

The Reading Profile of a Child with Autism: Theoretical Implications

by

Keira Chivawne Ogle  
B.A., University of Guelph, 2004

A Thesis Submitted in Partial Fulfillment of the  
Requirements for the Degree of

MASTER OF ARTS

in the Department of Educational Psychology of Leadership Studies

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University of Victoria

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### ABSTRACT

The present study examined the utility of the simple view of reading (Gough & Tunmer, 1986) in explaining the reading profile in one case of autism. A case study design was employed to describe reading decoding, reading comprehension, and oral language comprehension using parent interviews, direct observations, and standardized and experimental measures. A twelve year-old girl with autism, CG, relied on a visual approach when decoding rather than a phonological or semantic approach. She demonstrated the greatest ease with literal and vocabulary-based comprehension. Syntactic knowledge and cohesive inferential comprehension were also well developed. CG was able to integrate real world knowledge only when the requirements were explicit. She had the most difficulty with pragmatic language and evaluative inferences. While the simple view was consistent with CG's case, this model was not helpful in understanding her reading profile due to its broader skill focus as opposed to a component skill focus.

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### **Acknowledgements**

I would like to express my sincerest gratitude to several people who guided and supported me as I completed my thesis. For Dr. Gina Harrison, who worked with me to shape my vision of this research project and whose dedicated and thoughtful guidance helped me complete a work that I feel proud of, I am very thankful to have had you helping me. I would also like to thank Dr. Jillian Roberts, whose advice throughout the process has been critical in the direction that this research has taken. Thanks also to Megan, who made writing this paper fun, when it might have been difficult, and without whom I would have missed many deadlines. Finally, I wish to thank Adam and Camryn from the bottom of my heart for their help in many practical ways and for their support and encouragement throughout this entire process.

## **Chapter 1**

### **Introduction**

#### **Rationale**

The present study will explore the theoretical and practical implications of the literacy profile evidenced in a case of childhood autism. Autistic disorder is a developmental disorder that affects 0.1% of the population (Gillberg, 2005). Recently, the question has been raised as to whether autism is a spectrum, with variations of a single disease, or a syndrome, with a common phenotype expressed by many different underlying diseases (Coleman & Betancur, 2005). A review of genetic research over the last 10 years suggests that autistic disorder is most accurately represented as a syndrome, which reflects a variety of underlying diseases, each perhaps with a different neuropathological mechanism (Coleman & Betancur, 2005). In light of this research, the utility of identifying one single explanation of autism has been questioned (Happé, Ronald, & Plomin, 2006). The identification of a consistent and comprehensive phenotype, however, would provide critical information as to how so many different diseases could lead to the same group of symptoms.

According to the DSM-IV-TR, the common phenotype is currently represented by the diagnostic criteria for autistic disorder and includes a triad of impairments: qualitative impairments in social interaction, qualitative impairments in communication, and restricted, repetitive, and stereotyped patterns of behaviour, interests, and activities (American Psychiatric Association, 2000). Frith and Happé (1994) discuss the importance of considering, as part of the phenotype, consistently documented, non-triad symptoms of autism. These include a restricted repertoire of interests, obsessive desire for sameness, preoccupation with parts of objects, and islets of ability. They also note that it is important to consider the occurrence of savant abilities

and excellent rote memory in some individuals with autism. The documentation of this consistent cognitive profile has been essential in the evaluation of theories of autism and in the creation of effective interventions.

While there is a dearth of research on the cognitive profiles of individuals with autism, there is a similar paucity of research on reading profiles in this population. Reading is the cornerstone to the majority of educational programs (Mastropieri & Scruggs, 1997) and, as such, creating interventions to target reading in children with autism is critical. Documenting a pattern of reading abilities will be essential to creating effective and specific educational interventions. This documentation will also be essential to consolidating a comprehensive profile of the abilities of individuals with autism to evaluate theory and identify possible neurological mechanisms responsible for the *full* pattern of symptoms evidenced in individuals with autism.

### **Statement of the Problem and Overview of the Study**

Currently the research on the reading profiles of individuals with autism suggests that this population consistently demonstrates a reading pattern characterized by impairments in comprehension relative to word level decoding abilities (Nation, Clarke, Wright, & Williams, 2006). A number of researchers (Dunn & Bates, 2005; Frith & Snowling, 1983; Nation et al., 2006) have suggested that this pattern can be most parsimoniously explained by the theory of central coherence, which posits that individuals with autism see the parts rather than the wholes (Frith, 1989). It is problematic to conclude that the discrepancy between word level decoding and reading comprehension can be attributed to deficits in central coherence as these two skills draw on different cognitive resources, not simply different levels of central coherence.

The simple view of reading (SVR) posits that reading comprehension is the product of decoding ability and oral language comprehension. According to the SVR, difficulty with

reading comprehension compared to word level decoding is the result of difficulty with oral language comprehension. While the SVR has been found to account for individual variation in reading ability among typically developing individuals (Hoover & Gough, 1990), individuals with reading disabilities (Catts & Hogan, 2003), and individuals with specific reading comprehension difficulties (Catts, Adolf, & Weismer, 2006), no research to date has explored the utility of the SVR in explaining the reading profile of individuals with autism.

The present study was, therefore, designed to comprehensively document the literacy profile in one case of childhood autism. Of particular interest was the utility of the SVR model in describing the literacy profile presented by this case. In order to examine this question, several measures assessing word level reading, reading comprehension, and oral language comprehension were administered to a child with autism. The data collected from the assessments was used to qualitatively analyze how well the reading profile evidenced by this child fit the SVR model.

## Chapter 2

### Literacy Profiles in Individuals with Autism

#### Overview

This chapter will first propose that in order to explore the reading profile of individuals with autism, researchers would benefit from a model that most parsimoniously accounts for variation in the reading abilities of this population and for the consistent pattern of abilities demonstrated by this population. The current explanatory model being considered by researchers is the model of central coherence (Frith, 1989). An investigation of the utility of the SVR (Gough & Tunmer, 1986) is potentially more fruitful for informing future research on the reading abilities of children with autism and for informing interventions aimed at improving reading abilities in this population.

In order to investigate the possible utility of the SVR, this chapter will elucidate and evaluate current research on the reading abilities of individuals with autism, as well as identify gaps in the research that require further investigation. A review of research will begin by situating the proposed study within its conceptual framework, the SVR. The SVR posits that reading comprehension is the product of word decoding and oral language comprehension (Gough & Tunmer, 1986). To address these areas, the research exploring word level decoding in this population will first be reviewed, followed by research on reading comprehension, and, finally, on oral language comprehension. A review of the research on literacy skills in individuals with autism will reveal great variability in skill across this population. It will also demonstrate that individuals with autism consistently demonstrate a reading pattern characterized by impairments in comprehension relative to word level decoding (Frith & Snowling, 1983;

Mayes & Calhoun, 2003; Nation et al., 2006; Rapin & Dunn, 2003). The possible theoretical implications of this profile will be considered.

### **The Simple View of Reading**

Gough and Tunmer (1986) introduced the SVR, a model that posits that reading ability, defined as reading comprehension, is the product of skill in two components: decoding ability and oral language comprehension. According to this view there are four types of readers: (1) skilled readers, who demonstrate skilled oral language comprehension and skilled decoding; (2) poor readers, who demonstrate poor oral language comprehension and poor decoding; (3) individuals with dyslexia, who demonstrate skilled oral language comprehension and poor decoding; and (4) individuals with hyperlexia, who demonstrate poor oral language comprehension and skilled decoding. Table 1 illustrates these four types of readers.

Table 1

#### *Subtypes of readers*

	<b>Skilled Decoding</b>	<b>Poor Decoding</b>
<b>Skilled Oral language Comprehension</b>	Skilled reader	Individuals with dyslexia
<b>Poor Oral language Comprehension</b>	Individuals with Hyperlexia	Generally poor readers

Hoover and Gough (1990) examined whether the SVR could account for various patterns in the development of reading in 254 primary school students over the course of five years. Data was gathered through multiple yearly assessments of reading, language, and cognition. For all grades, their results supported three predictions that were drawn from the SVR. Firstly, advances in either oral language comprehension or word level decoding will result in improved

reading ability. Secondly, within individuals with reading difficulties, skill in one component will be accompanied by deficits in the other. For example, skill in oral language comprehension will be accompanied by deficits in decoding or skill in decoding will be accompanied by deficits in oral language comprehension. Finally, if an individual has poor decoding skills and poor oral language comprehension skills, an improvement in their oral language comprehension will not completely remediate their reading difficulties.

The SVR has been found to account for individual variation in reading ability among typically developing individuals (e.g., Hoover & Gough, 1990), individuals with reading disabilities (e.g., Catts & Hogan, 2003), and individuals with specific reading comprehension difficulties (e.g., Catts, Adolf, & Weismer, 2006). The success of the SVR in explaining variation in reading ability has led researchers (e.g., Catts & Hogan, 2003; Roberts & Scott, 2006; Savage, 2001) to recommend that this model be used to guide the assessment and remediation of reading difficulties.

Adopting the SVR model for assessment and remediation of reading difficulties in individuals with autism is premature, as no research to date has addressed the utility of this model in explaining the influence of language and decoding on overall reading ability for individuals with autism. The following documented literacy profile of individuals with autism, however, suggests that this model might be effective in explaining the reading abilities of this population.

### **Word Level Decoding**

**Word level decoding and the simple view.** The SVR posits that reading comprehension is the product of skill in word level decoding and skill in oral language comprehension. Research on the cognitive processes involved in word reading identifies the use of two routes as critical to

successful word level reading: the phonological route and the orthographic route (Henderson, 1982). The phonological route involves both phonological awareness and knowledge of phoneme-grapheme conversion rules (Siegel, 2003). Phonological awareness refers to the ability to perceive, distinguish, and manipulate the distinct sounds that we use to construct language. For example, an individual with skilled phonological awareness would be able to identify that the word 'chat' has three phonemes (the sounds made by 'ch', 'a', and 't') (Ehri, et al., 2001). While phonological awareness allows individuals to break down oral language into its smallest units of sound, its phonemes, knowledge of phoneme grapheme conversion rules allows the reader to associate those units of sound with a letter or group of letters (i.e. its graphemes) (Siegel, 1993).

In addition to using the phonological route, readers may read using the orthographic route. Using the orthographic route involves reading by directly accessing a word, letter, or letter sequence from an internal visual store in lexical memory (Berninger, 1990). Research on the word level reading skills of individuals with autism has explored phonological awareness, knowledge of phoneme grapheme conversion rules, and orthographic awareness. To comprehensively assess the word level decoding skills in this population it is essential to explore all of these areas.

**Phonological awareness.** Research has provided extensive evidence of the importance of phonological awareness to reading. Share, Jorm, Maclean, and Matthews (1984) investigated the sources of variance in reading ability in 543 kindergarten students. They found that phonological awareness was the skill most highly correlated with reading. Moreover, in a regression analysis, phonological awareness was the most accurate predictor of reading ability.

Frith & Snowling (1983) compared the phonological abilities of 8 individuals with autism

with 19 typically developing individuals without autism. The participants were between the ages of 9 and 17. To measure phonological processing, the researchers asked students to read sentences containing a nonword that ends in a vowel and a final 's'. In half of the sentences the nonword was marked as singular, as in 'I like to fly in a gakis', and in the other half the nonword was marked as plural, as in 'Twenty gakis lived in a box'. Individuals who are skilled in phonological processing pronounce the 's' in the singular nonword as an unvoiced form, as in bus, and the plural nonword in a voiced form, as in buses. Researchers found that individuals with autism performed no differently than individuals without autism in this task and concluded that phonological processes are not impaired in individuals with autism.

Subsequent researchers have challenged Frith and Snowling's (1983) conclusion that phonological processing is unimpaired in individuals with autism. Hooper, Poon, Marcus, and Fine (2006) recently assessed phonological processing in 23 individuals with high functioning autism with a mean chronological age of 9 years 6 months. Individuals were considered high functioning if they were assessed with a full scale IQ greater than 70. Researchers found that 26% of their sample fell below the 10<sup>th</sup> percentile on a measure of phonological processing. Their results demonstrated that phonological processing deficits are evidenced in high functioning, older individuals with autism. Contrary to the conclusions made by Frith and Snowling (1983), Hooper and colleagues (2006) suggested that phonological processing can be an area of difficulty in individuals with autism. Moreover, difficulty with phonological processing was demonstrated in high-functioning individuals with autism, suggesting that even when controlling for intellectual functioning some individuals with autism have difficulty with phonological processing. One notable difference between these two studies was that Frith and Snowling (1983) controlled for reading age while Hooper and colleagues (2006) controlled for

intellectual functioning. It is possible that individuals with autism who have higher reading abilities do not demonstrate phonological processing difficulties whereas individuals with lower reading abilities do experience phonological processing difficulties. This possibility is consistent with the finding (Share et al., 1984) that phonological processing is critical to the development of reading.

Rapin and Dunn (2003) assessed the phonological processing abilities of two separate cohorts of young children with autism. They did not control for reading level or intellectual functioning. In the first cohort, 299 children with autism were assessed, with a mean age of 3 years 6 months. In the second cohort, 197 children with autism were assessed, with a mean age of 5 years 2 months. In the first cohort, the results revealed that 63% of the children had deficits in phonological processing. In the second, slightly older cohort, 59% of the children evidenced deficits in phonological processing. Consistent with Hooper and colleagues (2006), Rapin and Dunn (2006) found that many individuals with autism do demonstrate impairments in phonological processing. There were three notable differences in their samples. First, the sample size reported in Rapin and Dunn's (2003) research was much greater than that used by Frith and Snowling (1983). Second, Frith and Snowling (1983) controlled for reading ability whereas Rapin and Dunn did not. Finally, while Rapin and Dunn (2003) assessed young children, Frith and Snowling's sample was composed of individuals between the ages of 9 and 17.

This research suggests that phonological processing is impaired in many individuals with autism, both high functioning and low functioning, and across the developmental stages. These impairments, however, are not universal across the population. While we know that, as a group, individuals with autism demonstrate more difficulty with phonological processing than typically

developing individuals, researchers have not investigated their phonological processing relative to their other reading skills. Is phonological processing as important to the development of reading in individuals with autism as it is in the general reading population? The current study will explore this question.

**Single word reading.** In addition to exploring phonological processing, researchers exploring the literacy profiles of individuals with autism have examined their knowledge of grapheme phoneme conversion (GPC) rules and orthographic awareness. Both of these skills are used when reading words.

Research on reading in children with autism has drawn from two contrasting theories of how knowledge of GPC and orthographic awareness interact to facilitate word level decoding. The first is the dual route model, which proposes that there are two possible dissociable routes that can be employed to decode words: the phonological route, where knowledge of GPC rules is used to translate a graphemic code into a phonemic code, and the orthographic route, where the word is recognized by accessing its letter sequences or entire sequence from memory (Coltheart, 1981).

According to the dual route model, researchers can identify the route that individuals are employing by examining the difference between their performance on reading exception words and nonwords (Coltheart, 1981). Exception words are words that do not follow predictable GPC rules (i.e. sure) and nonwords are a string of letters that can be read using GPC rules but are not real words (i.e. blat). This model predicts that the reading of nonwords cannot be attributed to direct access to the visual appearance of words in memory (lexicon) as there would be no representation of the word in the lexicon. As such, skilled performance in nonword decoding would demonstrate consolidated knowledge of GPC rules.

While the dual route model proposes that skill in exception word and nonword reading could completely dissociate, Harm and Seidenberg (1999) propose a connectionist, single route, model, whereby learning to read relies on the mapping of orthography to phonology. This mapping is facilitated by phonological representation. According to their model the pronunciations of nonwords are obtained through the lexicon by analogy to real words sharing orthographic characteristics. For example, 'tain' could be pronounced through analogy with 'stain'. Research on the word level decoding skills in individuals with autism has primarily focused on whether individuals with autism show a discrepancy between their performance on reading real words as opposed to nonwords in order to determine whether they evidence more difficulty with the phonological route or the orthographic route.

Frith and Snowling (1983), in a study that was reviewed previously, investigated the performance of 8 individuals with autism on word reading and nonword reading measures. Their performance was compared with a group of 10 typically developing individuals and 10 individuals with dyslexia. These researchers found that individuals with autism and typically developing individuals performed better in measures of word recognition than nonword decoding. Moreover, these two groups did not differ significantly from one another. While performance was better for words than nonwords in this group, this pattern did not deviate from the norm and, therefore, neither word nor nonword decoding was impaired in this sample of individuals with autism. The sample was small and composed only of individuals with a reading age between 8 and 10 years and, consequently, the conclusions drawn from this sample cannot be generalized to all individuals with autism.

Nation and colleagues (2006) investigated the performance of a more representative sample of individuals with autism on word reading and nonword reading measures. Their

sample included 41 individuals with autism between the ages of 6 and 15. Consistent with research by Frith and Snowling (1983), students in this study performed better on word recognition measures than on nonword decoding measures; however, Nation and colleagues (2006) found that the reading pattern evidenced by individuals with autism did differ from the norm. This finding was inconsistent with the research by Frith and Snowling (1983) who claimed that this pattern did *not* differ from the norm. Nation and colleagues (2006) reported that while word and nonword reading scores in typically developing individuals correlate between 0.78 and 0.83, scores for the students in this study were only correlated at 0.69. This finding suggested that for individuals with autism, word recognition and nonword decoding skills are unusually discrepant; word recognition shows less impairment than knowledge of GPC rules.

The research conducted by Nation and colleagues (2006) and Frith and Snowling (1983) was based on the dual-route model, where difficulty in nonword reading is interpreted as an impairment in knowledge of GPC rules. In contrast, according to the connectionist model, nonword reading is accomplished through analogy to words sharing orthographic features that have been accessed from the lexicon (Harm & Seidenberg, 1999).

Calhoon's (2001) study, investigating reading in 10 children with autism, 10 children with Down syndrome, and 20 typically developing children, evidenced support for a connectionist model. Participants were matched for reading level but their mean ages differed. The mean age for the typically developing group was 7 years and the mean age for the children with cognitive disabilities was 9 years. Calhoon (2001) investigated the students' ability to recognize words, nonwords, and consonant and vowel sound knowledge in isolation. Words were prepared in triplets. Each word in the triplet shared a main orthographic feature. Of the

words in the triplet, one was a nonword, one was a high frequency word, and one was a low frequency word. For example, one triplet might include ‘dain’, ‘rain’, and ‘stain’. Frequency was determined according to the Standard Frequency Index, which is a measure of the frequency per million words with which a word appears in children’s reading material. Moreover, triplets were categorized with respect to the frequency of the orthographic feature. Letter patterns that are common were considered large rime words (-ain, -at, -ip), and letters patterns that are less common were considered small rime words (-oud, -oal, -eef). Calhoon (2001) reasoned that if students demonstrated more ease reading nonwords with common letter patterns than nonwords with uncommon letter patterns then students must be reading nonwords according to analogy with words stored in the lexicon that share similar orthographic features.

Calhoon’s (2001) research revealed that all students demonstrated a similar pattern of reading. The accuracy of word recognition by children with cognitive disabilities was similar to that of their typically developing peers. This finding is not surprising as these two groups were matched for word recognition ability. More importantly, however, all students performed better reading frequent words and nonwords with common orthographic patterns. This finding suggests that, in this sample, word level decoding for both words and nonwords took place through a common mechanism. This mechanism involves the use of connections, in the lexicon, between orthographic and phonological representations as opposed to the exclusive use of GPC rules.

Calhoon (2001) also conducted an error analysis on low frequency words and nonwords. She found that children with cognitive disabilities made more errors that preserved the rimes than typically developing children and that typically developing children made more errors that preserved the initial and final consonant sounds than children with cognitive disabilities. She

concluded that individuals with cognitive disabilities relied more on orthographic awareness for decoding nonwords than did their typical peers. Unfortunately, the results for individuals with autism and individuals with Down syndrome were collapsed into one group and, therefore, it is difficult to know what the profile of abilities would look like for individuals with autism only. The present study will investigate the reliance on orthographic awareness in a child with autism and describe the relationship of this skill to other reading skills.

The research reviewed thus far on the phonological and orthographic processes at the word level indicate that children with autism may read words and nonwords based on their analogy to familiar words. In order to clarify the relative contribution of GPC and orthographic awareness to word level reading, further research needs to compare the performance of individuals with autism when reading nonwords with common letter patterns and nonwords with uncommon letter patterns. The current study will explore this question.

**Word level decoding summary.** In sum, researchers have identified varying skill levels in word level decoding by individuals with autism. Phonological processing is impaired in many, but not all, individuals with autism. In addition, orthographic awareness appears to be less impaired in this population than knowledge of GPC rules. Given the heterogeneous samples, the lack of control for reading, and the limited research conducted to date, it is difficult to identify whether this group, on average, has significant difficulties with word level reading. The differences reported can often be attributed to the selection criteria for the sample. Many studies controlled for IQ and therefore the findings from studies whose participants had an IQ in the average range differed from studies whose participants had an IQ that is well below average.

