Predicting Reading Abilities from Oral Language Skills: A Critical Review of the Literature

Prévoir les aptitudes à la lecture à partir des capacités langagières : un compte rendu documentaire

Elizabeth Ekins
Phyllis Schneider

Abstract

The early identification of children who may be at risk for reading difficulty is important so that intervention can be provided early and subsequent reading problems can be avoided. Traditionally, children with reading problems are identified after reading instruction has begun. However, knowledge of oral language skills that predict reading abilities is necessary to identify children who may be at risk for later reading problems.

This document discusses research literature documenting oral language measures that may predict lower level (decoding) and higher level (comprehension) reading abilities as well as reader-group membership. The predictive ability of expressive language, receptive language, Rapid Automatized Naming (RAN), and phonological awareness are discussed.

The research results indicate that some oral language measures predict reading achievement. Although standardized measures of expressive language account for some variance in lower level reading, phonological awareness and RAN account for more. Standardized measures of expressive and receptive language predict reading comprehension in Grade 2. RAN tasks predict lower level reading and reader-group membership. Various combinations of syllable and phoneme deletion, syllable and phoneme blending, and rhyme detection predict lower level reading achievement, reading comprehension, or reader-group membership. The research information reviewed here can help guide future investigations in the area of predicting reading abilities.

Abrégé

Il est important de repérer très tôt les enfants qui risquent d'avoir de la difficulté à lire, afin de pouvoir intervenir rapidement et prévenir l'apparition de troubles ultérieurs. Habituellement, nous arrivons à identifier les enfants éprouvant de la difficulté à lire après le début de l'enseignement de la lecture. Toutefois, il est nécessaire de connaître au préalable les capacités langagières qui permettent de prédire les aptitudes à la lecture.

Le présent article traite des recherches sur les mesures de la capacité langagière qui peuvent prédire les aptitudes à la lecture de niveau inférieur (décodage) et de niveau supérieur (compréhension) de même que l'adhésion à un groupe de lecture. Il examine la valeur prédictive de l'expression orale du langage, du langage dans son versant réceptif, de la dénomination rapide automatisée (DRA) et de la reconnaissance des sons.

Les résultats de la recherche indiquent que certaines mesures du langage verbal permettent de prédire le niveau de lecture. Bien que les mesures normalisées de l'expression orale du langage expliquent certaines variations des capacités de lecture au niveau inférieur, la reconnaissance des sons et la DRA en expliquent davantage. Les mesures normalisées de l'expression orale du langage et du langage dans son versant réceptif permettent de prédire la compréhension en deuxième année. Les exercices de la DRA permettent de prédire les capacités de lecture au niveau inférieur et l'adhésion éventuelle à un groupe de lecture. Il est possible de prédire la capacité de lecture au niveau inférieur, la compréhension de ce que l'enfant lira ou l'adhésion éventuelle à un groupe de lecture selon que l'enfant combine la suppression de syllabes et de phonèmes, la confusion de syllabes et de phonèmes et la détection des rimes. Les résultats de la recherche dont on donne ici le compte rendu peuvent aider à orienter des études futures dans le domaine de la prédiction des aptitudes à la lecture.

Key Words: reading, oral language, receptive language, expressive language, phonological awareness

Elizabeth Ekins, M.S.L.P., S-LP(C)
Royal Inland Hospital
Kamloops, BC Canada

Phyllis Schneider, PhD
Department of Speech Pathology and Audiology
University of Alberta
Edmonton, AB Canada

Speech-language pathologists (S-LPs) have been viewed as experts on speech and language, yet have not had extensive involvement in children's development of reading skills. However, given the growing view that reading is a language-based skill combined with S-LPs' expertise in the area of language, S-LPs are becoming more actively involved in the assessment of and the intervention for reading disabilities. Further, S-LPs potentially have an important role in the process because oral language problems develop before children receive formal reading instruction. Since S-LPs often see these children first in the preschool years, they can play an important role in the early identification of reading problems.

Traditionally, reading disabilities have been identified after reading instruction has begun (Catts, 1997). That is, children with reading problems are identified when they receive reading instruction in school and experience significant difficulties in learning to read. However, the number of children with early language disorders who eventually experience reading problems is estimated to be around 50% (Catts & Kamhi, 1999). Oral language does not need to be exceedingly weak to be related to poor reading; children may be found to be at risk even though present oral language status does not qualify them for S-LP services (Catts, Fey, Zhang, & Tomblin, 2001). Some negative consequences of reading problems include decreased motivation (Taylor, Harris, Pearson, & Garcia, 1995), lowered expectations of one's abilities, and falling further behind peers in reading and consequently in academic achievement (Spear-Swerling & Sternberg, 1994). These negative consequences provide support for the early identification of children at risk for reading difficulties to prevent subsequent reading problems. Once these children are identified, treatment could begin before reading instruction. Such intervention may decrease any negative effects of reading failure on a child's self-esteem, encourage academic achievement, and foster a positive outlook on reading and the value of reading abilities. An S-LP's expertise on language should lead to his/her involvement in program design to help decrease a child's risk for future reading problems. Oral language is a broad construct and for intervention to proceed, S-LPs need to know which of its many variables are the strongest predictors of reading ability.

This paper summarizes and discusses the results of 13 research articles that examined oral language measures that may predict both lower level and higher level (comprehension) reading abilities. Studies included in the review were longitudinal studies conducted between 1990 and 2001 that used correlational or regression designs and included at least one measure of oral language as a predictor. After a short review of current views on oral language and reading, the research findings are summarized followed by a discussion of clinical implications.

Statistical Methods of Identifying Predictors

One method of identifying which measures predict later reading achievement is to look for correlations between oral language measures and reading tasks. Correlational research is used to analyze relationships between and among two or more variables. The strength and the direction (positive or negative) of the relationship are examined. The results of correlational research indicate an association or relationship. Causation cannot be attributed between the variables. Correlational research can be applied to both longitudinal and cross-sectional study designs. Longitudinal studies are more appropriate for predicting reading abilities because the same children are followed over a period of time and the relations among variables are examined across time.

Studies using correlational techniques have established that a relationship exists between oral language abilities and reading achievement. However, correlational techniques do not automatically correct for multiple comparisons; they cannot reveal which of a set of variables is the best predictor of a criterion variable. Investigators can apply the statistical method of multiple regression to a longitudinal study to examine the contribution of different variables in predicting reading achievement. Multiple regression enables the identification of more than one predictor variable of a criterion variable and the relative predictive value of each predictor (Norman & Streiner, 1998; Rosenberg & Daly, 1993; Schiavetti & Metz, 2002). Hierarchical (or fixed-order) regression is a type of regression analysis. The predictor variables are entered into the equation in an order determined by the researcher (Tabachnick & Fidell, 1996). Stepwise multiple regression is another type of regression analysis. In this case, the order of the entry of variables is determined by correlations among the variables, with the independent variable most highly correlated with the dependent variable entered first.

Measurement of Oral Language and Reading Ability

A variety of standardized and nonstandardized measures of oral language have been used to predict reading ability. These measures can be categorized into phonological awareness, Rapid Automatized Naming (RAN), expressive language, and receptive language. A description of the measures used in all the studies reviewed can be found in Appendix A.

Two approaches to reading have been discussed in the literature — lower level and higher level (Catts and Kamhi, 1999). Lower level reading abilities include sound-symbol correspondence and word recognition. When one reads written words, the word's meaning can be accessed by two methods. The first is an indirect method of phonological representation in which the reader uses knowledge of phoneme-letter correspondence to recode the letters into their corresponding phonemes. The second method is a direct method by way of visual representation. A match is made between the visual configuration and a visual representation that is part of the mental lexicon for the particular word. The first method could be thought of as *sounding a word out* or *decoding* and the second method a *whole-word* approach.

To assess lower level reading abilities, children say real words and nonwords, also referred to as pseudowords. Tasks involving real words are referred to as reading accuracy, real

word tasks, or word identification (Bishop & Adams, 1990; Felton & Brown, 1990). Tasks involving nonwords are referred to as nonword or word attack tasks (Bishop & Adams, 1990; Felton & Brown, 1990; Muter & Snowling, 1998).

Higher level reading abilities, or reading comprehension, enable one to understand sentences and paragraphs (Catts & Kamhi, 1999). Lower level reading skills may be the focus of attention when a child is learning to read, whereas comprehension skills may be a concern for older children who have mastered lower-level skills but now must read to learn. To assess higher level reading, children are typically instructed to answer questions based on a reading passage. A variety of standardized and nonstandardized tests assess lower level and higher level reading abilities. A list of the tests used in the studies reviewed can be found in Appendix A.

