprehension, until they can understand written text as well as spoken language. Adding to this model, Perfetti et al. (2005) identified additional complexities involved in understanding written text, including inherent differences in the nature of written and spoken language. Although Gough and Tunmer's model does not account for children with poor reading comprehension despite adequate performance in decoding and listening comprehension (Gregoriou et al. 2009), this early model was important as it considered comprehension an essential component of reading.

Thus, reading comprehension involves many correlated components (Randi et al. 2005). Reading comprehension is a complex cognitive process and the ability to understand text is dependent upon a confluence of factors. To read for understanding, readers draw upon a wide range of cognitive abilities, such as inferencing and attention, motivational strategies, such as setting a purpose for reading, and knowledge, such as vocabulary and prior knowledge of the topic (Snow 2002). Readers vary in their cognition, motivation, and knowledge levels, including background knowledge (Snow et al. 2005). It follows then that there are no simple explanations for reading deficits and no single explanation of how readers construct meaning. What then are the components of reading comprehension and how do they work together to promote understanding?

Making Sense of Text: Cognitive Skills and Processes

We turn now to a review of the cognitive skills and processes involved in making sense of text, and we consider which of these skills might be especially challenging for children with ASDs to acquire. Perfetti et al. (2005) examined how people develop reading comprehension skills. They examined the processes involved in reading written text and proposed a model consisting of two classes of processing events: (1) word identification and (2) language processing, or the assembly of words into messages. Next these authors explored higher-level factors enabling readers to go beyond the literal meaning of text. They identified three components of comprehension that were not only sources of comprehension development, but also potential sources of comprehension problems: (1) sensitivity to story structure, (2) inference making, and (3) comprehension-monitoring.

Inference making is an especially difficult skill for students to acquire. It has been suggested (Perfetti et al. 2005) that several factors may underlie the difficulties associated with inference making. For example, the authors cited limited processing resources or working memory, not knowing when to draw inferences, and failure to monitor comprehension for text coherence (i.e., focusing on words rather than global meaning).

Perfetti et al. (2005) made the argument that comprehension monitoring is prompted by a high standard for text coherence. They explained that readers who strive to make sense of what they read will be more likely to monitor and repair their understanding than readers with a low standard of coherence. They cited other factors that may also be involved in comprehension-monitoring difficulties, such as a reader's failure to detect inconsistencies at the sentence level.

The third higher-level component Perfetti et al. (2005) identified is knowledge of story structure. Although text structures (e.g., narrative, expository) can all cause comprehension problems, the authors focused exclusively on narrative text structure, citing multiple studies on this genre, which the authors claim has attracted the most attention among researchers. Although contemporary educators have called for more attention to expository text to assist young readers with difficulties associated with this genre's technical vocabulary and varying text structures (Duke 2000) narrative has received much attention in the special education literature because story presents unique challenges to children with disabilities. For example, children with ASDs are unable to determine character's motives or identify with characters' emotions or perspectives because of theory of mind deficits (Happé 1994). These kinds of deficits are not as easy to remediate as lack of vocabulary or failure to recognize a particular text structure.

In their review of reading acquisition, Perfetti et al. (2005) include vocabulary in their discussion of the processes that enable readers to convert sentences into meaningful content. Knowledge of vocabulary, of course, aids comprehension, but as these pointed out, readers also need to infer the meaning of unfamiliar words from context. Working memory and syntactic processing are also contributive to understanding.

In short, we know a great deal about the cognitive processes readers use to make sense of text. Reading comprehension research with struggling readers serves to highlight what aspects of reading comprehension are especially challenging. Because of the complexity of reading comprehension, reading understanding poses challenges to both typically and atypically developing children.

What Makes Reading Comprehension Difficult?

Approaching reading comprehension from a componential perspective, research on reading comprehension has focused components that contribute to reading comprehension difficulties. Taking this approach, Cain and Oakhill (2004) described reading comprehension difficulties