Nevertheless, the variation in word level reading among individuals with autism indicates that there are many who have difficulty with this skill. According to the SVR model, this

difficulty could account for some of the difficulties individuals with autism have with reading comprehension. It may be more useful to establish which components of word level reading account for variation in reading comprehension to identify the relative importance of these components in assessment and intervention. According to the SVR, reading comprehension is the product of word level decoding and oral language comprehension. Identifying an individual's word level reading skill will, therefore, allow teachers, researchers, and treatment providers to determine the extent to which oral language comprehension influences reading comprehension. The following section will review the current research available on reading comprehension in individuals with autism.

### **Reading Comprehension**

**Reading comprehension and the simple view.** According to the SVR, reading comprehension is the product of word level decoding and oral language comprehension. It has been established that there is a great deal of variability in the word level decoding skills of individuals with autism. The current study seeks to describe the relationship between word level decoding and reading comprehension in a child with autism.

Researchers have explored reading comprehension in individuals with autism at both the sentence level and the passage level. The research reviewed will reveal that individuals with autism demonstrate greater impairments in sentence level and passage level reading comprehension than in word level decoding.

**Sentence level reading comprehension.** In the study by Frith and Snowling (1983) that has been reviewed previously, the researchers compared the ability of 8 individuals with autism, 10 typically developing individuals, and 10 individuals with dyslexia to use context to disambiguate a homograph (e.g. a word that is spelled the same as another but has a different

pronunciation). Participants were between the ages of 9 and 17 years. In the first experiment, before the presentation of the homograph in a sentence, researchers measured word reading in all groups. No significant differences were found between the three groups on word reading skills; individuals with autism read words at the same level as their typically developing peers.

In the second experiment participants read a sentence that contained a homograph (e.g. ‘the girl had a *tear* in her dress.’). The pronunciation of the homograph indicated whether the student was using their comprehension of the sentence to identify the correct homograph. The three groups differed significantly from one another on the homograph task. Individuals with dyslexia performed the best and individuals with autism performed the worst. This study demonstrated that, even in the absence of word level reading problems, the participants with autism had difficulty with sentence level comprehension.

To investigate ways to facilitate reading comprehension, O’Connor and Klein (2004) evaluated the effectiveness of four reading treatments in improving sentence comprehension in 20 individuals with autism. Students read passages under four different conditions: reading only, answering pre-reading questions, filling in the gaps in a text, and identifying the referent for an anaphor. An anaphor is the reference in a text to an earlier version of itself. For example, Anne went to *her* house. The referent in this example is ‘Anne’, and the anaphor is ‘her’.

The researchers found that only the anaphoric cueing significantly improved students’ comprehension of the passage. Moreover, the number of anaphors resolved correctly correlated with the total passage comprehension score at 0.49 indicating that difficulties with passage comprehension were often the result of difficulties in resolving anaphoric ambiguity.

These two studies indicated that several features of sentences are characterized by ambiguity that individuals with autism find difficult to resolve. In addition, they have

significantly more difficulty resolving these ambiguities than their typically developing peers and individuals with dyslexia even when they demonstrate equivalent word level reading skills. The current study will investigate whether these specific difficulties are also evidenced in oral language comprehension.

**Passage level reading comprehension.** While research on sentence level reading comprehension focuses on tasks that measure the comprehension of a sentence only, research on passage level reading comprehension focuses on tasks that measure the comprehension of a passage composed of several sentences. Research on the sentence level reading comprehension of individuals with autism has found that comprehension is more impaired than word level reading and that the discrepancy between these two skills is greater in individuals with autism than in their typically developing peers. Research on passage level reading comprehension is consistent with this position. In their investigation of the reading profiles of individuals with autism, Nation and colleagues (2006) assessed reading comprehension using the Neale Analysis of Reading Ability, second edition (NARA II). They found that 65% of their sample had reading comprehension scores at least one standard deviation below population norms. Of these, 50% scored at least two standard deviations below the population norms. Moreover, the individuals whose comprehension scores were within one standard deviation of the norm had significantly lower scores in passage comprehension than reading decoding. For all individuals with autism, with the exception of one, within their own reading profiles, reading comprehension was the component of reading that was the most impaired.

Mayes and Calhoun (2003) also investigated reading comprehension in children with autism but they divided children into groups according to IQ. They compared reading comprehension and reading decoding in 42 children with high functioning autism and 21 with

low functioning autism. Participants were between the ages of 3 and 7. In the group of children with low functioning autism, although 55% were reading in the normal range or higher, many were unable to complete the reading comprehension subtests. These findings led the researchers to suggest that reading comprehension is more severely impaired than reading decoding in children with low functioning autism. In the group of children with high functioning autism, however, there was not a significant difference between reading comprehension and reading decoding.

Mayes and Calhoun's (2003) finding, that individuals with high functioning autism did not demonstrate differences between reading decoding and reading comprehension, was inconsistent with Nation and colleagues' (2006) finding. It is possible that this discrepancy is due to the assessment tools used to measure reading comprehension. Mayes and Calhoun (2003) measured reading comprehension using the Wechsler Individual Achievement Test (WIAT) and Nation and colleagues measured reading comprehension using the NARA-II. Bowyer-Crane and Snowling (2005) conducted a qualitative analysis of the NARA-II and the Wechsler Objective Reading Dimensions Test of Reading Comprehension (WORD) and revealed that the NARA-II primarily measured inferential reading comprehension and the WORD primarily measured literal comprehension. Unfortunately the type of reading comprehension measured by the WIAT has not been analyzed. It is possible, however, that individuals with autism demonstrate more difficulty with some types of reading comprehension than with others. Research investigating reading comprehension in individuals with autism should clarify which components of reading comprehension are being measured.

**Elements of reading comprehension.** Bowyer-Crane and Snowling (2005) have identified six different elements involved in reading comprehension. These include literal

comprehension, cohesive inferences, knowledge-based inferences, elaborative inferences, evaluative inferences, and vocabulary-dependent comprehension questions. Literal information can be found directly in the text and requires no inferences. Cohesive inferences rely on resolving linguistic cues present in the text, such as an anaphor. Knowledge-based inferences require the reader to integrate their real-world knowledge into the text to understand it as an interconnected unit. Elaborative inferences require the reader to integrate their real-world knowledge into the text to ensure a rich representation of the text. Evaluative inferences rely on understanding the emotional outcome of an event. Finally, vocabulary-dependent questions rely on understanding the meaning of a difficult word.

**Reading comprehension summary.** Research to date suggests that reading comprehension is the reading skill that is the most impaired in individuals with autism. Identifying which particular components are impaired will be critical to the development of specific and effective interventions and could also be pivotal in informing theory. Exploring the relationship between these components in oral language comprehension and reading comprehension will also help to determine whether, consistent with the SVR, the discrepancy between word level decoding skills and reading comprehension in individuals with autism can be attributed to oral language comprehension.

### **Summary of Reading Profiles in Individuals with Autism**

Research to date has largely indicated that individuals with autism demonstrate a reading pattern characterized by impairments in reading comprehension relative to word level reading. Researchers have reported large variation in word level decoding in individuals with autism. The research in the field is scant, however, and each study has focused on a different population of individuals, varying from high functioning autism to low functioning autism. As the level of

functioning of the population shifts, so do the findings regarding word level decoding. But while individuals with autism vary in their word level reading skills, the research has largely demonstrated greater deficits in reading comprehension relative to decoding abilities. There is some inconsistency with this finding as one study demonstrated that for individuals with high functioning autism, skill in reading comprehension was not significantly different from skill in word level reading. There is very little research currently available on reading comprehension in individuals with autism with which to clarify this inconsistency. It is possible that the inconsistency found is due to differences in the elements of comprehension being measured. The research available to date has also not yet determined to what extent reading comprehension impairments are influenced by oral language comprehension.

In order to obtain a comprehensive understanding of the reading skills in individuals with autism, further research is essential. There is currently a lack of research on phonological awareness in individuals with autism relative to their other reading skills. In addition, there is a lack of research on the different approaches used by individuals with autism to read words. Moreover, while most researchers have agreed that reading comprehension is the central reading impairment observed in individuals with autism, none have adequately explored which components of reading comprehension are the most impaired and whether these impairments in reading comprehension can be attributed to deficits in oral language comprehension. Research investigating specific components of reading comprehension (i.e. inferential reading comprehension, cohesive reading comprehension) as well as the equivalent components of oral language comprehension (inferential oral comprehension, cohesive oral comprehension) in individuals with autism is, therefore, critical. The current investigation will explore these gaps in order to describe the literacy profile in a case of childhood autism and determine whether this

profile can be understood using the SVR. An investigation of these gaps will inform intervention and will allow for a more accurate evaluation of current theoretical models in the field.

### **Theoretical Implications of Reading Profiles**

A number of researchers (Dunn & Bates, 2005; Frith & Snowling, 1983; Nation et al., 2006) have suggested that the currently identified pattern of reading abilities in individuals with autism can be most parsimoniously explained by the theory of central coherence. According to this theory, autism is characterized by an imbalance in the integration of information at different levels; individuals with autism see the parts rather than the wholes (Frith, 1989). For example, when looking at a visual illusion they will process the details as opposed to the entire picture. According to these researchers, the relative impairments in reading comprehension compared to word level reading in individuals with autism lend support for this theory.

There is currently no research that has assessed the utility of the central coherence model to account for variance in the reading abilities of individuals with autism. Moreover, it is problematic to conclude that the discrepancy between word level decoding and reading comprehension can be attributed to deficits in central coherence as these two skills draw on different cognitive resources, not simply different levels of central coherence. Word level decoding relies on phonological processing, knowledge of GPC, and morphological and orthographic awareness, while reading comprehension relies on word level decoding and oral language comprehension. Given these limitations, it is critical to explore other models that may more accurately account for variation in the reading abilities of individuals with autism and that can account for the consistent pattern of abilities demonstrated within this population. Investigating oral language comprehension and its relationship to reading comprehension will allow researchers to determine whether the SVR can be used as a more parsimonious model to

explain the literacy profile of individuals with autism. The current study will examine the utility of the SVR in explaining the influence of word level reading skills and oral language comprehension on reading comprehension.

### **Oral Language Comprehension**

**Oral language comprehension and the simple view.** While researchers have reported varying levels of impairment in word level decoding, they have largely documented greater impairments in reading comprehension relative to word level decoding in individuals with autism (Frith & Snowling, 1983; Nation et al., 2006). The SVR would predict that this discrepancy is due to difficulties with oral language comprehension. Unfortunately, the research that examines the relationship between reading skills and oral language comprehension in this population is limited. An examination of the documented language profile of individuals with autism, however, will reveal that, as a group, their language profile bares some similarities to their literacy profile. While their literacy profile is characterized by deficits in reading comprehension compared to word level decoding, their language profile is characterized by deficits in pragmatics and oral language comprehension compared to word level expressive and receptive vocabulary. This parallel between the oral comprehension difficulties and reading comprehension difficulties lends further support for the possible applicability of the SVR to the literacy profile of individuals with autism. For this reason, literature pertaining to oral language comprehension at both the word level (e.g. expressive and receptive vocabulary) and the passage level (e.g. oral comprehension of a sentence or many sentences) will be reviewed. In addition, pragmatic language deficits in particular will be discussed as they have been identified as the most impaired language skills among individuals with autism. Finally, research exploring the

relationship between reading comprehension and oral language comprehension in individuals with autism will be reviewed.

**Receptive and expressive vocabulary.** Studies exploring the word level oral comprehension of individuals with autism have typically explored whether expressive and receptive vocabulary is impaired in this population. The research indicates that there is great variability in word level comprehension in individuals with autism; some individuals have difficulty with receptive and expressive vocabulary while others perform at the level of their typically developing peers. It has been suggested that their receptive and expressive vocabularies are following the same course as in typical development but that, in many individuals with autism, this course is delayed.

Dunn and Bates (2005) conducted a study, with a sample of 22 children with autism and 22 children developing typically, all between the ages of 8 and 12. They measured the receptive vocabulary of all participants using the Peabody Picture Vocabulary Test, third edition (PPVT-III). On this task children were shown four pictures for each stimulus word and they were asked to point to the picture that corresponded with the stimulus word. Dunn and Bates found a great deal of variability in receptive vocabulary across this population. An average score calculated for the whole sample revealed that, overall, children with autism did demonstrate impairments in receptive vocabulary when compared with typically developing peers. They then separated the participants with autism and the typically developing children into two groups: the younger group, 8 and 9 year-olds, and the older group, 11 and 12 year-olds. They found that the younger group of children with autism had significantly lower scores in receptive vocabulary than their typical peers, whereas, the older group of children with autism did not have significantly different scores than their typical peers. The researchers concluded that impairments in receptive

language in the younger group represented a developmental delay in receptive language acquisition.

Kjelgaard and Tager-Flusberg (2001) were also interested in the oral language profile of individuals with autism and administered measures assessing both receptive and expressive vocabulary in 89 children with autism between the ages of 4 and 14. Consistent with the findings of Dunn and Bates (2005), Kjelgaard and Tager-Flusberg found a great deal of variability in receptive and expressive vocabulary across this population. Receptive vocabulary was measured using the PPVT-III. Of the 82 children who completed the PPVT-III, 22 children performed within the normal range (standard scores of 85 and above), 10 children performed between one and two standard deviations below the mean (standard scores between 74 and 84), and 50 children performed more than two standard deviations below the mean (standard scores below 70). The researchers found no difference between the children's performance on the receptive vocabulary measures and the expressive vocabulary measures.

Research has demonstrated that many individuals with autism evidence deficits in receptive and expressive vocabulary but that these deficits are not universal across the population. Researchers have subsequently turned their attention to the relationship of receptive and expressive vocabulary to passage level oral comprehension.

**Passage level oral language comprehension.** While vocabulary comprehension might be an area of difficulty for many children with autism, when compared to their same age typically developing peers, researchers have found that it can be a relative area of strength *within* the language profile of individuals with autism.

In an early study of the oral language profiles of individuals with autism, Bartak, Rutter, and Cox (1977) explored the oral language skills of 19 individuals with autism and 23

individuals with a developmental language disorder. Participants completed the Peabody Picture Vocabulary Test (PPVT) as a measure of receptive language and the Wechsler Intelligence Scale for Children (WISC) as a measure of oral passage comprehension. The researchers found that individuals with autism performed significantly worse than individuals with a developmental language disorder on both measures, however, the difference between the two groups on passage comprehension was much greater than the difference between the two groups on receptive vocabulary.

More recently, Rapin and Dunn (2003) conducted a study where they assessed the oral language abilities of 299 students with autism and 262 students with a developmental language disorder. In this unusually large population, 100% of the students with autism had impairments in language comprehension, whereas only 65% of students with developmental language disorders had impairments in language comprehension. The difference between the phonology and syntax abilities in these two groups was not as marked. Phonology and syntax were deficient in 63% of individuals with autism and 50% of individuals with developmental language disorders. These two studies demonstrated that one way to differentiate individuals with autism is by comprehension impairments, which are characteristic of the oral language profile of individuals with autism.

Mayes and Calhoun (2003) also explored oral comprehension in individuals with autism. They compared individuals with high functioning autism (IQ over 80) and low functioning autism (IQ less than 80). They administered the Wechsler Intelligence Scale for Children, third edition (WISC-III) to measure expressive vocabulary and oral comprehension in 63 individuals with autism. The researchers found that both high functioning and low functioning individuals with autism evidenced higher levels of expressive vocabulary than oral language comprehension.

Collectively, this research has demonstrated that passage level comprehension deficits in individuals with autism differentiate them from their typically developing peers and their peers with developmental language disorders more than receptive and expressive vocabulary. Moreover, within their own abilities, they have less difficulty with receptive and expressive language than passage level oral comprehension.

Mayes and Calhoun (2003) and Bartak, Rutter, and Cox (1977) measured oral comprehension using the comprehension subtest of the WISC. This subtest is also a measure of social judgment. As such, it is unclear, on the basis of these studies, whether oral comprehension is impaired or whether the impairments reported are actually a reflection of difficulties with social interaction. Rapin and Dunn (2003) failed to report the measure they used to assess comprehension and, consequently, their research does not help clarify this issue. Future research on oral language impairment in this population must clearly distinguish what components of oral comprehension are being measured. The current study will examine oral language comprehension in a child with autism by measuring the six different components of comprehension identified by Bowyer-Crane and Snowling (2005).

**Pragmatic language.** Within the research of passage level oral comprehension, pragmatic language deficits warrant special attention with this population. The research suggests that pragmatic language deficits are present in most, if not all, individuals with autism. Baltaxe (1977) conducted an early study of pragmatic language in individuals with autism. Pragmatic language refers to the ability to use language appropriately in a social context. Baltaxe administered structured interviews to 5 adolescents with autism. He noted that all participants exhibited difficulties in taking the other speaker's viewpoint, conforming to the unspoken rules

that govern a dialogue, and discriminating between relevant and irrelevant information when involved in discourse.

Tager-Flusberg and Anderson (1991) also noted pragmatic difficulties in the sample of individuals they were studying. They compared spontaneous speech samples collected in the homes of 6 children with autism and 6 children with Down syndrome. The researchers found that, at early stages of language development, individuals with autism look very similar to individuals with Down syndrome. At more sophisticated levels of language development, however, individuals with autism began to look quite different from individuals with Down syndrome. Specifically, individuals with Down syndrome tended to add new information to a conversation by introducing new related topics and challenging and expanding on what their conversational partners were saying. In contrast, individuals with autism failed to increase the amount of new information they added to a topic. They tended to provide simple responses, to use routine social phrases when in conversation, and to simply repeat what had been said to them with slight alterations. At a more sophisticated level of language, the tendency to rely of these earlier developmental conversational strategies indicates pragmatic language difficulties. Capps, Kehres, and Sigman (1998) conducted a very similar study and also noted that children with autism tended to rely on developmentally primitive ways of maintaining conversation.

Surian, Baron-Cohen, and Van der Lely (1996) found that, not only was expressive pragmatic language impaired, but receptive pragmatic language was impaired also. Compared with both typically developing children and children with specific language impairments, children with autism were impaired in their ability to detect violations of pragmatic language. Violations of pragmatic language included providing rude, redundant, unrelated, uninformative, or obviously incorrect information in response to a question.

In a recent review of the oral language profile of individuals with autism, Tager-Flusberg (2006) concluded that pragmatic language impairments were a universal symptom of autism. This echoed an earlier claim by Lord and Paul (1997) that pragmatic language impairments were the primary defining feature of the oral language profile of individuals with autism.

A review of the research demonstrated that there is great variability in the language abilities of individuals with autism. Receptive and expressive vocabulary was delayed in many individuals with autism but, in some, no impairment was present. Even when receptive and expressive vocabulary was not impaired passage level oral comprehension was impaired. Passage level comprehension evidenced greater impairment than expressive and receptive vocabulary in this population. A discrepancy between vocabulary and passage level oral comprehension is not unusual but the discrepancy between these two skills in individuals with autism is greater than in individuals with developmental language delays and in typically developing individuals. Moreover, pragmatic language deficits are believed to be a universal symptom of autism. Unfortunately, there is a paucity of research exploring the relationship between the oral language profile and the literacy profile of individuals with autism. A few studies, however, have investigated this question.

**Reading and oral language comprehension.** In a study reviewed previously, Frith and Snowling (1983) compared the ability of 8 individuals with autism, 10 typically developing individuals, and 10 individuals with dyslexia to use context to disambiguate a homograph. Participants were between the ages of 9 and 17 years. Before the presentation of the homograph in a sentence, researchers conducted an experiment to determine whether students demonstrated oral language comprehension for the vocabulary used in the study. They found no significant differences between the three groups. In the second experiment, a sentence was presented that

contained a homograph. The participants' oral pronunciation of the homograph indicated whether the student was making use of their comprehension of the sentence to identify the correct homograph. The results revealed that the three groups differed significantly from one another, with individuals with dyslexia showing the highest scores and individuals with autism showing the lowest scores. Moreover, the researchers found that, with one exception, individuals with autism always chose the most frequent pronunciation regardless of the context.

Frith and Snowling (1983) asserted that participants' ability to recognize the meaning of both homographs indicated that they did not have oral language comprehension difficulties and their inability to disambiguate the homophone indicated that they did have reading comprehension difficulties. These findings prompted the researchers to conclude that, even in the absence of receptive vocabulary difficulties, individuals with autism demonstrate reading comprehension difficulties. On the basis of this research, however, it is unclear whether oral language comprehension or reading comprehension is impaired. It is possible that participants would have found it difficult to use context to disambiguate the homophone in an oral language assessment as well, indicating oral language comprehension difficulties. Research that seeks to compare oral language comprehension and reading comprehension should measure comparable components of comprehension. For example, if studying word level comprehension, the researcher could use a measure of receptive or expressive vocabulary and a measure of vocabulary-dependent reading comprehension. Similarly, if studying inferential comprehension they could look at the relationship between oral inferential tasks and reading inferential tasks.

