IDENTIFYING READING DISABILITIES:
WHY DISCREPANCY-BASED DEFINITIONS DO NOT WORK

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Education
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Abstract

This study addresses the validity of distinguishing whether children who 
are discrepant in their reading relative to their IQ ("Dyslexics") are different 
from children who are discrepant in their reading relative to their age ("Poor 
Readers"). Under the present Ontario education system, governed by The 
Education Act (Revised Statutes of Ontario, 1990), dyslexics represent a specific 
group with a reading disability and are treated differently from the normal 
distribution of poor readers. As such, they have a statutory right to remedial 
programs. Non-dyslexic poor readers do not have the same right.

To evaluate whether discrepancy-based measures are appropriate for 
distinguishing children with reading disabilities, the present study assessed the 
reading and reading-related cognitive skills of a cohort of grade 3 children in 
three different schools in the Greater Toronto Area.

From this cohort of 203 children, two groups--the normal reader group and 
the poor reader group--were identified by their performance on the WRAT-R 
Reading subtest (Jastak & Wilkinson, 1984). The poor reader group were those 
children whose scores were <25th percentile; the normal reader group were those 
children whose scores were ≥25th percentile. The third group, the dyslexic group,
was "System-Identified" by an Identification, Placement and Review Committee (IPRC) process. In order to be System-identified as dyslexic, a Full Scale IQ score in the broad average range of 85 or above on the Wechsler Intelligence Scale for Children-Revised (Wechsler, 1974) was required along with a standardized reading test score of at least two years below the expected grade level determined by age on the Standard Reading Inventory (Newcomer, 1986).

The findings support the hypothesis that System-identified dyslexics do not constitute a distinct group different from the group commonly identified in the study as poor readers. The data suggest that both groups are reading disabled and share many similar deficits on reading, language and memory tasks. The data also suggest that English as a second language (ESL) learners are more likely to be classified as poor readers. This study suggests that, regardless of language proficiency, both groups should receive the same opportunity for remediation.
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Age-Based and IQ-Based Definitions of Reading Disabilities in a School Population

Definition is critical to the process of identification of learning disabilities and to the provision of services for children with reading disabilities. Many legal and professional definitions of reading disabilities emphasize the existence of a discrepancy between school achievement and the intelligence (IQ) score (Kavale & Forness, 1995). The significance of the concept of "discrepancy" between achievement and potential in identifying learning and, specifically reading disabilities has had a long history.

Overview of Discrepancy Definitions

Learning disabilities was formally recognized as a category of special education in 1965. Until this time special education had lacked a designation that focused on students whose academic problems emanated from processing deficits believed to be associated with neurological dysfunction. The emergence of reading disabilities as a category of special education created a new concept: a specific form of academic difficulty interfering with learning and manifesting itself in a set of symptoms independent of mental retardation (Winzer, Rogrov, & David, 1987). To specify the nature of the reading disabled, various referents
were used: specific reading retardation (Rutter & Yule, 1975), specific reading disability (Orton, 1937), dyslexia (Critchley, 1971).

Hereafter in the text, when appropriate, the term reading disabilities shall be referred to as dyslexia.

The current accepted definition of reading disabilities (dyslexia) is based upon the discrepancy between the student's perceived potential (IQ) and actual achievement. This translates into the concept that the dyslexic child has an unexpected disability in reading that is not predicted by his or her IQ (Stanovich, 1991). There are a number reasons why discrepancy defined and used in this manner is a concern.

First, there is the erroneous belief that IQ is a valid measure of potential. It has been argued that this assumption of innate potential coupled with the practice of measuring discrepancy from IQ scores should be avoided since both discrepancy and IQ are hypothetical constructs (Siegel, 1989a, 1990a; Stanovich, 1991).

Another concept of discrepancy has been described as the difference between expected achievement and actual achievement referred to as the deviation-from-grade-level method (Kavale & Forness, 1995). Operationalizing the difference between expected and actual achievement (usually two years below grade level in a standardized reading test) meets the criteria of defining dyslexia. This calculation ignores the research showing the unreliability of these difference scores. According to Reynolds (1981), grade equivalent scores assume
erroneously a constant rate of learning over the school year. These scores exaggerate the significance of small performance differences between individuals. According to Kavale and Forness (1995), discrepancy which measures deviation-from-grade-level measures low achievement rather than the under-achievement necessary for the diagnosis of dyslexia.

A further variation in the application of the discrepancy definition has been to quantify the aptitude-achievement discrepancy using the z-score as the common metric. This method is referred to as the standard-score-difference method. According to Macmann and Barnett (cited in Kavale & Forness, 1995), this method, while perhaps one of the most defensible, has problems as well since the correlation between IQ and achievement can show variation across age, dislexic populations and social class. According to Stanovich (1992), the z-score discrepancy "...over-identifies high IQ children and under-identifies low-IQ children, a pattern of identification that has fueled social criticism of the learning disabilities concept..." (p. 180).

Moreover, Stanovich (1992) indicates that perhaps the psychometrically most justifiable method of defining the aptitude-reading discrepancy is the regression-discrepancy method which he describes in the following way: "...the discrepancy is calculated from an expected achievement level based on the regression of reading achievement on the aptitude measure, thus taking into account the imperfect correlation between achievement and aptitude" (p. 180).
However, Stanovich does indicate that a level of sophistication is required to use this method and suggests some computer programs to assist the practitioner.

Furthermore, there is also the unfortunate glorification of the concept by the media portrayal of the dyslexic as an extremely bright child whose potential (IQ) remains unlocked because of "a 'glitch' (presumably biologically based) that prevents him or her from reading" (Stanovich, 1991, p. 270). This absence of any negative connotation does not justify ignoring the conceptual difficulties of assuming that IQ is a measure of innate potential (Wechsler, 1975).

To this point the description of reading disabilities has been confined to those disabilities identified as such by the use of the discrepancy definition. However, the identification of dyslexia as a discrete category of reading disability is a relatively recent phenomenon. Prior to 1963, children with reading disabilities were labelled variously as brain damaged, neurologically impaired, developmentally aphasic, or minimally brain dysfunctional (Winzer et al., 1987). The first monograph on the unique problems of children we now refer to as dyslexics was published in the 1800s by Hinshelwood under the title "Word Blindness" (Critchley, 1971). The modern category of reading disabilities was chiefly developed from concepts put forward by Strauss, a psychiatrist, and Werner, a psychology professor, both of whom left Germany when Hitler came to power and who subsequently met and joined the staff of the Wayne County Training School. Their work was important not only for the development of the concept of reading disabilities but also for their focus on education (Kavale &
Forness, 1995). Gradually, the focus changed from a medical model to one that involved children who were doing poorly in school. In 1963, at a Chicago parents’ conference, S. A. Kirk suggested that medical labels were inappropriate for describing deficits that were educational and proposed the term ‘learning [reading] disabilities’ which he defined in the following terms:

Recently, I have used the term “learning disabilities” to describe a group of children who have disorders in development in language, speech, reading and associated communication skills needed for social interaction. In this group, I do not include children who have sensory handicaps such as blindness or deafness, because we have methods of managing and training the deaf and the blind. I also exclude from this group children who have generalized mental retardation. (cited in Winzer, Rogrow, & David, 1987, p. 237)

**Current Definitions**

In summary, the problems of definition remain while the reading disabled population continues to grow both in Canada and the United States (Kavale & Forness, 1985; Winzer et al., 1987). The primary operational definition for reading disabilities is still discrepancy between innate potential and performance. The Ministry of Education of Ontario and, consequently, educators, still use the IQ test score as a basis for the discrepancy definition of the reading disabled (dyslexics). It follows therefore that the definition of discrepancy remains critical to the process of identification and to the provision of services for children with reading difficulties. Legal and professional definitions of reading disability maintain the existence of a discrepancy between school achievement
and an intelligence score. Definitions from the following sources continue to have a considerable influence on both education and research.

The World Federation of Neurology (1970) defined specific developmental dyslexia as: “a disorder manifested by difficulty in learning to read despite conventional instruction, adequate intelligence, and socio-cultural opportunity. It is dependent upon fundamental cognitive disabilities which are frequently of constitutional origin.” (Critchley, 1970, p. 11)

The Education for All Handicapped Children Act, (1975): “Specific learning disability means a disorder in one or more of the basic psychological processes involved in understanding or in using language spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage.”

Ontario Ministry of Education Definition of Learning Disability (1985): “A learning disorder evident in both academic and social situations that involves one or more of the processes necessary for the proper use of spoken language of the symbols of communication and that is characterized by a condition that is not primarily the result of impairment of vision; impairment of hearing; physical handicap; mental retardation; primary emotional disturbance; or cultural differences, and results in a significant discrepancy between academic achievement and assessed intellectual ability, with deficits in one or more of: receptive language (i.e., listening, reading); language processing (i.e., thinking, conceptualizing, integrating); expressive language (i.e., talking, spelling, writing); mathematical computations; and may be associated with one or more conditions diagnosed as: a perceptual handicap; a brain injury; minimal brain dysfunction; dyslexia; or developmental aphasia.” (Special Education Information Handbook, p. 8)

Each of these definitions emphasize the existence of discrepancies between the dyslexic child’s school achievement and his or her intellectual capacity. These
definitions do not specify how the discrepancy is to be measured. Consequently, researchers and educators have interpreted the definitions in a variety of ways and have developed different approaches to identification and remediation.

Two of the most frequently used definitions are based on chronological age ("age-based") or intelligence as measured by an intelligence test score ("IQ-based"). The IQ-based definition identifies as reading disabled those individuals whose reading scores are significantly below the level expected from their IQ scores. The age-based definition identifies as reading disabled those individuals whose reading scores are significantly lower than would be expected for their chronological age. The age-based definition identifies reading disabled children as "poor readers" rather than dyslexics (Siegel, 1992).

The following discussion of these two definitions will focus on (a) the validity of the criteria in the definitions as stated above and (b) the suitability of using the IQ score as a measure in the identification of reading disabilities.