Studies have tried to predict lower level and/or higher level reading skills from oral language measures (Badian, 2001; Bishop & Adams, 1990; Catts, 1993; Catts et al., 1999 & 2001; Felton & Brown, 1990; Hurford, Schauf, Bunce, Blaich, & Moore, 1994; Manis, Seidenberg, & Doi, 1999; McCormick, Stoner, & Duncan, 1994; Menyuk, Chesnick, Liebergott, Korngold, D'Agostino, & Belanger, 1991; Muter & Snowling, 1998; O'Connor & Jenkins, 1999; Snow, Tabors, Nicholson, & Kurland, 1995). Some studies have included lower level reading skills or higher level reading skills (Felton & Brown, 1990; Manis, Seidenberg, & Doi, 1999; Muter & Snowling; 1998), have included both lower level and higher level reading skills (Badian, 2001; Bishop & Adams, 1990; Catts, 1993; Catts et al., 1999; Menyuk et al., 1991), or have combined these two skills under one label called reading (McCormick et al., 1994; Snow, Tabors, Nicolson, & Kurland, 1995). It should be noted that when two skills are combined into one measure, it is impossible to determine which oral language skills predict lower level reading and which oral language skills predict higher level reading.

Methods

Criteria were outlined to determine the inclusion of studies in the literature review. Studies since 1990 were chosen because they seem to have a richer view on predicting reading skills and include phonological skills, narratives and standard tests in the studies. Studies prior to 1990 are generally limited to phonological skills and reading. Further, studies that used longitudinal designs were included in this review. These studies are more effective and appropriate for determining what oral language abilities predict later reading difficulties. Once the criteria were determined, an exhaustive search was completed using the online data bases ERIC, PsycInfo, and PUBMED as well as through secondary references.

Summary of Studies Reviewed

A brief summary of the participants as well as the oral language and reading measures used in each of the studies can be found in Appendix B. Although some studies included measures other than oral language and reading, only oral language and reading variables are of interest in this review. This section comments on general strengths and weaknesses of the studies.

It is important to comment on the number of participants in each study compared to the number of predictor variables entered in the regression analysis. When discussing regression analysis, Norman and Streiner (1998) suggest that the number of participants be 5 or 10 times the number of variables entered in the regression analysis. When the authors discuss logistic regression analysis and analysis of covariance, they suggest that the number of participants be 10 times the number of predictor variables. The authors recommend that caution be used when overinterpreting regression models based on relatively small samples. However, they do not define a small sample size. Other authors recommend that the sample size be 30 (Pedhazur, 1983) or 50 (Glass & Hopkins, 1996) subjects for every predictor variable, providing support for more than 5 subjects for every predictor variable. It seems that larger numbers of subjects for every predictor variable is more desirable. We will use the smallest recommendation of 5 subjects per variable as the minimum when evaluating studies.

Some studies had an adequate number of participants based on Norman and Streiner's (1998) suggestion of 10 participants for each predictor variable entered in the regression analysis (Badian, 2001; Bishop and Adams, 1990; Catts, 1993; Catts et al., 1999; Felton & Brown, 1990; Manis et al., 1999;). Muter and Snowling (1998) were close to the suggestion of 10 subjects for every predictor variable. Menyuk et al. (1991) met the minimum of 5 participants for every predictor variable and McCormick et al. (1994) fell short of the minimum recommendation.

Tabachnick and Fidell (1996) suggest that when predicting group membership and using a discriminant analysis or stepwise logistic regression, the smallest group size needs to exceed the number of predictor variables. All studies that predicted group membership (Catts et al., 2001; Hurford et al., 1994; Muter & Snowling, 1998; O'Connor & Jenkins, 1999;) included an adequate number of participants.

In one study, (Menyuk et al., 1991) the authors did not differentiate between kindergarten, Grade 1, and Grade 2 reading skills. Rather, these three levels were considered together. When all three grades are grouped together, it is possible to lose the accuracy in predicting because the predictability of skills may change with different ages. As well, it is possible that kindergarten children may not yet have learned decoding skills.

Two studies (McCormick et al., 1994; Snow et al., 1995) combined lower level and higher level reading measures. It is difficult to interpret the findings of McCormick et al. (1994) because the reading measure, *Iowa Tests of Basic Skills* (Hieronymus, Hoover, & Lindquist, 1986), included both lower level and higher level skills. As well, Snow et al. (1995) combined the subtests of the *Wide Range Achievement Test* (WRAT) (Jastak & Jastak, 1976). When the two skills are combined, one cannot determine which oral language skills predict lower level reading and which oral language skills predict higher level reading.

Catts (1993) and Catts et al. (1999) entered scores from different tests into the regression analysis, thereby losing some information on the predictive value of individual tests.

In one study (Catts, 1993), the oral language measures were entered into the regression analysis as receptive language, expressive language, RAN, and phonological awareness. In another study (Catts et al., 1999), the language measures were entered into the regression analysis as oral language, RAN, and phonological awareness.

Most of the studies used some measure of intellectual ability to control for this factor. Some studies used a general measure of IQ (e.g., Catts, 1999; Felton & Brown, 1990; Muter & Snowling, 1999), while others used a measure of verbal IQ (Badian, 2001) or nonverbal IQ (Catts, 1993; Catts et al., 2001). Authors do not discuss why they chose one of these types over the other. However, there are important implications of each of these choices. If we are interested in the predictive ability of language measures on reading scores, then using either full-scale or verbal IQ is likely to remove some of the effect of the language measures, since the IQ tests will be testing at least some of the same aspects of language, and thus there is likely to be a smaller relationship between the language and reading measures. Studies that control for nonverbal IQ would have avoided this confound by controlling for non-verbal cognitive abilities only. Bishop and Adams's (1990) study was the only one to look at regression results with the effects of verbal IQ as well as both verbal and nonverbal IQ, but they do not discuss the implications of these different analyses.

In some studies, the authors do not indicate whether or not the potentially confounding variable of nonverbal ability was controlled for (Badian, 2001; Manis et al., 1999; McCormick, 1994). These factors are important to control for as differences may arise from them. For example, without controlling for the non-verbal abilities of children, one does not know if these abilities contribute to the prediction of reading skills. Authors chose to control for non-verbal abilities in a variety of ways.

Catts (1993) is the only researcher who controlled for grade differences as a result of some students repeating a grade or being placed in an alternative classroom. A 'matriculation' variable was entered first into the regression analysis. It is possible that previous classroom exposure may influence reading ability.

Many of the studies performed correlations on the variables before entering oral language measures into a regression analysis. Menyuk et al. (1991) did not perform correlations before entering predictor variables into regression analyses. Further, all studies, with the exception of Felton and Brown (1990), entered all the predictor variables into a regression analysis. Felton and Brown entered only the variables that showed the highest correlations to reading outcome and that were representative of the three areas of phonological processing in the study. According to Stevens (2002), entering only those variables that are the most correlated to the dependent variables tends to make the results sample specific and therefore unreplicable.

Reader-Group Membership

Some studies were interested in predicting reader-group membership rather than or in addition to predicting actual reading scores. This approach determines whether and to what degree the measures used in a particular study discriminated between previously identified groups of children and thus adds another dimension to the investigation of prediction. An individual measure may predict a reading measure in isolation, but it might not predict who would actually be identified as having a reading problem, which is likely to be based on problems in several skill areas.

There have been a variety of methods used to classify reader-group membership. Menyuk et al. (1991) used a cut-off score of 79 on the WRAT to define poor readers. The authors state that this score indicates borderline or deficient reading abilities at the beginning stages.

In Hurford et al. (1994), the three reading groups (nondisabled, reading disabled, and "garden variety" poor readers) were created according to the reading tasks and the *Peabody Picture Vocabulary Test – Revised* (PPVT-R) performance at the end of grade 2. The authors state that PPVT-R scores were used as a measure of intellectual ability. The nondisabled group consisted of children whose standard scores were above 1 standard deviation below the mean on composite reading score. The children classified as reading disabled had standard scores equal to or below 1 standard deviation below the mean in composite reading, with PPVT-R standard scores above 1 standard deviation below the mean. The garden-variety group had standard scores equal to or below 1 standard deviation below the mean in composite reading, but also had PPVT-R standard scores equal to or below 1 standard deviation below the mean.

Muter et al. (1998) defined good readers as those having reading accuracy scores above the 75th percentile on the *Neale Analysis of Reading Ability Test* (Neale, 1966). Poor readers had reading accuracy scores below the 25th percentile on the same test.

Badian (2001) defined poor readers as those children who scored below the 25th percentile on word recognition. Although not stated, this definition leaves good readers to be defined as those who scored above the 25th percentile on the word recognition task.

O'Connor and Jenkins (1999) used the Word Identification and Word Attack subtests of the *Woodcock Reading Mastery Tests- Revised* (WRMT-R) (Woodcock, 1987) to classify the children into one of two groups (average readers and reading disabled). The authors do not describe in detail the criteria for classifying the children.

Catts et al. (2001) defined reading difficulties as scores greater than 1 standard deviation below the mean on the composite measure of reading comprehension. This definition is consistent with Hurford et al. (1994). The authors felt that this definition is a compromise when compared to more liberal definitions and more conservative definitions of reading disabilities used in the literature.

Thus, studies used different definitions of poor or disabled readers. Some were based on lower-level reading skills, others on higher-level skills, and others on composite reading scores. Cut-off scores ranged from at or below one standard deviation to the 25th percentile, which is well within the normal range of scores.