In a more recent study of the relationship between oral language proficiency and reading comprehension, Nation and others (2006) assessed language and literacy in 41 individuals with autism. They separated their group according to reading comprehension scores and in doing so

were able to provide valuable information on the impact of receptive vocabulary and oral language comprehension on reading comprehension. Of their sample they identified 10 individuals with autism who were skilled in reading comprehension and 10 who were less-skilled in reading comprehension. They found that while word level decoding was not significantly different in these two groups, receptive vocabulary, as measured by the BPVS-II, and oral language comprehension, as measured by the WISC-III, were significantly lower in individuals identified as less-skilled in reading comprehension. The authors concluded that reading comprehension is, in part, a product of receptive vocabulary and oral language comprehension. The current study explored this finding in more depth, using a variety of measures assessing various aspects of both oral language comprehension and reading comprehension.

**Oral language comprehension summary.** Researchers have clearly identified that receptive and expressive vocabulary is less impaired in individuals with autism than oral language comprehension. Future research that compares comprehension of passages presented orally and presented through written text, as well as vocabulary presented orally and presented through written text, would help clarify the extent to which difficulties in reading comprehension are the result of impairments in oral language ability or impairments in word level decoding. The purpose of the current study was to explore the applicability of the SVR to the literacy profile of a child with autism. This involved determining whether there was a discrepancy in word level reading compared to reading comprehension and whether this discrepancy is connected at a basic level with the language comprehension deficits symptomatic of autistic disorder.

### **Summary of Background Research and Overview of the Present Study**

A review of the current research on the literacy profiles of individuals with autism has indicated that, while varying levels of impairment in word level decoding abilities have been found, researchers have largely documented greater impairments in reading comprehension relative to decoding abilities. Nation and colleagues (2006) found that, when holding word level decoding constant, reading comprehension scores were significantly lower in individuals with oral language comprehension difficulties. The authors concluded that overall comprehension deficits are, in part, a result of impairments in the individuals' vocabulary comprehension. According to the SVR, if decoding skill remained the same, an increase in oral language comprehension would result in greater reading comprehension. The results of the study by Nation and colleagues (2006) are consistent with the SVR, suggesting that this model might have potential in explaining variation in the reading abilities of individuals with autism.

If the SVR is a useful model for individuals with autism, it will be possible to clarify the extent to which word level decoding and oral language comprehension are accounting for variation in an individual's reading comprehension ability. This information will be essential in guiding assessment of reading abilities and to targeting specific and effective interventions for individuals with autism. In addition, knowledge of the utility of this model for individuals with autism will guide an evaluation of those theories of autism that are currently being used to explain variation in reading ability in this population.

In order to examine whether the SVR is a useful model for understanding the literacy profile presented, standardized norm-referenced and unstandardized, experimental measures assessing components of reading and oral language were administered to a child with autism. These assessments were used to explore the following questions:

1. How does phonological processing compare with other reading abilities in this case of childhood autism?
2. How does this child with autism perform on tasks measuring the identification of words, nonwords with common letter patterns, and nonwords with uncommon letter patterns?
3. How does this child with autism perform on tasks measuring expressive and receptive vocabulary and vocabulary-dependent reading comprehension?
4. How does this child with autism perform on tasks measuring elaborative inferential oral comprehension and elaborative inferential reading comprehension?
5. How does this child with autism perform on tasks measuring cohesive inferential oral comprehension and cohesive inferential reading comprehension?
6. How does this child with autism perform on tasks measuring knowledge-based inferential oral comprehension and knowledge-based inferential reading comprehension?
7. How does this child with autism perform on tasks measuring evaluative inferential oral comprehension and evaluative inferential reading comprehension?
8. How does this child with autism perform on tasks measuring literal oral comprehension and literal reading comprehension?

### **Chapter 3**

#### **Methodology**

##### **Design**

The current study comprehensively described the literacy profile in a case of childhood autism to explore the theoretical implications of the documented profile. An embedded case study design, examining three sources of evidence, was employed to explore and compare the component reading decoding, reading comprehension, and oral language comprehension processes of the participant. The data collected was then used to qualitatively assess the utility of the SVR in understanding the literacy profile in this case of childhood autism. A qualitative approach was used to develop this descriptive case study. McMillan and Wergin (2006) stated that a qualitative approach is appropriate when the questions to be explored by the researcher are concerned with description and understanding. Since the central focus of the current study is to understand the reading profile of a child with autism, respecting the particularities of the child's case, the development of a richly detailed case study was the most appropriate research method.

A case study design provided an opportunity for the in-depth analysis of the literacy profile that was required to investigate the questions posed by this study. In addition, this design provided a comprehensive picture to generalize, not to a population as an experimental design would allow, but to theoretical propositions, as a systematic case study allows (Yin, 1984).

This design was also appropriate for the specific population being investigated. Tager-Flusberg (2004) wrote a critique of the various methodological approaches that have been used in research with children with autism. She stated that the heterogeneity across the population of individuals with autism results in performance data that is characterized by a great deal of variance. This variance, she argued, can mask significant differences between individuals with

autism and any comparison group. In addition, this variance indicates that simply reporting means for performance measures across a group of individuals with autism could result in a loss of critical information. For example, in reporting the receptive vocabulary of individuals with autism, participants will range from little to no receptive vocabulary to receptive vocabulary scores that are well above average. Reporting an average score of 92 on a standardized test suggests that individuals with autism perform within the average range when compared to their same-age typically developing peers. However, this data masks information on the many children who have little to no receptive vocabulary and those who perform well above average on receptive vocabulary tasks. A case study design was chosen to address these concerns. The child's performance scores in one area were compared with a comparison group and with her own performance scores in other areas. This resulted in a rich description of her profile of scores across the components of language and literacy. This profile was then used to investigate the explanatory power of different theoretical models (Yin, 1984).

Data was collected on the oral language comprehension, reading decoding, and reading comprehension skills in one case of childhood autism. An embedded design, whereby attention was given to different components, was chosen for this purpose. Three sources of evidence were collected and examined pertaining to each of these components. These included parent interviews, direct observations, and standardized norm-referenced and non-standardized experimental measures. The questions posed by the study were examined through each of these sources of evidence and the extent to which each source lead to similar findings was explored. This process of data triangulation was an important step in ensuring a reliable and valid interpretation of the results (Yin, 2003).

The steps presented in the following section served as the case study protocol, the design of which was recommended by Yin (2003).

### **Participant**

**Selection criteria.** The participant was selected according to the following criteria. The first criteria for selection required that the participant be a child who had already been formally diagnosed with autism by a qualified medical practitioner (i.e. psychiatrist, psychologist, pediatrician) using the diagnostic criteria described by the American Psychiatric Association according to the DSM-IV-TR (American Psychiatric Association, 2000). The DSM-IV-TR criteria for autistic disorder include: (1) at least two forms of evidence of a qualitative impairment in social interaction; (2) at least one form of evidence of a qualitative impairment in communication; and (3) at least one form of evidence of restricted repetitive and stereotyped patterns of behaviour, interest, and activity. In addition, for an individual to be diagnosed with autistic disorder they must evidence delays or atypical functioning in at least one of the following areas, with onset prior to 3 years of age: (1) social interaction, (2) language as used in social interaction, and (3) symbolic or imaginative play (American Psychiatric Association, 2000). Individuals diagnosed with any other diagnosis within the Autism Spectrum Disorder, or who were diagnosed with a comorbid disorder known to affect intellectual development, were not asked to participate in the current study.

The second selection criteria involved reading level. The participant was required to be able to read at a grade two- to grade four-level according to the WIAT-II Word Recognition subtest. It is necessary that the participant read at least at a second grade level to complete the reading comprehension measures. Consistent with research conducted by Nation and colleagues

(2006), a participant who was under the age of 15 was recruited. This is also in keeping with autism being a childhood disorder (American Psychiatric Association, 2000).

Parents were also asked to report the IQ of the child participating. Given the current research that demonstrates a similar literacy profile of strengths and weaknesses for those children with autism with a high IQ and those with a low IQ (Mayes & Calhoun, 2003), intellectual functioning was not used as a selection criterion. The IQ score provided by the parents, however, was used to help guide an interpretation of the results.

**Recruitment.** Following receipt of approval to conduct the study by the Behavioural Ethics Board at the University of Victoria, the participant was recruited from a center in Victoria, British Columbia that provides resources for individuals with autism and their parents. A poster was displayed at the center and parents who were interested in assisting with the research contacted the researcher and were sent an information letter about the study through e-mail. Parents were asked to contact the researcher if they were still interested in participating. The researcher then personally delivered the consent form (see Appendix A) to the first parents to contact the researcher whose child met the selection criteria. Parents of this child were required to sign the consent form before they were able to participate in the study.

The participant's parents were asked to report the type of literacy instruction the child had received and this information was used in the interpretation of the results but not as a selection criterion.

**Case history.** The participating child, CG, was a 12 year-old girl who was diagnosed with autism when she was 4.5 years old. When CG was 2 years old her mother noticed that she was not answering to her name and was not asking questions. At age 3, her mother noted that she was repeating movie dialogue and flapping her hands often. Due to these behaviours CG

was referred for an assessment and received a diagnosis of autism. A diagnosis of mild to moderate autism (Full Scale IQ 67) was most recently confirmed in 2008.

Since her diagnosis, CG has received a great deal of learning support. She was enrolled in an Applied Behaviour Analysis program for one year, when she was five years old. Her mother did not feel that ABA was suitable for CG and enrolled her in a Relationship Development Intervention for the next five years. She has also had the support of a Speech and Language Pathologist since her diagnosis.

CG is currently integrated in a grade seven classroom. She has a teaching assistant assigned to her full time and has had a TA throughout her schooling. Her mother reported that CG has the most difficulty in math and the greatest facility in English, French, and Socials. CG has received extra literacy interventions each year of her education. The special education teacher has organized special reading groups that CG has attended. Her mother reports that CG decodes words very well. According to CG's mother, the school does not believe that CG understands what she is reading. CG's mother believes that CG understands more than her teachers recognize.

CG's mother revealed that CG is easily frustrated and gives up easily. When she is bored, disinterested, upset, or would rather be doing something else she will fidget, look away, lie on the floor, or hide. CG's mother reported that these behaviours are easily resolved with patience, the removal of distractions, a break during her work, and the presence of a stuffed animal nearby for comfort.

CG approached the testing situation very well. She was prepared to begin work right away and was generally attentive. When tasks became difficult she was more easily distracted

but was able to focus when her attention was redirected. During these periods she requested more breaks.

### **Setting and Researcher**

All assessment sessions took place individually in a quiet room in the child's home. The researcher, a graduate student in Special Education, who has 10 years experience working with individuals with autism, and who has taken graduate level courses in assessment and intervention, conducted all of the assessments.

### **Materials**

Three sources of evidence were collected. These included parent interviews, direct observations, and standardized and experimental assessments.

**Parents interviews.** To facilitate the collection of background information on CG, the Background Questionnaire, developed by Sattler (1992), was adapted for the purposes of the current study and was used to guide an interview with CG's mother. This was a structured questionnaire with some open-ended questions and some closed-ended questions. The questionnaire was designed to acquire background information on CG's social, intellectual, and behavioural functioning, both in the past and currently. CG's mother was also asked to report the type of support that has been provided for CG at school more generally, and specifically with respect to literacy instruction. The purpose of this questionnaire was to gather information that would be useful in accurately interpreting the results of the study. This questionnaire was administered prior to any assessment sessions.

CG's mother was also asked to complete the Conners' Parent Rating Scale – Revised, Long version (Conners, 1997; CPRS-R:L). This norm-referenced scale requires a child's caregiver to complete 80 Likert scale questions in order to obtain information on whether a child

is facing difficulties in any of the following areas: shyness, anxiety, inattention, perfectionism, social problems, cognitive problems, hyperactivity, psychosomatic tendencies, or oppositional behaviour. Internal reliability ranges from .73 to .94 and the test manual indicates that the scale demonstrates adequate convergent validity. This scale was administered to determine whether CG had difficulties with attention as this information would be essential in an accurate interpretation of the results of the study.

The final questionnaire that CG's mother was asked to complete was the Child Behaviour Checklist (Achenbach & Rescorla, 2001; CBCL). The CBCL is a norm referenced questionnaire which requires a child's caregiver or teacher to complete 20 Likert scale questions pertaining to their child's competencies and 120 Likert scale questions pertaining to the behaviour or emotional well being of their child within the last 6 months. The purpose of the CBCL is to obtain information on whether a child is facing difficulties in any of the following areas: Aggression, anxiety, depression, attention, rule-breaking, social interactions, somatic complaints, thought problems, and tendencies to withdraw, externalize, or internalize. Internal reliability ranges from .78 to .97 and the test manual indicates that the test demonstrates adequate criterion validity. This scale was also administered to determine whether CG had difficulties with attention as this information would be essential in an accurate interpretation of the results of the study.

**Assessment measures.** A collection of standardized norm-referenced and experimental measures were used to assess various components of language and literacy. Within the SVR it is important to test word level decoding, reading comprehension, and oral language comprehension. Word level decoding involves the phonological route (phonological awareness and knowledge of phoneme-grapheme conversion rules) and the orthographic route (direct

lexical access to a group of letters or to a word) (Henderson, 1982) and, therefore, both of these components were measured. All six components of reading comprehension identified by Bowyer-Crane and Snowling (2005) were measured. Oral language was assessed in a variety of ways. For example, receptive and expressive vocabulary skills were measured, as well as comprehension of sentences and passages. Oral language comprehension tasks also measured the six components of comprehension identified by Bowyer-Crane and Snowling.

Where possible, tests that have been normed on individuals with autism were used, however, there are very few standardized tests that have been normed on individuals with autism and thus, the majority of measures that were used did not have this advantage. The measures that had not been normed on individuals with autism were still quite useful in answering the central questions of the current study. Standard scores were collected to investigate whether CG's scores differed from her typically developing peers. The final profile will describe the components of language and literacy that differed the most from same-age typically developing peers and those components that differed the least.

In some cases, standardized assessments were not available to measure the components of language or literacy that were essential to answering the central questions of the study. In this case experimental assessments that had previously been demonstrated to be reliable and valid were selected.

***Receptive vocabulary, expressive vocabulary, and pragmatic language measures.***

Three individually administered, standardized measures were used to assess receptive vocabulary, expressive vocabulary, and pragmatic language. Table 2 describes each of these measures.

Table 2

*Measures used to assess receptive vocabulary, expressive vocabulary, and pragmatic language*

<b>Test name</b>	<b>Skills measured</b>	<b>Test description</b>	<b>Reliability and validity</b>
Peabody Picture Vocabulary Test – Fourth Edition (Dunn & Dunn, 2007; PPVT-IV)	Receptive vocabulary	Point to a picture that corresponds with an orally presented word (e.g., “Put your finger on the picture that shows crying.”)	Test-retest reliability: .92 to .96 Internal reliability: .89 to .97 Adequate content and convergent validity
Expressive Vocabulary Test – Second Edition (Williams, 2007; EVT-2)	Expressive vocabulary to label and identify words synonyms	Label a word that is compatible with a picture and verbal stimulus (e.g., When shown a picture of a watch the child is asked “What is this?”).	Test-retest reliability: .92 to .96 Internal reliability: .89 to .97 Adequate content and convergent validity
<i>Pragmatic Judgment</i> Subtest of the Comprehensive Assessment of Spoken Language (Carrow-Woolfolk, 1999; CASL)	Knowledge and use of pragmatic language rules and judgment of their appropriate application	Respond with an appropriate word or phrase to a picture and story that describes a situation that is common in everyday life (e.g., “Suppose the doorbell rings. You open the door. What do you say?”).	Internal reliability: .79-.92 Test-retest reliability: .66 to .85 Adequate construct and criterion-related validity

***Passage level oral comprehension.*** Eight measures were used to assess all six components of comprehension identified by Bowyer-Crane and Snowling (2005). These measures comprehensively assessed oral language comprehension. Table 3 describes each of these measures.

Table 3

*Measures used to assess oral language comprehension*

<b>Test name</b>	<b>Skills measured</b>	<b>Test description</b>	<b>Reliability and validity</b>
<i>Basic Concepts</i> subtest of the CASL	Comprehension of words or sentences that correspond to basic perceptual and conceptual relations	Point to a part of a single picture or to the picture in a set of four pictures that corresponds with the meaning of an orally presented word or sentence (e.g., “Point to the ball outside of the square.”).	Internal reliability: .82-.86 Test-retest reliability: .85 Adequate content, construct, and criterion-related validity.
Sentence comprehension section of the <i>Listening Comprehension</i> subtest of the Wechsler Individual Achievement Test – Second Edition (Wechsler, 2002; WIAT-II)	Literal comprehension of an orally presented sentence	Identify the picture that matches an orally presented sentence (e.g., “She is crying because she broke her toy.”).	Internal reliability: .67-.88 Adequate content, construct, and criterion-related validity
<i>Paragraph Comprehension</i> subtest of the CASL	Auditory comprehension of syntax and literal comprehension in spoken narratives	Listen to a paragraph and subsequent questions about the paragraph read by the researcher. Respond by pointing to one of four pictures that represents the correct answer (e.g., “Which is Sarah’s favourite cat?”).	Internal reliability: .68-.90 Test-retest reliability: .77-.86 Adequate content, construct, and criterion-related validity
<i>Sentence Completion</i> subtest of the CASL	Knowledge-based inferential comprehension, and knowledge of vocabulary and syntax.	Listen to a sentence with a missing word (e.g., “Sarah rides to school in a . . .”) and respond with a word that completes the sentence.	Internal reliability: .75-.85 Test-retest reliability: .77-.87 Adequate content, construct, and criterion-related validity
<i>Inference</i> subtest of the CASL	Integrate general knowledge to understand textual information.	Listen to a two- to three-sentence episode and infer the answers to comprehension questions from both the passage and his or her own knowledge (e.g., “Sarah could not find the candles, so she could not do her homework. Why?”).	Internal reliability: .85-.90 Test-retest reliability: .79-.83 Adequate content, construct, and criterion-related validity

Table 3 Continued

*Measures used to assess oral language comprehension*

<b>Test name</b>	<b>Skills measured</b>	<b>Test description</b>	<b>Reliability and validity</b>
Adaptation of Yuill & Oakhill's (1988) assessment of anaphoric resolution	Use of lexical cues such as pronoun resolution, ellipsis, substitution, and lexical cohesion to maintain textual coherence.	Listen to each paragraph (e.g., "Mary went to get her lunch box. She ate a sandwich. Sarah ate a pizza.") and respond to subsequent questions (e.g., "What did Mary eat for lunch?") by pointing to one of four pictures that represents the correct answer.	No information on reliability available Demonstrated convergent validity and face validity.
Adaptation of Oakhill's (1982) assessment of cohesive inferences	Integrate information explicitly provided by the text to establish cohesion between different sentences.	Listen to a short story. After a 10-minute delay, during which another subtest is administered, identify whether a sentence, presented visually and orally, was heard before.	No information on reliability available. Demonstrated predictive validity.
Adaptation of the experimental evaluative inferences task designed by Happe (1994)	Use knowledge of internal mental states to interpret textual information	Listen to a short story. Answer questions that ask why a character behaved in the way that they did where the answer is not explicitly stated in the text.	No information available

***Phonological processing.*** Two measures were used to assess phonological processing.

These measures examined syllable and phoneme detection, production, and segmentation. Table 4 describes each of these measures.

Table 4

*Measures used to assess phonological processing*

<b>Test name</b>	<b>Skills measured</b>	<b>Test description</b>	<b>Reliability and validity</b>
<i>Rhyme Detection, Rhyme Production, Word Completion, and Phoneme Deletion</i> subtests from the Phonological Abilities Test (Muter, Hulme, & Snowling, 1997; PAT)	Analyze rimes Discriminate and segment syllables and phonemes	Identify a rhyming word from three pictures (e.g., “Which of these three, list, gum, or cat rhymes with bat?”). Produce as many rhymes as possible in 30 seconds (e.g., “Tell me as many words as you can that rhyme with tell.”). Finish off the final syllable or phoneme in a stimulus word (e.g. This is a kitten. Ki...”). Identify the word that remains after dropping out a sound from a stimulus word (e.g., “Heat without the [h] says...”)	Internal reliability: .83 to .93. Test-retest reliability: .58 to .84. Adequate construct and criterion-related validity
<i>Elision</i> subtest of the Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 1999; CTOPP).	Sound segmentation	Say the word that remains after deleting either a word from a compound word, (e.g., “Say basketball. Now say basketball without saying basket.”) or a phoneme from an orally presented word (e.g., “Say sprain. Now say sprain without saying [r].”).	Test-retest reliability: .77 to .93. Internal reliability: .77 to .90. Adequate content, construct, and criterion-related validity.