Support for the validity of the concept of two distinct groups of reading disabled children comes from the work of Yule, Rutter, Berger, and Thompson (1974). The researchers based their findings on the experimental data of under-achievers in reading from the Isle of Wight studies, (1964-74) and concluded that the prevalence of severe underachievers was greater than expected on statistical grounds. The investigators found that in a distribution of over and under achievers, the under-achievers formed 'a hump' at the bottom of the normal curve for reading scores. These findings suggest that 'the hump' is a true
representation of a group of children with severe reading retardation which is not just the tail-end of a normal continuum. The results also suggest the validity of two distinct groups, namely the specific reading retardation group (dyslexics) and the general reading backwardness group (poor readers).

Referring to the Isle of Wight Studies, (1964-74), and the Yule et al. Study (1974), Rutter and Yule (1975) published a paper also identifying the two distinct groups of children with reading problems: (a) those children whose reading scores are discrepant with their IQ and age (in the terms of Yule et al., the specific reading retardation group and referred to above as dyslexics), and (b) those children whose reading scores are low in relation to their chronological age but not lower than would be predicted by their IQ (in the terms of Yule et al., the general reading backwardness group referred to above as poor readers). Evidence in the literature supporting the differentiation between the two groups was provided by the Isle of Wight study of 9 and 10 year-old children. According to the study, the first notable difference between the two groups concerned the sex ratio. In the specific reading retardation group the sex ratio was 3.3 to 1 (boys to girls), however it was only 1.3 to 1 in the general reading backwardness group. Neurological problems (cerebral palsy and other similar conditions) and motor impersistence (inability to sustain a voluntary motor act that has been requested) as well as praxic disorders (clumsiness) were more common in the general reading backwardness group. However, as Siegel notes, "...there was no
evidence that they [the groups] were different in reading or spelling skills or other basic cognitive processes” (Siegel, 1992, p. 619).

Other epidemiological studies have failed to replicate the bimodal distribution of the model of Rutter and Yule (1975). Rodgers (1983), using a national sample of 8,000 British school children, failed to find evidence of any bimodality that could be taken to indicate the presence of a 'hump' in the distribution of reading scores. Shaywitz, Escobar, Shaywitz, Fletcher, and Makuch (1992), using the data from the Connecticut Longitudinal Study, found that dyslexic children represented the lower portion of the continuum on a normal distribution of reading capabilities. Another important finding was the instability of the diagnosis for dyslexia over time. For example, only 28% of the children identified as dyslexic in grade one were also classified as dyslexic in grade 3. Both these studies failed to replicate the claim for the over-representation of subjects in the lower tail of a normal distribution of reading ability scores that appeared in Rutter et al. The Rodger and Shaywitz et al. findings, therefore, do not support the conclusion that dyslexia is a specific and distinct syndrome but rather that reading difficulties, including dyslexia, occur along a continuum that also includes normal readers (Rodgers, 1983; Shaywitz et al., 1992).

However, findings in the Dunedin epidemiological study (Silva, McGee, & Williams, 1985) supported Rutter and Yule's view that there were some important differences between the two disabled reading groups. In both the
Rutter and Yule and the Dunedin studies, there was a gender-based difference in the ratio (more boys than girls) in both groups with the higher ratio in the specific reading retardation group. The results of the Dunedin study also supported Rutter and Yule's findings that the general reading backwardness group had more neurological abnormalities and inferior motor measures on co-ordination and drawing tasks than those with specific reading retardation. However as in the Rutter & Yule (1975) study, there were no significant differences between the reading backwardness group and the specific reading retardation group in the pattern of reading and spelling test scores.

The Australian study of a cohort of 453 kindergarten children (Jorm, Share, Maclean, & Matthews, 1986b) also found that the specific reading retardation group and the general reading backwardness group differed from the normal reading group with the general reading backwardness group achieving significantly lower scores than the specific reading retardation group in name reading, name writing, letter copying, Peabody Picture Vocabulary Test, Northwestern Syntax Screening Test and memory for confusable sentences; yet, the patterns of their academic deficits were remarkably similar in the two groups despite the differences in terms of cognitive ability. Both groups had poor word recognition, reading comprehension, pseudoword recognition and spelling.

The data provided by Silva et al. (1985) and Jorm et al. (1986b) replicated the Rutter and Yule (1975) findings with the one exception that neither study found any language deficits in the specific reading retardation group at school
entry, whereas the Rutter and Yule study found developmental delays in speech and language in both groups.

In the Dunedin study, Share, McGee, McKenzie, Williams, and Silva, (1987) found no evidence to support the notion of a 'hump' in the distribution of under-achievement in either the individual or the group data. The most significant finding was the instability of the groups over time. Using similar measures at ages 7, 9, and 11, children were reclassified at age 11 with some children moving from the specific reading retardation group to the normal group, and others from the general reading backwardness group to the specific reading retardation group. There was no evidence to support the validity of the distinction between specific reading retardation (dyslexics) and general reading backwardness (poor readers). Since the New England, Australian and New Zealand studies cited here used different measures, smaller sample sizes which make tentative any conclusions and a differently defined age-group than the British study by Rutter and Yule (1975), it is possible that some of the discrepancies in their respective findings are a result of these inconsistencies (Jorm et al., 1986a; Share et al., 1987; Shaywitz et al; Silva et al., 1985).

Van der Wissel and Zegers (1985) used a computer simulation to recreate the 'hump' identified by Rutter and Yule (1975). They concluded that 'the hump' was created by introducing a ceiling on the reading scores into a bivariate normal distribution which resulted in a noticeable increase of extreme under-achievers at the lower end of the distribution. Consequently, 'the hump' did not reflect a
meaningful group at the tail-end of the distribution. From these findings one concludes that the outcomes in reading as discussed by Rutter and Yule (1975) were artifacts of ceiling and floor effects in the reading measures.

The Rutter and Yule study (1975) had a significant impact on educators and academics by providing empirical evidence which appeared to demonstrate that children with specific reading retardation (dyslexics) differed from children with general reading backwardness (poor readers). However, a number of the Rutter and Yule findings have not been replicated.

Both in theory and in practice the assumption is that these two groups, the dyslexics and poor readers, constitute two distinct subtypes with different reading patterns (Siegel, 1992). However, the empirical question as to whether there is a difference between poor readers and dyslexics is a profound one. The assumed evidence concerning the differences and similarities between these two groups is controversial. Studies cited above (Rogers, 1983; Shaywitz, Escobar, et al., 1992; Shaywitz, Fletcher, et al., 1992; Silva et al., 1985; van der Wissel & Zegers, 1985) question the validity of the claim for two distinct groups as posited by the studies of Rutter and Yule (1975), Rutter, Tizard, Yule, Graham, and Whitmore (1976), and Rutter (1989).

Additional studies investigating the similarities and differences between the two groups were carried out. Silva et al. (1985), in a study of 9 year old boys found similarities between dyslexics and poor readers, specifically that dyslexics
and poor readers did not differ on reading and spelling measures. However, poor readers had lower arithmetic and motor scores than dyslexics.

Similarly, an Australian longitudinal study of children over the first three years of schooling found that grade 2 poor readers did not differ from dyslexics in pseudoword reading, comprehension, spelling or reading accuracy rate. In Kindergarten and grade 1 the dyslexics scored higher than the poor readers on phoneme segmentation. However, both groups (i.e., dyslexics and poor readers) had similar scores in phonological recoding (Jorm et al., 1986b; Jorm & Share, 1993).

Another study examining the behaviours of these two groups found that there was a higher incidence of behaviour problems in the poor reader sample than in the dyslexic group (Jorm, Share, Maclean, & Matthews, 1986a).

In comparing dyslexics and poor readers on a number of real and pseudoword reading and spelling measures, Share et al., cited in Siegel (1992), found a statistically significant difference on only one measure--word substitution in reading--out of 28 measures.

Likewise, using the Woodcock Reading Mastery Test (Woodcock, 1987), Bloom, Wagner, Reskin, and Bergman (1980) found no differentiating characteristics between the poor reader group and the dyslexic group in word identification, word attack, word comprehension and reading comprehension. In fact, the dyslexic group scored higher than the poor reader group on the letter identification task. That may be explained by the fact that this task is more of a
visual-spatial nature than a reading task such as pseudoword reading and dyslexics have been found to have superior orthographic skills (Siegel, Share, & Geva, 1995).

Johnston, Rugg, and Scott (1987b, 1988) studied two groups of poor readers. One group consisted of poor readers with average IQ (dyslexics), the other group with lower than average IQ (poor readers). Although neither group scores were based on discrepancy between IQ and achievement, the groups' patterns did not differ on memory tasks nor did they differ on tasks that involved the recognition of the incorrect spelling of pseudohomophones.

In an attempt to distinguish dyslexics from other disabled readers, Taylor, Satz, and Friel (1979) conducted a longitudinal study of male kindergarten children. At the end of the third year, two measures of reading ability were obtained: a word recognition assessment from the Monroe Diagnostic Reading Test, and a Teacher Judgment of Reading Level Rating Scale. Of the children tested, 80 (14%) were identified as disabled readers. Forty (50%) from the disabled reader group met the criteria of the World Federation of Neurology's definition for dyslexia:

A disorder manifested in learning to read despite conventional instruction, adequate intelligence, and sociocultural opportunity. It is dependent upon fundamental cognitive disabilities which are of constitutional origin. (Critchley, 1970, p. 11)
The two groups identified as dyslexics and non-dyslexic disabled (i.e., poor readers) were age-matched to a group of 80 of the normal readers. The three groups, dyslexic, poor readers and normal readers were then assessed on factors critical to the study of reading. The results of the research showed that dyslexics could not be distinguished from non-dyslexic disabled readers (poor readers) in frequency of reversal errors, spelling competencies, mathematics skills, neurological status, personality functioning and familial reading (blood parents of the dyslexics and non-dyslexic poor readers were tested in reading and spelling). Both the non-dyslexic disabled reader group (poor readers) and the dyslexic group showed similar performances. Since most measures differentiated the total reading disabled group (dyslexics and non-dyslexic reading disabled) from the normal reading group, the data support the general distinction between normal and disabled readers. However, here too, the validity of the separation of the disabled into dyslexic and non-dyslexic disabled readers was not justified on the basis of these data.