at the word-level, sentence-level, and discourse-level. At the word-level, in addition to word identification and phonological skills, vocabulary knowledge affects reading comprehension. But vocabulary development is aided by reading and vice versa. Sentence-level deficits may contribute more directly to reading comprehension failures. In this category, Cain and Oakhill (2004) include syntactic knowledge and use of sentence context. As with vocabulary development, the direction of the relationship between use of context and comprehension is unclear. At the text or discourse-level, higher level processing skills contribute to the construction of meaning. At this level, readers make inferences, use anaphoric references, recognize text structures, use context at the discourse level, and monitor their comprehension. Notably, as discussed by Perfetti et al. (2005), these higher level processes come into service as readers strive for text coherence. Put another way, these are the processing skills that enable readers to construct meaning from written text. Processes at the word-level and sentence-level are of course prerequisite to understanding the text, but it is possible to understand the meaning of a word or a sentence and still not understand the message the entire text conveys. Word-to-text integration, or connecting the meaning of a word to a representation of the text, accounts for reading comprehension differences among college students (Perfetti et al. 2008). These researchers argued that word-to-text integration involves word processing, including the ability to link word meanings appropriately in sentence contexts. They attribute deficits in text integration to limited working memory capacity and low lexical quality, or accessible knowledge of word meanings in context. These researchers hypothesize that word-to-text integration may be a passive process that is triggered when reading a word activates memory traces from prior reading. If this hypothesis is correct, then children with reading comprehension deficits at the sentence level may need scaffolds reminding them to associate newly encountered words with information in previous sentences.

The next section focuses on reading comprehension deficits in children with ASDs. We review the literature on ASDs to develop a profile of the reader with these disorders. We focus on impairments that are likely to impact the component processes readers draw upon to make sense of text, as well as areas of strength that can be used to compensate for weaknesses. We conclude this section with a discussion of narrative text, which poses particular challenges to readers with reading comprehension deficits associated with the cognitive profiles of individuals with ASDs.

The ASD Reader: Characteristics of Children with Autism Spectrum Disorders

As previously mentioned, children on the autism spectrum exhibit a range of strengths and weaknesses, suggesting that a single reading comprehension intervention may not be appropriate for all. To provide a sense of the range of characteristics and possible interventions, we have included in our review studies that target children at different points on the spectrum, including children with autism and serious cognitive deficits, as well as those with high functioning autism and Asperger's Syndrome.

For the sake of the clarity of the discussion below, it is important to point out that autism is a developmental disorder characterized by deficits in social interactions and communication (including language) skills, along with limited imagination and a tendency toward a repetitive pattern of behavior (American Psychiatric Association 1994). Asperger's syndrome (AS) is characterized by these same impairments but without language delay. Researchers have found that individuals with AS demonstrate better imaginative abilities and demonstrate more circumscribed interests than those with high functioning autism (HFA) at the age of 13, but that their early histories show more pronounced differences in language and communication development, with individuals with HFA showing more delays than those with AS (Ozonoff et al. 2000). These researchers conclude that individuals with AS and HFA have similar

cognitive and behavioral profiles but differ in degree of impairment and thus, given special education interventions, those with AS have a better chance of “catching up” to their normal peers than those with HFA. Some researchers distinguish AS from autism based on different neurological profiles (Klin et al. 1995) while others consider AS as a form of ASD indistinguishable from high-functioning autism (Macintosh and Dissanayake 2004). Researchers describe ASD on a continuum and some place Asperger’s at the far end of the continuum, considering it as a “bridge” between autism and typical development (Baron-Cohen et al. 2001). Thus, developing a single profile of the reader with ASDs is complicated by the nature of autism and the varying degree of impairment. We next discuss the cognitive profiles of individuals with ASDs and show how these profiles contribute to reading comprehension abilities and deficits.

Cognitive Profiles of Individuals with ASDs

Nonetheless, cognitive profiles of children with ASDs can provide insight into reading comprehension strengths and weaknesses. As previously discussed, individuals with autism tend to focus attention on details, or single words, rather than global coherence (Nation 1999). Thus, children on the spectrum have well-developed word recognition skills. But can these children understand the assembly of words into sentences to comprehend at the sentence level? Early research has established that children with ASD have strengths in syntactic processing and weaknesses in semantic processing (Tager-Flusberg 1997).

Other research, however, has found that children with ASDs respond to sentence comprehension tasks in a manner similar to typically developing children matched for language and cognitive development (Paul et al. 1988). These researchers found that typically developing children and children with ASD used word order in interpreting sentences but only a few children in either group used probable event strategies. It was suggested that children at this developmental level might have outgrown the need to use probable event strategies, leading to the conclusion that language acquisition in children with ASDs is delayed, rather than impaired. This may explain why high-functioning children with autism have more difficulty “catching up” to their normal peers than those with AS, where early language delays are not present. In addition, the researchers found that children with ASDs did use world knowledge in interpreting sentences. These conclusions are promising and suggest that early interventions targeting linguistic processing at the sentence level might be particularly effective in helping children with autism “catch up” to their normal peers.

