The relation between text reading fluency and reading comprehension for students with autism spectrum disorders

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**ARTICLE INFO**

**Keywords:**
Higher functioning autism
Reading comprehension
Reading fluency

**ABSTRACT**

Deficits in reading comprehension have been well documented in individuals with autism. Researchers have begun to identify predictors of reading comprehension; we sought to add to this knowledge base by investigating the role of text reading fluency in the prediction of reading comprehension in a sample of individuals with higher functioning autism (HFASD). A comprehensive reading battery was administered to students with HFASD (\(N = 68\)) and age-matched typically developing (TD) students (\(N = 38\)). Significant differences were detected between the HFASD and TD samples on every reading measure, favoring the TD sample. Structural Equation Models with the HFASD indicates that text reading fluency significantly predicts reading comprehension above and beyond the contribution of other reading variables which have been shown to be significant predictors in previous studies. This finding has important implications for the treatment of reading deficits in individuals with HFASD.

1. Introduction

The importance of understanding the course, nature, and treatment of autism spectrum disorders (ASD) during the early preschool years is often emphasized (Mundy & Crowson, 1997; Dawson, 2008). Yet, it is not clear that preschool research alone can lead to a complete understanding of the neurodevelopmental course, or treatment, of this heterogeneous disorder. In part, this is because many children affected by higher functioning ASD (HFASD) are identified after the preschool period (Daniels & Mandell, 2014). Furthermore, a noteworthy phase of neural plasticity and frontal cortical organization occurs between 8 and 16 years of age, which is associated with significant changes in social-cognition, communication, executive mental faculties, and behavior (Best, Miller, & Jones, 2009; Paus, 2005; van den Bos, van Dijk, Westenberg, Rombouts, & Crone, 2011). This marks a post-preschool period of vulnerability for children with neurodevelopmental disorders, including those with ASD (Crone, 2009; Luna, Doll, Hedges, Minshew, & Sweeney, 2007); this period has potential to be critical for both behavioral and academic development. Extant data suggests that between 35% and 80% of samples of students with ASD display difficulties in one or more components of literacy development, which is lower than expected based on their IQs (Estes, Rivera, Bryan, Cali, & Dawson, 2011; Huemer & Mann, 2010; Jones et al., 2009; Mayes & Calhoun, 2008; Nation, Clarke, Wright, & Williams, 2006). Underachievement in one specific literacy domain, reading comprehension, is one of the most frequent and pernicious domains of academic learning impairment displayed by students with ASD (Huemer & Mann, 2010; Jones et al., 2009; Mayes & Calhoun, 2008; McIntyre et al., 2017; Randi, 2017).
Newman, & Grigorenko, 2010; Ricketts, 2011; Whitby & Mancil, 2009); there is a convergence of evidence that 35% to 58% of students identified with ASD have difficulties with reading comprehension. This current study investigates reading comprehension and its subcomponent skills in a sample of individuals was HFASD in order to better understand its developmental patterns and areas of difficulties in this population.

Reading comprehension is a multifaceted process that requires successful integration of a wide range of capacities and abilities; these processes include a variety of cognitive abilities, including early decoding skills, motivation, and linguistic abilities. One pertinent hypothesis is that the cognitive impairments related to the social communication deficits that characterize ASD overlap with the cognitive demands of reading comprehension. In other words, reading comprehension is a receptive social communication skill that develops in the school age years of childhood and its impairment may be an important part of the cognitive and social communication phenotype for a substantial subgroup of individuals with ASD (Jones et al., 2009; McIntyre et al., 2017; Norbury & Nation, 2011; Randi et al., 2010; Ricketts, 2011). In addition to the social communication deficit hypotheses of reading comprehension for individuals with ASD, there may also be other underlying subcomponent skills important for reading development that impede successful reading comprehension for students with ASD.

2. Reading development in individuals with ASD

Recent attempts to synthesize research investigating impairments in reading comprehension among individuals with ASD have emerged in the literature (Randi et al., 2010; Ricketts, 2011; Whalon, Al Otaiba, & Delano, 2009). This new emphasis on research related to reading impairments in ASD reflects the recognition that the development of adequate reading comprehension, by the end of elementary school, is essential to subsequent academic achievement, cognitive development, and ultimately vocational success (Ricketts, 2011). Hence, research that provides a deeper understanding of the development of the necessary skills with the intent to prevent or reduce reading comprehension impairments is crucial to the comprehensive treatment of ASD.