The findings from the Taylor et al. (1979) study which indicate the similarities between the dyslexics and the poor readers would seem to support the positions taken by Siegel in her 1988 and 1989 studies and the Fletcher, Espy, Francis, Davidson, Rourke, & Shaywitz (1989) study indicating that reading ability should be defined without attempting to further categorize children as dyslexic or non-dyslexic (Gough & Tunmer, 1986; Stanovich, 1986a,

In all the studies reviewed, the most significant differences between the dyslexic and the poor reader were related to ability as tested by intelligence tests. Siegel has argued that IQ measures neither intelligence nor potential. She states that “… the term intelligence implies problem solving skills, logical reasoning, and adaptation to the environment” (Siegel, 1989, p. 469). What IQ does measure are broad general skills related to performances on school tasks (Siegel, 1991b; Siegel & Himel, 1998; Torgesen, 1989).

The IQ-based definition of a reading disability requires that a child be of average or above average intelligence and, as a consequence, those children who fail to meet the requirements of this definition are considered poor readers. The use of the IQ in defining learning disabilities is not a satisfactory measure for the poor reader. For example, a poor reader could have a processing deficiency in language which may be associated with reading problems and thus would reduce the verbal IQ score. Since IQ is linked to verbal ability, the poor reader would not meet the requirements needed to receive help (Fletcher, 1992; Siegel, 1991b, Stanovich, 1991; Torgesen, 1982).

The practice of relying on a discrepancy between an IQ and an achievement test score to determine a learning disability is common as a result of the work of Rutter and Yule (1975) and the definitions noted previously (Critchley, 1970; United States Government, 1975, 1977; the Ontario Education Act R.S.O, 1990).
This practice penalizes the child for several reasons. A child’s performance on an IQ test is influenced by past learning, cultural factors, and instructional methods which may negatively influence the IQ score (Fletcher et al., 1989; Siegel, 1988b, 1989b; Stanovich, 1991). It is not clear, because of the IQ factor, whether children with IQ-based discrepancies have more disabilities than children with age-based discrepancies for there is little empirical evidence showing that, in fact, dyslexics and poor readers differ greatly on measures other than IQ (Fletcher, Francis, Rourke, Shaywitz, & Shaywitz, 1992). Sometimes a Full Scale IQ score is used for the discrepancy based identification, other times a Performance or Verbal IQ score is suggested. This either/or strategy results in different criteria being used for different children (Siegel & Heaven, 1986; Stanovich, 1991; Torgesen, 1986).

Siegel suggests that a definition for reading disabilities should be based on reading ability, not IQ. She argues that the issue of specificity, inherent in current definitions of dyslexia, is unreasonable as it is unrealistic to assume that a problem in one domain will not affect other domains, i.e., slow reading acquisition has cognitive consequences for other domains that are in a reciprocal relationship with reading. According to Stanovich, Nathan, and Vala-Rossi (1986), research has shown a causal connection between vocabulary knowledge and reading comprehension. Thus children with poor vocabularies will read more slowly, enjoy reading less and, as a consequence, be less skilled readers. Since reading capability through print exposure is in a reciprocal relationship with vocabulary growth, poorer rates of academic and intellectual achievement will be
the result (Jorm, Share, Maclean, & Matthews, 1984; Siegel, 1988; Stanovich, 1993). In addressing this interdependence issue, research has indicated that reading skill is linked to various verbal abilities that are in turn reflected in the IQ score (Siegel, 1988; Stanovich, 1986, 1993; Sternberg, 1987; Torgesen, 1988). Consequently, some of the theoretical problems involved in using IQ as a measure of intellectual aptitude have to do with the content of the IQ test. The subtests of an IQ test require various linguistic abilities such as vocabulary skills, expressive language skills and phonological acquisition which are related to reading. As a consequence, children with reading problems will generally have lower IQ scores than children without reading problems (Naglieri & Reardon, 1993; Siegel & Linder, 1984; Siegel & Heaven, 1986; Siegel, 1988, 1989, 1991b; Siegel & Ryan, 1989; Stanovich, 1986a, 1989, 1991, 1993; Stanovich, Cunningham, & Feeman, 1984; Torgesen, 1988, 1989; Vellutino, 1979; Wong, 1986, 1989).

Since print exposure is a potent predictor of vocabulary growth and knowledge acquisition as well as many other verbal skills (Stanovich, 1991, 1993), a child who has less exposure and experience with print will have depressed achievement in vocabulary and knowledge skills. Those skills are subskills of IQ tests and children with less print exposure are, therefore, more likely to have lower scores on the verbal subtests of an IQ test (Jorm et al., 1984; Siegel, 1988a, 1989). Stanovich (1986b) refers to this syndrome as the "Matthew Effect," citing the following passage from the Gospel according to Matthew
(XXX:29): “For unto everyone that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath.”

There are many issues raised in research and in education concerning testing, and suggestions have been given as to which test and what kind is appropriate. The review of the literature would suggest caution against relying solely on IQ-based discrepancy scores and IQ measures for identification of children with reading disabilities. The current use of the discrepancy-based definition may result in reduced opportunity for educational growth for a significant segment of children--those characterized as poor readers. The use of the discrepancy definition may result in the identification of a relatively small group of less-skilled readers characterized as dyslexics. Historically, the dyslexic group has been treated differently from the non-dyslexic poor readers. Typically the dyslexic readers receive specialized remedial treatment while the others--the poor readers--do not have the benefit of such treatment (Stanovich, 1991, 1994). Consequently, those less fortunate, poor readers, who are often found among children of low socioeconomic status, are at a significant disadvantage (Chall, Jacobs, & Baldwin, 1990; Fletcher, 1992; Siegel, 1989, 1990; Siegel & Himel, 1998).

The reduced opportunity for educational growth for the poor readers should be addressed by educators. Research has shown that children identified as dyslexics have similar reading and reading-related cognitive deficits as those
children classified as poor readers and respond positively to appropriate intervention (Siegel, 1988b, 1991a; Stanovich, 1993, 1994; Vandervelden & Siegel, 1997). It is lack of instruction rather than lack of ability that puts children at a disadvantage in reading (Adams, 1990; Chall, 1993; Chall et al., 1990; Stanovich et al., 1986). In the present study there was no significant difference in the performances of the two reading disabled groups--the dyslexic group and the poor reader group--in reading and reading-related cognitive tasks. It follows, therefore, that both groups of disabled readers--the dyslexic group and the poor reader group--would benefit from reading instruction that would provide the best strategies possible for the purpose of learning to read.

**Rationale**

The research findings discussed in the current literature establish many similarities in the reading and reading-related cognitive disabilities of dyslexics and poor readers. There is strong evidence in the literature that reading disability is distributed on a continuum which also includes normal readers (Johnston et al., 1987b, 1988; Rogers, 1983; Share et al., 1987; Shaywitch et al., 1992; van der Wissel & Zeger, 1985). The current practice of relying on an IQ score in the identification of dyslexics has been an Achilles heel for those researchers in the field who argue that the dyslexic child has a discrete condition in the domain of reading, a condition not predicted by the child's intellectual competence (Fletcher et al., 1989; Siegel, 1988b, 1989, 1990; Stanovich, 1989,
1991, 1994; Taylor et al., 1979). However, despite the persuasive evidence casting doubt on the discrepancy-based definition educators have continued to concentrate on the standard discrepancy definition and do not question the validity of using the IQ benchmark as an educational practice. Their assumption is that dyslexia is a cognitive deficiency justifying differential educational classification and treatment for dyslexics (Stanovich, 1991). Consequently the present study set out to examine the issue of differential identification and educational treatment for children with reading disabilities by proposing the following hypothesis: The group of children identified as dyslexics would demonstrate deficits in reading and reading-related cognitive skills similar to those demonstrated by the group of children identified as poor readers.

Three groups of children were identified for the study and were subsequently assessed on a battery of standardized and experimental measures tapping various reading and reading-related cognitive skills. The selection of these measures was influenced by the research literature that covered aspects of early literacy.
Method

Sample Selection

Three schools in a city within the Greater Toronto Area were involved in the study. The selection of the schools was made by the Research Department of the Board of Education. The schools selected were from two distinct regions within the city. Two schools (school A and school B) were in the north end of the city. School A had twenty-four different nationalities from countries in Europe, Asia, South America, Africa and the West Indies with no one nationality predominating. In School B the majority of the population was East Indian children. The third school (school C) was located in the extreme south end of the city in a poorer, blue collar section with a predominantly white Anglo-Saxon population.

The sample was composed of 203 grade 3 children and consisted of 108 girls (53.2%) and 95 boys (46.8%). The ages of the cohort ranged from 101 to 125 months. The mean age was 107.4 months. The Standard Deviation was 4.2 with the mode 107 months. Eighty-one children (39.9%), predominantly from Schools A and B, were from homes where English was not the first language. However, the majority of the children were born in Canada and had been in the school system since junior kindergarten. Consequently, only 7.4% of the cohort were teacher-identified as ESL and were receiving additional help in English. All the
children were included in the sample. Consent forms were signed by the parents of the children prior to testing. Testing was done in late May and early June.