Evidence from neuroscience also supports the conclusion that individuals with ASDs are able to process text at the sentence level. In an fMRI study, individuals with high-functioning autism showed more activation in the parietal and occipital regions of the brain than control subjects (Kana et al. 2006). The study concluded that individuals with autism relied more on visual imagery to understand sentences than those in the control group. These researchers suggested that thinking in pictures in order to understand sentences was an adaptation to underconnectivity because connections between frontal and parietal regions are compromised in autism. We next examine how this underconnectivity may contribute to reading comprehension deficits at the discourse or text level.

Especially when reading longer texts, memory dysfunction may contribute to reading comprehension deficits (Perfetti et al. 2005). Connecting sentences together to construct a global understanding requires memory capacity. Although high-functioning children with autism have strengths in rote memory, they have memory impairment due to poor use of organizational strategies, especially when the information is complex and requires the creation of an organizational structure to facilitate memory (Williams et al. 2006). Reading for understanding requires individuals to construct an organizational structure and schema to aid memory. In addition to memory deficits and poor organization strategies, a tendency to focus

on details makes it challenging for readers on the spectrum to connect text into a coherent whole.

It is commonly agreed that children with ASDs have “weak central coherence” or a processing style that focuses on details or individual words, making it difficult for them to understand text at the global level (Happé and Frith 2006). These authors described these children’s preoccupation with parts and their reluctance to combine the parts into a coherent whole to “see the big picture.” Reviewing the literature on central coherence, Happé and Frith (2006) rejected the view that weak coherence reflects a deficit in central processing in those with ASDs. Rather, they explained it as a superiority in local processing and a processing bias or cognitive style. The authors argued that strong and weak coherence styles may be artifacts of individual differences in the general population, but stylistic preferences in the general population can be mediated by executive function. That is, those with an “eye for detail” can extract global meaning if there is a need. In this view, individuals with ASDs represent an extreme on the local–global processing continuum. Important for the design of interventions is the authors’ conclusion that people with ASDs can process globally when the task so demands. We have anecdotal evidence that children on the spectrum can be guided to generalize a main idea in expository text by prompting them to underline repeated words in a passage and then guiding them to form a generalization.

Thus, it is possible to teach children with ASDs to capitalize on their strengths, such as their attention to detail, and to use well-developed skills to accomplish tasks that call for skills that are otherwise lacking. Based on the cognitive profiles of children with ASDs, it is reasonable to expect that they may have different ways of accomplishing tasks than typically developing children. We next provide an example of how children with ASDs might be guided to draw upon their areas of strength to make inferences, a particularly challenging reading comprehension skill.

Turning Cognitive Weaknesses into Strengths: One Example

Inference is an important skill in reading comprehension. Although children with ASD can be guided to make a generalization from parts to whole, they have difficulty with inference making at the abstract level. For example, one study found that preschool children with ASD could categorize animate and inanimate objects based on surface features (Johnson and Rakison 2006). The children tended, however, to rely on rules to support inductive inferences (e.g., things that have legs or things that have wheels), which led them to make some inappropriate categorizations (e.g., classifying a table with animals). The children with ASD were unable to categorize when the task required the formation of a prototype or abstract representation, such as what features of animate and inanimate objects that distinguish them beyond surface appearances. This study concluded that children on the spectrum are delayed in the process of concept formation, performing more like infants than typically developing children of the same preschool age. Nonetheless, the children with ASDs relied on inductive reasoning to form categories, although they did not always attend to all the defining attributes. This suggests that children with ASDs may rely on their ability to focus on details that are salient to them, ignoring other attributes that matter. Accordingly, children with ASDs may benefit from guided concept formation that calls attention to those attributes that distinguish one concept from another. Future research might investigate whether or not instruction in concept formation may guide children with ASDs to more abstract forms of reasoning and category formation based on prototypes. Thus, children with ASDs may be able to acquire more abstract reading comprehension skills through guided instruction that refocuses attention where it matters and provides appropriate models for imitation.