Results

This section summarizes those measures found to predict lower level reading, higher level comprehension skills, and reader-group membership. The predictive ability of phonological awareness, RAN, expressive language, and receptive language is discussed.

Phonological Awareness

Phonological awareness is the ability to attend to, reflect on or manipulate the speech sounds in a word. Five phonological awareness activities were explored in seven of the articles reviewed. The results indicate that some phonological measures predict reading achievement while other measures need further research before making firm conclusions.

Syllable and phoneme deletion and blending are phonological awareness tasks that predict lower level (Catts, 1993; Catts et al., 1999; Manis et al., 1999; Muter & Snowling, 1998) and higher level (Catts, 1993; Manis et al., 1999) reading ability. In some studies, syllable and phoneme deletion combined were found to predict both lower level and higher level reading (Catts et al., 1999; Manis et al, 1998). Muter and Snowling (1998) found that phoneme deletion alone predicts lower level reading. If phoneme deletion alone can predict lower level reading, then fewer tests would need to be administered. One cannot determine how much syllable deletion contributes to the prediction of lower level reading or comprehension as this task was not considered independently from phoneme deletion in the studies reviewed.

Catts (1993) found syllable and phoneme deletion, combined with syllable and phoneme blending, to predict both word identification and word attack in Grade 1 and Grade 2, accounting for 4% to 37% of the variance. Further, this measure accounted for 25% of the variance when predicting comprehension in Grade 2. Although phonological awareness tasks predicted comprehension in Grade 2, receptive and expressive language measures accounted for more variance when entered first in the regression analysis (Catts, 1993).

None of the studies reviewed for this paper looked at syllable and phoneme blending independently of deletion tasks. Therefore, it is difficult to determine which task, deletion or blending, contributes more to predicting or if both tasks contribute equally. The research to date indicates that 1) syllable and phoneme deletion together predict lower level reading and comprehension, 2) phoneme deletion predicts lower level reading, 3) syllable and phoneme deletion and syllable and phoneme blending combined predict lower level reading.

A number of phonological measures require further research before one can conclude that these tasks predict reading. Syllable and phoneme segmenting were found to predict lower level and higher level reading in one study (Menyuk et al. 1991). The results of this study need to be interpreted with caution. First, the scores from kindergarten, Grade 1, and Grade 2 participants were grouped together. The relationships may not be the same at all these ages since reading level changes dramatically during this period. Second, the authors did not indicate whether they had controlled for potentially confounding variables such as nonverbal ability and children repeating grades. Finally, the inclusion of more than 130 participants would have strengthened the study given that 17 variables were in the regression analysis.

Further, although syllable segmenting was found to predict lower level reading in Badian (2001), this task only accounted for a small amount of variance (never more than 7%) (Badian, 2001). Another measure, rhyme detection, was not found to predict lower level reading in one study (Muter & Snowling, 1998). However, the results from the study conducted by Badian (2001) indicated that rhyme detection predicted word reading in Grade 1, although it accounted for a small amount of variance (never more than 6%). Further, rhyme detection inconsistently predicted a small amount of variance in reading comprehension in this study.

McCormick et al. (1994) found the identification of consonants at the beginning of words presented orally to significantly predict a combined reading score of lower level reading and reading comprehension. Consonant identification accounted for 34% of the variance. It is unclear which level of reading this measure predicts as lower level and higher level reading were combined as a composite score. Further, the amount of variance consonant identification accounts for is unclear because the amount of variance changed from 34% to 6% depending upon the order entered into the regression. The unclear results make it difficult to determine the predictive power of consonant identification, and thus additional research is needed.

Syllable and phoneme segmenting, syllable and phoneme deletion, and rhyme detection were used in two studies to predict reader group membership (good versus poor reader), either on its own or with a combination of other tasks. Rhyme detection did not contribute to the prediction of group membership in the study conducted by Muter and Snowling (1998), but it did identify 71% of the poor readers and 85% of the good readers in the study conducted by Badian (2001). Differences between these two studies may be explained by the small number of participants, 34, used by Muter and Snowling. Badian's study had a larger number of participants and thus had greater power to yield significant results. Another reason for differences may be explained by the definition of reader-group membership. Muter and Snowling had used composite reading scores to define poor readers, while Badian used word recognition only; it is possible that rhyme detection would be more closely related to word

recognition, a lower-level reading skill, than to a composite reading score.

Phoneme and syllable deletion seem to be predictors of reader-group membership when measured at an early age. Catts et al. (2001) determined phoneme and syllable deletion to be among the best five predictors of reader-group membership when measured in kindergarten. Muter and Snowling (1998) found phoneme deletion combined with nonword repetition measures to predict group membership when measured at age 5 or 6. Finally, O'Connor and Jenkins (1999) found that syllable deletion when combined with two other measures predicted group membership only when it was measured in early kindergarten.

Of the two segmenting tasks, syllable and phoneme, phoneme segmenting predicts reader-group membership in kindergarten and in Grade 1 (O'Connor and Jenkins, 1999). Badian (2001) found syllable segmenting to classify most good readers, but only a small percentage of poor readers. Ideally, one would want the measurements used to classify correctly most of the members of both groups. Based on these results, syllable segmenting may not be a strong variable in predicting reader-group membership.

Rapid Automatized Naming

In rapid automatized naming (RAN) tasks, children are shown an array of items to name as quickly as possible proceeding left to right, row by row. Before beginning the task, the children demonstrate their ability to name each item in isolation.

Five different RAN measures, numbers, letters, objects, colours, and animals, have been used in several of the studies reviewed as either a composite score or as a single score to predict lower level reading. The results of the studies reviewed indicate strong support for the prediction of lower level reading from RAN measures (Catts, 1993; Catts et al., 1999; Felton & Brown, 1990; Manis et al., 1999; Menyuk et al., 1991).

For example, Felton & Brown calculated simple correlations between RAN measures and word identification and word attack skills for children in first grade. Correlations ranged from .19 to .30 and were stronger for word identification than for word attack. All correlations were significant except for the correlation between colours and word attack and letters and word attack.

Catts et al. (1993) calculated correlations between RAN measures and word identification and word attack in first and second grade, all of which are significant. Correlations ranged from .35 to .56. Catts and his colleagues (1999) only included the rapid naming of animals. The correlation between this measure and the combination of second grade reading comprehension and word recognition was 0.424. The above results indicate that a variety of RAN measures can be used to predict lower level reading.

One study remains the exception. Menyuk and her colleagues (1991) found RAN letters, rather than tasks with colours, numbers, or objects, to be the only significant RAN task to predict word identification and a composite reading score consisting of word identification, word attack, and comprehension. The methodology of this study differs from the other studies. RAN tasks were administered prior to kindergarten and subjects from all 3 grades were included in the correlations without considering grade as a factor, which may affect generalizability of the results.

Catts and his colleagues (1999) offered an argument for the use of one RAN measure in research. The investigators included only RAN animals in their study because previous work (Catts, 1993) had shown that many kindergarten children, particularly those with language impairment, could not consistently name letters or numbers. However, correlations obtained by Felton and Brown (1990) for numbers and letters summarized above do not appear to support this argument. Although it is evident that lower level reading can be predicted from RAN measures, more research is needed in this area to determine which RAN measure, if any, is best at predicting lower level reading. Such research could support these initial findings that, in fact, it does not matter which RAN measure is used.

Although RAN tasks were found to predict reading comprehension in the four studies, the results indicate that RAN measures may not be the strongest predictor of reading comprehension. In Catts' 1993 study, when a composite score of RAN was entered first in the multiple regression analysis, it accounted for 16% of the variance. However, phonological awareness, receptive language, and expressive language, when entered first, accounted for much more variance in reading comprehension (25%, 35%, and 33% respectively). When phonological awareness was entered first, RAN accounted for 7% of the variance, when receptive language was entered first, RAN accounted for 4% of the variance, and when expressive language was entered first, RAN was not significant. In another study, Manis et al. (1999) found that RAN letters accounted for 4% of the variance and RAN digits 3% of the variance once prior reading level was accounted for in the hierarchical regression analyses. Finally, in the study conducted by Catts and his colleagues (1999), once RAN was entered into the hierarchical regression, it only accounted for an additional 7% of the variance in one instance and 2% of the variance in another. Menyuk and her colleagues (1991) found RAN letters to consistently account for the largest amount of the variance, accounting for 22.52 % for the WRAT, 1.35% for the *Gray Oral Reading Test* (GORT) (Weiderholt & Bryant, 1986) and 19.45% using the *Test of Reading Comprehension* (TORC) (Brown, Hammill, & Weiderholt, 1978). It is difficult to determine the predictive nature of RAN in this study because of the methodology concerns discussed earlier and the fact that reading comprehension and lower level reading abilities were measured together in two of the tests.