Simple View of Reading. Recent empirical investigations of the development of reading comprehension in samples of students with ASD have relied upon the Simple View of Reading (Huemer & Mann, 2010; Randi et al., 2010; Ricketts, 2011). The Simple View postulates that reading comprehension is the product of word decoding and linguistic comprehension. Decoding is an individual's ability to accurately read single words; this requires the ability to map speech sounds onto single letters and letter combinations, and to use this knowledge to accurately read words. Linguistic comprehension refers to an individual's ability to understand spoken language. The Simple View has been used in two important ways in the reading literature when investigating reading development in samples of students with typical development. First, the Simple View has been used as a theoretical framework by which researchers have modeled empirical data to understand the development of reading comprehension. Empirical data highlights the importance of word decoding when children are younger; linguistic comprehension becomes the more salient predictor of reading comprehension in middle elementary years and later (e.g., Kendeou, Van den Broek, White, & Lynch, 2009; Storch & Whitehurst, 2002; Vellutino, Tunmer, Jaccard, & Chen, 2007). Second, researchers have used the Simple View to profile struggling readers (Catts, Hogan, & Fey, 2003; Gough & Tunmer, 1986), demonstrating that reading comprehension challenges may be the result of poor linguistic comprehension, poor word decoding, or difficulty with both of these skills.

In the ASD reading literature, The Simple View has also proven to be a useful framework; multiple studies have shown that both word decoding and linguistic comprehension impairments help explain reading comprehension difficulties in ASD samples (Nation et al., 2006; Norbury & Nation, 2011; Ricketts, Jones, Happé, & Charman, 2013). However, evidence suggests that while word decoding and reading comprehension were associated in samples with ASD, the correlation was lower than in typically developing samples, due to a higher incidence of a discrepant profile characterized by adequate word reading alongside poorer comprehension in many children and adolescents with ASD (e.g., Jones et al., 2009; Nation et al., 2006). Some studies have reported adequate single word decoding for individuals with ASD (Brown, Oram-Cardy, & Johnson, 2013; Huemer & Mann, 2010; Jones et al., 2009; Nation et al., 2006), others have demonstrated considerable heterogeneity in word decoding, associated with supporting language and phonological skills, in their samples (Åberg & Sandberg, 2012; Henderson, Clarke, & Snowling, 2014; Nation et al., 2006; White et al., 2006). Linguistic comprehension skills have been shown to predict word reading and reading comprehension skills in children with ASD (Brown et al., 2013; Lindgren, Folstein, Tomblin, & Tager-Flusberg, 2009; Lucas & Norbury, 2014; Norbury & Nation, 2011).

One critique of the Simple View is that the framework does not take into account additional ability domains that have been shown to be important in the prediction of reading comprehension; one of these is measured in terms of oral reading fluency. Oral reading fluency involves the cognitive and motor functions that enable the oral translation of text with speed and accuracy (Adams, 1990; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Wolf & Katzir-Cohen, 2001), resulting in automatic reading of connected text. Oral reading fluency goes beyond basic word decoding as decoding assessments simply measure accuracy of word reading, not the automaticity of reading words. Furthermore, oral reading fluency measures an individual's ability to read connected text, not single word reading. While theories differ slightly on the relation between word decoding, reading fluency, and comprehension, in general, theories suggest that the significant relation is due to the allocation of attentional stores (Fuchs et al., 2001; LaBerge & Samuels, 1974; Posner & Snyder, 1975). Reading comprehension demands considerable cognitive resources, therefore, it is likely the rate at which words are recognized is an important consideration in successful reading comprehension. Specifically, it is theorized that individuals who are skilled at oral reading fluency free up cognitive capacity for higher-level comprehension of text, perhaps, more specifically, in formulating inferences about text while reading (Thurlow & van den Broek, 1997). The verbal efficiency theory (Perfetti, 1985) suggests that the cognitive system has limited capacity to both decode words and extract meaning at the same time. This would suggest that it is important for word decoding to become automatic, or as it is often referred to, fluent, in order for an individual to fully attend to extracting meaning from written text. If word decoding is accurate, but not automatic or fluent, it is possible that the
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