Abstract reasoning skills are particularly critical for reading comprehension, especially when reading narrative text. Reading expository text, such as a set of rules or directions, or

descriptions of processes, requires less abstraction than reading narrative, where readers engage cognitive processes to infer character's traits, draw conclusions, and identify causal attributes. In our experience, children with ASDs typically prefer expository text, such as science texts. This may be because they find narrative text especially challenging because of its more abstract (and social) reasoning demands. In the next section, we discuss the nature of narrative text and why narrative is especially challenging to children with ASDs.

Reading Comprehension and Narrative Text

Impairments in abstract reasoning may cause reading comprehension difficulties in expository or narrative text. Narrative text, however, may be especially challenging to readers with ASDs. Narrative is complex form of discourse that invites readers' interpretations of problems and solutions, characters' intentions and beliefs, abstract themes, and the causal chain of events contributing to plot development (Stein 1986). One reason that children with autism are challenged by narrative is that children with autism have delays in the development of theory of mind or the ability to infer intentions and emotions in others; this impairment is related to language ability (Colle et al. 2008).

Despite its challenges, understanding narrative is important in that narrative mirrors life experiences. Jerome Bruner (1985) has argued that narrative is an essential way of knowing and that children's ability to comprehend stories develops early on. Bruner also pointed out, however, that children's narratives are linear—a mere retelling of events as they occur. Most children enter elementary school with a poorly formed concept of story, which is later developed through direct and indirect instruction about story structure (Stein 1986). In many school curricula, narrative text is emphasized over expository in the early grades perhaps because children develop their knowledge of narrative genre at home through bedtime stories, and teachers then build on this knowledge base through formal instruction (Duke and Purcell-Gates 2003). The implication here is that reading and interpreting narrative may be challenging for all children, and not surprisingly especially challenging for children with ASD. Although challenging, acquiring narrative competence is important for academic success (Houston 1997).

Children with ASDs have difficulty with the pragmatic aspects of language such as communicative intentions and social contexts, and so it is not surprising that narrative presents special challenges for these children. One study examined story recall and narrative coherence to measure pragmatic language abilities among children with high-functioning ASDs (Diehl et al. 2000). These researchers found that children with ASDs were able to recall gist events but they had difficulty organizing these events into a coherent, meaningful story. The stories told by children with ASDs had fewer causal links than those told by typically developing children matched on age. Important for the design of interventions, the researchers suggested that children with ASDs may benefit from cues, such as what happened to characters in the past, to improve their understanding of causal relations. The authors also suggested that reading and understanding narrative may improve these children's social and pragmatic skills in that narrative is a reflection of life experiences.

Other research has also investigated atypical development through an analysis of narrative competence. Researchers (Capps et al. 2000) compared the narrative abilities of 13 children with autism, 13 children with developmental delays (i.e., mental retardation), and 13 typically developing children. The researchers asked the children to narrate a wordless picture book about a frog's journey. The researchers coded the children's narratives for length and evaluative elements, such as inferential causal statements, references to characters' affective and cognitive states, as well as various literary devices such as attention getters and the use of dialog.

As expected, the researchers found that children in the autistic and developmentally-delayed group made fewer causal attributions about characters' internal states and used less complex syntax than typically developing children. The researchers found correlations between theory of mind tasks and narrative qualities within the group with autism but not within the group with developmental delays, suggesting that the etiology of narrative impairment is different for each group. Because children with autism tended to identify characters' emotions without giving causal explanation of character's mental states, the researchers suggested that the story pictures may have elicited the identification of emotions based on easily recognizable facial expressions.

In Capps et al. (2000) study of narrative competence, children in all three groups used about the same number of evaluative devices to engage the listener but typically-developing children used a broader range of strategies. This suggests that children with ASDs may benefit from direct instruction in literary devices to engage the listener. The authors also suggested that future research might investigate the relationship between the level of language ability and narrative competence, raising the hope that, equipped with more sophisticated linguistic resources, children with autism might use narrative as a means of making sense of their own life experiences.

Arguing that narrative is a primary means of communication and cognition, researchers (Losh and Capps 2003) claimed that the ability to understand narrative opens "access to this rich form of interaction and can significantly affect social-emotional and communicative competence" (p. 239). Building on their previous research, Losh and Capps (2003) examined narrative ability in a high-functioning group of children with autism or Asperger's Syndrome (AS). In this study, the researchers asked children to tell personal narratives or stories about themselves and things they liked to do. As in the previous study (Capps et al. 2000), Losh and Capps (2003) asked the children to narrate the wordless picture book about a frog's journey. Stories were coded for narrative complexity and structure, as well as the use of evaluative devices. In addition to the personal and storybook narrative tasks, researchers assessed the children's theory of mind by presenting story vignettes and asking questions about the characters' states of mind. In addition to assessing theory of mind, Losh and Capps (2003) also assessed emotional knowledge through examining children's definitions of emotions as well as their labeling of emotional responses elicited by video clips.