**Reading and spelling.** Four assessments of word level decoding were collected. These assessments examined knowledge of GPC and orthographic awareness. In addition, they explored recognition of both frequent and infrequent words. Spelling was assessed to examine the child’s knowledge of GPC and orthographic awareness as well as her knowledge of the meaning of words. Table 5 describes these measures.

Table 5

*Measures used to assess word level decoding*

<b>Test name</b>	<b>Skills measured</b>	<b>Test description</b>	<b>Reliability and validity</b>
<i>Pseudoword Decoding</i> subtest of the WIAT-II	Phonetic decoding skills	Read aloud a list of nonsense words (e.g., lim, taft)	Internal reliability: .94 to .98. Adequate content, construct, and criterion-related validity.
<i>Word Reading</i> subtest of the WIAT-II	Word recognition, and phonetic decoding skills	Read aloud words from a word list (e.g., and, proud)	Internal reliability: .87 to .99. Adequate content, construct, and criterion-related validity
Experimental word/nonword decoding task (Calhoun, 2001)	Word recognition, consonant and vowel sound knowledge in isolation, and orthographic awareness	Read words and nonwords with shared orthographic features (e.g., rain, stain, daïn) varying in frequency of word (e.g., rain vs. stain) and frequency of the orthographic feature (e.g., -at vs. -oal)	Internal reliability: .86 to .97.
<i>Spelling</i> subtest of the WIAT-II	Spell dictated words. The inclusion of homonyms required the child to use context clues from the dictated sentences to spell the appropriate word	Spell words (e.g., car, there) after listening to the dictated word in a sentence	Internal reliability: .95 to .96. Test-retest reliability: .89 to .96. Adequate content, construct, and criterion-related validity

***Reading comprehension.*** Six measures were used to assess all six components of comprehension identified by Bowyer-Crane and Snowling (2005). These measures comprehensively assessed reading comprehension. Table 6 describes each of these measures.

Table 6

*Measures used to assess reading comprehension*

<b>Test name</b>	<b>Skills measured</b>	<b>Test description</b>	<b>Reliability and validity</b>
<i>Reading Comprehension</i> subtest of the WIAT-II	Literal comprehension; vocabulary-based comprehension; knowledge-based, cohesive, elaborative, and evaluative inferential comprehension	Read passages and answer questions involving the comprehension of content, (e.g., “What does the cat do?” and “What fruit is this sentence about?”).	Internal reliability: .92-.95 Adequate content, construct, and criterion-related validity
<i>Passage Comprehension</i> subtest of the WJ-III	Knowledge of syntax; knowledge-based, cohesive, and evaluative inferential comprehension	Read short passages and identify a missing key word that made sense in the context of the passage (e.g., “I used my money to buy a paddle. I can’t wait to go ...”)	Internal reliability: .83 Test-retest reliability: .84-.91 Adequate content, construct, and criterion-related validity.
Experimental inferential comprehension task designed by Oakhill (1984)	Literal comprehension, knowledge-based inferential comprehension	Read short stories and answer questions about the story without reference to the text (e.g., “Where was Bill’s fishing rod,” “What was the Captain trying to do?”).	No information on reliability available. Demonstrated predictive validity.
Adaptation of Yuill & Oakhill’s (1988) assessment of anaphoric resolution	Use of lexical cues such as pronoun resolution, ellipsis, substitution, and lexical cohesion to maintain textual coherence.	Read each paragraph (e.g., Mary went for a swim. She saw an apple. Sarah saw a pear.) and respond to questions about the paragraph (e.g., “What did Mary see?”) by pointing to one of four pictures that represents the correct answer.	No information on reliability available Demonstrated convergent validity and face validity.
Adaptation of Oakhill’s (1982) assessment of cohesive inferences	Integrate information explicitly provided by the text to establish cohesion between different sentences.	Listen to a short story. After a 10-minute delay, during which another subtest is administered, identify whether a sentence, presented visually and orally, was heard before.	No information on reliability available. Demonstrated predictive validity.
Adaptation of the experimental evaluative inferences task designed by Happe (1994)	Use knowledge of internal mental states to interpret textual information	Listen to a short story. Answer questions that ask why a character behaved in the way that they did where the answer is not explicitly stated in the text.	No information available

***Estimate of cognitive functioning.*** The *Similarities*, *Vocabulary*, *Matrix Reasoning*, and *Block Design* subtests from the Wechsler Intelligence Scale for Children – Fourth Edition (Wechsler, 2003; WISC-IV) were administered to obtain an estimate of the child’s cognitive functioning. These four subtests were selected from the 15 subtests in the WISC-IV because they correlated the most highly with general intelligence. The purpose of obtaining an estimate of the child’s cognitive functioning was to help guide an interpretation of the findings from language and literacy tasks rather than to use this information as part of the profile analysis of language and literacy skills. Table 7 describes each of the subtests that were used to obtain an estimate of cognitive functioning.

Table 7

*Measures used to assess cognitive functioning*

<b>Test name</b>	<b>Skills measured</b>	<b>Test description</b>	<b>Reliability and validity</b>
<i>Similarities</i> subtest of the WISC-IV	Verbal reasoning and concept formation.	Describe how two words (e.g., pink, red) that represented common objects or concepts are similar (e.g., they are both colours).	Internal reliability: .82-.89 Adequate content, construct, and criterion-related validity
<i>Vocabulary</i> subtest of the WISC-IV	Word knowledge and verbal concept formation.	Name pictures in a stimulus book (e.g., tree) and give definitions for words that the examiner reads aloud (e.g., What is a horse?)	Internal reliability: .82-.94 Adequate content, construct, and criterion-related validity
<i>Matrix Reasoning</i> subtest of the WISC-IV	Visual information processing and abstract reasoning skills	Look at an incomplete matrix and select the missing portion from 5 response options	Internal reliability: .86-.92 Adequate content, construct, and criterion-related validity
<i>Block Design</i> subtest of the WISC-IV	Ability to analyze and synthesize abstract visual stimuli.	Look at a constructed model or a picture in the stimulus book and use red-and-white blocks to re-create the design within a specified time limit	Internal reliability: .83-.88 Adequate content, construct, and criterion-related validity

**Direct observations.** The final sources of evidence that were collected were direct observations. Observations were collected on the reading and language strategies that were used and the behaviour that occurred during the assessment sessions.

***Reading and language strategy observations.*** A list of reading decoding strategies (see Appendix B) was appended to the end of all reading decoding tasks and the researcher recorded the frequency with which each listed behaviour occurred. The same was done for linguistic decoding habits (see Appendix C) and reading comprehension habits (see Appendix D). Strategies that were observed included, but were not limited to, attention to whether CG read fluently, self-corrected, sounded out words, read silently or aloud, answered questions verbatim from text, used context to decode unknown words, and used general knowledge to respond to questions. Finally, any comments that pertained to the work being done were recorded. The length of the task and the order in which it was administered was also recorded so that fatigue effects and length of task were considered in the interpretation of the findings.

***Behavioural observations.*** Following each task, the frequency with which each of a list of behaviours (see Appendix E) occurred was recorded. Targeted behaviours included ease, engagement, requests for breaks, acting-out behaviour, off-topic discussion, and expressions of frustration. The length of the task and the order in which it was administered was also recorded so that fatigue effects and differences in opportunities for behaviour were considered in the interpretation of the findings.

**Reflective journal.** Consistent with Creswell (2005), the researcher recorded personal thoughts that arose during both the data collection phase and the analysis phase in a reflective journal. These personal thoughts included insights, hypotheses, impressions, or ideas regarding broad themes that emerged during observation or analysis. The reflective journal provided a

means of recording the evolution of ideas and adherence to theoretical positions throughout the course of the study.

### **Procedure**

The assessments were individually administered in 5 1-hour sessions. Individual assessment sessions did not go beyond 1 hour.

**Managing anxiety.** New situations and routines can induce anxiety in all individuals, but especially in those with autism (Muris, Steerneman, & Merchelback, 1998). To increase the reliability of the assessments it was important to minimize anxiety and behavioural disturbances in the child being assessed. Ali and Frederickson (2006) conducted a review of the utility of social stories for individuals with autism and concluded that they do help individuals with autism reduce anxiety and manage their behaviour in new social situations. Social stories are stories that provide accurate information to an individual about a situation they may find difficult or confusing in order to help them predict what will occur. One week before the first assessment session the child was provided with a social story describing the procedures that would take place over the course of the study. Pictures and rebuses were used to increase comprehension (see Appendix F).

Visual schedules have also been demonstrated to help individuals with autism manage their anxiety and behavioural disturbances (Bopp, Brown, & Mirenda, 2004). A visual schedule is a text that provides a list, accompanied by pictures, that depicts the sequence of activities and steps that apply to a specific routine. In each intervention session a visual schedule was used to demonstrate to the child what activities she would be asked to do and in what sequence she would be asked to do them in. The activities were crossed off as they were completed.

In addition to these measures, prior to the first assessment session, the child's mother was

asked to identify any behaviours that signal that her child is feeling anxious, upset, or threatened. She was also asked what protocol she would like the researcher to follow in the event of those signaling behaviours. The protocol given by the parent was recorded and followed by the researcher.

**Order of assessments.** In each assessment session, both simple and complex tasks were administered to ensure that the cognitive resources needed in any given assessment session were not being overly strained. Each session began with the most basic task in order to help the child feel successful and encouraged for the rest of the session. Each session ended with a relatively basic task to provide a successful end to the session. The reading comprehension tasks were administered in the middle of the session and were spread across all of the assessment sessions.

Prior to the first assessment session, the researcher met with the parents to be introduced to the child and to administer the background questionnaire, CBCL, and the CPRS – R:L with the parents. The location for testing was also determined during this meeting.

The first assessment session was comprised of the following assessments, in this order: PPVT-IV, PAT, WJ-III Passage Comprehension, and WIAT-II Pseudoword Decoding. The second assessment session was comprised of the following assessments, in this order: CASL Basic Concepts, CASL Sentence Completion, CASL Inference, Yuill & Oakhill's (1988) Cohesive Reading Comprehension and Cohesive Linguistic Comprehension, Oakhill's (1982) Reading Text Connecting Inference Task and Oral Text Connecting Inference Task, and CASL Paragraph Comprehension. The third assessment session was comprised of the following assessments, in this order: WIAT-II Listening Comprehension, CTOPP Elision, Oakhill's (1984) Inferential Comprehension Task, Calhoon's (2001) Word/Nonword Decoding Task, WIAT-II Spelling, and WIAT-II Word Reading. The fourth assessment session was comprised of the

following assessments, in this order: EVT-2, Happe's (1994) Evaluative Inferences Reading Comprehension Task and Evaluative Inferences Listening Comprehension Task, WIAT-II Reading Comprehension, and CASL Pragmatic Judgment. The final assessment session was comprised of the following assessments, in this order: WISC-IV Block Design, WISC-IV Similarities, WISC-IV Vocabulary, and WISC-IV Matrix Reasoning.

**Follow-up discussion with caregiver.** Consistent with Yin (1984), once the assessments were conducted and the scores were calculated, a detailed profile was shared with the child's mother. This profile included information on CG's scores on the different tasks. For the norm-referenced tests, standardized scores as well as an explanation of the meaning of these scores were provided. For the experimental measures the raw scores and an explanation of the meaning of these scores were provided. A summary of CG's overall performance, including her strengths and weaknesses, was also provided. CG's mother was then asked if she had any additional information that would help interpret the findings. This step was useful for ensuring the validity of the conclusions and interpretations (Yin, 1984).

## Chapter 4

### Results

#### Overview of analysis

The primary question of interest to the current study was whether the literacy profile in a case of childhood autism could be explained using the SVR. In order to analyze the data collected and interpret it in terms of the SVR, a technique, developed by Campbell (1975), called pattern matching was employed. Pattern matching involves comparing an empirically based pattern with a predicted one and it is an effective technique for improving internal validity (Yin, 1984). In order to demonstrate the empirically based pattern seen in this case, CG's performance on language and literacy tasks will first be comprehensively described.

This comprehensive description will involve an examination of CG's scores across the following twelve standardized and experimental measures: receptive language, expressive language, pragmatic language, phonological processing, knowledge of phoneme-grapheme conversion rules, word recognition, orthographic awareness, oral language and reading sentence comprehension, oral language and reading passage comprehension, oral language and reading knowledge-based inferential comprehension, oral language and reading cohesive inferential comprehension, and oral language and reading evaluative inferential comprehension. Embedded within this description will also be information obtained through interviews with CG's mother and through direct observations of strategies CG used and behaviours she exhibited while completing language and literacy tasks. Thoughts, questions, and ideas that were documented in the reflective journal will also be included.

Information obtained through each of these sources of information will then be used to provide a profile analysis within areas assessed and between areas assessed. The analysis *within*

the areas assessed will examine which components within phonological processing, word level reading, reading comprehension, and oral language comprehension caused the most difficulty for CG and which components caused her the least difficulty. For example, the analysis within the area of word level decoding explored CG's scores in word identification, nonword identification, high frequency words, low frequency words, words with high frequency letter patterns, and words with low frequency letter patterns, to determine which of these components caused CG the most and the least difficulty.

Once a comprehensive profile within the areas assessed has been described, an analysis *between* the areas assessed will then compare CG's performance on phonological processing, word level decoding, reading comprehension, and oral language comprehension. This description will then be compared with the predicted pattern that would be drawn from the SVR to determine whether the SVR is useful in helping explain the literacy profile in this case of childhood autism.

The SVR states that performance in reading comprehension is the product of performance in oral language comprehension and performance in word decoding (Gough & Tunmer, 1986). The following predictions are expected if the SVR is useful in explaining CG's profile:

1. If word level decoding is higher than reading comprehension, we would expect that oral language comprehension standard scores would be lower than word level decoding standard scores.
2. If word level decoding is lower than reading comprehension, we would expect that oral language comprehension standard scores would be higher than word level decoding standard scores.

3. If word level decoding is comparable to reading comprehension, we would expect that oral language comprehension standard scores would be equivalent to word level decoding standard scores.

### **CG's profile within areas assessed**

CG's performance in component language and literacy skills will be examined in the following order: (1) phonological processing, (2) word level decoding, (3) reading comprehension, and (4) oral language comprehension. A description of CG's strengths and weaknesses across phonological processing tasks will provide insight into her profile across component word level decoding skills. Her word level decoding skills will then be compared to her reading comprehension profile. Following this, her oral language comprehension skills will be examined to determine if, consistent with the SVR, any observed discrepancies between her word level reading skills and her skill in reading comprehension can be explained by her performance on oral language comprehension tasks.

**Estimate of cognitive functioning and attention.** In order to be confident in the reliability and validity of measures assessing CG's language and literacy skills it was necessary to determine whether CG had the ability to attend to the tasks and the cognitive ability to comprehend the tasks that she was asked to complete. Selected subtests from the WISC-IV were administered to provide an estimate of CG's cognitive functioning and the CPRS-R:L and the CBCL were administered to provide an estimate of CG's observed attention skills.

CG demonstrated a range of abilities across the different subtests of the WISC-IV. Four subtests were administered: (1) *Similarities*, (2) *Vocabulary*, (3) *Matrix Reasoning*, and (4) *Block Design*. CG performed within age expectations in the *Similarities* subtest, below age expectations in the *Block Design* subtest, and well below age expectations on both the

*Vocabulary* subtest and the *Matrix Reasoning* subtest. While CG performed below age expectations on some subtests, she did not perform below age expectations on the *Vocabulary* subtest, indicating that she did have the cognitive ability to complete at least some tasks at the same level as her same age peers.

The assessments of CG's capacity to attend were conducted using the Child Behavior Checklist (CBCL) and the Conners' Parent Rating Scale – Revised (CPRS-R:L). CG's Total Competence score and her School Competency scores were in the normal range. Her scores on the Attention Deficit/Hyperactivity Problems Scales were in the borderline clinical range (93<sup>rd</sup> to 97<sup>th</sup> percentiles). The Conners' also revealed that CG demonstrated some difficulty with attention but found that these difficulties were not clinically significant. Where a score of 6-9 indicates a possible DSM-IV diagnosis of Attention Deficit Disorder, CG obtained a score of 2 indicating that she likely does not have clinically significant difficulties with attention (Conners, 1997). On the basis of these assessments, there were no indications of clinically significant difficulties with attention that would prevent an accurate interpretation of her performance on the reading and language measures.

**Phonological awareness.** Research has established that phonological awareness is the skill the most highly correlated with reading and the best predictor of reading ability in typically developing kindergarten students (Share et al., 1984). In order to comprehensively describe CG's word level decoding skill it is essential, therefore, to explore her phonological awareness. The literature reviewed has indicated that researchers have not yet explored whether phonological processing is as important to the development of reading in individuals with autism as it is in the general reading population. The current study sought to explore this question in a case of childhood autism.

An assessment of CG's phonological awareness was conducted using the *Elision* subtest of the CTOPP, as well as the *Syllable Completion*, *Phoneme Completion*, *Beginning Phoneme Deletion*, *Ending Phoneme Deletion*, *Rhyme Detection*, and *Rhyme Production* subtests of the PAT. Table 8 provides a summary of CG's performance on measures assessing phonological awareness.

Table 8

*CG's performance on measures assessing phonological awareness*

Name of Subtest	Standard Score	Classification	Percentile Rank
CTOPP: <i>Elision</i>	4	Well Below age expectations	2
PAT: <i>Syllable Completion</i>	n/a		0-10 Centile*
PAT: <i>Phoneme Completion</i>	n/a		0-10 Centile*
PAT: <i>Beginning Phoneme Deletion</i>	n/a		50-100 Centile*
PAT: <i>Ending Phoneme Deletion</i>	n/a		0-10 Centile*
PAT: <i>Rhyme Detection</i>	n/a		75-100 Centile*
PAT: <i>Rhyme Production</i>	n/a		25-50 Centile*

\*Compared with children who are 7:11

CG demonstrated substantial difficulties with phonological awareness. The *Elision* subtest of the CTOPP measures sound segmentation ability by having children say the word that remains after deleting a word from a compound word or a phoneme from an orally presented word. CG achieved an *Elision* score corresponding to the second percentile when tested with the CTOPP. She was able to complete the items where she was asked to say the word that remained after deleting a word from a compound word (e.g., say heartbeat without saying heart) (6/6; 100%) and the items where she was asked to say the word that remained after deleting the first phoneme in a word (5/5; 100%). She had more difficulty completing items where she was asked to say the word that remained after deleting the last phoneme in a word (1/3; 33%) and items where she was asked to say the word that remained after deleting the phoneme in the middle of a word (0/1; 0%).

The *Elision* subtest is a complex measure of phonological awareness. To ensure that CG's performance was measuring her skill in phonological awareness, and not her ability to comprehend the task, the PAT was also administered. The PAT was designed for children between the ages of 5 and 7, and children are required to complete tasks with simple instructions. Norms are only provided for children up 7:11 years of age, as such, CG's performance will be compared to that of typically developing children 7:11 years of age. The PAT also revealed that CG is performing well below the level of children who are 7 years of age on tasks where she is asked to complete the phonemes in the end of a word and delete phonemes from the end of a word. On these tasks she performed as well or better than 0-10% of children who are 7:11 years of age. CG demonstrated relative ease at segmenting and manipulating phonemes at the beginning of a word. On the *Phoneme Deletion Test: Beginning Sounds*, where CG was asked to identify the word that remains after dropping out a beginning phoneme from a stimulus word, she achieved 100% accuracy (8/8), performing as well or better than 50-100% of children who are 7:11 years of age. Her difficulty with segmenting and manipulating phonemes at the end of a word in the PAT items and relative ease at segmenting and manipulating phonemes at the beginning of a word was consistent with an analysis of her errors on the *Elision* subtest. CG's word level decoding skills will now be examined and the relationship between her word level reading skills and her phonological processing will be discussed.

**Word level decoding.** The research reviewed thus far on the word level decoding skills of individuals with autism has provided some evidence that children with autism might read words and nonwords based on their analogy to familiar words as opposed to through an application of GPC rules. In order to clarify the relative contribution of GPC and orthographic awareness to word level reading in this case of childhood autism, CG's performance on measures assessing word identification, nonword identification, and spelling will be explored. To provide a richly detailed picture of these two skills, error analyses were conducted and will be discussed.

An assessment of CG's word level decoding skills was conducted using the *Word Reading*, the *Pseudoword Decoding*, and the *Spelling* subtests of the WIAT-II. In addition, an experimental measure (Calhoun, 2001) was used to assess word reading accuracy on words and nonwords composed of frequent, as opposed to, infrequent rimes. Table 9 provides a summary of CG's performance on standardized measures of word level decoding.