RAN has been used to differentiate between reading groups (Catts et al., 2001; Menyuk et al., 1991; O'Connor & Jenkins, 1999). Again, the studies differed on which RAN score was used. One study used animals (Catts et al., 2001),

one used letters (O'Connor & Jenkins, 1999), and another used four separate scores — animals, objects, numbers, and colours (Menyuk et al., 1991). O'Connor and Jenkins found RAN letters to be one of the best three predictors of group membership. It consistently predicted group membership when administered in kindergarten and Grade 1. O'Connors & Jenkins started with a large number of predictors before narrowing to the best three.

Catts and his colleagues (2001) started with a large number of predictors. However, the logistic regression analysis identified five significant variables that predicted the probability of reading difficulties in Grade 2. RAN (animals) was the fifth best predictor. The scores of the five predictors are entered into an equation devised by the authors to determine the probability of reading problems in Grade 2. With a cut off score of 0.30, the specificity level (accuracy at identifying normal readers as such) was high at 91.1%, the sensitivity level (accuracy at identifying problem readers as such) was moderate at 73.5% and the percentage of false negatives was 4.9%.

In the study conducted by Menyuk and her colleagues (1991), the seven battery measures of which RAN colours, numbers, letters and objects were a part, identified only 21.7% of the poor readers as poor readers. The combination of 17 intake and battery measures identified only 45.7% of the poor readers as poor readers. Given the methodological concerns previously discussed regarding the study conducted by Menyuk and her colleagues, it can be argued that more weight should be given to the results of the other two studies. It appears reasonable to include RAN letters and animals as predictors of reader group membership.

Expressive Language

Expressive language has not been studied extensively as a predictor of reading ability, with only 5 out of the 13 studies reviewed including measures of this (Bishop & Adams, 1990; Catts, 1993; Catts et al., 1999; Menyuk et al., 1991; Snow et al., 1993). The expressive language measures found to predict lower level reading skills in these studies were mean length of utterance (MLU), a cloze task, formal definitions, superordinates, narrative production, and standardized measures of expressive language. The measures that predicted reading comprehension included formal definition, narrative ability, and standardized measures.

MLU, measure of syntactic skill, was found to predict reading accuracy and nonword reading at age 8 when measures were taken at 4 ½ and 5 ½ years of age (Bishop & Adams, 1990). MLU accounted for 43% to 48% of the variance. Granted that because this study is the only one to include MLU, the strength of MLU in predicting lower level reading in this study warrants further investigation. If the findings of Bishop and Adams are replicated, it would warrant the use of this measure in practice. MLU is a measure of linguistic productivity that predicts syntactic development in young, typically-developing children. Thus it represents an aspect of language distinct from phonological awareness measures. One advantage of using MLU in practice is its ease of use. Further, this study measured MLU in preschool. The validation of MLU as a predictor would enable clinicians to use this measure with confidence to determine if preschoolers were to encounter later reading problems. The earlier a child is recognized to have future reading difficulties, the earlier intervention can begin.

A cloze task, designed to measure syntactic skills, was found to predict word identification and comprehension composite scores using the GORT, accounting for 31% of the variance. It was also found to predict lower level reading behaviors measured with the WRAT-R, accounting for 34% of the variance (Menyuk et al., 1991). The authors did not specify if other subtests of the WRAT-R were used. It is difficult to determine exactly which aspect of reading their cloze task predicts when the WRAT-R and the GORT are used.

The results of this study need to be interpreted with caution. First, the scores from kindergarten, Grade 1, and Grade 2 participants were grouped together. It is possible that kindergarten children may not yet have learned decoding skills. Second, this study is the only one that used a cloze task. Other concerns discussed previously were sample size and no indication of controlling for potentially confounding variables. However, if the usefulness of the cloze task as a predictor is replicated in subsequent studies, clinical practice would benefit with the inclusion of a cloze task in assessment materials.

Snow, Tabors, Nicholson, and Kurland (1995) investigated how print knowledge, metalinguistic awareness, and oral language skills relate to each other and how these skills relate to later literacy achievement, lower level reading ability, comprehension, and spelling abilities. The authors found that narrative production was strongly related to the WRAT-R score, but not to the GORT score; in both of these composite scores, lower and higher reading skills are combined.

Two semantic language tasks, one requiring the child to provide a formal definition of an item and another requiring the child to supply a superordinate, were found to be correlated to the WRAT-R and the GORT (Snow et al., 1995). These results need to be interpreted carefully as the WRAT-R and the GORT measure a range of reading skills.

Bishop and Adams (1990) used the Bus Story (Renfrew, 1995) among other variables to predict reading comprehension using the Neale Analysis of Reading Ability. Using multiple regression analysis, narrative production at age 4 ½ was found to predict reading comprehension at age 8, accounting for 57% of the variance. This finding suggests that narrative production may be useful for predicting higher level reading abilities, if confirmed with additional research. The authors describe the Bus Story measure to be a measure of the ability to express semantic relationships. However, the explanation for its predictiveness may lie in the fact that it is a narrative measure, and as such taps the ability to use a number of language skills (syntax, semantics, and pragmatics) to convey a story to a listener. Narratives have been described as a bridge between oral and written language, and knowledge of story schemas is believed to be important for reading comprehension (Westby, 2005).

Catts (1993) found expressive language skills measured by the *Expressive One-Word Picture Vocabulary Test* (Gardner, 1979), the *Structured Photographic Expressive Language Test-II* (SPELT-II) (Werner & Kresheck, 1983), and the sentence imitation and grammatical closure subtests of the *Test of Language Development* (TOLD-2) (Newcomer & Hammill, 1988) to predict word attack and word identification abilities in Grade 1 (24% and 14% respectively) and in Grade 2 (17% and 15% respectively) when entered first in the multiple regression. However, phonological awareness skills and RAN tasks accounted for more variance for both grades when entered into the regression analysis before the expressive language measures. Catts et al. (1999) combined expressive and receptive language skills to predict word recognition abilities (word identification and word attack) in Grade 2. These results are consistent with Catts' 1993 study, but phonological awareness and expressive and receptive language accounted for a large and similar amount of variance when entered first in the 1999 study. Perhaps when expressive language is combined with receptive language skills to include a larger language skill base, they contributed as much to prediction of word recognition as phonological awareness. Although expressive language measures were found to predict lower level reading, other measures such as phonological awareness and RAN have been investigated much more often.

The results predicting reading comprehension from expressive language abilities are inconsistent among the three studies that included this measure. It is important to remember that expressive language is a broad construct and was measured differently across studies. In one study (Menyuk et al., 1991), scores from expressive language tests did not predict reading comprehension when scores from kindergarten, Grade 1, and Grade 2 were combined. However, the cloze task did predict reading comprehension in this study. In two other studies, expressive language (Catts, 1993) and expressive language combined with other oral language measures (Catts et al., 1999) predicted Grade 2 reading comprehension (33% and 56% respectively). In the latter two studies, the language measures contributed as much or more to Grade 2 reading comprehension than the phonological awareness and RAN tasks. The study conducted by Menyuk and her colleagues may have different results because the comprehension scores were reported on one group of students from a variety of grades, most of whom probably had not developed enough reading comprehension for the relationship to have developed yet. At present, with the available research, expressive language measures collected in kindergarten appear to predict reading comprehension in Grade 2.

Two studies included expressive language measures when predicting reader group membership (Catts et al., 2001; Menyuk et al., 1991). Menyuk and her colleagues included expressive language scores along with receptive language measures, an articulation measure, a verbal fluency measure, and an auditory discrimination measure. These measures correctly classified only 6.5% of the poor readers. When Menyuk and her colleagues combined all the predictor variables, they classified 46% of the poor readers. In the study conducted by Catts and his colleagues, expressive and receptive language skills were combined. This composite score was not a significant variable in predicting reader-group membership. The low classification rates in one study and the finding that expressive language scores are not significant predictors in another study suggest that expressive language scores are not an ideal predictor of reader-group membership, at least in the lower grades.

Additional research is needed in the area of expressive language. Although a variety of expressive language skills have been studied, many have not been studied extensively. It would be beneficial to continue to use a range of expressive language subskills and analyze them separately and together. Further research is warranted in predicting reader-group membership since some expressive language skills have been shown to predict individual scores but not group membership.

Receptive Language

Like expressive language abilities, receptive language abilities have not been studied extensively in predicting reading achievement. Six of the studies reviewed included this independent variable (Bishop & Adams, 1990; Catts, 1993; Catts et al., 1999; McCormick, 1994; Menyuk et al., 1991; Snow et al., 1995).

The results of the studies suggest that receptive language abilities are not the strongest predictors of lower level reading skills. Receptive vocabulary skills, measured using the *Peabody Picture Vocabulary Test-Revised* (PPVT-R) (Dunn & Dunn, 1981) or the *British Picture Vocabulary Scale* (BPVS) (Dunn, Dunn, Whetton, & Pintilie, 1982), either did not predict lower level skills (Bishop & Adams, 1990; Catts, 1993; McCormick et al., 1994; Menyuk, 1991) or accounted for little variance (10%) (Catts, 1993). PPVT-R was entered into the regression analysis with the *Token Test for Children* and the *Test of Language Development – 2* (TOLD-2). There is one exception to this finding. Snow et al. (1995) found the PPVT-R to have a strong correlation with word identification (.44) and a strong correlation to scores on the *Gray Oral Reading Test – Revised* (GORT-R) (.48), a test that measures both lower level and comprehension abilities. It is difficult to compare this result to others because it is a bivariate correlation; studies in which the PPVT-R was used in multiple regressions may not have found it to be a predictor because the variance was better accounted for by other variables in the regression.