From the cohort of 203, two groups were identified initially by the WRAT-R Reading subtest (Jastak & Wilkinson, 1984), poor readers and normal readers. Poor readers were those children whose scores were <25th percentile and normal readers were those children whose scores were ≥25th percentile. Seventy of the 203 children (34.5%) with scores ≥25th percentile were considered the normal reader group and 95 (46.8%) with scores <25th percentile were considered the poor reader group. Thirty-eight (18.7%) of the cohort of 203 were the dyslexic group and had been previously System-identified as dyslexics by an Identification Placement and Review Committee (IPRC) process which requires the child to have an educational assessment including the Wechsler Intelligence Scale for Children-Revised (Wechsler, 1974) and a standardized reading test (the Standard Reading Inventory, (Newcomer, 1986). Thus a Full Scale IQ score in the broad average range of 85 and above and a reading score at least two years below the expected grade level determined by age on a standardized reading test identifies the child as dyslexic with special remedial help provided. The sample selection in the study identified three groups: the poor reader group, children whose scores were <25th percentile; the normal reader group, children whose scores were ≥25th percentile; and the dyslexic group who had been System-identified as learning disabled by an IPRC. The following chart indicates the distribution of the reading groups by school.
<table>
<thead>
<tr>
<th>School</th>
<th>Dyslexics</th>
<th>Poor Readers</th>
<th>Normal Readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>n=10(13.7%)</td>
<td>n=44(60.3%)</td>
<td>n=19(26%)</td>
</tr>
<tr>
<td>B</td>
<td>n=20(21.5%)</td>
<td>n=43(46.2%)</td>
<td>n=30(32.3%)</td>
</tr>
<tr>
<td>C</td>
<td>n=8(21.6%)</td>
<td>n=8(21.6%)</td>
<td>n=21(56.8%)</td>
</tr>
</tbody>
</table>

Since the WRAT-R reading subtest administered at the beginning of the study requires the child to recognize words out of context, several factors were possibly influencing the disproportionate number of children with reading difficulties. Presumably, the children were unable to decode efficiently since they did not necessarily possess the grapheme-phoneme conversion rules for phonological processing. However, school C, a more traditional school than either school A or school B, provided a curriculum based on a phonics program with a particular emphasis on spelling, whereas, schools A and B provided a more whole language approach to teaching reading. This factor, as well as the fact that school C had a lower proportion of multi-ethnic children, may have accounted for the higher incidence of children in the normal reader group in school C (Bradley, 1988; Bradley & Bryant, 1983, 1985; Gough & Tunmer, 1986; Jorm et al., 1984; Juel, 1988; Siegel, 1988b, 1992; Siegel & Faux, 1989; Snowling, 1980; Stanovich, 1988a, 1988b, 1994; Wagner & Torgesen, 1987; Vandervelden & Siegel, 1997). It became evident during the analysis phase of the study that the teacher-identification of only 7.4% ESL children who needed additional help in English
was not necessarily representative of the actual needs of the multi-ethnic population.

**Procedures**

In order to test the strength of the hypothesis which stated that the poor reader group and the dyslexic group would have similar reading and reading-related cognitive deficits, the participants in the study completed a battery of standardized and experimental tasks tapping various aspects of reading and reading-related cognitive skills. The group tests included CCAT, a test of cognitive skills, the WRAT-R, Spelling, a test of decoding skills, the WRAT-R Arithmetic, a test of computation skills and the Stanford Diagnostic Reading Test a test of reading comprehension. All the tests were administered in one session with the exception of the CCAT which took three sessions to administer.

The standardized measures used were as follows: to assess reading comprehension, Form G of the Stanford Diagnostic Reading Test (SDRT) (Karlsen & Gardener, 1985) was administered; to assess decoding ability, the children were administered Form G of the Word Attack subtest from the Woodcock Reading Mastery Tests (Woodcock, 1987), a test of pseudoword reading, and the spelling subtest of the Wide Range Achievement Test-Revised (WRAT-R) (Jastak & Williamson, 1984); to assess word recognition ability, the children were administered the Word Identification subtest of the Woodcock Reading Mastery Test (Form G) and the reading subtest of the (WRAT-R); to
assess computation skills the arithmetic subtest of the (WRAT-R) was also administered.

The experimental measures were as follows: Verbal Working Memory (Siegel & Ryan, 1989, a variation of a working memory test (developed by Daneman & Carpenter, 1980), was used to measure verbal working memory; Rosner Auditory Analysis (Rosner & Simon, 1971) was used to assess phonological sensitivity; Syntactic Judgment (Siegel & Ryan, 1988, adapted from Willows & Ryan, 1986) was used to assess syntax skills; and an Orthographic Measure (Siegel, Share, & Geva, 1995) was used to assess visual memory for whole word configurations.

Wide Range Achievement Test (WRAT-R) Revised - Level 1 (Jastak & Wilkinson, 1984). There are three subtests: Reading, Spelling and Arithmetic. All the subtests were administered and scores were reported in Percentiles.

The Reading subtest, an individual test, required the child to read words. Words were scored as either right or wrong. The time limit was 10 seconds per word. The test limit was 10 consecutive errors. The child was given the following instructions: “Look at each word carefully and say it aloud.” At the end of 10 seconds, the instructor would say “next” as an indication the child was to proceed to the next word. There were 75 words in total ranging from common and simple to infrequent and complex orthographically, e.g., cat, see, red, collapse, glutton, clarify, itinerary, pseudonym, and aborigines.
The Spelling subtest, administered in small groups, required the children to write words to dictation. The children were given the following instructions: “I will say the word, then I will say the word in a sentence. I will then repeat the word which you will write.” The test consisted of 45 words ranging in difficulty from simple to complex. The test was continued until 10 consecutive words were misspelled. Sample words are go, cat, boy, museum, necessity, beneficial and prejudice.

The Arithmetic subtest, administered in a group setting, was a written, timed test of 10 minutes in length. There were 15 computation questions including whole numbers, common and decimal fractions and percent. The children were given the following instructions: “Look at each problem carefully to see what you are supposed to do: add, subtract, multiply or divide. Then put your answer in the space or under the line.” Sample questions ranged from “1+1=2” to “find the square root of 334.89.” Each correct answer was given 1 point.

Canadian Cognitive Abilities Test (CCAT) (Thorndike & Hagen, 1989). The CCAT, Canadian Edition, was the Canadian adaptation of the Cognitive Abilities Test (CAT). The CAT was a revision of the Lorge-Thorndike Intelligence Tests (McInnis, 1986). The CCAT is a group test administered by teachers. The subtests were verbal (V), non-verbal (NV), and quantitative (Q). The V subtests (vocabulary, sentence completion, verbal classifications and
verbal analogies) were very similar in form and content to other measures of verbal ability. The NV subtest reflects the child's ability to compare items and detect similarities and differences in relative size, position, quantity, shape and time. The Q subtest reflects a child's understanding of concepts of number and quantity as well as spatial relationships. The pupil working time for each subtest ranged from 12 to 18 minutes. The scale on which these scores were used was the standardized age score with a mean of 100 and a standard deviation of 16. For all the subtests, the instructions as well as each item on the test were read aloud to the children by the teachers. For example, in the Vocabulary test, the children were instructed to "place their finger on the little moon next to the row of pictures." (Pause.) The teacher would then ask, "Which one (picture) shows something that has an eraser?" (Pause.) The teacher would then repeat, "The pencil has an eraser. So, fill in the oval under the pencil to show that it is the right answer."

The Stanford Diagnostic Reading Test- Green Level Form G . (SDTR) (Karlsen & Gardner, 1985). This timed reading comprehension test (30 minutes) was administered by the teacher in a group setting. The subtest measures both literal and inferential comprehension. The children were given the following instructions: "Read the story silently and then answer some questions about the story by filling in the shaded ovals beside the correct answer." A sample story would be:
Billy dug a hole to plant a rosebush. In the ground was an arrowhead. Billy's father said it must be about one hundred years old.

To the question, "What did Billy put in the ground?" the child would fill in the correct oval from the choices: a tree, a vegetable plant, a rosebush, an arrowhead. The children were instructed to check their work if finished early. Scores were reported in Percentile Ranks.

Woodcock Reading Mastery Tests-Revised (WRMT-R) (Woodcock, R. W., 1987). Two subtests were administered: Word Identification and Word Attack. The subtest contain 106 and 45 items, respectively, arranged in an ascending order of difficulty. The subtests were administered individually to each child.

The Word Attack subtest measured the child's ability to apply phonic and structural analysis skills in order to pronounce pseudowords. The items in the test were selected so that almost all phonemes in the English language were represented. All children began the test by responding to two sample items. If the child failed a sample item, training was continued until the child completed the item correctly. The child was given the following instructions: "I want you to read some words that are not real words. I want you to tell me how they sound." The instructor would point to the word 'tat' and ask "How does this word sound?" If the child responded incorrectly, the instructor would point to the word 'tat' and repeat the word. The instructor would point to the word 'tat' again and would
say, "Now try it again. How does this word sound?" The instructor would repeat the same instructions for the sample word "op." These sample words were the only ones pronounced by the instructor during the test. The instructor began the test by saying "How do these words sound?" and would point to each word if necessary, allowing 5 seconds for each response. The test consists of 45 words. Some sample words on the test are: dee, gaked, cigbet, and pnomocher.

The Word Identification subtest required the child to identify and pronounce words correctly. The items ranged in difficulty from words that are typically presented in a beginning reading program to words that are very complex even for adults. The instructor would point to the first word on the subject page and say: "What is the word?" If the child did not respond to the first word, the item was scored zero. The instructor then would say the word and ask the child to repeat the word. The instructor would not tell the child any other word during the test. If the child failed to respond to a word in 5 seconds, the instructor continued the test by pointing to the next word and saying: "Try this word." The test continued until the last six consecutive failed responses. Some examples of words on the test are you, urgent, naive, and taupe.

**Verbal Working Memory Task** (Siegel & Ryan, 1989 was modelled on a procedure developed by Daneman and Carpenter, 1980). The child was required to listen to sets of sentences on a tape. The child received three 2-item sets, three 3-item sets and three 4-item sets. The instructions for the 2-item set were
“You are going to hear a voice on a tape. At the end of each sentence, you will hear a ‘beep’. When you hear the ‘beep’ answer TRUE or FALSE to the sentence. When you hear two ‘beeps’ you will give the last word in each of the sentences that you have just heard. It does not matter if you give the words in the same order as the sentences.” The instructor would record the responses in the order reported.

The child was given the following sample instructions: “You are a boy” (asked so that the answer was true) and “I am sitting” (asked so that the answer was false). The correct answer is “boy, sitting.” The child was not penalized for answering slowly. The sentences were short with a mean length of 5.5 words and a range of 4-9 words. The sentences were designed to contain information familiar to most school children and they were grammatically quite simple (e.g., ‘birds fly in the water,’ ‘the sun rises in the evening’). The maximum score was 27 since the children were marked on the number of items recalled correctly. The items are shown in Appendix A.