Table 9

*CG's performance on measures assessing word level decoding*

<b>Name of Subtest</b>	<b>Standard Score</b>	<b>Classification</b>	<b>Percentile Rank</b>
WIAT-II: <i>Word Reading</i>	83	Below age expectations	13
WIAT-II: <i>Pseudoword Decoding</i>	89	Below age expectations	23
WIAT-II: <i>Spelling</i>	81	Below age expectations	10

Across tasks, CG demonstrated difficulty compared with her peers on word reading and spelling. On the *Word Reading* subtest CG performed as well or better than 13% of all children when compared to the norms for her age. CG's performance on spelling was also assessed in order to provide more detailed information on the strategies she used to decode words. On the *Spelling* subtest CG performed as well or better than 10% of all children when compared to the norms for her age. She also demonstrated difficulty compared with her peers in nonword

reading, however, the differences between her and her peers on this task were not as great. CG performed as well or better than 23% of all children when compared to the norms for her age on the *Pseudoword Decoding* subtest.

An experimental word/nonword decoding task designed by Calhoon (2001) was administered to explore CG's performance on reading words and nonwords that were common and uncommon, with common and uncommon orthographic features. CG performed very well on this task, answering 79/81 items correctly (97.5%). Her performance indicated that this task was too easy for her to provide meaningful information, however her errors did tend to be in infrequent words with less frequent rimes. This pattern, of greater difficulty with lower frequency words and words with more uncommon rimes, is similar in typically developing children (Calhoon, 2001).

After calculating CG's results across word level decoding tasks I recorded interest, in my reflective journal, in the reasons behind the discrepancy between CG's skilled performance in nonword reading and her poor performance on phonological tasks. Nonword reading is considered a measure of reading using a phonological route (Coltheart, 1981) and I was interested in why she could perform so well on this task if her phonological processing was impaired.

Error analyses were, therefore, conducted to further examine the relative contribution of orthographic awareness and phoneme grapheme correspondence in CG's word level decoding and to explore why she demonstrated less difficulty with nonword reading than word reading.

***Error Analyses.*** An exploration of CG's word level decoding skills revealed that she appeared to use a mostly visual approach to word level decoding, failing to activate her semantic and phonological knowledge to help her in reading these tasks.

*Phonological approach.* Across tasks, CG would read or spell words quickly and automatically, showing no signs that she was sounding words out. Error analyses were conducted, at the level of the phoneme, to determine whether her errors were phonologically accurate, phonologically plausible, or phonologically distant (Roeltgen, 1992). According to Roeltgen's classification, a phonologically accurate spelling or pronunciation was an exact representation of the phonology of the stimulus (e.g., spelling 'hete' for *heat*; reading 'know' by pronouncing the k). Phonologically plausible errors are consistent with the alphabetic approach but are not phonologically exact. Consonants substitutions that are the same in two of the three following ways were considered phonologically plausible: manner of articulation (e.g., /p/ and /b/ are both stops), place of articulation (e.g., /b/ and /m/ are both bilabial), and voicing (e.g., /v/ is voiced, /f/ is unvoiced). In addition, one place change in articulation using any manner of articulation, is considered phonologically plausible if the voicing remains the same (e.g., a stop that is bilabial and unvoiced, /p/, in place of a fricative that is labial-dental and unvoiced, /f/). Vowel substitutions, where the place of articulation is similar, were considered phonologically plausible (e.g., spelling 'coe' for *cow*). Errors that were not categorized as phonologically exact or phonologically plausible were considered phonologically distant errors.

In word reading, 82% of CG's errors were considered phonologically distant in that these errors could not be considered phonologically exact or phonologically plausible. In nonword reading, 67% were considered phonologically distant. Her rate of phonologically distant errors in reading words is higher than that of reading nonwords, however, this is to be expected given that readers are expected to use, primarily, the application of phoneme grapheme correspondence rules and blending to read nonwords. Given the task, the high rate of errors that are not phonologically plausible errors are, therefore, surprising. In the *Spelling* subtest, 50% of CG's

errors were phonologically distant. The majority (67%) of her phonologically exact errors were preserving, either the spelling of the central lexeme (easier/easier; absence/absence) or the most common spelling of the phoneme (ei/ie; silent b/omission of b). Even her phonologically exact errors, therefore, might not have been due to consolidated knowledge of GPC rules. It appears that these errors might have resulted from her lexical knowledge or a less sophisticated knowledge of GPC rules. Her low rate of phonologically plausible errors suggests that CG is, for the most part, not reading or spelling through the application of phoneme grapheme conversion rules.

*Semantic approach.* Throughout my reflective journal I had recorded observations of CG's activities during assessments that differed from my experiences with other children. When completing word level decoding tasks I had recorded several instances where it appeared that CG was not attending to the meaning of the words she was decoding. When reading she would pronounce words automatically and without pause even when the word she listed was not a real word. This was even true when the correct word was very similar to the fake word she had read. For example, when reading the word *cutlery* she automatically said that the word was *cultery* and did not pause to reflect on the fact that this was not a word. When spelling she needed reminding to wait to spell the word until she had heard it in a sentence.

Of her 11 reading errors, eight (73%) were non-lexical errors, errors that are not real words. The substantial number of non-lexical errors suggests that she was not activating her vocabulary knowledge to read. The spelling task required CG to spell three words that were homophones. For each of these homophones she spelled the homophone that was inconsistent

with the sentence provided (knew/new; they're/their; accept/except). She failed to use the sentence to disambiguate the homophone.

The majority of CG's errors, across tasks, demonstrated that she was not activating her phonological or semantic knowledge in decoding; however, she demonstrated a comparatively strong sense of orthographic awareness.

*Visual approach.* CG's errors were explored to determine the proportion of her errors that were pure visual paralexias. In order to be considered a pure visual paralexia, the response must be a whole word without a semantic or morphological relation to the stimulus word. It must, however, bear a visual relation to the stimulus word; at least half of the letters in the stimulus word must be present in the response (Sinn & Blanken, 1999). In the *Word Reading* subtest, 88% of CG's non-lexical errors were pure visual paralexias, in nonword reading 89% of CG's non-lexical errors were pure visual paralexias, and in spelling 100% of CG's non-lexical errors were pure visual paralexias.

Additionally, in reading and spelling, CG's errors tended to result from her attempt to preserve either the most common lexeme in a word or the most common GPC rule, indicating knowledge of the common appearance of words and letter clusters. Bernt, Reggia, and Mitchum's (1987) work was consulted to determine the probability of certain graphemes being pronounced as specific phonemes. In the *Word Reading* subtest, of CG's three lexical errors, errors that represented real words, two (67%) preserved the most common pronunciations of the central lexeme (e.g., cleanness for cleanse, and veterinarian for veterinary). In addition, common letter clusters were preserved (e.g., *-ology*, *-inity*, *-ous*, *-ery*). When a letter was used in an uncommon way, the phoneme substitutions and insertions appeared to allow that letter to be pronounced as it most frequently is. For example, CG pronounced the word vicinity as victinity,

allowing her to pronounce the c in its most common pronunciation of /k/ as opposed to /s/. Similarly, she pronounced “negotiate” as “negotalie”, allowing her to pronounce the t in its most common pronunciation of /t/ as opposed to /sh/. In nonword reading, the majority of her errors involved either digraphs (th, ch) or inconsistently pronounced letters (e.g., c, g). In spelling, as stated earlier, the majority of her phonologically exact errors were preserving either the spelling of the central lexeme or the most common spelling of the phoneme.

**Word decoding summary.** In conclusion, CG relied more on orthographic knowledge when decoding than phonological knowledge or semantic knowledge. This tendency to avoid using the phonological route to decode is likely related to her poor phonological processing and her less sophisticated knowledge of GPC rules.

**Reading comprehension.** An examination of CG’s phonological awareness and her word level decoding skills has revealed that she performs far below her same age peers on measures of phonological awareness. While she is also performing below her same age peers in measures of word level decoding, the difference between her and her peers is much smaller for decoding tasks than for phonological awareness tasks. She shows skill in applying orthographic knowledge when decoding words relative to her difficulties in applying GPC rules to decode words. CG’s performance on reading comprehension tasks will now be explored to determine whether there is a discrepancy between her word level decoding skills and her performance on reading comprehension tasks. Examining the relation between these two skills will be essential in determining the utility of the SVR in explaining CG’s literacy profile.

The research that has been reviewed thus far has indicated that reading comprehension is the reading skill that has been demonstrated to be the most impaired in individuals with autism. While many components of reading comprehension have been identified (Bowyer-Crane &

Snowling, 2005) research on the literacy skills of children with autism has not explored which components cause the greatest or least difficulty within reading comprehension. The current research explored the differences across the components of reading comprehension to develop a comprehensive description of CG's reading profile. Exploring the relationship between components of oral language comprehension and reading comprehension will help determine whether any discrepancy between word level decoding and reading comprehension can be attributed to language comprehension as would be predicted according to the SVR.

An assessment of CG's reading comprehension was conducted using the *Reading Comprehension* subtest of the WIAT-II and the *Passage Comprehension* subtest of the WJ-III. In addition, several experimental measures were administered to allow for an exploration of CG's skill in all six of the components of reading comprehension identified by Bowyer-Crane and Snowling (2005). (1) Knowledge-based inferential comprehension was measured using the experimental inferential comprehension task designed by Oakhill (1984); (2) Yuill & Oakhill's (1988) assessment of anaphoric resolution was used to assess CG's ability to use lexical cues such as pronoun resolution, ellipsis, substitution, and lexical cohesion to maintain textual coherence; (3) Oakhill's (1982) assessment of cohesive inferences was used to assess CG's ability to integrate information explicitly provided by the text to establish cohesion between different sentences and; (4) an experimental evaluative inferences task designed by Happe (1994) was used to assess CG's ability to use knowledge of internal mental states to interpret textual information. Table 10 provides a summary of CG's performance on standardized measures assessing reading comprehension.

Table 10

*CG's performance on measures assessing reading comprehension*

Name of Subtest	Standard Score	Classification	Percentile Rank
WIAT-II: <i>Reading Comprehension</i>	82	Below age expectations	12
WJ-III: <i>Reading Comprehension</i>	88	Below age expectations	19

CG demonstrated substantial difficulty compared with her peers on reading comprehension tasks. CG performed as well or better than 12% of all children when compared to the norms for her age on the *Reading Comprehension* subtest of the WIAT-II and as well or better than 19% of all children when compared to the norms for her age on the *Passage Comprehension* subtest of the WJ-III. Her reading behaviour in these tasks was consistent with her reading behaviour in the decoding subtests. Once again, she read very quickly, not showing any evidence that she was trying to sound words out to read them. Even the words that she read incorrectly were pronounced fluently, without pause. In the vast majority of cases where she read a word wrong that did not make sense within the sentence, she did not self-correct, indicating that she was not activating her semantic system while reading.

**Error analyses.** Error analyses were conducted to provide information on CG's performance on each of the components of comprehension outlined by Bowyer-Crane and Snowling (2005). These error analyses revealed that CG had the least difficulty with literal and vocabulary-dependent comprehension.

**WIAT-II Reading Comprehension.** In the WIAT-II *Reading Comprehension* subtest, CG achieved a score of 12/21 (57%) for literal comprehension questions. Of these questions, CG's responses were formed with the exact phrasing found in the text in 7 (64%) out of 11 questions. CG received points for all 7 answers given with the exact phrasing from the text and 0 points for all answers that were given with wording that was not found in the text. This finding indicates

that CG's correct responses on literal questions were not due to the integration and understanding of the story within her own mind, but were found in the text and re-read.

CG achieved a score of 8/22 (36%) for questions measuring her comprehension of vocabulary, 0/8 (0%) on questions tapping knowledge-based inferential comprehension, 0/5 (0%) on questions tapping cohesive inferential comprehension, 0/6 (0%) on questions tapping elaborative comprehension, and 0/6 (0%) on questions tapping evaluative comprehension. Every point that CG received in the *Reading Comprehension* subtest of the WIAT-II was for questions where either the response could be found directly in the text, and was given verbatim from the text, or the question required the definition of a word. She obtained 0 points for questions that relied on her to spontaneously: (1) integrate relevant knowledge into the text to determine the correct response, (2) integrate her knowledge of people's emotions into the text to determine the correct response, (3) pull together different pieces of the text to determine the correct response, or (4) integrate knowledge and ensure a rich representation of the text in order to determine the correct response.

*WJ-III Passage Comprehension.* In addition to the *Reading Comprehension* subtest of the WIAT-II, the *Passage Comprehension* subtest of the WJ-III was also administered. The WJ-III measured reading comprehension using a cloze task, whereby CG was required to read a short passage and identify a missing key word that made sense in the context of the passage (e.g., "I used my money to buy a paddle. I can't wait to go ..."). The WIAT-II and the WJ-III were both administered as they measured reading comprehension in different ways and, thus, each provided unique information about CG's reading comprehension profile. While the WIAT-II measured comprehension in a more traditional manner, similar to the comprehension skills taught in the

classroom and used in everyday life, the cloze procedure in the WJ-III also assessed the ability to use semantic and syntactic cues to aid comprehension.

Given the type of comprehension task, there were no literal comprehension questions. The blank spaces were not, specifically, designed to see if you understood parts of the text, they were designed to have you complete the text based on your understanding. Most often CG was asked to employ her real world knowledge to complete the cloze. On this subtest, CG achieved 8/15 (53%) on questions tapping knowledge-based inferential comprehension, 4/7 (57%) on questions tapping cohesive inferential comprehension, 0/3 (0%) on questions tapping evaluative comprehension, and 3/3 (100%) on questions tapping knowledge of syntax (e.g., The man was scared and began to \_\_\_\_\_. He ran and ran.). CG demonstrated the greatest ease with questions tapping syntax awareness and cohesive inferential comprehension. She also performed fairly well on questions tapping knowledge-based inferential comprehension.

Notes recorded in my reflective journal indicated that CG's performance on the WJ-III was inconsistent with her performance on the WIAT-II. When completing the WIAT-II she was unable to respond to questions tapping knowledge-based or cohesive inferential comprehension, however, when completing the WJ-III she was able to respond to these types of questions. I recorded in my reflective journal that it would be interesting to explore how these two tasks evaluate components of comprehension differently. On the WIAT-II, the reader is able to answer the question correctly only if she spontaneously integrates real world knowledge and draws together parts of the text. It is not clear from the question, however, that this needs to be done to answer correctly. For example, a sentence in the text could read, "Seven geese were flying to the lake. One of the geese accidentally hit a tree and damaged her wing. The rest of the geese continued flying and landed at the lake." The question, "how many geese arrived at the

lake” requires that CG integrate her knowledge of math and draw together two pieces of the text to respond correctly, however, the question is not making it clear that she is being asked to state her knowledge of math or her ability to draw two pieces of information together. On the WJ-III, however, it is clear that the cloze requires that CG integrate her real world knowledge or draw together pieces of the text to answer the question. For example, a question could read, “\_\_\_\_\_ is the furthest planet from the sun. It is very cold there.” These questions make it clear that to answer the question CG would need to activate real world knowledge. While, on the WIAT-II, CG was unable to correctly respond to questions that required her to spontaneously integrate real world knowledge and draw together different portions of the text, on the WJ-III, when it was clear that she was required to do so, she was able to integrate her real world knowledge and draw together different portions of the text.

*Experimental measures assessing reading comprehension.* Experimental tasks provided further information on CG’s performance on the six components of reading comprehension outlined by Bowyer-Crane and Snowling (2005).

*Cohesive inferential comprehension.* Cohesive inferences rely on oral language cues present in the text, such as the resolution of an anaphor (a word which refers back to a previously expressed word or phrase) or the integration of textual information, in order for the text to be understood. While CG demonstrated difficulty with cohesive inferential comprehension in the WIAT-II, she demonstrated the greatest ease with questions tapping syntax awareness and cohesive inferential comprehension in the WJ-III. Two experimental measures were used to provide further information regarding CG’s skill in cohesive inferential reading comprehension. The cohesive reading comprehension task (adapted from Yuill & Oakhill, 1988) measured cohesive inferences using anaphor resolution tasks and the text-connecting inferential

comprehension task (Oakhill, 1982) measured CG's ability to integrate explicit textual information to establish cohesion between different sentences.

In the text-connecting inferential comprehension task CG answered 10 of 12 questions correctly (83%). Given that these tasks were adapted from Yuill and Oakhill's (1988) experimental measure there was not normative data to compare CG's performance with, however, her performance indicated that she was able to resolve the majority of anaphors in these tasks. Her skilled performance in these tasks was consistent with her performance on the WJ-III but inconsistent with her performance on the WIAT-II. It is possible that this is because the WIAT-II requires the reader to spontaneously integrate textual information and both the task by Yuill and Oakhill (1988) and the WJ-III make it explicit that textual information needs to be integrated to answer the question correctly.

The text-connecting inferential comprehension tasks (Oakhill, 1982) did not provide useful information in CG's case. This assessment required that CG read a series of short stories and, after a 10-minute delay, identify whether she had heard the exact sentences she was presented with before. In my reflective journal I noted that this task did not appear to measure what it was intended to measure. In this task CG reported that she had heard all of the sentences presented before. CG's pattern of results suggests that she did not understand the task and was simply saying yes to all questions or that she was not actively constructing the meaning of the sentences enough to recognize the false sentences and just believed she had heard each of the sentences before because they sounded similar to the story. Alternatively, her memory could be limiting her ability to answer this question. Given that there are so many possible interpretations to CG's performance, the utility of this measure in helping to understand CG's text-connecting inferential comprehension ability is limited.

*Knowledge-based inferential comprehension.* An experimental knowledge-based inferential comprehension task designed by Oakhill (1984) was used to explore CG's ability to integrate general knowledge with information in the text to fill in missing detail. CG was required to answer 16 literal comprehension questions and 16 inferential comprehension questions. She responded correctly to 14.5 (91%) of the literal comprehension questions and to 12 (75%) of the inferential questions.

Oakhill (1984), in her original study, compared the performance of two groups on this measure: Skilled comprehenders and unskilled comprehenders. The decoding performance of the skilled comprehenders was at the same level as 8 year olds, and their comprehension was at the level of 9 year olds. The decoding performance of the unskilled comprehenders was, again, at the same level as 8 year olds, however, their comprehension was at the level of 7 year olds. According to the WIAT-II, CG is decoding at the level of a 10-year old and her comprehension is at the level of a 9-year old. Even though CG has a higher level of decoding and comprehension than the skilled comprehenders, she performed worse than this group in both literal (skilled: 99%; CG: 91%) and inferential tasks (skilled: 91%; CG: 75%). In comparison with the unskilled comprehenders, she performed worse in literal tasks (unskilled: 96%; CG: 91%), but better in inferential tasks (unskilled: 65%; CG: 75%).

CG demonstrated a similar pattern to skilled and unskilled comprehenders, showing more difficulty with inferential comprehension than literal comprehension, however, she did not demonstrate the substantial drop in inferential comprehension over literal comprehension evidenced by the unskilled comprehenders. Once again, it is important to note that, similar to the questions on the WJ-III, the questions in this experimental task make it clear that to answer the question CG would need to activate real world knowledge.

*Evaluative inferential comprehension.* According to the WIAT-II and the WJ-III, CG demonstrated the most difficulty with evaluative inferential comprehension. An experimental evaluative inference task, designed by Happe (1994), was used to investigate this skill further. CG responded correctly to three of the four (75%) evaluative inferential comprehension questions. Due to the type of data provided in the Happe (1994) article, CG's scores could not be compared to a norm-group. An analysis of her responses was conducted to gain understanding about the type of responding used for these tasks. There were two types of questions in Happe's (1994) task. The first type required CG to label a feeling. An example of this type of question is asking CG, "Why did Anna say this?" in response to a story where Anna broke a vase and told her mother that the dog broke the vase because she was afraid her mother would be mad. The second type required her to label the behaviour of others that came from an internal mental state that was not a feeling. An example of this is asking why a character held a banana up to her ear and said, "hello". CG was unable to respond correctly to the one question (0/1; 0%) that required her to label a feeling. She responded correctly to all three questions (3/3; 100%) that required her to identify the cause of the behaviour that comes from an internal mental state. For example, she identified that characters were saying things that were not literally true because they were pretending, using expressions, or telling someone that they were not meeting expectations, however, she did not discuss the feelings involved in each of these scenarios and how they led to the pretending, using expressions, or telling someone that they were not meeting expectations.

In my reflective journal I noted that it would be important to explore the discrepancy between CG's performance in evaluative comprehension across measures. I noted that her relatively good performance on evaluative inferential comprehension questions in Happe's (1994) experimental task, compared with her very poor performance on this type of

comprehension in the WIAT-II and the WJ-III could be attributed to two causes. The first is that, on the WIAT-II and WJ-III only half of the evaluative comprehension questions were explicitly asking CG to identify an internal mental state. For the remaining half of the questions CG was required to spontaneously integrate her knowledge of the characters feelings into the text to be able to answer a question whereas, in the current task, CG was directly asked to identify the internal mental state for all questions. The second possibility is that in the WIAT-II and the WJ-III, the majority of correct responses to the evaluative inferential comprehension task rely on knowledge of the feelings of the characters, whereas, in the current task, CG was only required to label the behaviours that might result from an internal mental state for all of the questions she responded correctly to.