The Token Test for Children, a measure of receptive language, was found to predict lower level reading (Catts, 1993; Menyuk et al., 1991). This test accounted for 25% of the variance in the study conducted by Menyuk and her colleagues. However, there were concerns regarding the methodology used by Menyuk and her colleagues as discussed earlier. Further, Catts entered the *Token Test for Children* into the multiple regression with the scores from the PPVT-R and TOLD-2; the results indicated that receptive language accounted for only a small amount of variance (10%) or was insignificant in some cases. Given these factors,

the *Token Test for Children* cannot be considered a reliable predictor of lower level reading achievement.

The TOLD-2 was used in two studies with inconsistent results. First, Catts (1993) entered the Grammatical Understanding subtest of the TOLD-2 into a multiple regression with the *Token Test for Children* and the PPVT-R, and they accounted for no or little variance (10% to 17%). However, lower level reading was predicted when the TOLD-2 was entered with the other receptive language scores as well as the expressive language scores (Catts et al., 1999). It is difficult to determine which area of language, receptive or expressive, is accounting for the prediction. It is possible that expressive language accounts for more of the prediction capabilities when receptive and expressive language scores are combined. Bishop and Adams (1990) found the *Test for Reception of Grammar* (TROG) (Bishop, 1989), a British test of receptive syntax, to predict reading accuracy, accounting for 52% of the variance at age 4 ½ and 51% at age 5 ½. Given the mixed results involving the TOLD-2 and the TROG, further investigation of receptive syntax would be beneficial. The above results indicate that syntactic measures of receptive language may be stronger predictors of lower level reading skills than semantic measures alone or as syntactic and semantic measures combined.

Receptive language scores have been found to predict reading comprehension. Bishop and Adams (1990) determined that the TROG and the BPVS predicted reading comprehension at age 5 ½. The TROG accounted for 63% of the variance and the BPVS accounted for 57% of the variance. Catts (1993) determined that the PPVT-R, the *Token Test for Children,* and the TOLD-2, when entered together, predicted reading comprehension. These three tests accounted for 6% to 35% of the variance. Menyuk and her colleagues (1991) also determined that the *Token Test for Children* predicted comprehension, accounting for 10% of the variance. The *Screening Test of Auditory Comprehension of Language* (TACL) (Carrow, 1973) and the PPVT-R did not account for any variance, although the methodology concerns in Menyuk et al. make the results less reliable. Snow and her colleagues (1995) found PPVT-R scores to be strongly related to lower level and comprehension abilities measured by the GORT-R. However, in McCormick et al. (1994), PPVT-R failed to predict reading comprehension. There were two concerns with this study. First, the reading measure, the *Iowa Test of Basic Skills*, combines decoding and comprehension abilities as one score. When the two skills are combined, one cannot determine which oral language skills predict lower level reading and which oral language skills predict higher level reading. Second, the study may have lacked sufficient power given the number of variables entered into the regression analysis relative to the number of subjects. Given the results from Bishop and Adams (1990) and Catts (1993), receptive language tests that measure semantic and syntactic skills do appear to predict reading comprehension.

Three studies included receptive language as possible predictors of reader-group membership. Two of these studies, Menyuk et al. (1990) and Catts et al., (2001), were discussed earlier. One study (Menyuk et al., 1990) found that receptive language, when combined with the other measures used in the study, had low group prediction abilities. The other study (Catts et al., 2001) did not find receptive language scores, when combined with expressive language scores, to be a significant predictor of group membership. The third study (Hurford et al., 1994) included PPVT-R scores with other scores (phonological discrimination task and phonemic segmentation task) and had high group membership classification with only 2% being misclassified. However, the authors defined the reading disabled group as having weak reading abilities and typical receptive vocabulary abilities. This definition assumes that reading disabled children have normal language abilities. In contrast, many authors hold that most reading disabled children have accompanying language problems (Catts, 1997).

As with expressive language scores, receptive language scores may not be ideal for predicting group membership. Given the limited scope of research in this area, more research is needed. In particular, it is important to consider expressive and receptive language skills separately in order to determine whether they each are predictive of reading skills or only predict when both are considered.

Conclusions

The research results from these studies indicate that some oral language measures predict lower level and higher level reading achievement as well as reader-group membership. Although standardized measures of expressive language account for some variance in lower level reading, other measures, phonological awareness and RAN, account for more. Standardized measures of expressive and receptive language are better than phonological awareness skills and RAN tasks when predicting reading comprehension in Grade 2. They seem to be more suited for predicting reading comprehension than for predicting lower level reading skills. RAN tasks predict lower level reading and reader-group membership. RAN also contributes to the prediction of reading comprehension, although it does not account for as much variance as other measures. Results of the studies indicate that syllable and phoneme deletion together, phoneme deletion alone, and syllable and phoneme deletion and blending all predict lower level reading achievement. Syllable and phoneme deletion together predict reading comprehension. Finally, rhyme detection and syllable and phoneme deletion predict reader-group membership.

From the research results, one can start to create a battery of tests that predict reading. Measures that predict lower and higher level reading should be included in the battery as lower level reading skills are the foundation to reading and higher level reading enables one to understand sentences and paragraphs. Ideally the smallest number of tests should be used to maximize efficiency. Syllable and phoneme deletion and RAN could be included in a battery to predict lower level reading abilities. To predict higher level reading skills, the TOLD-2: P and a narration task, such as the Bus Story, could be included in the battery.

Some measures require further research before making firm conclusions. More research is needed regarding MLU,

cloze tasks, formal definition, and superordinates in relation to lower level reading. In addition, receptive language results are inconclusive for lower level reading because of inconsistencies among studies. Additional research is needed to determine the predictive nature of syllable and phoneme segmenting, rhyme detection, and consonant identification for reading comprehension. As well, more research is needed to determine whether or not syllable segmenting can be used to predict reader-group membership.

When designing future research studies, there are some suggestions to keep in mind. First, the use of regression analysis enables the identification of the relative predictive value of a predictor variable. Second, it may be helpful to enter oral language measures independently into a regression analysis rather than grouping them into broad categories such as receptive language or expressive language. This would allow one to determine the specific measures that enable one to predict. Third, it is important to distinguish between lower level reading and higher level reading measures as a criterion variable. Fourth, it is important to include an adequate number of participants in the study. We recommend that the number of participants be at least 5 or 10 times the number of variables entered in the regression analysis. It is also important to control for nonverbal abilities when entering variables into the regression analysis to help ensure that the variance accounted for can be attributed to oral language skills and not nonverbal abilities.

The conclusions made regarding the variables that predict reading achievement are based on those measures and tasks used in the studies reviewed here. Other measures such as memory, cognition, parent/child interactions, and mother's education level may also be useful in predicting reading achievement.

Clinical Application

Research to date has provided insight on predicting reading problems from oral language skills and will help guide future research. S-LPs, who have an expertise in the area of language, will assess preschoolers' language skills and thus can have an important role in helping to identify children who would be at risk for later reading problems in school.

The research results suggest possible measures that can help determine whether or not a young child would be at risk for future reading problems. Phonological measures, such as syllable and phoneme deletion and syllable and phoneme blending, as well as RAN measures predict lower level reading skills. Further, standard measures of expressive and receptive language predict reading comprehension abilities. It is important to remember that a child's score that is within normal limits on language tests does not guarantee that the child will not have future reading difficulties.

Once these measures are collected, the information needs to be utilized to benefit the child. There are a few available options. First, the child could receive early intervention regarding language skills from an S-LP to help eliminate or reduce future reading difficulties. This may be challenging given the large caseloads of S-LPs. However, it need not involve additional therapy — the S-LP can choose to work on language goals that will benefit both oral and written language. As well, suggestions can be made to classroom teachers about activities from which all students can benefit.

Specific phonological awareness activities can be incorporated into speech and language therapy. Rhyme awareness is a beginning form of phonological awareness because it involves an ability to analyze words at the level of the onset and rime. When treating phonological processes minimal pairs and nonsense words can be used. Children's books written using rhymes can be utilized in therapy. The concept of segmentation can be incorporated into therapy by the careful selection of words. For example, compound words and their parts can be used to indirectly demonstrate syllable deletion (e.g. 'cowboy', 'cow', and 'boy'). The work that S-LPs do to improve oral language skills contributes to children's reading comprehension abilities.

A second way to utilize the information to benefit the child is to inform the child's parents or caregivers about how early oral language difficulties can impact later reading skills. With this information, parents or caregivers, with the support of an S-LP, may be able to implement a home program to benefit the child. As well, parents or caregivers can help to transfer the information to the school when the child enters kindergarten.