The researchers reported surprising findings. Unlike in studies with lower-functioning children, the high-functioning children with autism or AS in this study performed similarly to the typically developing children. For example, their personal stories were of similar length and the topics of their personal narratives were similar, except that children with ASDs reported different favorite activities (i.e., computers) than typically developing children (i.e., sports). Both groups conveyed the storybook's theme. Further analyses, however, revealed more subtle differences between the groups. The children with autism or AS depended more on the experimenters when constructing their personal narratives. These children also used fewer and less diverse devices to capture the listener's attention than typically developing children. In both the storybook and personal narrative tasks, children with autism or AS made limited use of causal language.

One important finding from this study is that the ability to identify and define a range of simple and complex emotions was correlated with the measures of narrative performance, including length and syntax use. The researchers concluded that the ability to understand emotion is associated with the formulation of extended and coherent narratives. They argued that understanding narrative may both draw upon and promote emotional knowledge and they called for future research to investigate the how the relationship between narrative and social-emotional knowledge develops over time in both typical and atypical populations.

Other research has demonstrated that narrative competence reveals both linguistic and social-cognitive skills (Colle et al. 2008). These researchers investigated narrative discourse in adults with high-functioning autism and Asperger's Syndrome (AS). These researchers elicited a story retell with the same picture book about a frog's journey. However, in this study with adults, the researchers analyzed the participants' production of anaphora, such as pronoun referents, which require theory of mind (ToM) abilities, in this case, pragmatic abilities to engage the listener in the narrative. Results showed that participants with ASDs produced less coherent and less organized stories than those in the control group, although they were able to sustain a story structure and use noun or pronoun referents to introduce and reintroduce characters. Close analysis of story structure revealed, however, that participants with ASDs used fewer temporal expressions to connect events and more ambiguous pronoun referents than those in the control group. The researchers concluded that when linguistic abilities needed to rely on pragmatic knowledge (i.e., when and how to engage the listener), individuals with ASDs were not able to make appropriate use of referential pronouns and temporal expressions. The researchers called for further research to determine what aspects of language are related to ToM and which are not.

Taken together, the studies on narrative reviewed here suggest that children on the spectrum can benefit from experience with narrative and that challenges associated with understanding narrative might be overcome by instruction in literary devices, as well as prompting that focuses attention on possible causes of characters' mental states. Direct instruction that targets knowledge of emotions may also facilitate narrative understanding. For example, children with ASDs may benefit from vocabulary instruction that helps them label emotions and learn about social situations (Chan and O'Reilly 2008). Given evidence that as early as preschool-age, children with ASDs can use inductive reasoning to form categories (Johnson and Rakison 2006), future research might investigate instructional approaches such as concept attainment and concept formation to facilitate acquisition of vocabulary concepts, including vocabulary related to emotional knowledge among high-functioning children with autism. [For an example of teaching vocabulary words as concepts, see (Boulware and Crow 2008)].

In the final section, we review reading comprehension interventions that may benefit children with ASDs. After describing the current educational landscape of inclusion, we briefly review reading comprehension instructional practices in general, including those that may benefit children with ASDs, as well as those in the general population. We next review several intervention studies conducted with children with ASDs. Unfortunately, we found relatively few such studies and these studies were typically conducted with a small sample and included children with a variety of impairments.

Reading Comprehension Interventions

Among educators and parents, there is a sense of urgency for locating effective instructional interventions for children with ASDs (Eikeseth 2009; Hess et al. 2008; Howlin et al. 2009; Swiezy et al. 2008). Legislative mandates (NCLB 2001; IDEIA 2004) have focused educators' attention on reading research as guidance for teaching *all* children to read, including those with reading disabilities. In addition to federal mandates, states have enacted legislation for the identification and education of children with developmental disabilities. As one example, Connecticut's *Act Concerning the Teaching of Children with Autism and Other Developmental Disabilities* (Special Act No. 08–5) requires preservice and inservice teacher education focusing on learner characteristics and best practice pedagogy concerning the teaching of children with autism and other developmental disabilities. Recent studies on the prevalence of ASDs suggest that the prevalence rate may be increasing, especially in some regional populations (Scott et al. 2002). Among adults in the general population, population, ASD-like tendencies have been noted in mathematicians and scientists (Baron-Cohen et al. 2001). All

these reports point to a sense of urgency for the identification of effective interventions to provide individuals with ASDs with skills needed to function in society, especially given that classroom teachers are being asked to provide “evidence-based” reading instruction to an increasing number of children with autism and other developmental disorders.