***Reading comprehension summary.*** In sum, CG demonstrated the greatest ease with literal and vocabulary based comprehension. She was unable to answer questions requiring her to spontaneously integrate textual knowledge, real world knowledge, and a rich representation of the text to respond correctly. When the questions explicitly required this integration, however, she was often able to respond correctly. CG had the greatest difficulty integrating her knowledge of internal mental states to understand the text. While she was unable to answer those questions that required her to discuss the feelings behind a character's behaviour, she did demonstrate knowledge of how a character would act in a given scenario, indicating that she could understand the internal mental state of another individual.

**Oral language comprehension.** According to CG's performance on standardized measures of word level decoding and reading comprehension, she performed below her same age peers in both skill areas. Moreover, the difference between her and in peers in word reading was very similar to the difference between her and her peers in reading comprehension. An analysis

of her errors in reading comprehension revealed that her performance scores were lowered more by some components of reading comprehension (i.e., inferential comprehension) than others (i.e., literal comprehension).

According to the SVR, if word level decoding is comparable to reading comprehension, as it is in CG's case, we would expect that oral language comprehension would be equivalent to word level decoding. The following section will summarize CG's performance on measures of oral language to determine: (1) whether the components of oral language comprehension that provide difficulty for CG are similar to the components of reading comprehension that provide difficulty for her and vice versa, and (2) whether, consistent with the SVR, her performance on oral language comprehension is comparable to her performance on word level decoding and reading comprehension.

An assessment of CG's oral language was conducted using the PPVT-IV, the EVT-2, the *Listening Comprehension* subtest of the WIAT-II, and the *Paragraph Comprehension, Sentence Completion, Inference, and Pragmatic Judgment* subtests of the CASL. In addition, two experimental measures were administered to explore CG's performance on all six components of reading comprehension identified by Bowyer-Crane and Snowling (2005). CG's receptive and expressive skills will first be reviewed followed by a description of her performance on standardized measures of literal comprehension, inferential comprehension, and pragmatic language. CG's performance on experimental measures assessing cohesive inferential comprehension and evaluative inferential comprehension will then be described.

Table 11 summarizes CG's performance on measures assessing oral language.

Table 11

*CG's performance on measures assessing oral language*

<b>Name of Subtest</b>	<b>Standard Score</b>	<b>Classification</b>	<b>Percentile Rank</b>
EVT-2: <i>Expressive Vocabulary</i>	74	Well below age expectations	4
PPVT-IV: <i>Receptive Vocabulary</i>	85	Below age expectations	16
WIAT-II <i>Listening Comprehension</i>	97	Within age expectations	42
CASL: <i>Sentence Completion</i>	83	Below age expectations	13
CASL: <i>Inference</i>	60	Well below age expectations	0.4
CASL: <i>Paragraph Comprehension</i>	85	Below age expectations	16
CASL: <i>Pragmatic Judgment</i>	52	Well below age expectations	0.1

As Table 11 reveals, CG demonstrated a wide range of ability across oral language measures. Her standard scores in decoding subtests and reading comprehension subtests ranged from 81-89, whereas her standard scores across language tasks ranged from 52-97. This could be due to the fact that the subtests designed to measure oral language were more specifically evaluating one type of comprehension (i.e. pragmatic skill, inference skill). As such, they were able to clearly delineate areas of ease and areas of difficulty.

An analysis of her errors revealed that she differed the least from her typically developing peers on literal comprehension measures and that her performance was affected by the type of tasks she was performing and the components of comprehension being measured.

***Receptive and expressive vocabulary.*** The PPVT-IV was used to measure receptive vocabulary. On this measure CG performed as well or better than 16% of all children when compared to the norms for her age. CG had substantially more difficulty identifying words that were attributes than she did identifying both nouns and verbs. She identified 26 out of 35 nouns (74%) correctly, 10 out of 13 (77%) verbs correctly, and only 6 out of 12 (50%) attributes correctly. Her expressive vocabulary differed from her typically developing peers more than her receptive vocabulary. According to the EVT-2, CG performed as well or better than 4% of all

children when compared to the norms for her age. The items of difficulty for her on the expressive vocabulary measure were those where she was required to identify synonyms (13/20; 65%) rather than those where she was required to identify a picture (20/23; 87%). These subtests revealed that CG performed below her same age peers in measures assessing both receptive and expressive vocabulary.

***Literal comprehension.*** Literal comprehension of sentences and passages was assessed using the *Listening Comprehension* subtest of the WIAT-II and the *Paragraph Comprehension* subtest of the CASL. In contrast to CG's performance on the PPVT-IV and the EVT-2, CG performed within age expectations on the *Listening Comprehension* subtest of the WIAT-II, a measure assessing the following three components involved in the comprehension of orally presented information: Receptive vocabulary, sentence comprehension, and expressive vocabulary. On this subtest, CG performed as well or better than 42% of all children when compared to the norms for her age. In the sentence comprehension section of the subtest, which required the comprehension of all the vocabulary in the sentence and literal comprehension, she responded correctly to all (10/10; 100%) of the questions. This subtest revealed that CG differed less than her peers in measures of literal comprehension than in measures of receptive vocabulary of attributes and expressive vocabulary where she is asked to identify synonyms.

The *Paragraph Comprehension* subtest of the CASL was also used to assess literal comprehension in spoken narratives. On this subtest, CG performed as well or better than 16% of all children when compared to the norms for her age. Analyses of her errors revealed that 4/5 (80%) of her errors were on questions that required that she identify the correct sequence of events in the paragraph (i.e. "What happened next?" and "What was the first thing she did?"). Of the 20 literal comprehension questions that did not requiring sequencing, she responded

correctly to 19 (95%). Although CG performed below age expectations on this measure of literal comprehension, she did not appear to have difficulty with literal sentence comprehension. She did, however, appear to have difficulty remembering the correct sequence of a text.

***Inferential comprehension.*** Inferential comprehension was assessed using the *Sentence Completion* subtest of the CASL and the *Inference* subtest of the CASL. In contrast to CG's performance on measures of literal comprehension of paragraphs and sentences, she had more difficulty on measures of inferential comprehension of sentences.

The *Sentence Completion* subtest of the CASL measured CG's syntax and vocabulary, as well as her ability to integrate real world knowledge into the text. On this subtest, CG performed as well or better than 13% of all children when compared to the norms for her age. Knowledge-based inferential comprehension was also measured using the *Inference* subtest of the CASL. On this subtest, CG performed as well or better than 0.4% of all children when compared to the norms for her age. CG's performance on this subtest differed much more from her same age peers than her performance on the CASL *Sentence Completion* subtest, which was also intended to measure knowledge-based inferences. The *Sentence Completion* subtest, however, also assessed aspects of comprehension that were less difficult for CG, such as cohesive comprehension and syntax. In addition, while both subtests measured knowledge-based inferences, they measured it in different ways. The *Sentence Completion* subtest is classified as a lexical/semantic test, where knowledge and use of words and word combinations help answer the questions. The *Inferences* subtest is classified as a supralinguistic test, where comprehension of complex language is required when the meaning is not directly available from lexical or grammatical information. It is possible, therefore, that CG was using her knowledge of words

and word meaning to assist retrieval of knowledge-based information in the *Sentence Completion* subtest, whereas, that option was not available to her in the *Inference* subtest.

*Error Analyses.* An error analysis was conducted to determine which components of language comprehension CG demonstrated the most difficulty with within the *Sentence Completion* subtest of the CASL. Comprehension within this subtest is measured using a cloze task and, as such, there were no literal comprehension questions. The blank spaces were not specifically designed to see if parts of the text are understood, they were designed to have the child complete the text based on their understanding. Most often CG was asked to integrate her real world knowledge with the information provided in the sentence to complete the cloze (i.e., Sarah rides to school with her friends at the back of the \_\_\_\_).

The error analysis revealed that CG achieved 6/12 (50%) on questions tapping knowledge-based inferential comprehension, 2/2 (100%) on questions tapping cohesive inferential comprehension, 3/8 (38%) on questions tapping evaluative comprehension, 1/1 (100%) on questions tapping elaborative inferential comprehension, and 1/4 (25%) on questions tapping vocabulary-dependent questions. CG's knowledge of syntax was quite good. Each question had to have correct syntax and be appropriate to the sentence to be considered correct. Out of her 13 incorrect responses, only 1 (8%) was grammatically inappropriate.

CG showed similar patterns in the CASL *Sentence Completion* task and the WJ-III *Passage Comprehension* subtest. In both she demonstrated skill in awareness of syntax and in cohesive inferential comprehension. She also performed fairly well on questions tapping knowledge-based inferential comprehension. In contrast to her performance on the WJ-III and the WIAT-II, however, in this task she was able to respond correctly to some evaluative comprehension question. Notes in my reflective journal indicated that there could be two

reasons for this discrepancy. All of the evaluative comprehension questions in this task were explicitly required for the question to be completed, whereas many of the questions in the WJ-III and the WIAT-II required the integration of knowledge of internal mental states for comprehension but did not explicitly ask for it. An additional reason for the discrepancy could be that that 2/3 (67%) questions that CG responded correctly to required her knowledge of a characters internal mental state that was not a feeling (i.e. Julie forgot to make a list, so when she went to the store it was hard for her to remember what she \_\_\_\_\_).

***Pragmatic language.*** Of the standardized measures used, CG demonstrated the greatest difficulty with pragmatic language. The *Pragmatic Judgment* subtest of the CASL was used to measure CG's knowledge and use of pragmatic language rules and judgment of their appropriate application. On this subtest, CG performed as well or better than 0.1% of all children when compared to the norms for her age. CG had less difficulty asking questions (3/4; 75%) and making requests (4/5; 80%) than demonstrating her knowledge of socially appropriate behaviour (0/3; 0%) and of niceties (4/6; 67%).

***Experimental measures assessing oral language comprehension.*** Experimental tasks provided further information on CG's performance on the six components of oral language comprehension outlined by Bowyer-Crane and Snowling (2005).

***Cohesive inferential comprehension.*** Cohesive inferences rely on linguistic cues present in the text, such as the resolution of an anaphor (a word which refers back to a previously expressed word or phrase) or the integration of textual information, in order for the text to be understood. The *Sentence Completion* subtest of the CASL revealed that CG is skilled in cohesive inferential comprehension when completing oral language comprehension tasks. In contrast, when completing reading comprehension tasks CG demonstrated difficulty with the

cohesive inferential questions on the WIAT-II but not the WJ-III. Two experimental measures were used to provide further information regarding CG's skill in cohesive inferential oral language comprehension. The cohesive oral language comprehension task (adapted from Yuill & Oakhill, 1988) measured cohesive inferences using anaphor resolution tasks and the text-connecting inferential comprehension task (Oakhill, 1982) measured CG's ability to integrate explicit textual information to establish cohesion between different sentences.

In the cohesive oral language comprehension task CG answered 9 of 12 questions correctly (75%). Given that these tasks were adapted from Yuill and Oakhill's (1988) experimental measure there was not normative data to compare CG's performance with, however, her performance indicated that she was able to resolve the majority of anaphors in these tasks. Her skilled performance on this task is consistent with her performance on the *Sentence Completion* subtest of the CASL. The cohesive oral language comprehension questions in Yuill and Oakhill's experimental task and the *Sentence Completion* subtest of the CASL make it explicit that textual information needs to be integrated to answer the question correctly. In contrast, when CG had difficulty with cohesive reading comprehension in the WIAT-II she was required to spontaneously integrate textual information.

The text-connecting inferential comprehension task (Oakhill, 1982) did not provide useful information in CG's case. This assessment required that CG listen to a series of short stories and, after a 10-minute delay, identify whether she had heard the exact sentences she was presented with before. In this task CG reported that she had heard all of the sentences presented before. CG's pattern of results suggests that she either did not understand the task and was simply saying yes to all questions or that she was not actively constructing the meaning of the sentences enough to recognize the false sentences and believed she had heard each of the

sentences before because they sounded similar to the story. Alternatively, her memory could be limiting her ability to answer this question. Given that there are so many possible interpretations to CG's performance, the utility of this measure in helping to understand CG's ability is limited.

*Evaluative inferential comprehension.* According to the *Sentence Completion* subtest of the CASL, CG demonstrated some difficulty with evaluative inferential comprehension. This is consistent with her performance on the reading comprehension subtests of the WJ-III and the WIAT-II. An experimental evaluative inference task, designed by Happe (1994), was used to investigate this skill further.

Happe's (1994) evaluative inference test provided additional information to evaluate CG's ability to use knowledge of internal mental states to interpret textual information. She responded correctly to three of the four (75%) evaluative inferential comprehension questions. All of the questions required CG to label the behaviour of others that come from an internal mental state that was not a feeling. Her relatively good performance on evaluative inferential comprehension questions in this subtest in comparison with other subtests is consistent with the finding that CG has much less difficulty identifying internal mental states that do not include feelings.

*Oral language summary.* In sum, CG demonstrated the least difficulty with literal comprehension. Her receptive vocabulary was less impaired than her expressive vocabulary. Her knowledge of syntax was very good and she demonstrated the ability to maintain textual coherence in both tasks that made it explicit that she was required to do so. Her performance on knowledge-based inferences was much better when she could take advantage of her knowledge of words and word meaning to assist retrieval of knowledge-based information. Her areas of greatest difficulty were pragmatic language and evaluative inferences. Within evaluative

inferential comprehension, CG had much less difficulty identifying internal mental states that did not include feelings and within pragmatic language she had the most difficulty understanding socially appropriate behaviour and common niceties.

### **CG's profile between areas assessed**

A comparison of CG's performance on standardized measures of word level decoding and reading comprehension has revealed that CG performed below her same age peers in both tasks and that, overall, her word level decoding and reading comprehension skills are comparable.

*Standard score comparison.* Her standard scores on measures assessing word level decoding ranged from 81 to 89 with an average standard score of 84. Her standard scores on standardized measures assessing reading comprehension ranged from 82 to 88 with an average standard score of 85. According to the SVR, if word level decoding and reading comprehension are comparable, as they are in CG's case, then we would expect that performance would be similar on measures of oral language comprehension and word level decoding. Standardized measures of oral language comprehension have revealed, however, that CG's overall performance on oral language comprehension tasks is substantially lower than her performance on word level decoding and reading comprehension tasks. Her standard scores on standardized measures assessing word level decoding ranged from 52 to 97 with an average standard score of 77. This finding, based on the calculated average of CG's standard scores on measures assessing word level decoding, reading comprehension, and oral language comprehension, is contrary to the prediction that CG's scores on oral language comprehension measures would be comparable to her scores on measures of word level decoding.

The within areas profile analysis, however, revealed that CG's performance on standardized measures varied widely according to the specific skills measured by the individual items in each measure. CG's overall scores therefore, were largely a reflection of the extent to which each standardized measure was tapping components that were easier or more difficult for her and were also a reflection of how the measure was tapping each of those components. CG's lower scores across oral language comprehension measures, therefore, might be a reflection of the fact that there exists standardized subtests designed to measure specific components of oral language (i.e. pragmatic skill, inference skill), whereas standardized measures assessing reading comprehension are not yet designed to measure the specific components of reading comprehension (Fletcher, 2006). CG's higher overall reading comprehension score might reflect a greater number of items measuring literal comprehension, which she finds easier, and her lower overall oral language comprehension score might reflect more balance between literal comprehension and inferential comprehension, which she finds much more difficult. It is impossible to say, on the basis of standard scores alone, that the SVR was not a useful model in explaining this case.

*Comparison of equivalent component skills.* A comparison of CG's performance on measures assessing each component of reading comprehension and its equivalent component in oral language comprehension (i.e., literal reading comprehension, literal oral language comprehension) has demonstrated that CG's strengths and weaknesses in specific components of reading comprehension are largely paralleled by her strengths and weaknesses in the equivalent components of oral language comprehension.

CG had the least difficulty with syntax, as well as literal and vocabulary-based comprehension, in both reading and oral language comprehension. In both reading and oral

language comprehension she had great difficulty spontaneously integrating textual knowledge, real world knowledge, and a rich representation of the text to respond correctly to comprehension questions; however, when the question explicitly required this integration she was often able to respond correctly. In both reading and oral language comprehension, CG had the greatest difficulty integrating her knowledge of internal mental states to understand the text. Her low scores in pragmatic oral language, where she had to understand socially appropriate behaviours, are possibly accounted for by her difficulties integrating her knowledge of internal mental states to aid in her comprehension. In both reading and oral language comprehension, whereas she was unable to answer those questions that required her to discuss the feelings behind the characters behaviours, she did demonstrate knowledge of how a character would act in a given scenario, indicating that she could understand the internal mental state of another individual when she was explicitly required to. These parallels indicate that CG's skill in reading comprehension and her skill in oral language comprehension were comparable.

**Utility of the simple view in understanding CG's profile.** These parallels are consistent with the prediction, drawn from the SVR, that when performance on measures of word level decoding and reading comprehension are comparable then oral language comprehension would be comparable to reading comprehension. The SVR was, therefore, consistent with CG's reading profile, but it was not particularly helpful in explaining her reading profile. CG's profile was marked by large variation across components of comprehension and word level decoding and across different question formats. The SVR's focus on global word level decoding, global reading comprehension, and global oral language comprehension masks critical information regarding those specific components that are areas of strength or difficulty. Knowledge of these specific areas of strength and difficulty are critical to understanding the reading profile described

and to the development of effective intervention to target the difficulties found. The model, therefore, provided a general framework through which to examine CG's reading profile, however, more specific sources of difficulty were found within her profile that the SVR was unable to explain. It appears, therefore, that the simple view of reading was too simple to explain the complexities of reading in a child with autism.

## Chapter 5

### Discussion and Summary

#### Overview

This study was conducted to determine whether the simple view of reading is a useful model for understanding the reading profile of CG, who has been diagnosed with autism. The following chapter examines the findings presented in Chapter 4 organized around a discussion of the complexities of CG's case and the utility of the SVR in understanding CG's reading profile. This discussion will be situated within the literature on literacy and on children with autism. Alternative models that might be useful in understanding CG's reading profile will also be explored. The implications of the findings will be presented along with a discussion of the limitations of this research and suggested directions for future research.

#### Utility of the simple view in understanding CG's profile

The SVR posits that skill in reading comprehension is the product of skill in word level decoding and oral language comprehension (Hoover & Gough, 1990). According to Hoover and Gough (1990) any measure of oral language comprehension would need to assess "the ability to answer questions about the contents of a listened to narrative" (p.131). This definition of oral language comprehension does not acknowledge the complexity underlying comprehension. Many researchers (Catts & Hogan, 2003; Roberts & Scott, 2006; Savage, 2001) have recommended that the SVR be used to guide the assessment and remediation of reading difficulties. The present case demonstrated that the SVR may not be helpful in explaining the reading profile of a child with autism. There was a great deal of variation in CG's performance across components of reading and oral language comprehension. In addition, the type of questions asked had a large impact on her performance. A global view of reading and oral

language comprehension appeared to mask critical information regarding specific aspects of comprehension that were the most impaired and which types of question formats provided the greatest difficulty.

### **Profile summary**

In this case of childhood autism, it was particularly informative to explore the complexity underlying performance on reading and oral language measures. Perhaps, therefore, the most important role for the current investigation was to elucidate CG's profile of skills and difficulties across language and literacy tasks. In the following section I will provide a summary of CG's word level decoding, reading comprehension, and oral language comprehension and situate the complexities of her case within what we already know about reading and about children with autism. In this section I will illustrate how CG's case has contributed to our knowledge of reading in children with autism and I will identify a framework that might be useful in explaining CG's literacy profile.

**Word level decoding.** An investigation of CG's phonological processing revealed substantial difficulties. This finding was consistent with research by Hooper and colleagues (2006) and Rapin and Dunn (2006) who demonstrated that many individuals with autism do have difficulties with phonological processing. To date, researchers have not, however, explored the relationship between phonological processing and word reading in children with autism. For CG, it was found that performance on phonological processing tasks was much poorer than performance on word reading. This dissociation between her phonological processing and word reading is inconsistent with the established finding, in typically developing children, that phonological processing skill predicts word reading ability (Share, Jorm, Maclean, & Matthews, 1984).

An error analysis of CG's word reading provides some explanation for this finding. Performance on several tasks assessing word reading and spelling revealed that CG demonstrated relative strength using a visual approach, compared to a phonological or semantic approach, when decoding. This finding suggested that she was compensating for her difficulties with phonological processing by using her orthographic knowledge. CG's ease using a visual route as opposed to a phonological route to read and spell is consistent with Calhoun's (2001) position that children with cognitive disabilities rely more on orthographic awareness for decoding than do their typical peers.

An exploration of CG's performance across spelling, word reading, and nonword reading tasks provided further insight into her reading strategies. CG demonstrated similar performance on measures of spelling and word reading, and slightly less difficulty with nonword reading. This is inconsistent with Nation et al.'s (2006) finding that word reading showed less impairment than nonword reading in children with autism. The dual route model would predict that greater skill in word reading, compared with nonword reading, demonstrates greater facility with the lexical route than the phonological route (Coltheart, 1981). Error analyses revealed that CG's pattern of reading and spelling demonstrated greater facility with the visual route than the phonological route and yet she differed less from her peers in nonword reading than word reading. This finding is not well explained by the dual route model. In contrast to the predictions of the dual route model, it appeared that CG only read nonwords by applying phoneme grapheme conversion rules in some cases. She maintained a primarily visual approach to reading even these words.