Third, it is important to increase the awareness of S-LPs and other professionals, such as teachers, regarding the relationship of oral language skills and reading abilities. This will enable professionals who did not work with the child in preschool to apply the knowledge of oral language measures to the acquisition of reading in school. In addition, shared knowledge about this topic among those involved with the child will increase the child's support system. The current research, combined with future investigations regarding the predictive nature of oral language skills, will assist in the early identification of children who are at risk for reading difficulties.

References

Badian, N.A. (2001). Phonological and orthographic processing: Their roles in reading prediction. *Annals of Dyslexia, 51*, 179-202.

Beery, K.E. (1982). *Revised administration, scoring and teaching manual for the Developmental Test of Visual Motor Integration*. Cleveland, OH: Modern Curriculum Press.

Bishop, D.V.M., & Adams, C. (1990). A prospective study of the relationship between specific language impairment, phonological disorders and reading retardation. *Journal of Child Psychology and Psychiatry, 31*, 1927-1050.

Bishop, D.V.M. (1989). *Test for Reception of Grammar* (2nd ed.). Age and Cognitive Performance Research Centre, University of Manchester.

Bradley, L. & Bryant, P.E. (1983). Categorizing sounds and learning to read – a causal connection. *Nature*, 301, 419-421.

Brown, U., Hammill, D., & Weiderholt, J. (1978). *Test of Reading Comprehension: A method of assessing the understanding of written language*. Austin, TX: Pro-Ed.

Carrow, E. (1973). *Screening Test for Auditory Comprehension of Language*. Boston, MA: Testing Resources Corporation.

Catts, H.W. (1993). The relationship between speech-language impairments and reading disabilities. *Journal of Speech and Hearing Research, 36*, 948-958.

Catts, H.W. (1997). The early identification of language-based reading disabilities. *Language, Speech, and Hearing Services in Schools, 28*, 86-89.

Catts, H. W., Fey, M. E., Zhang, X., & Tomblin, J. B. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. *Scientific Studies of Reading, 3*, 331-361.

Catts, H. W., Fey, M. E., Zhang, X., & Tomblin, J. B. (2001). Estimating the risk of future reading difficulties in kindergarten children: A research-based model and its clinical implications. *Language, Speech, and Hearing Services in Schools, 32*, 38-50.

Catts, H. W., & Kamhi, A. G. (Eds.). (1999). *Language and reading disabilities*. Needham Heights, MA: Allyn & Bacon.

DeRenzi, E. & Gerrari, C. (1978). The Reporters Test: A sensitive test to detect expressive disturbances in aphasia. *Cortex*, 14, 279-293.

DiSimoni, F. (1978). *The Token Test for Children*. Boston, MA: Teaching Resources Corporation.

Dunn, L.M., & Dunn, L.M., (1981). *Peabody Picture Vocabulary Test- Revised*. Circle Pines, MN: American Guidance Service.

Dunn, L.M., Dunn, L.M., Whetton, C., & Pintilie, D. (1982). *British Picture Vocabulary Scale*. Windsor: NFER-Nelson.

Elliott, C.D., Murray, D.J., & Pearson, L. (1978). *British Ability Scales*. Windsor: NFER-Nelson.

Felton, R.H., & Brown, I.S. (1990). Phonological processes as predictors of specific reading skills in children at risk for reading failure. *Reading and Writing: An Interdisciplinary Journal*, 2, 39-59.

Glass, G.V., & Hopkins, K.D. (1996). *Statistical methods in education and psychology*. (3rd Ed.). Needham Heights, MA: Allyn and Bacon.

Gardner, M.F. (1979). *Expressive One-Word Picture Vocabulary Test*. Novato, CA: Academic Therapy Publications.

Garson, D. *Regression Analysis*. Retrieved March 27, 2005, from http://www2.chass.ncsu.edu/garson/pa765/regress.htm.

Goldman, R., & Fristoe, M. (1986). *Goldman-Fristoe Test of Articulation*. Circle Pines, MN: American Guidance Service.

Hieronymus, A. N., Hoover, H. D., & Lindquist, I. F. (1986). *Iowa Test of Basic Skills*. Chicago, IL: Riverside Publications.

Hurford, D. P., Schauf, J.D., Bunce, L., Blaich, T., & Moore, K. (1994). Early identification of children at risk for reading disabilities. *Journal of Learning Disabilities*, 27, 371-382.

Jastak, S., & Jastak, S. (1976). *Wide Range Achievement Test*. Wilmington, DE: Guidance Associates.

Kaplan, E., Goodglass, H. & Weintraub, S. (1982). *Boston Naming Test*. Philadelphia: Lea & Fibiger.

Kirk, S., McCarthy, J., & Kirk, W. (1968). *Illinois Test of Psycholinguistic Ability*. Urbana, IL: University of Illinois Press.

Lee, L. (1974). *Developmental sentence scoring procedures*. Evanston, IL: Northwestern University Press.

Lindamood, C.H. & Lindamood, P.C. (1979). *Lindamood Auditory Conceptualization Test*. Boston: Teaching Resources Corporation.

Manis, F.R., Seidenberg, M.S., & Doi, L.M. (1999). See Dick RAN: Rapid naming and the longitudinal prediction of reading subskills in first and second graders. *Scientific Studies of Reading*, 3, 129-157.

Mason, J., & Stewart, J. (1989). *Early Childhood Diagnostic Instrument*. Iowa City, IA: American Testronics.

McCarthy, D. (1970). *McCarthy Scales of Children's Abilities*. New York: Psychological Corporation.

McCormick, C.E., Stoner, S.B., & Duncan, S. (1994). Kindergarten predictors of first-grade reading achievement: A regular classroom sample. *Psychological Reports*, 74, 403-407.

Menyuk. P., Chesnick, M., Liebergott, J.W., Korngold, B., D'Agostino, R., & Belanger, A. (1991). Predicting reading problems in at-risk children. *Journal of Speech and Hearing Research*, 34, 893-903.

Muter, V., Hulme, C., Snowling, M., & Taylor, S. (1997). Segmentation, not rhyming, predicts early progress in learning to read. *Journal of Experimental Child Psychology*, 58, 112-133.

Muter, V., & Snowling, M. (1998). Concurrent and longitudinal predictors of reading: The role of metalinguistic and short-term memory skills. *Reading Research Quarterly*, 33, 320-337.

Muter, V., Snowling, M., & Taylor, S. (1994). Orthographic analogies and phonological awareness: Their role and significance in early reading development. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 35, 293-310.

Neale, M. D. (1966). *Neale Analysis of Reading Ability*. London: Macmillan.

Newcomer, P. L. (1990). *Diagnostic Achievement Battery-2*. Austin, TX: Pro-Ed.

Newcomer, P. L., & Hammill, D. D. (1988). *Test of Language Development-2 Primary*. Austin, TX: Pro-Ed.

Norman, G. R., & Streiner, D. L. (1998). *Biostatistics: The bare essentials*. Hamilton: B.C. Decker Inc.

Nurss, J. R., & McGauvran, M. E. (1976). *Metropolitan Readiness Test*. New York: Harcourt Brace Jovanovich.

O'Connor, R. E., & Jenkins, J. R. (1999). Prediction of reading disabilities in kindergarten and first grade. *Scientific Studies of Reading*, 3, 159-197.

Owens, R. E. (2001). *Language development: An introduction*. (5th ed.). Boston: Allyn and Bacon.

Pedhazur, E. J. (1983). *Multiple regression in behavioral research: Explanation and prediction*. (2nd Ed.). New York: Holt, Rinehart, & Wilson.

Psychological Corporation. (1992). *Stanford Achievement Test* (8th Ed.). San Antonio, TX: Harcourt Brace.

Renfrew, C. (1995). *The Bus Story: A test of continuous speech*. Old Headington, Oxford, UK: Renfrew.

Rosenberg, K. M., & Daly, H. B. (1993). *Foundations of behavioral research: A basic question approach*. Fort Worth: Harcourt, Brace, & Jovanovich.

Scarborough, H. S. (1998). Early identification of children at risk for reading disabilities: Phonological awareness and some other promising predictors. In B. K. Shapiro, P. J. Accardo, & A. J. Capute (Eds.), *Specific reading disability: A view of the spectrum* (pp. 75-119). Timonium, MD: York Press.

Schiavetti, N., & Metz, D. E. (2002). *Evaluating research in communicative disorders*. Boston: Allyn and Bacon.

Semel, E., Wiig, E., & Secord, W. (1987). *Clinical Evaluation of Language Fundamentals- Revised*. San Antonio, TX: Psychological Corporation.

Silveroli, N.J. (1984). *Classroom Reading Inventory* (4th ed.). Dubuque, IA: Brown.

Snow, C.E., Tabors, P.O., Nicholson, P.A., & Kurland, B.F. (1995). SHELL: Oral language and early literacy skills in kindergarten and first-grade children. *Journal of Research in Childhood Education*, 10, 37-48.