**Rosner Auditory Analysis Task** (Rosner & Simon, 1971). This task contains 40 items and is a test of phonological processing involving both syllable and phoneme deletion. Participants were asked to delete syllables and single phonemes from initial and final positions in words as well as single phonemes from blends. A maximum of one repetition was allowed per item if the participant had required a repetition or had not responded within approximately
15 seconds. Test items were arranged in order of difficulty. Testing for all subjects ended after five consecutive errors. The child was given the following instructions: “We are going to play a game of removing sounds from words. I am going to say a word and then tell you to take part of the sound off and then say what's left.” The instructor would say the word ‘cowboy.’ The instructor would repeat the word ‘cowboy’ again but without the ‘boy’ sound. Two practice items were given. If the child failed either of the two practice items, there was an attempt to teach the task by giving the correct response, explaining the response and presenting the items again. The test proceeded if the items were answered correctly. If either item was failed again, testing was discontinued and the test was scored zero. The 40 items on the test were arranged in order of difficulty. The items are shown in Appendix B.

**Syntactic Judgment Task** (Siegel & Ryan, 1988 adapted from Willows & Ryan, 1986). In this task the instructor orally presented syntactically correct and incorrect sentences. The task was introduced as follows: “I am going to say some sentences. Some of the sentences are right and some of them are wrong. I just want you to tell me which sentences are right and which sentences are wrong. Let's practice.” The two practice items were presented: e.g., the tester would say “This is a chair. Is it right or wrong?” The child answered and was corrected if necessary. The tester would say, “I am sit. Is it right or wrong?” If the child attempted to correct the sentence, the response was, “I just want you to tell me if
the sentence is right or wrong.” A maximum of one repetition was allowed per sentence upon the child's request or if the child failed to respond to the sentence within approximately 15 seconds. There were 25 sentences with errors presented and 10 sentences without errors. The maximum score on the task was 35. The sentences are shown in Appendix C.

**Orthographic Task** (Siegel, Share, & Geva, 1995). This task consisted of 17 pairs of stimuli, shown one pair at a time. One pseudoword in each pair contained a sequence of letters that never occur in that position in the English language but were pronounceable. The instructions were as follows: “You are going to see a pair of letter groups that are not words. One of each pair is more like a word than the other. I want you to tell me which of the two is more like a word. Which one of the pair looks more like a word than the other? Which one has a spelling that is more like a word?” Sample task items were (1) filv, filk; (2) tolz, tolb; (3) moke, moje; (4) bnad, blad. The maximum score possible on the test was 17. The complete test appears in Appendix D.

**RESULTS**

Tables 1 to 4 present the Means, Standard Deviations and Ranges for all three reading groups: the normal reader group, the dyslexic group and the poor reader group. Analysis of variance (ANOVAS) was selected to compare the
performances of all three groups on each task. Post-hoc Scheffe comparisons were performed among the groups with \( p < .05 \). A chi-square analysis was carried out to test for differences between groups in categorical data.

Table 1

Performance of Dyslexics, Poor Readers, and Normal Readers on the Canadian Cognitive Achievement Test Summary Statistics (Standard Scores)

<table>
<thead>
<tr>
<th></th>
<th>Normal Readers</th>
<th>Dyslexics</th>
<th>Poor Readers</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n=46 )</td>
<td>( n=38 )</td>
<td>( n=48 )</td>
<td>( n=132 )</td>
</tr>
<tr>
<td>Verbal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Standard Score)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td>95.46</td>
<td>103.13</td>
<td>84.04</td>
<td>93.64</td>
</tr>
<tr>
<td>SD</td>
<td>17.03</td>
<td>16.52</td>
<td>9.33</td>
<td>16.40</td>
</tr>
<tr>
<td>Range</td>
<td>61-140</td>
<td>71-150</td>
<td>62-100</td>
<td>61-150</td>
</tr>
<tr>
<td>Non verbal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Standard Score)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td>95.70</td>
<td>92.68</td>
<td>87.13</td>
<td>91.67</td>
</tr>
<tr>
<td>SD</td>
<td>14.56</td>
<td>12.95</td>
<td>13.04</td>
<td>13.91</td>
</tr>
<tr>
<td>Range</td>
<td>65-130</td>
<td>61-118</td>
<td>63-109</td>
<td>61-130</td>
</tr>
<tr>
<td>Quantitative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Standard Score)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td>93.54</td>
<td>92.66</td>
<td>84.96</td>
<td>90.23</td>
</tr>
<tr>
<td>SD</td>
<td>16.94</td>
<td>14.18</td>
<td>14.81</td>
<td>15.76</td>
</tr>
<tr>
<td>Range</td>
<td>50-132</td>
<td>63-122</td>
<td>61-131</td>
<td>50-133</td>
</tr>
</tbody>
</table>

The scores for the CCAT test, as shown in Table 1, were obtained from the Research Department of the Board. Since the CCAT was given in the spring of
the grade 2 year, many children had moved to other areas. Consequently, we could only obtain the scores for 132 out of the cohort of 203.

On the Verbal subtest, there was a group main effect, $F(2, 129) = 18.93, p < .0001$. Post-hoc tests showed a significant difference between the dyslexics and the poor readers (Scheffe = 18.303, $p < .05$) and the normal readers and the poor readers (Scheffe = 7.25, $p < .05$). As shown on Table 1, there was no significant difference between the dyslexics and the normal readers on the verbal subtest. The normal reader group and the dyslexic group both scored higher than the poor reader group. On the nonverbal and quantitative subtests there was a group main effect $F(2,129) = 4.83, p < .01$ and $F(2, 129) = 4.34, p < .02$ respectively. Post-hoc tests showed a significant difference between normal and poor readers on the nonverbal subtest (Scheffe = 4.69, $p < .05$) and on the quantitative subtest (Scheffe = 3.64, $p < .05$). On both the nonverbal quantitative subtests there was no significant difference between the normal readers and the dyslexics or between the poor readers and the dyslexics. Since the CCAT is standardized and the representative norms are based on an English speaking school population (McInnis, 1986), children in the poor reader group for whom English is a second language ($n=45$) were then compared to those children also in the poor reader group for whom English is the first language ($n=42$). The difference between the ESL group and the first language group was not significant at the $.05$ level for the Non-Verbal and Quantitative subtests. For the Verbal subtest, there was a
significant difference between first and second language learners (Scheffe = 6.70, p < .01).

As shown in Table 2, there was a significant group effect on all three reading measures: the WRAT-R Reading subtest, $F(2,200) = 332.32, p < .0001$; the Woodcock Word Identification subtest, $F(2,200) = 178.28, p < .0001$; and the Stanford Diagnostic Reading Test $F(2,195) = 45.53, p < .0001$. The dyslexic group had lower scores than the normal reader group but not lower than the poor reader group.

On the WRAT-R Reading subtest there was a significant difference between the normal readers and the dyslexics (Scheffe = 202.07, p < .05) and between the normal readers and the poor readers (Scheffe = 275.2, p < .05). On the Woodcock Word Identification subtest there was a significant difference between the normal readers and the dyslexics (Scheffe = 115.60, p < .05) and between the normal readers and the poor readers (Scheffe = 141.83, p < .05). There was no significant difference between the dyslexics and poor readers. Both groups scored lower than the normal reader group. On the Stanford Diagnostic Reading Test there was a significant difference between the normal readers and the dyslexics (Scheffe = 29.86, p < .05) and between the normal readers and the poor readers (Scheffe = 35.79, p < .05). There was no significant difference between the dyslexics and the poor readers on any of the three reading measures.
Table 2
Performance on Reading, Spelling and Arithmetic Tasks Summary Statistics
(Percentile Scores)

<table>
<thead>
<tr>
<th></th>
<th>Normal Readers n=70</th>
<th>Dyslexics n=38</th>
<th>Poor Readers n=95</th>
<th>All n=203</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WRAT-R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Word Reading</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>58.10</td>
<td>5.64</td>
<td>10.24</td>
<td>25.88</td>
</tr>
<tr>
<td>SD</td>
<td>19.76</td>
<td>5.59</td>
<td>7.61</td>
<td>26.79</td>
</tr>
<tr>
<td>Range</td>
<td>27-96</td>
<td>0-21</td>
<td>0-25</td>
<td>0-96</td>
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<tr>
<td><strong>Woodcock</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Word Identification</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>62.36</td>
<td>11.23</td>
<td>18.09</td>
<td>32.07</td>
</tr>
<tr>
<td>SD</td>
<td>21.77</td>
<td>10.83</td>
<td>14.08</td>
<td>27.70</td>
</tr>
<tr>
<td>Range</td>
<td>12-98</td>
<td>0-37</td>
<td>0-68</td>
<td>0-98</td>
</tr>
<tr>
<td><strong>Stanford</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reading Comprehension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>45.26</td>
<td>12.86</td>
<td>17.54</td>
<td>26.13</td>
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<tr>
<td>SD</td>
<td>25.05</td>
<td>15.75</td>
<td>18.44</td>
<td>24.75</td>
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<td>Range</td>
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<td>0-90</td>
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<tr>
<td><strong>Spelling</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>WRAT-R</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>49.37</td>
<td>5.87</td>
<td>12.87</td>
<td>24.13</td>
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<tr>
<td>SD</td>
<td>23.80</td>
<td>6.81</td>
<td>13.16</td>
<td>24.96</td>
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<tr>
<td>Range</td>
<td>4-99</td>
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<td>1-75</td>
<td>0-99</td>
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<tr>
<td><strong>Arithmetic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WRAT-R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>46.87</td>
<td>29.90</td>
<td>28.11</td>
<td>34.78</td>
</tr>
<tr>
<td>SD</td>
<td>26.29</td>
<td>18.75</td>
<td>20.48</td>
<td>23.84</td>
</tr>
<tr>
<td>Range</td>
<td>7-100</td>
<td>1-79</td>
<td>0-79</td>
<td>0-100</td>
</tr>
</tbody>
</table>
However, both the dyslexics and poor reader group scored lower than the normal reader group.