The connectionist model predicts that the pronunciations of nonwords are read through analogy to real words sharing orthographic characteristics (Harm & Seidenberg, 1999). CG's

performance was not entirely consistent with model either. She did not engage her semantic system to determine whether the word she saw was a word that she knew or not, implying that she was not necessarily searching her lexicon for familiar words and reading with analogy to them. In addition, there were cases where her errors revealed that she was attempting to preserve the most common GPC's, indicating that she was not always using whole rimes to pronounce the words.

CG's decoding strategy was most consistent with a decoding model developed by Berndt and Haendiges et al. (1996), who proposed a dual route model whereby the pronunciation of nonwords is based on stored associations between sublexical orthographic and phonological segments that have been generalized from experience in reading words rather than on linguistically-defined rules for grapheme phoneme conversion. According to this model, words and nonwords would be read using the same strategy and CG, therefore, would not have shown more difficulty with the nonwords even though she has poor phonological processing. We would also expect then that she would have less difficulty with common orthographic and phonological segments than uncommon segments. Finally, we would expect that CG's difficulty with phonological awareness would result in some trouble reading both words and nonwords due to her reduced ability to attach the phonological to the sublexical orthographic segments. The patterns that would be predicted by Berndt, Haendiges, and colleagues (1996) are consistent with CG's patterns of word and nonword reading.

**Reading comprehension.** While research exploring the relationship between word level decoding and reading comprehension has been slightly inconsistent, it has primarily suggested that reading comprehension is more impaired than word level decoding in children with autism (Frith & Snowling, 1984; Nation et al., 2006). CG's profile was inconsistent with this research.

Her performance on measures of reading comprehension was comparable to her performance on measures of word level decoding. Across the three subtests measuring word level decoding CG's standard scores ranged from 81 to 89. Across the two subtests measuring reading comprehension CG's standard scores ranged from 82 to 88. Mayes and Calhoun (2003) also found that individuals with high functioning autism did not demonstrate differences between their reading decoding skills and their reading comprehension skills.

It is possible that the discrepancies between the findings in this area are due to the assessments used to measure reading comprehension. Mayes and Calhoun (2003) and the current research measured reading comprehension using the WIAT while Nation and colleagues (2006) measured reading comprehension using the NARA-II. Bowyer-Crane and Snowling (2005) conducted a qualitative analysis of questions on the NARA-II and found that only 14% of comprehension questions on the NARA-II could be answered on the basis of literal comprehension. In contrast, a qualitative analysis of the questions in the WIAT-II in the current research revealed that 38% of comprehension questions that were administered to CG could be answered on the basis of literal comprehension. Therefore, the finding that children with autism demonstrated more difficulty in reading comprehension than word level decoding using the NARA-II might indicate that children with autism have more difficulty with inferential comprehension than word level decoding rather than that they have more difficulty with reading comprehension, generally, than word level decoding.

It becomes critical, therefore, to identify which assessments are being used and which types of comprehension are being measured. In CG's case, error analyses of each of the components of comprehension outlined by Bowyer-Crane and Snowling (2005) revealed that CG did have the least difficulty with literal and vocabulary-dependent comprehension. These

findings are consistent with research by Mayes and Calhoun (2003) who found that individuals with autism did not evidence difficulty with reading comprehension using a measure that tapped largely literal comprehension. They also help explain the finding by Frith and Snowling (1983) that even when children with autism had no difficulty defining a word they would still have difficulty with cohesive inferential comprehension when asked to disambiguate a homophone, as this area posed more difficulty for CG than literal comprehension.

CG evidenced difficulty with cohesive inferential comprehension, knowledge-based inferential comprehension, elaborative inferential comprehension, and evaluative inferential comprehension. In all of these areas, however, her performance decreased if she was expected to spontaneously integrate real world knowledge, textual information, knowledge of internal mental states, or a rich representation of text to respond correctly to questions and increased if she was explicitly required to do so. Wang, Lee, Sigman, and colleagues (2007) discovered a similar pattern when they conducted a study examining the neural activity of children with ASD and typically developing children while being assessed for comprehension of irony. They found that when processing irony, children with autism engaged the same cognitive activity as when they were processing no irony. This was in contrast to typically developing children who engaged additional cognitive areas when processing irony compared with no irony. Similar to the findings of the current research, when children with autism were explicitly instructed to attend to the facial expression or tone of voice they did show significant activity in regions that were also recruited by typically developing children.

CG evidenced the most difficulty with evaluative inferential comprehension, but only for those questions that required her to discuss the feelings behind the characters behaviours. She did demonstrate knowledge of how a character would act in a given scenario, indicating that she

could understand the internal mental state of another individual. This finding is in contrast to the theory that children with autism do not have theory of mind (Baron Cohen, Leslie, & Frith, 1985). Lack of theory of mind refers to the inability to attribute independent mental states to oneself or to others in order to explain or predict behaviour. CG was, however, able to attribute mental states to others in order to explain or predict their behaviour, except in cases where the mental state was a feeling.

**Oral language comprehension.** In comparing standard scores for measures of reading comprehension to standard scores for measures of language comprehension, CG's performance across language measures demonstrated much more variation. In exploring the error analyses within these measures, however, CG's language comprehension profile demonstrated a similar pattern to her reading comprehension profile.

According to the standardized measures, CG's receptive vocabulary was only slightly lower than her peers. Within the administered items, she had more difficulty identifying attribution words than nouns and verbs. In contrast with the finding that children with autism did not differ on measures of receptive and expressive vocabulary (Kjelgaard & Tager Flusberg, 2001), CG's receptive vocabulary was better than her expressive vocabulary. Her difficulty with expressive vocabulary was primarily with items where she was required to identify synonyms and provide a word given a definition. She had very little difficulty with items where she was required to name a picture.

While several researchers (Bartak, Rutter, & Cox, 1977; Mayes & Calhoun, 2003; Rapin & Dunn, 2003) have found that receptive and expressive vocabulary is a relative strength within the language profile of children with autism compared to passage level oral comprehension, the current research demonstrated that only some aspects of oral passage comprehension were more

difficult for CG than receptive and expressive vocabulary. CG's performance on measures of literal comprehension alone did not deviate from her same age peers and were greater than her performance on measures of receptive and expressive vocabulary. Consistent with Rapin and Dunn's (2003) findings, CG also demonstrated relative skill in syntactic awareness.

In contrast, her performance on measures of knowledge-based inferences was much lower than her peers, especially when she could not use her knowledge of common word combinations and syntax to help her respond correctly. Similarly, and consistent with previous research (Lord & Paul, 1997; Tager-Flusberg, 2006), CG demonstrated much more difficulty than her peers in measures of pragmatic language comprehension.

Her performance on evaluative inferential comprehension questions was quite poor for questions that required her to discuss the feelings behind the characters behaviours, however, she did demonstrate that she could understand the internal mental state of another individual when that mental state did not involve the other individuals' feelings. Similar to CG's performance with reading evaluative comprehension, this finding is also in contrast the theory that children with autism do not have theory of mind (Baron Cohen, Leslie, & Frith, 1985).

While previous researchers (Bartak, Rutter, & Cox, 1977; Mayes & Calhoun, 2003; Rapin & Dunn, 2003) have concluded that children with autism demonstrate greater difficulty with oral comprehension of passages than receptive and expressive vocabulary, the present research demonstrates that comprehension is much more complicated than this. Some aspects of comprehension (e.g., literal comprehension and syntax) demonstrated less impairment than vocabulary and some aspects of comprehension (e.g., inferences, pragmatic language) demonstrated greater impairment.

The difficulty with the conclusions made by Bartak, Rutter, and Cox (1977), as well as Mayes and Calhoun (2003), is that the measure that they used to assess oral passage comprehension (i.e., the *Comprehension* subtest from the WISC-III) is actually a measure of social judgment. Rapin and Dunn (2003) failed to report the measure they used to assess oral passage comprehension. In contrast to the SVR, the current research highlights the importance of recognizing the complexity of comprehension and delineating which types of comprehension are being discussed. This complexity becomes critical in understanding and explaining the cognitive profiles underlying the language and literacy profiles found and providing a model with which to discuss these profiles.

### **Useful alternative models for understanding CG's profile**

According to a number of researchers (Dunn & Bates, 2005; Frith & Snowling, 1983; Nation et al., 2006) the relative impairments in global comprehension compared to vocabulary knowledge and word level decoding in individuals with autism lend support for the theory of central coherence. This theory posits that autism is characterized by an imbalance in the integration of information at different levels; individuals with autism see the parts rather than the whole (Frith, 1989). The current research demonstrated that these conclusions about global comprehension may be misleading. While CG did demonstrate difficulty with some aspects of passage comprehension she did not demonstrate difficulty with all aspects of passage comprehension. Similarly, while she demonstrated difficulty with some aspects of word level decoding and vocabulary she did not demonstrate difficulty with all aspects of word level decoding and vocabulary. CG's profile was not consistent with the theory of central coherence in that her difficulties were not all in areas where she was required to see the whole, nor were her skills all in areas where she was required to attend to only the parts. For example, she

demonstrated relative skill in passage level literal comprehension and she demonstrated a great deal of difficulty in phonological processing. The comprehensive description provided by the current investigation may be useful in identifying a model that could help explain cognitive processes underlying the language and literacy profile found.

**Themes identified in CG's profile.** An analysis of CG's performance revealed a language and literacy profile marked by two themes. The first theme was the tendency to have greater difficulty with tasks that are less law-governed and less difficulty with tasks that are more law-governed. Law-governed tasks include tasks where following a set of rules will always lead to a correct response. For example, literal comprehension would be a highly law-governed task. If a reader were to search the text to find the answer to a question and read that section of the text aloud they would respond correctly to the question. In comprehension, CG demonstrated the least difficulty with components of comprehension that are highly law-governed (i.e., literal comprehension, syntax, cohesion, vocabulary) and the most difficulty with comprehension components that are not law-governed (i.e., pragmatics, comprehension that relies on knowledge of feelings, inferences).

In reading decoding, CG relied primarily on an orthographic approach, where she accessed whole words or letter clusters from an internal lexicon. This approach is highly law-governed, relative to the use of GPC, as there is generally one pronunciation for one word, whereas there are several pronunciations of one grapheme. This first theme is consistent with Baron Cohen's (2006) hyper-systemizing account of autism, which holds that individuals with ASD are only able to process information that is highly systemizable, highly law-governed.

The second theme was that CG appeared to have great difficulty in spontaneously activating two processing systems at a time. Children, who are developing typically, employ

phonological, orthographic, and semantic processing systems when decoding words (Patterson, Suzuki & Wydell, 1996). CG tended to rely heavily on the orthographic system, largely neglecting the phonological and semantic systems. In oral language and reading comprehension she had a great deal of difficulty spontaneously integrating her knowledge to understand the text or narrative, though she was able to, to some extent, when provided explicit instruction to do so.

This second theme is consistent with the theory of excess neural excitability, recently proposed by Courchesne and colleagues (2007). They conducted the first review of research exploring the neurological correlates of autism in young children. They demonstrated that children with autism tend to have early brain overgrowth at the beginning of life and an arrest or slowing of brain growth in later life. They proposed that this overgrowth is the result of an excess of neurons. They argue that this surplus of neurons generates excessive local excitation that impedes signals from distant brain regions. Difficulties in spontaneously activating two processing systems at a time would naturally result if local excitation impeded signals from distant brain regions.

## **Implications**

**Implication for CG's instruction.** This understanding of CG's profile has direct implications for the kind of instruction that might be useful for her. According to this account, instruction in new concepts might be as law-governed as possible. Once law-governed information is attended to, it might be important to be explicit in the requirement that CG begin integrating knowledge across two or more processing systems. For example, in reading decoding she could receive practice in phonological processing using very explicit, law-governed instruction. Once she is able to do that, she might practice integrating her knowledge of GPCs to decode new words. In addition, she might practice asking herself if a word she is reading is a

real word. In reading comprehension she might first ensure fluent decoding of a text, then practice activating her real world knowledge before, finally, integrating that knowledge to comprehend the text.

**Implications for practice.** The current research has illustrated the importance of obtaining a comprehensive description of language and literacy skills before developing reading intervention for a child with autism. This involved identifying each of the components of word level decoding and comprehension and then obtaining a clear measure of functioning in each component. This level of detail was critical to explaining and understanding CG's language and literacy profile and it was an essential first step in determining the type of intervention that would be effective for her. Research has documented wide variation in skills among children with autism, highlighting that each case is unique (Tager-Flusberg, 2004). As such, it is critical that special educators and interventionists attend to the complexity of word level decoding and comprehension when conducting assessments to inform instruction. The information gained through this comprehensive assessment process is critical to the development of specific and effective instruction.

**Implications for theory.** In addition to helping direct instruction for CG and illustrating effective practice for using assessments to inform instruction generally, this case study has been informative in considerations of theories of reading and theories of autism. The current research has demonstrated the limitations of applying the SVR to understand CG's reading profile and possibly the reading profile of others with childhood autism. Moreover, the current research had highlighted the need to examine complexity in word level decoding and comprehension in order to gain a more thorough understanding of the cognitive processes underlying the literacy

difficulties facing children with autism and possibly children with other comprehension difficulties as well.

The current case study has illustrated how examining this complexity was critical in determining that the recent hyper-systemizing account of autism (Baron Cohen, 2006) and the recent neurological theory of autism (Courchesne et al., 2007) were useful in explaining CG's literacy profile. Future research could investigate whether these theories are also useful in explaining the reading profile in other children with autism.

### **Limitations**

It is important, however, to address the limitations of the current research. It is unclear whether CG's performance reflected the cognitive patterns outlined by these two theories or limitations in her general cognitive functioning or her ability to attend. While CG did not demonstrate clinically significant attention deficits, her scores did indicate some difficulty with attention. This suggests that caution should be taken in assuming that her performance on assessments reflected her knowledge. In addition, CG's scores on measures of general intelligence demonstrated significant cognitive constraints. The extent to which low general intelligence resulted in her language and reading profile, as opposed to the neurological anomalies specific to CG's diagnosis of autism needs to be clarified. The pattern CG demonstrated does appear to be largely consistent with other researcher's descriptions of language and literacy profiles of children with autism. Nevertheless, studying each of the components of comprehension in children with both low- and high-functioning autism as well as children without a diagnosis with low and high intelligence would help to clarify the extent to which the pattern found is due to intelligence as opposed to a diagnosis of autism.

Other methodological limitations of the current study must also be addressed. It is of concern that the researcher who interpreted the data also conducted the assessments. This introduces concerns of examiner bias. In determining the standard scores, however, the majority of the subtests are scored in a straightforward and objective manner. The *Reading Comprehension* subtest of the WIAT-II requires more personal judgment in scoring, however, the average interscorer reliability coefficient is reported by the examiners manual of the WIAT-II as being .94. In addition, the score in the *Reading Comprehension* subtest of the WIAT-II was only slightly lower than that of the *Passage Comprehension* subtest of the WJ-III, which is scored in an objective manner, suggesting that examiner bias did not result in unreliable information.

Another concern is the reliability of the error analyses. Only one rater determined which components of comprehension were being tapped by each of the items on the standardized assessments. Similarly, only one rater determined which types of errors were being committed in word level decoding. The fact that no inter-rater reliability was calculated for the error analyses leads to questions regarding the reliability of the error analyses. Moreover, the researcher conducting the error analyses also interpreted the data, again leading to concerns of examiner bias in the error analyses. For the word decoding error analyses however, the researcher selected error analyses that had been used previously (Roeltgen, 1992) and that allowed for the items to be scored in as objective a manner as possible. Determining which types of comprehension were being measured by each comprehension item was more subjective, however, the researcher was blind to CG's performance on each item when determining which type of comprehension was being tapped. This reduced the amount of researcher bias that could have affected the categorizations in the error analyses for comprehension.

The methodological concerns regarding the reliability and validity of the error analyses for reading comprehension could have been resolved if standardized assessments that measured each component of reading comprehension separately had been used; however, no such standardized assessments are available for reading comprehension. These assessments are available for oral language comprehension, however, and the standardized assessments in oral language comprehension revealed a similar pattern to the error analyses of the reading comprehension measures. This similarity lends credibility to the findings of the error analyses for reading comprehension items.

The lack of standardization for reading comprehension measures assessing components of comprehension separately also leads to the problem of determining whether CG's profile is common to typically developing children as well. It is possible that all children demonstrate more ease with literal comprehension than inferential comprehension and that the difference between these skills in typically developing children is similar to the difference in these two skills in children with autism. The discrepancy between CG's literal versus inferential comprehension on standardized measures of oral language comprehension, however, does suggest that CG's profile for reading comprehension would also differ from the norm. Future research using standardized measures assessing each of the components of reading comprehension separately would be necessary to ensure that the conclusions regarding CG's profile of strengths and difficulties was reliable and valid.

### **Future Research**

The current research explored the language and literacy profile in only one case of childhood autism. It was never the purpose to generalize this case to all children with autism, only to generalize this case to theories of reading and theories of autism. While the hyper-

systemizing theory (Baron Cohen, 2006) and the theory of excess neural excitation (Courchesne et al., 2007) were useful in explaining CG's case, it is critical that multiple methodologies test the applicability of these theories to many children with autism. This research would be essential in studies where researchers are designing and testing interventions that might be useful for the general population of individuals with autism.

**Cognitive profiles of children with autism.** Future research could investigate the profiles of reading in many other individuals with autism to determine whether their profiles are also consistent with the hyper-systemizing account of autism (Baron Cohen, 2006) and Courchesne and colleagues' (2007) account of autism. This research could also explore how individuals' profiles change over time and as skill levels increase.

Another promising avenue for researchers is to explore the relationship between neurological research and observational research; to map the behavioural onto the biological. The relationship between the hyper-systemizing account of autism and the excess neural excitation hypothesis could be explored. Researchers could also seek to determine whether individuals with lower functioning autism demonstrate more excess neural excitation than individuals with higher functioning autism. Moreover, neurological research could determine whether individuals with more excess neural excitation are less able to process unsystemizable information than individuals with less neural excitation. In addition, it would be informative to determine whether the activation of more than one processing system at a time would lead to advantages in the processing of unsystemizable information.

Research investigating the effectiveness of interventions designed according to the hyper-systemizing account of autism (Baron Cohen, 2006) and Courchesne and colleagues' (2007)

account of autism would also provide critical information on the utility of these theories to individuals with ASD.

**Research on treatment.** If the hyper-systemizing account (Baron Cohen, 2006) and the excess neural excitation account (Courchesne et al., 2007) of autism are accurate accounts of the cognitive processes underlying language and literacy in children with autism they have direct implications for intervention with this population. Early intensive behavioural intervention (EIBI) is currently a widely advocated and employed intervention for children with ASD (McEachin, Smith, & Lovaas, 1993). Researchers (McEachin et al., 1993) studying EIBI, a behavioural intervention using discrete trial training, have suggested that it could compensate for neurological anomalies in children with ASD. Discrete trial training involves categorizing teaching into steps and, systematically and repetitively, teaching each step. The hyper-systemizing account of ASD would predict that an effective intervention be implemented systematically and would present relevant information in a rule-oriented format, similar to discrete trial training. It is, therefore, possible that the success of the EIBI lies not in its systematic control of consequence but in the congruence between the systematic teaching style, characteristic of a behavioural approach, and the learning style of individuals with ASD. This implies that there is more room for flexibility in the design of such intervention than McEachin et al. contended. The hyper-systemizing account of ASD, then, would shift the focus of the intervention away from considerations of reinforcing desirable behaviours or punishing undesirable behaviours to presenting information in a systematic rule-governed manner. This shift would allow for many adaptations to the current EIBI model.

EIBI is traditionally conducted individually (McEachin et al., 1993) ensuring that children receive reinforcement whenever they obtain a correct response. Once children are

school-aged, however, this treatment usually ceases (Hess, Morrier, Heflin, & Ivey, 2008), possibly because schools are largely not equipped to provide one-on-one instruction to all their students with ASD and are, therefore, at a loss in how best to approximate EIBI in the schools. A treatment based on hyper-systemizing theory would provide a framework for instruction for children with ASD in the schools.

Presenting information in a rule-governed, explicit format, however, is only one part of the puzzle. If the excess neural excitation hypothesis is helpful in understanding the literacy development in children with autism, then once children with autism become proficient in attending to and understanding information presented in a discrete, law-governed format, they would need to practice integrating information from more than one processing system at a time. This provides clear direction for children with higher functioning autism who have no difficulty with literal comprehension, for example, but who still demonstrate a great deal of difficulty with inferential comprehension and pragmatic language. Inferential comprehension instruction might involve reminding them to activate their prior knowledge before reading, and reminding them to consult that knowledge to provide a richer representation of the text. Pragmatic language instruction might involve reminding them of each of the components in the story that indicate how the social understanding of a text is created and then reminding them to integrate that knowledge into their reading of the text. Word reading instruction might involve teaching attention to each of the phonological, orthographic, and semantic systems when decoding.