Reading Comprehension Instruction

Because children with ASDs and other disabilities are expected to be “included” within the general education classroom (NCLB 2001), it seems important that reading comprehension *instruction* be an essential component of the curriculum. Unfortunately, although teachers tend to ask many comprehension questions, reading comprehension *instruction* has traditionally been neglected in schools (Durkin 1978; Pressley et al. 1998). Despite reading comprehension research that has identified skilled readers’ cognitive processes as well as effective teaching practices for developing comprehension, many teachers still do not focus directly on teaching reading comprehension strategies (Duke and Pearson 2002). At upper grade levels, the need for reading comprehension instruction may be masked by reading fluency (Nation 2001) and measures of comprehension that focus only on factual recall (Cain and Oakhill 2006). Reading comprehension instruction has received less emphasis in schools than phonics instruction, although decoding alone is not sufficient for reading. Teaching children to read for meaning is no easy task as reading comprehension involves a complex set of skills and processes and is sensitive to individual differences, often requiring different kinds of instruction for different learners (Duke and Pearson 2002). This is especially true for children with ASDs where individualized interventions may be necessary for behavior management as well as training in academic skills (Koegel et al. 2009).

Fortunately, there is a growing body of literature guiding the teaching of reading comprehension. One example is an edited volume (McNamara 2009) in which internationally recognized scholars describe reading comprehension interventions linked to theories of readers’ cognitive processes. Given the wide variety of strengths and weaknesses exhibited by children on the spectrum, it seems reasonable that reading comprehension interventions targeted for typically developing children who struggle with the complexities of reading comprehension may also benefit children with ASDs. For example, poor comprehenders are typically adept at phonological processing and word recognition, but are less skilled at attending to semantic representations (Nation et al. 2002). Similarly, children with ASDs, especially those with hyperlexia, may focus on word recognition and neglect semantic processing. Cartwright’s (2002) work on cognitive flexibility may help all children think flexibly about reading tasks, so that they attend to both phonological and semantic processing. Cartwright (2006) described cognitive flexibility exercises, which classroom teachers, parents, and paraprofessionals could use to assist children in developing reading-specific cognitive flexibility. The exercises consist of word sorts, in which readers are asked to sort a set of word cards, first based on phonological rules, such as initial consonant sounds, and then again, based on semantic categories, such as foods and non-foods.

Reading Comprehension Interventions Implemented with Children on the Spectrum

To assist teachers in choosing the types of reading comprehension interventions most likely to benefit children with ASDs, we describe the small number of reading comprehension interventions actually implemented with children on the spectrum. Given the paucity of the studies and limited implementation of these interventions, generalizing “instructional prescriptions” and guidelines is unwise. Rather, we describe several types of interventions and instructional approaches, from which professionals might select and tailor to their students’ particular cognitive profiles.

With regard to instructional approaches, there is evidence that children with ASDs benefit from direct instruction (Flores and Ganz 2007; Ganz and Flores 2009), instruction in natural settings using authentic materials and rewards (Koegel et al. 2009), usage of many support materials (Arick and Krug 1978), peer-mediated (Whalon and Hanline 2008) and parent-enhanced (Benson et al. 2008) instruction, and computer-assisted instruction (Bosseler and Massaro 2003; Moore and Calvert 2000). Although there are numerous studies of interventions for children with ASDs, surprisingly few interventions for teaching reading comprehension have been described in the literature, and most of these focus on instructional approaches, rather than interventions that target particular reading comprehension difficulties. For example, in a review of the literature on reading comprehension instruction for children with ASDs, researchers (Chiang and Lin 2007) identified only 11 studies meeting these criteria: published in English in a peer-reviewed journal and using experimental design. Of the 11 studies, only four focused on text comprehension, with the other studies focusing on sight word comprehension. Of the four text comprehension studies, three described instructional approaches (i.e., peer tutoring or cooperative learning); only one of the reviewed studies (O'Connor and Klein 2004) focused on a specific strategy to remediate a reading comprehension deficit (i.e., anaphoric cuing).