On the WRAT-R Spelling subtest, as shown in Table 2, there was a group main effect, $F(2, 200) = 121.48, p < .0001$. There was a significant difference between the normal readers and the dyslexics ($\text{Scheffe} = 81.68, p < .05$) and between the normal readers and the poor readers ($\text{Scheffe} = 94.12, p < .05$). Again, there was no significant difference between the dyslexics and the poor readers, however, both groups scored lower than the normal readers.

On the WRAT-R Arithmetic subtest, as shown in Table 2, there was a group main effect, $F(2, 199) = 15.23, p < .0001$. Post-hoc tests showed that there was a significant difference between the normal readers and dyslexics ($\text{Scheffe} = 7.06, p < .05$) and between the normal readers and the poor readers ($\text{Scheffe} = 14.08, p < .05$). There was no significant difference between the dyslexics and the poor readers, however, both groups had lower scores than the normal reader group.

The performance of the three groups on phonological measures is summarized in Table 3. On the Woodcock Word Attack subtest there was a group main effect, $F(2, 199) = 173.45, p < .0001$. Post-hoc tests showed that there was a significant difference between the normal readers and the dyslexics ($\text{Scheffe} = 110.63, p < .05$) and between the normal readers and the poor readers ($\text{Scheffe} = 138.92, p < .05$). Again, there was no significant difference, however,
between the dyslexics and the poor readers. Both had significantly lower scores than the normal readers and did not differ from each other.

Table 3
Performance on Phonological and Orthographic Measures Summary Statistics Woodcock (percentile scores); Rosner and Orthographic scores are percent correct.

<table>
<thead>
<tr>
<th></th>
<th>Normal Readers</th>
<th>Dyslexics</th>
<th>Poor Readers</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=70</td>
<td>n=38</td>
<td>n=95</td>
<td>n=203</td>
</tr>
<tr>
<td>Woodcock Word Attack</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>55.97</td>
<td>5.57</td>
<td>12.20</td>
<td>26.15</td>
</tr>
<tr>
<td>SD</td>
<td>23.73</td>
<td>6.30</td>
<td>12.63</td>
<td>27.47</td>
</tr>
<tr>
<td>Range</td>
<td>5-100</td>
<td>0-21</td>
<td>0-56</td>
<td>0-100</td>
</tr>
<tr>
<td>Rosner Auditory Analysis Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>69.14</td>
<td>34.41</td>
<td>41.0</td>
<td>49.47</td>
</tr>
<tr>
<td>SD</td>
<td>19.65</td>
<td>22.32</td>
<td>22.05</td>
<td>25.69</td>
</tr>
<tr>
<td>Range</td>
<td>8-95</td>
<td>8-85</td>
<td>3-83</td>
<td>3-95</td>
</tr>
<tr>
<td>Orthographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>82.02</td>
<td>62.07</td>
<td>68.05</td>
<td>71.39</td>
</tr>
<tr>
<td>SD</td>
<td>10.21</td>
<td>20.09</td>
<td>15.91</td>
<td>17.61</td>
</tr>
<tr>
<td>Range</td>
<td>59-100</td>
<td>0-94</td>
<td>6-100</td>
<td>0-100</td>
</tr>
</tbody>
</table>

On the Rosner Auditory Analysis Measure there was a significant main effect, \(F(2, 200) = 46.85, p < .0001\). There was a significant difference between the normal readers and the dyslexics (Scheffe = 32.73, \(p < .05\)) and between the normal readers and poor readers (Scheffe = 35.16, \(p < .05\)). There was no
significant difference between the dyslexics and the poor readers. Both groups had significantly different lower scores than the normal group but did not differ from each other.

On the Orthographic Task there was also a significant main effect, $F(2, 200) = 26.66$, $p < .0001$. Post-hoc tests showed that there was a significant difference between the normal readers and the dyslexics (Scheffe = 21.34, $p < .05$) and between the normal readers and the poor readers (Scheffe = 17.13, $p < .05$). There was no significant difference between the dyslexics and the poor readers. Again, both groups had significantly lower scores from the normal group but did not differ from each other.

Table 4
Performance on Memory and Syntactic Judgment Tasks Summary Statistics
(Scores are in percent correct)

<table>
<thead>
<tr>
<th></th>
<th>Normal Readers</th>
<th>Dyslexics</th>
<th>Poor Readers</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=70</td>
<td>n=38</td>
<td>n=95</td>
<td>n=203</td>
</tr>
<tr>
<td>Verbal Working</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{X}$</td>
<td>59.21</td>
<td>48.15</td>
<td>46.41</td>
<td>51.17</td>
</tr>
<tr>
<td>SD</td>
<td>12.36</td>
<td>17.30</td>
<td>14.70</td>
<td>4.21</td>
</tr>
<tr>
<td>Range</td>
<td>30-89</td>
<td>4-78</td>
<td>11-74</td>
<td>4-89</td>
</tr>
<tr>
<td>Syntactic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judgment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{X}$</td>
<td>71.47</td>
<td>64.60</td>
<td>63.19</td>
<td>66.27</td>
</tr>
<tr>
<td>SD</td>
<td>10.57</td>
<td>10.60</td>
<td>9.86</td>
<td>10.86</td>
</tr>
<tr>
<td>Range</td>
<td>43-100</td>
<td>37-83</td>
<td>34-83</td>
<td>34-100</td>
</tr>
</tbody>
</table>
As shown above in Table 4, on the Verbal Working Memory measure, there was a significant group main effect, $F(2, 199) = 16.69, p < .0001$. Post-hoc tests showed that there was also a significant difference between the normal readers and the dyslexics (Scheffe = 7.19, $p < .05$) and between the normal readers and the poor readers (Scheffe = 15.66, $p < .05$). Again, there was no significant difference between the dyslexics and poor readers.

In the Syntactic Judgment measure, there was a significant group main effect, $F(2, 200) = 13.81, p < .0001$. Post-hoc tests showed that there was again a significant difference between the normal readers and the dyslexics (Scheffe = 5.55, $p < .05$) and between the normal readers and the poor readers (Scheffe = 13.16, $p < .05$). There was no significant difference between the dyslexics and the poor readers. However, both groups had significantly lower scores than the normal group.

This study was not designed originally to tease apart the contribution of the ESL status to the performance of the normal and poor readers on the various measures. For this reason, more detailed information about second language proficiency was not collected, nor was there an attempt to classify children a priori as ESL or non-ESL. The question of the ESL status emerged in the data analysis phase. In order to investigate this issue, the ethnic identity of the children was used as an approximation of the ESL classification. That is, the children with an ESL background, were classified as ESL. The remainder of the children from the study were classified as native English speakers. To
investigate the frequency of ESL children and non-ESL children in the three reading groups, i.e., normal readers, dyslexics and poor readers, a cross tab chi-square analysis was performed. The composition of the three groups was as follows: normal reader group ESL 23, non-ESL 46; dyslexic group-ESL 13, non-ESL 22; poor reader group ESL 45, non-ESL 42. The ESD group of 12 were not included. A cross tab chi-square analysis was also performed for the poor reader group and the normal reader group. The analysis indicated that there was a higher percentage of ESL children in the poor reader group, n=45 (66.2%), than in the normal reader group, n=23 (33.8%) ($x^2 = 5.29$, df = 1, $p < .02$).
Figure 1
Cognitive Measures (Standard Scores) for Normal Readers, Poor Readers and Dyslexics

Canadian Cognitive Achievement Test
Figure 2
Pre-requisite Reading Measures (Percentages) for Normal Readers, Poor Readers and Dyslexics

Experimental Measures
Figure 3
Reading Measures (Percentiles) for Normal Readers, Poor Readers and Dyslexics
Discussion

As shown in Figure 1, the results of the CCAT, a cognitive test with a correlation range of .67 to .75 with the Stanford-Binet IQ test (Hopkins, 1978), indicated that there was no significant difference between the dyslexics and the poor readers on the Quantitative and Non-Verbal subtests. There was, nevertheless, a significant difference among the three groups on the Verbal subtest.

On the verbal subtest the dyslexics and the normal reader group both exceeded the performance of the poor reader group. The fact that the normal and dyslexic groups performed similarly may reflect the fact that the test is an oral test. The teacher reads the test and the child simply follows the instructions. In the primary grades, the child's listening skill is often superior to the reading comprehension skill because of the child's weak decoding skills. This explains the higher than expected performance of the dyslexic group. Accordingly, the dyslexics group's performance is not confounded by their weak decoding skills (Carlisle, 1995; Stanovich, 1991). In the non-verbal and quantitative subtests which are also oral tests there is no significant difference between the poor reader and dyslexic group. However, in these subtests the children have to employ both listening and reasoning skills. The literature indicates that poor readers have difficulty comprehending spoken sentences that place heavy
demands on working memory (Shankweiler, Crain, Brady, & Macaruso, 1992). That being the case, the heavier demands of listening to the language and reasoning out the answers would explain the poorer performance of the two groups. Another confounding factor affecting the group performance may be the higher percentage of ESL children in the poor reader group. The test manual indicates that the test is not appropriate for children with a poor understanding of the English language. Hence the test is not culturally appropriate for measuring the cognitive skills of ESL children.

In the Verbal Working Memory task, shown in Figure 2, there was no significant difference in performances between the dyslexics and the poor reader group. According to Daneman and Carpenter (1980), working memory refers to a temporary storage of information while other cognitive tasks are being performed. The working memory task in this study was designed to examine the interaction between the sentence-processing skill and recall. In this task, the child was not only required to listen to a sentence or sentences and indicate whether the sentence(s) were true or false, but also, the child was required to recall the last word of the sentence(s). As the number of words a child has to remember is increased, the demands on the working memory are also increased. Effectively for both reading disabled groups--the dyslexics and the poor reader group--the demands of the tasks negatively affected the limited capacity of the working memory. The performance of the two groups in the study is consistent with the evidence in the literature which demonstrates that the major difference
between good and poor readers is the efficiency of the working memory. (Daneman & Carpenter, 1980; Siegel & Ryan, 1989) The literature also points out that this memory task is analogous to the tasks a child performs in reading comprehension. It was included as one of the measures in this study because of the prevailing view that one of the contributing factors to reading comprehension may be poor working memory (Ellis & Large, 1987; Jorm, 1983; Share et al., 1984; Siegel & Ryan, 1989; Swanson & Ramalgia, 1992; Torgesen, 1985).