Spear-Swerling, L., & Sternberg, R. J. (1994). The road not taken: An integrative theoretical model of reading disability. *Journal of Learning Disabilities*, 27, 91-103.

Stevens, S. (2002). *Applied multivariate statistics for the social sciences* (4th Ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics* (3rd Ed.). New York: Harpercollins College Publishers.

Taylor, B., Harris, L. A., Pearson, P. D., & Garcia, G. (1995). *Reading difficulties: Instruction and assessment*. New York: McGraw-Hill, Inc.

Templin, M., & Darley, F. (1969). *Articulation Screening Test*. Minneapolis, MN: University of Minnesota Press.

Werner, E. O., & Kresheck, J. D. (1983). *Structured Photographic Expressive Language Test-II*. Sandwich, IL: Janelle Publications.

Wechsler, D. (1967). *Preschool and Primary Scale of Intelligence*. New York: Psychological Corporation.

Westby, C. E. (2005). Assessing and remediating text comprehension problems. In H. W. Catts & A. G. Kamhi (Eds.), *Language and reading disabilities* (2nd Ed.), pp. 157-232. Boston: Allyn & Bacon.

Wiederhold, J., & Bryant, B. (1986). *Gray Oral Reading Test*. Austin, TX: Pro-Ed.

Woodcock, R. W. (1987). *Woodcock Reading Mastery Tests-Revised*. Circle Pines, MN: American Guidance Service.

Acknowledgements

We would like to extend our thanks to Bonnie Dobbs, professor and colleague, for assisting with statistical analysis, as well as the Editor at the time, Phil Doyle, and reviewers of JSLPA for guidance during the editorial process.

Author note

Correspondence concerning this article should be addressed to Elizabeth Ekins, Rehabilitation Services, Royal Inland Hospital, 311 Columbia Street, Kamloops, BC V2C 2T1, elizabethekins@interiorhealth.ca

Received: November 20, 2003

Accepted: April 25, 2005

APPENDIX A

Oral Language and Reading Measures

The standardized and nonstandardized tests are described as they are in the articles, with a description of either the task or the skills that the task measures. In some cases, such as with a rhyme task, authors used variations to a similar task.

Phonological Awareness-Standardized Tests	
Lindamood Auditory Conceptualization Test (Lindamood & Lindamood, 1979)	The child manipulates different coloured blocks to indicate conceptualization of the speech sound patterns presented by the examiner
Phonological Awareness-Nonstandardized Tests	
Initial Consonant Not Same (Felton & Brown, 1990)	Four words are spoken by the examiner and the child chooses the word that does not begin with the same sound as the first word in the list
Final Consonant Different (Felton & Brown, 1990)	Four words are spoken by examiner and child chooses the word that has a different ending sound from the other words
Rhyme (Felton & Brown, 1990)	The child names as many words as he can that rhyme with a given word
Rhyme production (O'Connor & Jenkins, 1990)	The child is required to provide a rhyme to a given word
Rhyme detection (Muter & Snowling, 1998; Badian, 2001)	Given the pictures of three words, the child had to indicate which of the three words, supplied by the examiner, rhymed with the target word. All words were depicted by a drawing, the examiner supplying the names of all four words in each item
Syllable Counting Test (Felton & Brown, 1990)	The examiner pronounces 1,2 or 3 syllable words and the child uses a wooden dowel to tap out the number of syllables heard
Word String Memory Test (Felton & Brown, 1990)	The child repeats a string of four words after the examiner. Four strings are composed of rhyming words and four strings are not. Researchers consider this phonetic recoding in working memory
Deletion task -- syllable (Catts, 1993; Catts et al., 1999 & 2001; Manis et al., 1999; O'Connor & Jenkins, 1999)	Requires the child to delete a syllable from a compound word or a two-syllable word and say the remaining sound sequence
Deletion task -- initial phoneme (Muter & Snowling, 1998)	Requires the child to delete the initial phoneme from a word and say the remaining sound sequence
Deletion task -- phoneme (Catts, 1993; Catts et al., 1999 & 2001; Manis et al., 1999)	Requires the child to delete a phoneme from a word and say the remaining sound sequence
Blending task -- syllable (Catts, 1993; O'Connor & Jenkins, 1999)	Requires the child to blend together and pronounce syllables
Blending task -- phoneme (Catts, 1993; O'Connor & Jenkins, 1999)	Requires the child to blend together and pronounce phonemes
Segmenting -- syllable (Menyuk et al., 1991; Badian, 2001)	Requires the child to say the word broken into syllables. Another version requires the child to tap the number of syllables in a given word
Segmenting -- phonemes (Menyuk et al., 1991; O'Connor & Jenkins, 1999)	Requires the child to segment monosyllabic words
Consonant identification task (McCormick et al., 1994)	The child names the letter for the beginning sound of a spoken word
Phonological discrimination task (Hurford et al., 1994)	Requires the child to compare a standard pair of syllables to a comparison pair separated by 1,000 ms. Each syllable within a pair is separated by intersyllable intervals of 10, 80 or 160 ms (e.g. /gi/10ms/gi/1,000ms/di/10ms/gi/)

APPENDIX A

Oral Language and Reading Measures (continued)

Phonemic segmentation task (O'Connor & Jenkins, 1999)	The child repeats a CVC word or pseudoword after the examiner and then pronounces the word again without the designated consonant (initial or final)
Non-word repetition test (Muter & Snowling, 1998)	The child repeats 40 nonwords of between one and four syllables in length
Sound repetition (O'Connor & Jenkins, 1999)	The child repeats isolated phonemes separated with a 0.5 second pause
Rapid letter naming (O'Connor & Jenkins, 1999)	The child is presented with a card of 60 randomly ordered letters in large uppercase type and is asked to name as many letters as he can in 1 minute
First-sound isolation (O'Connor & Jenkins, 1999)	Requires the child to say the first sound of an orally given word (i.e. "Tell me the first sound of _____.")
Rapid Automatized Reading (RAN)	
RAN requires the child to name representations of familiar items, such as common objects, colours, letters, numbers, or animals, presented in a series as rapidly as possible. This is a timed test and a lower score is more desirable. The items are displayed in an array and are named from left to right, row by row. The child demonstrates the ability to name each item in isolation before beginning.	
Expressive language- Standardized Tests	
Bus Story Test- Information Score	Standardized story retell test- the child retells a story while looking at a picture book; the amount of information recalled is totalled
Expressive One-Word Picture Vocabulary Test	Measures expressive vocabulary of single words
Structured Photographic Expressive Language Test- II (SPELT-II)	Declarative, interrogative, negative and embedded sentences are tested
Test of Language Development-2:Primary (TOLD-2:P) (Newcomer & Hammill, 1988)	Sentence Imitation, Grammatical Completion, and Oral Vocabulary subtests
Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1982)	Confrontation naming task; the child names line drawings
Illinois Test of Psycholinguistic Ability (ITPA) (Kirk, McCarthy, & Kirk, 1968) grammatical closure subtest	Screens the expression of syntactic class relations and morphological markers
Development Sentence Scoring Procedures (DSS) (Lee, 1974)	Measures syntactic structures in spontaneous speech
Reporters Test (DeRenzi & Ferrari, 1978)	Measures expression of semantic relations in utterances
Goldman-Fristoe Test of Articulation (Goldman & Fristoe, 1986)	Assesses the child's phonological skills
Templin-Darley Articulation Screening Test (Templin & Darley, 1969)	Assesses the child's phonological skills
McCarthy Scales of Children's Abilities --verbal fluency subtest (McCarthy, 1970)	The child is asked to name as many articles in a given category as possible within 20 seconds

APPENDIX A

Oral Language and Reading Measures (continued)

Expressive Language- Nonstandardized Tests	
Mean Length of Utterance (MLU) (Bishop & Adams, 1990)	The number of morphemes are calculated in relation to the number of utterances spoken by the child to measure syntactic development
Expressive phonology (Bishop & Adams, 1990)	Measured by the percentage of consonants correct in a picture naming task
Cloze (Menyuk et al, 1991)	The child is required to provide a word that has been left out of a sentence
Story recall (Menyuk et al., 1991)	The child listens to a story over headphones and retells the story to a puppet
Sementactic judgement (Menyuk et al., 1991)	The child is required to determine if a sentence is grammatically correct. If it is not, the child needs to correct the sentence
Word recall (Menyuk et al., 1991)	The child learns the names of pictures and then is required to tell the items back to the examiner without the use of the pictures
Narrative production (Snow et al., 1995)	The child tells a story based on three slides
Picture description (Snow et al., 1995)	Requires the child to describe a picture as completely as possible
Definitions (Snow et al., 1995)	The child defines 14 familiar nouns (e.g. bird, alphabet)
Narrative story task (Catts et al., 1999 & 2001)	Assesses child's abilities to comprehend, organize, and retell the major details of a story read aloud by the examiner