One other recent review of the literature on evidence-based reading instruction for students with ASDs (Whalon et al. 2009) reported on 11 reading intervention studies, 5 of which focused exclusively on reading comprehension or “meaning-focused” interventions. The other studies reviewed focused on decoding or multiple components of reading. Included among the “meaning-focused” interventions were studies of instructional approaches, such as collaborative learning activities in which peers quizzed each other on vocabulary and factual recall or played games based on reading materials. Instructional approaches that consist of reviews and rote activities focus on practicing skills, rather than *teaching* skills to scaffold the cognitive processes involved in reading for meaning. Of the five meaning-focused intervention studies reviewed by Whalon et al. (2009), only two investigated interventions targeting reading comprehension processes: anaphoric cuing (O'Connor and Klein 2004) and reciprocal questioning (Whalon and Hanline 2008). These two studies are important in that they describe interventions intended to scaffold the underlying cognitive processes involved in reading for meaning.

The first of these studies (O'Connor and Klein 2004) measured the reading comprehension of 20 adolescent students with ASDs. In a within subjects design, students read passages under four conditions: answering prereading questions, completing cloze sentences, identifying anaphoric references, and reading only. In the anaphoric cuing procedure, students were given a passage with the anaphora or “shortcuts” underlined and they were asked to choose the correct referent, given three choices listed under the underlined “shortcut.” Results indicated that anaphoric cuing significantly increased students’ understanding of the passage. These results are consistent with research that found students with ASD can benefit from prompting or calling their attention to relevant details (Wang et al. 2007). Interestingly, O'Connor and Klein (2004) also reported individual differences. For example, the reading comprehension of students with high-functioning autism appeared to be undermined by the prereading intervention, but improved somewhat by the cloze procedures. The authors reported these individual difference results cautiously because of the small sample, but nonetheless, these findings suggest the need for future research on individual differences in autism interventions.

The second reading comprehension intervention study (Whalon and Hanline 2008) investigated the effect of reciprocal questioning comprehension strategy among three students with ASDs and nine general education students in the early elementary grades. In cooperative pairs (each student with ASDs paired randomly with one of three general education students), children were taught to generate and respond to questions, using a story map framework. The

authors reported that all three children with ASD increased the frequency of unprompted question generating and responding from the baseline to the end of the intervention. The authors noted that both participants with ASDs and their general education peers, however, required more prompting when generating and responding to inferential questions than when stating facts from the story. Notably, this intervention, as with other interventions for children with autism, relied on peer-tutoring or cooperative learning, affording children with ASDs the opportunity to develop their language skills in a social setting.

Among promising instructional approaches for teaching children with autism, direct instruction has been effective in teaching oral language skills (Ganz and Flores 2009). In this study, three elementary school children were taught to identify materials out of which common objects were made. Using common objects, such as a shirt, a paper napkin, or a leather shoe, the researchers provided direct instruction that included modeling of correct responses, signals to cue students, choral student responses, and correction procedures for incorrect and non-responses. The researchers began instruction using actual objects, then used representations (pictures), and finally moved instruction to the abstract stage using words only. The researchers concluded that students increased their expressive language skills, based on an increasing number of correct responses to probes posed throughout instruction. The researchers also reported that one student spontaneously used language skills at home and at school, asking others to identify objects made of different materials. This study is significant in that it demonstrates that children with ASDs can be guided to more abstract uses of language through direct instruction. Deficits in oral language may contribute to reading comprehension difficulties (Nation and Norbury 2005).

Direct instruction is an approach that can address both reading comprehension and oral language skills (Flores and Ganz 2007). Flores and Ganz (2007) investigated delays in the components of reading comprehension in individuals with ASD and other developmental delays and implemented an intervention that used direct instruction to address those components. Four elementary students participated in the study, two of whom were diagnosed with an ASD. The researchers used a direct instruction reading comprehension program to teach three “thinking operations” (p. 250) or components of reading comprehension: statement inference, using facts, and analogies. Consistent with the direct instruction approach, the researchers modeled the skills, guided the students to practice the skills, and then asked the students to perform the skills independently. The researchers used probes to assess students’ comprehension throughout the study. Notably, the “using facts” condition required the students to decide whether particular events were caused by facts from the scenarios read aloud to the students. For example, after a scenario describing someone slipping in a hallway, students provided that fact that “wet floors are slippery” (p. 247). The researchers reported that all four students reached criterion on all three aspects and maintained their performance after instruction ended, for at least 1 month. Although these researchers investigated only a small sample, the study suggests that students with autism might be led to identify causality through direct instruction. The study is significant in that the intervention targeted specific reading comprehension skills thought to be especially challenging to individuals with autism. The studies of direct instruction (DI) interventions (Flores and Ganz 2007; Ganz and Flores 2009) demonstrated how the DI approach can be used effectively to teach and scaffold the underlying cognitive processes associated with reading comprehension. Likewise, collaborative learning and peer tutoring can be used to scaffold particular reading comprehension skills, as demonstrated by Whalon and Hanline (2008), or can be used to practice and review reading materials.