The performance of the three groups on the Syntactic Judgment task, as shown in Figure 2, demonstrates a similar pattern. There was no significant difference between the dyslexics and the poor readers. There was a significant difference between the two reading disabled groups and the normal reader group. Again the performance of the two reading disabled groups was consistent with the evidence in the literature which indicates that children with syntactic processing problems have significantly more difficulty with reading text (Siegel & Ryan, 1988; Willows & Ryan, 1986). Similarly for ESL students syntactic knowledge plays a significant role in language processing (Geva, in press). The high proportion of ESL children in the poor reader group may have been a contributing factor to the poor performance of the group.

The performance patterns on tasks of phonological processing, such as the Rosner (phonological sensitivity), shown on Figure 2, and the Woodcock Word Attack (pseudoword reading), shown on Figure 3, indicate that the dyslexic and the poor reader group had significantly poorer performances than the normal
reader group but did not differ from each other. These results are supported by evidence in the literature reviewed at the beginning of this study which indicates that children with a discrepancy (dyslexics) or without a discrepancy (poor readers) do not differ in phonological processing skills that determine word recognition (Gough & Tunmer, 1986; Siegel, 1986, 1993; Siegel & Stanovich, 1993; Stanovich, 1988a, 1988b; Stanovich et al., 1986a, 1986b). Deficient phonological coding processes impede the child's ability to attain reading fluency. However, an important positive implication from this study and other similar studies is that once the problem is recognized and validated, growth in reading ability can occur and children will attain reading fluency commensurate with their other cognitive abilities if the proper instructional resources are put in place for the child (Bradley & Bryant, 1983; Vandervelden & Siegel, 1997; Willows & Morgan, 1996).

In the orthographic task, shown on Figure 2, a visual recognition task which requires the recognition of visual patterns, both the dyslexics and poor readers, while not differing from each other, had more difficulty than the normal reader group. The orthographic aspect of reading skills represents an additional but independent and secondary, component to the phonological component (Castles & Coltheart, 1993). According to the literature children with a weak knowledge source will use a stronger knowledge source to compensate for the weaker one (Stanovich, 1980). Coltheart (1987) suggests that learning to read must involve the dual route of lexical and sublexical processing--in this study
referred to as orthographic and phonological processing respectively. Consequently, if one of the processes is weak there will be more reliance on the other process (Castles & Coltheart, 1993). This suggests that children with weak phonological skills may in fact be displaying an orthographic reading strategy that relies more on the visual than the phonetic form of words (Coltheart, 1987; Siegel, Share, & Geva, 1995).

As shown in Figure 3, there were no significant differences between the dyslexics and the poor readers on any of the following measures: the WRAT-R Reading subtest, the Woodcock Word Identification subtest and the Stanford Reading Comprehension test, WRAT-R Spelling subtest and WRAT-R Mathematics subtest. Both groups—the dyslexic group and the poor reader group—performances were significantly lower than the normal reader group on all these tasks. These performance patterns are remarkably similar and consistent with the data patterns exhibited by other studies in the literature, where a regression-based approach was used to define dyslexics (Bloom et al., 1980; Olsen et al., 1985; Siegel, 1988b, 1992; Siegel & Ryan, 1989; Stanovich & Siegel, 1993; Swanson & Ramalgia, 1992; Taylor, Satz, & Friel, 1979; Toth & Siegel, 1994; Wagner & Torgesen, 1987).

The performance profiles of the poor reader group and the dyslexics are remarkably similar. These profiles contradict the assumption that dyslexics differ from poor readers. For example, dyslexics and poor readers do not differ on the information-processing subskills of phonological and orthographic coding that
contribute to word recognition ability, primary indicators of reading ability (Stanovich & Siegel, 1993). The similar performances of the two groups challenge the long-held assumption that dyslexics constitute a distinct group and should therefore have special remediation. No longer can the “garden-variety” poor reader be ignored.

The results of this study support the initial hypothesis and provide evidence that is consistent with the findings reported in the literature referred to above. The results of this study support the view that dyslexics and poor readers have similar reading and reading-related cognitive deficits. The study therefore leads to the conclusion that both dyslexics and poor readers should receive remediation. However, under the present legislation, this does not happen, at least not officially. Poor readers are neglected.

The literature indicates, the neglect of the poor readers is created, in part, by the definition of dyslexia or reading disability which is implicitly embedded in the statutes governing special education practices in Ontario. This definition reserves the option of eligibility for additional remedial services in reading to those children with significant discrepancies between performance on intelligence tests and reading achievement on a standardized test. By linking IQ scores to reading achievement the assumption is that poor readers with at least average IQ and low reading scores are cognitively different from poor readers with low average IQ and similarly low reading scores. Much confusion has arisen around
this discrepancy definition and has led to a variety of interpretations in the field of education.

Ysseldyke, Epps, and Algozzine (1983) and Adelman (1989) studied the impact of different methods of interpreting a discrepancy in identifying students as either learning-disabled or non-learning disabled. The researchers found that students could be included in, or excluded from, either group by varying the way the definition was interpreted or applied by either the school personnel or by the decision-making of the diagnostician. They concluded that the definitions for learning disabilities, as presently conceptualized, are ill-conceived, with too little consistency in themselves to classify reliably the learning disabled. In another study of educational assessment and decision-making practices, Thurlow and Ysseldyke (1979) found that teachers were the most frequent source for the identification and referral of children for educational assessment, a factor which they concluded led to variability and inconsistency in identification.

In the present study those students identified as dyslexic were so identified in the first instance by teachers or by parental requests as confirmed by the Board diagnostician. Those students then proceeded to the IPRC process. Thirty eight (18.7%) of the cohort were confirmed as dyslexics by the IPRC process ("System-Identified dyslexics"). By way of comparison the proportion of children identified as reading disabled (dyslexics) across the former seven school boards of Metropolitan Toronto varied in both the percentage of children
identified (i.e., from 9% to 27%) and the provision of services offered (Wiener & Siegel, 1990).

In the current study the 38 System-identified dyslexics were receiving additional support as mandated by the Education Act, R.S.O. 1990, C.E.2, ss.11(1)5.iii. The other 95 (46.8%), identified in the study as poor readers, but not so identified in the IPRC process or through any other process for that matter, were not eligible to receive additional help. Yet, as demonstrated in the current study, the performances of the dyslexics and poor readers were similar on all the reading and reading-related cognitive tasks. Thus, the current practices in the diagnosis and identification of children with reading difficulties are becoming increasingly illogical. The conclusions drawn in this study, particularly with respect to the deficiencies of the discrepancy-based definition ensconced in the current legislation are consistent with similar critical findings with respect to the use of the aptitude/achievement formulae for the identification of dyslexics (Stanovich & Siegel, 1993). Stanovich and Siegel concluded that there was "... no support for the notion that there are critical differences between children with and children without an aptitude-achievement discrepancy in the phonological coding processes that are the proximal cause ... of their reading difficulties" (p. 40). The same statement applies to the use of the discrepancy-based definition mandated in the legislation.

Three sets of results from the study provide support for these assertions: First, both groups, the dyslexic group and the poor reader group show similar
profiles on all the decoding measures, in spite of differences on verbal IQ. Next, far too many children (46.8%) are designated as poor readers and, finally, the chi-square analysis suggests that there is a tendency to mis-identify ESL children. Using the System-defined formula, many of the ethnic children may be incorrectly diagnosed as poor readers. By definition, their verbal IQ may be depressed due to lack of oral proficiency in English. Given the composition of the cohort, results suggest that further study should be made for there is a growing concern over the ability of the educational system to correctly identify and to properly address the programming needs of the increasingly multi-ethnic/lingual classroom, and as well to similarly address the needs of the inordinately large number of children identified as “poor readers.”

**Implications for Education**

The study clearly emphasizes the need to promote changes so that we may ensure that all children have the necessary skills in order to learn to read. The key issue is how to address the problems of the poor readers in our schools. The information provided by the literature and the current study suggest that all reading under-achievers (i.e., dyslexics and poor readers) should receive the necessary programming to improve their literacy skills. For some considerable time the literature has provided evidence indicating a strong relationship between phonological processing and reading ability (Adams, 1990; Chall, 1983; Chall, Jacobs, & Baldwin, 1990; Jorm & Share, 1983; Siegel, 1991a; Siegel &
Faux, 1989; Stanovich et al., 1984; Stanovich & Siegel, 1993). However, there seems to be some hesitation on the part of boards of education to wholeheartedly endorse systematic phonics teaching as part of a literacy program for the early grades - kindergarten to grade 3. Yet, recent school studies in the United States (Chall et al., 1990; Adams, 1990) clearly indicate that word recognition and phonics skills are critical for success in reading in the early grades.

Similarly, the National Research Council responding in support of a recent report edited by Snow, Burns and Griffin (1998), prepared by a distinguished group of educators and researchers and responded to by the Secretary of Education for the United States, clearly emphasizes that children should learn their sounds and letters and how to read for meaning if they are to become successful readers by the end of the third grade.

Here in Canada, in the Greater Toronto Area, recent studies (Geva, in press; Willows, 1996; Willows & Morgan, 1996) present quite strong evidence that programs emphasizing systematic instruction in phonics as early as kindergarten have proven successful for all children, including those children who are second-language learners.

Willows (1998) also provides data showing how school restructuring through on-going professional development achieved and sustained gains in student performance. Based on the literature and the performances of the reading groups in this study, it is clearly indicated that programs, particularly in the early school years, should provide phonics instruction. Hopefully, the current
study will further emphasize the need to promote program changes so that all children will be equipped to become skilled readers.

**Limitations of the Study and Areas for Future Research**

An assessment for socioeconomic status, emotional adjustments, and physical handicaps would have revealed more about the composition of the groups in the study.

A survey of teachers' decision-making processes in their selection of ESL students would add important information to the study.

An exploration of the issue of differential error patterns in reading and spelling tasks of children with different IQ levels would provide more effective remediation techniques and, as well, provide information on the similarities of the reading difficulties between the two groups.