The hyper-systemizing theory and the excess neural excitation hypothesis open up many avenues to explore in the creation of more effective interventions. Researchers exploring the utility of these interventions could provide information that would be useful to theorists, parents, students, and educators.

**Measures assessing literacy.** In addition to future research for children with autism, the current research has demonstrated the importance of acknowledging the complexity underlying comprehension and word level decoding for all children. While several standardized assessments are available for measuring different components of word level decoding, standardized assessments measuring each of the components of reading comprehension outlined by Bowyer-Crane and Snowling (2005) would be invaluable in future research on reading comprehension. These assessments would then make it possible to explore the complexities underlying reading comprehension in several different populations with literacy difficulties.

### **Conclusion**

In conclusion, the purpose of the current study was to determine whether the SVR was useful in understanding the reading profile in a case of childhood autism. While CG's case was consistent with the SVR, it was not helpful in understanding her reading profile. The focus, within the SVR, on a global view of reading comprehension, oral language comprehension, and word level decoding, masked critical information regarding which specific components within CG's literacy skills were areas of strength or difficulty. Given CG's wide variation of skill across components, knowledge of these specific areas of strength and difficulty were critical to understanding her reading profile.

Two theories of autism, the first implicating excess neural excitability (Courchesne et al., 2007) in the inability to integrate information from different processing systems and the second implicating hyper-systemizing (Baron Cohen, 2006) in the inability to process unsystemizable information, were useful in understanding CG's reading profile. While further research is required to assess the utility of these theories in directing instruction for individuals with autism, the current research has demonstrated that these theories hold great promise for helping to

understand the literacy profiles of children with autism and to potentially improve the effectiveness of literacy instruction for children with autism.

### References

- Achenbach, T. M. & Rescorla, L.A. (2001). *Manual for the ASEBA School-Age Forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- Ali, S., & Frederickson, N. (2006). Investigating the evidence base of social stories. *Educational Psychology in Practice, 22*, 255-377.
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders, text revision (DSM-IV-TR)*. Washington, DC: Author.
- Baltaxe, C. (1977). Pragmatic deficits in the language of autistic adolescents. *Journal of Pediatric Psychology, 1977*, 176-180.
- Bartak, L., Rutter, M., & Cox, A. (1977). A comparative study of infantile autism and specific developmental receptive language disorders. *Journal of Autism and Childhood Schizophrenia, 7*, 383-396.
- Baron-Cohen, S. (2006). The hyper-systemizing and assortative mating theory of autism. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 30*, 865-872.
- Baron-Cohen, S., Leslie, A., & Frith, U. (1985). Does the autistic child have a “theory of mind”? *Cognition, 21*, 37-46.
- Berninger, V.W. (1990). Multiple orthographic codes: Key to alternative instructional methodologies for developing the orthographic-phonological connections underlying word identification. *School Psychology Review, 19*, 518-534.
- Berndt, R., Haendiges, A., Mitchum, C., & Wayland, S. (1996). An Investigation of Nonlexical Reading Impairments. *Cognitive Neuropsychology, 13*, 763-801.
- doi:10.1080/026432996381809.

- Berndt, R., Reggia, J., & Mitchum, C. (1987). Empirically derived probabilities for grapheme-to-phoneme correspondences in English. *Behavior Research Methods, Instruments & Computers, 19*(1), 1-9.
- Bopp, K., Brown, K., & Mirenda, P. (2004). Speech-Language Pathologists' roles in the delivery of positive behavior support for individuals with developmental disabilities. *American Journal of Speech-Language Pathology, 13*, 5-19.
- Bowyer-Crane, C., & Snowling, M. (2005). Assessing children's inference generation: What do tests of reading comprehension measure? *British Journal of Educational Psychology, 75*, 189-201.
- Calhoon, J. (2001). Factors affecting the reading of rimes in words and nonwords in beginning readers with cognitive disabilities and typically developing readers: Explorations in similarity and difference in word recognition cue use. *Journal of Autism and Developmental Disorders, 31*, 491-504.
- Campbell, D.T. (1975). Degrees of freedom and the case study. *Comparative Political Studies, 8*, 178-193.
- Capps, L., Kehres, J., Sigman, M. (1998). Conversational abilities among children with autism and children with developmental delays. *Autism, 2*, 325-346.
- Carrow-Woolfolk, E. (1999). *Comprehensive Assessment of Spoken Language*. Circle Pines, MN: American Guidance Service, Inc.
- Catts, H. W., Adlof, S. M., & Weismer, S. E. (2006). Language deficits in poor comprehenders: A case for the simple view of reading. *Journal of Speech, language, and Hearing Research, 49*, 278-293.

- Catts, H.W., & Hogan, T.P. (2003). Language basis of reading disabilities and implications for early identification and remediation. *Reading Psychology, 24*, 223-246.
- Coleman, M., & Betancur, C. (2005). Introduction. In M. Coleman (Ed.). *The Neurology of Autism*. New York: Oxford University Press, Inc.
- Coltheart, M. (1981). The MRC Psycholinguistic Database. *Quarterly Journal of Experimental Psychology, 33A*, 497-508.
- Conners, C. K. (1997). *Conners' Rating Scales—Revised*. Toronto, ON: Multi-Health Systems Inc.
- Courchesne, E., Pierce, K., Schumann, C., Redcay, E., Buckwalter, J., Kennedy, D., & Morgan, J. (2007). Mapping early brain development in autism. *Neuron, 56*, 399-413.
- Creswell, J. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2<sup>nd</sup> ed.). New Jersey: Pearson Education, Inc.
- Dunn, M., & Bates, J. (2005). Developmental change in neutral processing of words by children with autism. *Journal of Autism and Developmental Disorders, 35*, 361-376.
- Dunn, L., & Dunn, D. (2007). *Peabody Picture Vocabulary Test (4th ed.)*. Minneapolis, MN: NCS Pearson, Inc.
- Ehri, L., Nunes, S., Willows, D., Shuster, B., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly, 36*, 250-287.
- Fletcher, J. (2006). Measuring reading comprehension. *Scientific Studies of Reading, 10*(3), 323-330.

- Frith, U. (1989). *Autism: explaining the enigma*. Oxford: Blackwell Publishers Ltd.
- Frith, U., & Happe, F. (1994). Autism and theory of mind in everyday life. *Social Development, 3*, 108-124.
- Frith, U., & Snowling, M. (1983). Reading for meaning and reading for sound in autistic and dyslexic children. *British Journal of Educational Psychology, 1*, 329-342.
- Gillberg, C. (2005). The epidemiology of autism. In M. Coleman (Ed.). *The Neurology of Autism*. New York: Oxford University Press, Inc.
- Gough, P.B., & Tunmer, W.E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education, 7*, 6-10.
- Happe, F. (1994). An advanced test of theory of mind: Understanding of story characters thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders, 24*, 129-154.
- Happe, F., Ronald, A., & Plomin, R. (2006). Time to give up on a single explanation for autism. *Nature Neuroscience, 9*, 1218-1220.
- Harm, M., Seidenberg, M. (1999). Phonology, reading acquisition, and dyslexia: Insights from connectionist models. *Psychological Review, 106*, 491-528.
- Henderson, L. (1982). *Orthography and word recognition in reading*. London: Academic Press.
- Hess, K., Morrier, M., Heflin, L., & Ivey, M. (2008). Autism treatment survey: Services received by children with autism spectrum disorders in public school classrooms. *Journal of Autism and Developmental Disorders, 38*, 961-971. doi:10.1007/s10803-007-0470-5.

- Hooper, S., Poon, K., & Marcus, L. (2006). Neuropsychological characteristics of school-age children with high-functioning autism: Performance on the NEPSY. *Child Neuropsychology, 12*, 299-305.
- Hoover, W., & Gough, P. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal, 2*, 127-160.
- Kjelgaard, M., & Tager-Flusberg, H. (2001). An investigation of language impairment in autism: Implications for genetic subgroups. *Language and Cognitive Processes, 16*, 287-308.
- Lord, C., & Paul, R. (1997). Language and communication in autism. In D.J. Cohen & F.R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders*, 2<sup>nd</sup> edition (pp.195-225). New York: John Wiley & Sons.
- Mastropieri, M., & Scruggs, T. (1997). Best practices in promoting reading comprehension in students with learning disabilities. *Remedial & Special Education, 18*, 197-216.
- Mayes, S., & Calhoun, S. (2003). Analysis of WISC-III, Stanford-Binet: IV, and Academic Achievement Test Scores in Children with Autism. *Journal of Autism and Developmental Disorders, 33*, 329-341.
- McEachin, J., Smith, T., & Lovaas, O. (1993). Long-term outcomes for children with autism who received early intensive behavioral treatment. *American Journal on Mental Retardation, 97*, 359-372.
- McMillan, J., & Wergin, J. (2006). *Understanding and evaluating educational research* (3<sup>rd</sup> ed.). New Jersey: Pearson Education, Inc.

- Muris, P., Steerneman, P., Merchelback, H. (1998). Comorbid anxiety symptoms in children with pervasive developmental disorders. *Journal of Anxiety Disorders, 12*, 387–393.
- Muter, V., Hulme, C., & Snowling, M. (1997). *Phonological Abilities Test*. London: The Psychological Corporation.
- 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.
- Oakhill, J.V. (1982). Constructive processes in skilled and less-skilled comprehenders' memory for sentences. *British Journal of Psychology, 73*, 13-20.
- Oakhill, J.V. (1984). Inferential and memory skills in children's comprehension of stories. *British Journal of Educational Psychology, 54*, 31-39.
- O'Connor, I., & Klein, P. (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.
- Patterson, K., Suzuki, T., & Wydell, T. (1996). Interpreting a Case of Japanese Phonological Alexia: The Key is in Phonology. *Cognitive Neuropsychology, 13*, 803-822.  
doi:10.1080/026432996381818.
- Rapin, I., & Dunn, M. (2003). Update on the language disorders of individuals on the autistic spectrum. *Brain and Development, 25*, 166-172.
- Roberts, J.A., & Scott, K.A. (2006). The simple view of reading: Assessment and intervention. *Top Language Disorders, 26*, 127-143.

- Roeltgen, D. (1992). Phonological error analysis, development and empirical evaluation. *Brain and Language*, 43, 190-229. doi:10.1016/0093-934X(92)90128-2.
- Sattler, J. (1992). *Assessment of Children (3rd ed.)*. San Diego, CA: Jerome Sattler.
- Savage, R. (2001). The 'simple view' of reading: Some evidence and possible implications. *Educational Psychology in Practice*, 17, 18-33.
- Share, D.L., Jorm, A.F., Maclean, R., & Matthews, R. (1984). Sources of individual differences in reading acquisition. *Journal of Educational Psychology*, 76, 1309-1324.
- Siegel, L.S. (2003). Basic cognitive processes and reading disabilities. In H.L. Swanson, K.R. Harris, & S. Graham (Eds.). *Handbook of Learning Disabilities*. New York: The Guilford Press.
- Siegel, L.S. (1993). The cognitive basis of dyslexia. In M. Howe & R. Pasnak (Eds.). *Emerging themes in cognitive development* (pp. 33-52). New York: Springer-Verlag.
- Sinn, H., & Blanken, G. (1999). Visual errors in acquired dyslexia: Evidence for cascaded lexical processing. *Cognitive Neuropsychology*, 16, 631-653. doi:10.1080/026432999380672.
- Surian, L., Baron-Cohen, S., & Van der Lely, H. (1996). Are children with autism deaf to Gricean maxims? *Cognitive Neuropsychiatry*, 1, 55-71.
- Tager-Flusberg, H. (2006). Defining language phenotypes in autism. *Clinical Neuroscience Research*, 6, 219-224.
- Tager-Flusberg, H. (2004). Strategies for conducting research on language in autism. *Journal of Autism and Developmental Disorders*, 34, 75-80.

- Tager-Flusberg, H., & Anderson, M. (1991). The development of contingent discourse ability in autistic children. *Journal of Child Psychology and Psychiatry*, *32*, 1123-1134.
- Wagner, R., Torgesen, J., & Rashotte, C. (1999). *Comprehensive Test of Phonological Processing*. Austin, TX: PRO-ED, Inc.
- Wang, A.T., Lee, S.S., Sigman, M., and Dapretto, M. (2007). Reading affect in the face and voice: neural correlates of interpreting communicative intent in children and adolescents with autism spectrum disorder, *Archives of General Psychiatry*, *64*, 698-708.
- Wechsler, D. (2002). *Wechsler Individual Achievement Test (2nd ed.)*. Toronto, ON: The Psychological Corporation.
- Wechsler, D. (2003). *Wechsler Intelligence Scale for Children – Fourth Edition*. San Antonio, TX: Harcourt Assessment, Inc.
- Williams, K. (2007). *Expressive Vocabulary Test (2nd ed.)*. Minneapolis, MN: NCS Pearson, Inc.
- Woodcock, R.W., McGrew, K.S., & Mather, N. (2001). *Woodcock-Johnson (3rd ed.)*. Itasca, IL: Riverside Publishing.
- Yin, R.K. (1984). *Case study research*. Beverly Hills: CA: Sage Publications.
- Yin, R.K. (2003). *Case study research: Design and methods (3<sup>rd</sup> ed.)*. Beverly Hills: CA: Sage Publications.
- Yuill, N., & Oakhill, J. (1988). Understanding of anaphoric relations in skilled and less skilled comprehenders. *British Journal of Psychology*, *79*, 173-186.

## Appendices

### Appendix A

#### Parent Consent Form

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#### Theoretical Implications of Literacy Profiles in Individuals with Autism

You are invited to participate in a study entitled Theoretical Implications of Literacy Profiles in Individuals with Autism that is being conducted by Keira Ogle.

Keira Ogle is a graduate student in the department of Educational Psychology & Leadership Studies at the University of Victoria. You may contact her if you have further questions at 250-381-6281, E-mail: [kogle@uvic.ca](mailto:kogle@uvic.ca).

As a graduate student, I am required to conduct research as part of the requirements for a degree in Special Education. It is being conducted under the supervision of Dr. Harrison. You may contact my supervisor at 250-721-7783.

#### **Project Purpose and Objectives:**

The purpose of the study is to examine the literacy profile of individuals with autism. We are especially interested in the relationship between word reading, sound discrimination, language, and reading comprehension skills. We hope that this information will help determine whether the current model of assessment and intervention is suited to individuals with autism. We also hope that the knowledge gained on the literacy profile of individuals with autism will have practical implications to how we teach and provide instructional support to these individuals.

#### **Project Details and Procedures:**

If you agree that your child may voluntarily participate in this research, he/she will work individually with Keira Ogle in a quiet room or area of your home on a collection of language and literacy tasks. Specifically, your child will be asked to define words and complete sentences in English. They will also be asked to do some rhyming activities and sound games, and to identify letters and words. Your child will also be asked to answer some questions on passages that they have read and that have been read to them. Four sessions of about 1 hour each are required.

Participation in this study may cause some inconvenience to your child, including the time away from household activities and playing. However, there are no known or anticipated risks to your child by participating in this research. The potential benefits of your child's participation in this research include the individualized attention that the researcher will spend with your son/daughter working on literacy-related activities. Your child's participation will also help us learn more about the way literacy skills are learned in children with autism.

**On-going Consent**

To make sure that you continue to consent to participate in this research, I will provide you with a consent form at the beginning of each of our sessions. Only those children who receive parent permission and who themselves agree to participate will be involved. Child participation is voluntary, and your child has the right to withdraw from the study at any time without any type of penalty.

**Anonymity and Confidentiality:**

For record-keeping purposes, it will be necessary for the researcher to keep track of the names of children granted parental permission to participate. However, all information including any reports of the results of the study will be treated as strictly confidential. This form will be the only document containing identifying information and the form will be stored in a locked file cabinet in Keira Ogle's office in her home. All other forms will be numerically coded, and access to these forms will be restricted to Keira Ogle or her advisor, Dr. Harrison.

**Research Data:**

It is anticipated that the results of this study will be shared with others in the following ways: published articles; thesis; and presentations at professional conferences.

Data from this study will be disposed of after a period of 5 years. Paper copies will be shredded and electronic data will be erased.

**Contacts:**

In addition to being able to contact the researcher at the above phone number and e-mail, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or [ethics@uvic.ca](mailto:ethics@uvic.ca)).

**Consent:**

Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

I (*circle one*) **give/do not give** my permission for my son/daughter

(*name*) \_\_\_\_\_ to participate in the project entitled:

Writing

Development in ESL and Non-ESL Learners: A Longitudinal Study.

\_\_\_\_\_  
*Name of Parent*

\_\_\_\_\_  
*Signature*

\_\_\_\_\_  
*Date*

***Keep one copy of the consent form and mail the signed copy to Keira Ogle.***

**Appendix B**

*Reading Decoding Observations*

Please record the frequency with which each of the following behaviours occurred during the administration of the current measure.

Length of current task (in minutes): \_\_\_\_\_

Order of current task (in current assessment session): \_\_\_\_\_

Read aloud \_\_\_\_\_

Read silently \_\_\_\_\_

Sounds out words letter by letter \_\_\_\_\_

Sounds out words by letter cluster \_\_\_\_\_

Pronounces word automatically \_\_\_\_\_

Self-corrects \_\_\_\_\_

Makes accent errors \_\_\_\_\_

Errors reveal over-reliance on phonetic pronunciation \_\_\_\_\_

Errors reveal over-reliance on orthographic clues \_\_\_\_\_

Please write down child's comments relevant to task

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**Appendix C**

*Linguistic Observations*

Please record the frequency with which each of the following behaviours occurred during the administration of the current measure.

Length of current task (in minutes): \_\_\_\_\_

Order of current task (in current assessment session): \_\_\_\_\_

Understands vocabulary \_\_\_\_\_

Asks questions about passage while reading \_\_\_\_\_

Asks questions about passage after reading \_\_\_\_\_

Answers questions with own words \_\_\_\_\_

Answers questions verbatim from passage \_\_\_\_\_

Uses general knowledge to respond to questions \_\_\_\_\_

Can attend when being read to \_\_\_\_\_

Please write down child's comments relevant to task

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**Appendix D**

*Reading Comprehension Observations*

Please record the frequency with which each of the following behaviours occurred during the administration of the current measure.

Length of current task (in minutes): \_\_\_\_\_

Order of current task (in current assessment session): \_\_\_\_\_

Read aloud \_\_\_\_\_

Read silently \_\_\_\_\_

Sounds out words letter by letter \_\_\_\_\_

Sounds out words by letter cluster \_\_\_\_\_

Pronounces word automatically \_\_\_\_\_

Self-corrects \_\_\_\_\_

Makes accent errors \_\_\_\_\_

Errors reveal over-reliance on phonetic pronunciation \_\_\_\_\_

Errors reveal over-reliance on orthographic clues \_\_\_\_\_

Uses context to decode unknown words \_\_\_\_\_

Understands vocabulary \_\_\_\_\_

Refers to passage to answer \_\_\_\_\_

Asks questions about passage while reading \_\_\_\_\_

Asks questions about passage after reading \_\_\_\_\_

Answers questions with own words \_\_\_\_\_

Answers questions verbatim from passage \_\_\_\_\_

Uses general knowledge to respond to questions \_\_\_\_\_

Please write down child's comments relevant to task

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**Appendix E**

*Behavioural Observations*

Please record the frequency with which each of the following behaviours occurred during the administration of the current measure.

Length of current task (in minutes): \_\_\_\_\_

Order of current task (in current assessment session): \_\_\_\_\_

Behavioural Observation (list specific form that behaviour took and it's frequency)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Expressing frustration \_\_\_\_\_

Expressing ease \_\_\_\_\_

Engaged and focused \_\_\_\_\_

Asking for breaks \_\_\_\_\_

Off-topic discussion \_\_\_\_\_

Please write down child's comments relevant to their behaviour

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**Appendix F***Social Story Text*

Hi, my name is Keira.

Thank you for agreeing to help me help other people learn to read. To help others I have to learn about how you read. To learn how you read I am going to come over to your house to play word games and reading games with you. The first day I visit with you I will get to meet you and I will talk to your mom or dad. Together, we will decide where we should sit to play our games.

I will come back about a week later and we will play some word and reading games in our special games place for about one hour. Then I will come back a second time a week after that and we will play some more word and reading games for about one hour. Then I will come back a third time a week after that and we will play some more word and reading games for about one hour. Then I will come back a fourth time a week after that and we will play some more word and reading games for about one hour. Then I will come back one last time a week after that and we will play some more word and reading games for about one hour. The things I learn from playing these games with you are really going to help me help other children learn to read.

Thank you so much for your help.