Collaborative learning and peer tutoring may assist children with ASDs to develop social and communication skills, but many children with ASDs prefer to work alone; they tend to avoid interactions with people. Thus, one promising instructional tool is computer-based instruction,

which can be tailored to individual needs. As one example, we review a computer-based vocabulary intervention.

Teaching Vocabulary

Vocabulary knowledge serves an important role in reading comprehension. Although children with autism have strengths in rote memory, they have difficulty in acquiring more abstract concepts, such as emotions (Losh and Capps 2003). In one study, an intervention targeting vocabulary development was delivered through a computer-animated tutor to eight children with autism (Bosseler and Massaro 2003). Lessons were delivered by a talking head (“Baldi”) enabling visible speech and showing emotion and intention in face-to-face communication. Presentation of the vocabulary words initially included captioned pictures accompanied by Baldi’s speech; at the end of the tutorial, visual scaffolds were faded, requiring the child to rely on auditory speech alone. The researchers assessed children’s vocabulary development both within the context of the computer program and later within a natural setting, away from the computer. Results indicated that these children were able to apply their knowledge of target vocabulary in other contexts. Interesting, the vocabulary included a range of concrete and abstract nouns as well as verbs and prepositions. Five lessons focused on adjectives describing emotions. The lessons showed a person displaying each emotion and different faces were used to show the same emotion, requiring the children to recognize the same emotion on different faces. The same strategy was used to teach opposites, such as *big* and *little*. The children were shown different big and little objects, requiring generalization of the concept across objects. This study not only highlights the potential of computer-delivered instruction for children with autism, but also demonstrates that children with ASDs can be taught abstract concepts, including emotions, which contribute to reading for meaning.

Conclusion

Reading *comprehension* is an important skill for all children to acquire. Understanding language, whether in written or oral discourse, is essential for communicative interactions. Although individuals with ASDs are typically delayed in language development, experience with written text may actually facilitate the acquisition of language skills. For example, written text is visual and “permanent” in the sense that readers can return to important details and reread to repair understanding and construct meaning. It is logical to suggest that the permanent nature of written text is especially important for individuals with memory impairments, who may easily lose track of a speaker’s narrative, without the ability to return to previous statements, as readers can do. One example of the advantage of written text can be found in O’Connor and Klein’s (2004) study of anaphoric cuing. When the reader’s attention is focused on the necessity of locating referents, the written text provides a stable context for locating the relevant words. Unlike in oral language contexts, where the recipient (in this case, listener) cannot return to the spoken medium to extract relevant details, the reader can return to the text and reread for meaning. Likewise, the speaker, unlike the writer, cannot easily provide referents for the listener, without anticipating the listener’s needs before he utters. Thus, individuals with autism, who are not adept at recognizing others’ thoughts, are especially challenged to provide appropriate referents for their audience when they tell stories (Losh and Capps 2003). But, given written text, individuals with ASDs can be prompted or reminded to read for meaning, to locate antecedent events that caused subsequent events, to generate questions and read to find the answers, reread to repair understanding, to locate referents, and so forth.

Although there have been relatively few studies evaluating interventions addressing the particular cognitive processes that make reading for meaning challenging for individuals with ASDs, the results of these few studies are promising. Children with ASDs, through instructional approaches such as DI, collaborative learning, and computer-assisted instruction, can be taught

to engage the cognitive processes that undergird reading for meaning. Individuals with ASDs might especially benefit from more research and development to design and evaluate interventions specifically addressing the processes and skills that contribute to reading for understanding. Given the wide range of strengths and weaknesses exhibited among the individuals with ASD, it is reasonable to assume that parents and educators will look to researchers to provide a wide range of interventions to target individual needs.

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