More detailed information on the children's ESL skills should have been included in the original data collection.
References


Newcomer, C. (1986). The Standardized Reading Inventory. Austin, TX: Pro-Ed.


Ontario Ministry of Education Act, R.S.O. 1990, C.E.2, ss.11 (1)5.iii.


distribution of a reading ability. The New England Journal of Medicine, 326, 145-150.


**Appendix A: Working Memory Task**

You are going to hear a voice on the tape. After each sentence you will hear a “beep.” When you hear the “beep”, answer TRUE or FALSE to the statement. When you hear two “beeps”, you have to give the last word of each of the sentences in the group just given. It does not matter if you give the words in the same order as the sentences.

 e.g., You are a man/woman/boy/girl. (Ask so that the answer is TRUE)
 I am sitting/standing. (Ask so that answer is FALSE)

(If a young child does not know the concepts of True and False and gets confused during the training trials, accept Yes and No as alternatives.)
(You may want to stop the tape after the two beeps to allow the subject more time to respond. The subject should not be penalized for responding slowly. Record the subject's recalled responses in the order reported, although the subject should not worry about this.)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The sun rises in the evening.</td>
<td>T  F</td>
</tr>
<tr>
<td>2. Trees lose their leaves in the spring.</td>
<td>T  F</td>
</tr>
<tr>
<td>3. Cars have four wheels.</td>
<td>T  F</td>
</tr>
<tr>
<td>4. Cows and pigs eat meat.</td>
<td>T  F</td>
</tr>
<tr>
<td>5. A red traffic light means “Go.”</td>
<td>T  F</td>
</tr>
<tr>
<td>6. We get milk from cows.</td>
<td>T  F</td>
</tr>
<tr>
<td>7. Plants need water and light to grow.</td>
<td>T  F</td>
</tr>
<tr>
<td>8. In winter, it is warm.</td>
<td>T  F</td>
</tr>
<tr>
<td>9. The CN tower is in Toronto.</td>
<td>T  F</td>
</tr>
<tr>
<td>10. We read from right to left.</td>
<td>T  F</td>
</tr>
<tr>
<td>11. Lettuce and peas are vegetables.</td>
<td>T  F</td>
</tr>
</tbody>
</table>
12. Centimetres are used for measuring.
13. Elephants have grey spots.
14. Some birds have fur.

15. Canada is close to the United States.
16. A motorcycle can move faster than a bicycle.
17. An apple is a fruit.
18. Fish swim in the sky.

19. People can buy groceries in stores.
20. Ottawa is the capital of Canada.

21. We use a thermometer to tell time.
22. Boiling water is hot.
23. Toronto is on the shore of the Atlantic Ocean.

24. A football is round.
25. We sleep at night.
26. Insects have eight legs.
27. A feather is heavier than a rock.

*Give starred items only to subjects who get one of the four-item sets correct.

*28. Some birds fly north in winter.
*29. The earth travels around the sun.
*30. Purple, red and big are colours.
*31. Canada is the smallest country in the world.
*32. Tadpoles become frogs.
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>33. When it is heated, ice melts.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34. Canada has ten provinces.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35. Carrots and bananas are orange.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36. Whales are fish.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. Chickens and robins lay eggs.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38. When it rains, the ground gets wet.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39. Lions live on farms.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40. Dogs and cats bark.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41. The Canadian flag is red and white</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42. The moon and stars are in the sky.</td>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Rosner Auditory Analysis Test

Now we are going to play a game of removing sounds from words. I'm going to say a word and then tell you to take part of the sound off and then say what's left. Here is how it will work. "Say 'cowboy.'" Wait for response. "Now say cowboy again, but without the boy sound." "Say 'toothbrush.'" Wait for response. "Now say toothbrush again, but without the tooth sound." If the child fails either of the two practice items, attempt to teach the task by giving the correct response, explaining why it is correct, and re-presenting the item. If either item is failed again, discontinue testing and score the test zero. If the items are answered correctly, then proceed. Testing for all subjects ends after five consecutive errors. Present the remainder of the items in the same way (e.g., "Say 'man.' Now say 'man' without the /m/ sound").

cow(boy) (practice)
(tooth)brush (practice)

Check items answered correctly.
Mark line under last item attempted

1. birth(day) ______
2. (car)pet ______
3. (m)an ______
4. ro(de) ______
5. (w)ill ______
6. (l)end ______
7. (s)our ______
8. (g)ate ______
9. to(ne) ______
10. ti(me) ______
11. plea(se) ______
12. stea(k) ______
13. bel(t) ______
14. (sc)old ______
15 (c)lip ______
16. (s)mile ______
17. (p)ray ______
18. (b)lock ______
19. (b)reak ______
20. s(m)ell ______
21. (t)rail
22. de(s)k
23. (sh)rug
24. cr(e)ate remove (ee), answer (crate)
25. s(m)ack
26. re(pro)due remove (pra), answer (reduce)
27. s(k)in
28. s(w)ing
29. (st)rain
30. g(l)ow
31. st(r)eam
32. c(l)utter
33. off(er)ing remove (er), answer (offing)
34. dy(na)mo remove (nuh), answer (dimo)
35. auto(mo) bile remove (muh), answer (autobeel)
36. car(pen)ter remove (puhn), answer (carter)
37. Ger(ma)ny remove (muh, answer (journey)
38. lo(ca)tion remove (kaa), answer (lotion)
39. con(tin)ent remove (tin), answer content
40. phi(lo)sophy remove (law), answer (fuhsophy) {fisophy is wrong; circle if subject gives this answer}
Appendix C: Syntactic Error Judgment

I am going to say some sentences. Some of them are right and some of them are wrong. I want you to tell me which sentences are right and which sentences are wrong.

e.g., This is a chair. Is it right or wrong? (child’s response)
"This is a chair" is right.
I am sit. Is it right or wrong? (child’s response)
"I am sit" is wrong.

(This task is a forced choice task. No correction should be done in this section. If the subject attempts to correct the sentences, tell him/her “Now I just want you to tell me if the sentences are right or wrong.”)

<table>
<thead>
<tr>
<th>Subject’s Response</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clapped his hands Mark.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>2. The sun shone brightly.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>3. The bear brown growled.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>4. They went at school.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>5. He answered the ringing phone.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>6. I are happy.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>7. The boy run quickly.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>8. We thanked him very much.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>9. The waiter dropped the tray of plates.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>10. The boy be sad.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>11. The child the letter wrote.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>12. The woman turned on the light.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>13. The lion and the tiger lives in the jungle.</td>
<td>Right Wrong</td>
</tr>
<tr>
<td>14. The tourists travelled on car.</td>
<td>Right Wrong</td>
</tr>
</tbody>
</table>
15. Many of the children dressed up for the party.

16. The children’s mother work very hard.

17. The art the many artists displayed.

18. They went to visit their relatives in England.

19. The boy was chased by the dog.

20. They watched sadly as the cowboy rode the sunset into.

21. The flock of geese are on the lake.

22. Was reading the young woman the mystery novel.

23. When it rains, we wear our boots.

24. The tall, thin man playing was basketball.

25. The presentation for the award was done by the Queen.

26. The class was eager to see the movie.

27. The children with the young teacher enjoys the school trip.

28. The school of brightly coloured fish swam past the boat.

29. The new television were watching the people.

30. The plan was developed to cooperation with famous scientists.

31. One of the children are sick.

32. The child, raking the leaves, helps her parents.

33. The business person, waiting for the flight, travel to Europe often.
34. The visitor who wears the dark glasses are friendly. Right  Wrong

35. The racing care travelled quickly quite. Right  Wrong
## Appendix D: Orthographic Task

Name ___________________________  No. Correct __________

Orthographic task - #1

You are going to see pairs of letter strings that are not words. One of them is more like a word than the other. I want you to tell me which of the two is more like a word. Which one looks more like a word than the other? Which one has a spelling that is more like a word?

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>filv</td>
<td>filk</td>
</tr>
<tr>
<td>2.</td>
<td>tolz</td>
<td>tolb</td>
</tr>
<tr>
<td>3.</td>
<td>powl</td>
<td>lowp</td>
</tr>
<tr>
<td>4.</td>
<td>dlun</td>
<td>lund</td>
</tr>
<tr>
<td>5.</td>
<td>fant</td>
<td>tanf</td>
</tr>
<tr>
<td>6.</td>
<td>miln</td>
<td>milg</td>
</tr>
<tr>
<td>7.</td>
<td>togd</td>
<td>togn</td>
</tr>
<tr>
<td>8.</td>
<td>wolg</td>
<td>wolt</td>
</tr>
<tr>
<td>9.</td>
<td>moke</td>
<td>moje</td>
</tr>
<tr>
<td>10.</td>
<td>jofy</td>
<td>fojy</td>
</tr>
<tr>
<td>11.</td>
<td>cnif</td>
<td>crif</td>
</tr>
<tr>
<td>12.</td>
<td>bnad</td>
<td>blad</td>
</tr>
<tr>
<td>13.</td>
<td>hift</td>
<td>hifl</td>
</tr>
<tr>
<td>14.</td>
<td>gwup</td>
<td>gnup</td>
</tr>
<tr>
<td>15.</td>
<td>nitl</td>
<td>nilt</td>
</tr>
<tr>
<td>16.</td>
<td>clid</td>
<td>cdil</td>
</tr>
<tr>
<td>17.</td>
<td>vism</td>
<td>visn</td>
</tr>
</tbody>
</table>
Appendix E: Parental Permission Letter

Dear Parent/Guardian:

We at ______________________________ school are participating in a study of general trends in children's developments in the areas of reading, mathematics and spelling. The children will be given tasks both group and individual, the administration of which will be done by staff from the Ontario Institute for Studies in Education. We will be using the results of the study to develop programs for our learners.

Your child's response will not be identified in any way. A copy of the completed study will be made available to you.

If you wish your child to participate in this study, please complete the form at the bottom of the page and return it to the school as soon as possible. If you or your child wish to withdraw from the study at any time, you may do so.

Sincerely

______________________________
I wish my child to participate in the study.

______________________________
I do not wish my child to participate in the study.

______________________________
Student's Name

______________________________
Signature of Parent/Guardian