Receptive Language- StandardizedTests

British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Pintilie, 1982)	A British version of the Peabody Picture Vocabulary Test - Revised Child selects from an array of pictures that match the word spoken by examiner
Test for Reception of Grammar (TROG) (Bishop, 1989)	The child selects from an array of pictures that match the phrase or sentences spoken by examiner
British Abilities Scales (BAS) (Elliot, Murray, & Pearson, 1978)	Verbal comprehension subtest- a general measure of the ability to carry out instructions Naming vocabulary subtest - confrontation naming task
Peabody Picture Vocabulary Test-Revised (PPVT-R) (Dunn & Dunn, 1981)	The child selects from four pictures the one that best represents a word read by the examiner
Token Test for Children (DiSimoni, 1978)	Measures semantic comprehension in sentences
Test of Language Development-2:Primary (TOLD-2) (Newcomer & Hammill, 1988)	Grammatical understanding, picture vocabulary subtests auditory discrimination subtest
Metropolitan Readiness Test-Level II, Form P (Nurss & McGauvran, 1976)	Orally administered readiness test requiring the child to mark responses in a test booklet. Three components were 1) Auditory-discrimination of initial sounds and sound-symbol association, 2) visual discrimination among visual symbols and separation of visual patterns from context, 3) language- cognitive concepts, grammatical structures of standard English, and listening skills
Screening Test of Auditory Comprehension of Language (TACL) (Carrow, 1973)	Screens comprehension of syntactic classes and relations and morphological classes and relations
Clinical Evaluation of Language Fundamentals-Revised (CELF-R) (Semel, Wiig, & Secord, 1987)	Listening to Paragraphs subtest
Receptive Language- Nonstandardized Tests	
Story comprehension task (Snow et al., 1995)	Comprehension questions are asked while a story is read aloud
Comprehension of complex sentences (Menyuk et al., 1991)	The child is asked a question about what happened in a complex sentence.

APPENDIX A

Oral Language and Reading Measures (continued)

Lower Level Reading- Standardized Tests	
Neale Analysis of Reading Ability, form C	As the child reads stories a loud, errors in reading words are scored
Woodcock Reading Mastery Test - form A (WRMT-R)	Word Identification subtest- untimed reading of a list of sight words Word Attack subtest- untimed reading of a list of pseudo-words
Gray Oral Reading Test - Revised (GORT-R) (Wiederhold, & Bryant, 1986)	Measures ability to read passages with speed and accuracy, assesses oral reading comprehension, and provides a total measure of reading performance
Iowa Tests of Basic Skills, Early Primary Battery, Level 6 (Hieronymus, Hoover, & Lindquist, 1986)	Measures the child's ability to read words in isolation and to use context and picture cues for word identification. The children were also asked sentence and story comprehension questions.
Wide Range Achievement Test- Revised (WRAT-R) (Jastak & Jastak, 1976)	Sight word recognition subtest
Graded Nonword Reading Test (Muter & Snowling, 1998)	The child is required to read 20 nonwords, 10 one-syllable words and 10 two-syllable words
Stanford Achievement Test, 8th Edition (SAT) (Psychological Corporation, 1992)	Word reading subtest- The child reads several words and decides which word tells about a picture Word study skills subtest- Measures phonological awareness and knowledge of grapheme-phoneme relationships
Lower Level Reading - Nonstandardized Test	
Reading of non-words (Bishop & Adams, 1990)	The child reads a list of non-words (e.g. bab, wob, zok)
Exception-word reading task (Manis et al., 1999)	The child reads a list of 70 exception words until six errors in a row are made

Higher Level Reading Tests- Standardized	
Neale Analysis of Reading Ability, form C (Neale, 1966)	Comprehension questions are asked after the child has read a short passage
Gray Oral Reading Test- Revised (GORT-R) (Wiederhold, & Bryant, 1986)	Comprehension subtest- the child reads a passage and answers multiple choice questions
Iowa Tests of Basic Skills, Early Primary Battery, Level 6 (Hieronymus, Hoover, & Lindquist, 1986)	Measures the child's ability to read words in isolation and to use context and picture cues for word identification. The children were also asked sentence and story comprehension questions
Woodcock Reading Mastery Test- form A (WRMT-R)	Passage comprehension subtest
Diagnostic Achievement Battery- 2 (DAB) (Newcomer, 1990)	Reading Comprehension subtest- open-ended questions are asked
Silveroli Classroom Reading Inventory- Graded Oral Paragraphs (Silveroli, 1984)	The child reads paragraphs aloud with reading mistakes noted. The child is then asked to answer five questions without looking back at the paragraph
Stanford Achievement Test, 8th Edition (SAT) (Psychological Corporation, 1992)	Reading vocabulary subtest- The child reads a list of words and decides which one of them means the same as an underlined word Reading comprehension subtest- the grade 1 edition measures understanding of simple written sentences and short passages; the grade 3 and grade 7 edition measures the ability to read passages and to answer multiple-choice questions about them

APPENDIX A

Oral Language and Reading Measures (continued)

Higher level Reading Tests - Standardized (continued)	
Test of Reading Comprehension (TORC) (Brown, Hammill, & Weiderholt, 1978)	Silent reading of passages (no further information available)

Some studies included tests that were not oral language measures. These tests are described below.

Standardized Tests	
Developmental Test of Visual-Motor Integration (Beery, 1982)	The child copies geometric forms of increasing complexity
Early Childhood Diagnostic Instrument: The Comprehensive Assessment Program (Mason & Stewart, 1989)	The 5 subtests used include environmental print in and out of context, story and print concepts, upper and lower case letter naming, beginning and ending word sound awareness and writing
Verbal Memory (Weschler Preschool and Primary Scale of Intelligence Sentences; Weschler, 1967)	The child repeated sentences gradually increasing in length
Nonstandardized Tests	
Alphabet Recitation Test (Felton & Brown, 1990)	The child says the alphabet
Finger Localization Test (Felton & Brown, 1990)	With the child's hands under a cover, the examiner touches fingers one at a time in a random order and the child identifies which finger was touched by indicating it on a drawing
Uppercase and lowercase letter identification (McCormick et al., 1994)	First 26 uppercase and then the 26 lower case letters were presented in mixed order and the child was asked to give orally the name for each letter
Letter name knowledge (Muter & Snowling, 1998)	Child is required to give the name of each letter in the alphabet presented in random order and written in lower case
Short-vowel identification test (McCormick et al., 1994)	12 objects were pictured with three words printed under each and the child circled the correct word
Spelling test (Snow et al., 1995)	The child is required to spell eight words
Preschool Reading Achievement (PRA)	Parents were asked whether their child could read not at all, a few words, many words, or books
Orthographic processing (Badian, 2001)	The child points to the one of four stimuli (numbers, letters, and words) that exactly matches the item at the left of the row

APPENDIX B. Descriptions of the studies reviewed.

Bishop and Adams (1990)

Design	Longitudinal; multiple regression and step-wise multiple regression analyses
Participants	83 children whose language development had been impaired at 4 years of age; oral language measures were assessed at ages 4 ½ and 5 ½ and reading abilities assessed at 8 ½
Oral Language measures	Expressive phonology, MLU, Bus Story Test, BPVS, TROG, and BAS verbal comprehension and expressive vocabulary subtests
Lower level reading measures	Reading of non-words and the Neale Analysis of Reading Ability- form C
Higher level reading measures	Analysis of Reading Ability- form C

Felton and Brown (1990)

Design	Longitudinal; multiple regression analyses
Participants	81 children at risk for reading disabilities, 12 repeating kindergarten; oral language skills were assessed in kindergarten and lower level reading was assessed in Grade 1
Oral Language measures	Measures entered into the regression analyses: RAN of numbers and letters (combined score), Initial Consonant Not Same, Rhyme, Lindamood Auditory Conceptualization Test, Syllable Counting Test, Metropolitan Readiness Test auditory component, and Otis-Lennon Mental Ability Test Measures not entered into the regression analyses: Final Consonant Different, RAN of colours and objects, Metropolitan Readiness Test visual component and language component, Boston Naming Test, Word String Memory Test, Alphabet Recitation Test, and Finger Localization Test
Lower level reading measures	WRMT- form A (word identification and word attack subtests)
Higher level reading measures	N/A

Menyuk, Chesnick, Liebergott, Korngold, D'Agostino, and Belanger (1991)

Design	Longitudinal; step-wise regression analyses
Participants	130 children between the ages of 4 ½ and 6 ½ were followed for 3 years; the participants were divided into three groups: 1. Children with specific language impairment (SLI) as determined by standardized tests, 2. at-risk children who had previously been seen for speech and language evaluation, but did not meet the criteria for SLI, and 3. Children who had been born premature weighing less than 1500 grams at birth.
Oral Language measures	Token Test for Children, TACL, PPVT-R, DSS, Reporters Test, ITPA grammatical closure subtest, Expressive One Word Vocabulary Test, McCarthy Scales of Children's Ability Verbal Fluency subtest, Templin-Darley Articulation Screening Test, TOLD-P auditory discrimination subtest, syllable awareness (syllable segmentation task), phoneme awareness (phoneme segmentation task), word recall, RAN of colours, numbers, letters, and objects, semantactic judgement, cloze, story recall, comprehension of complex sentences.
Lower level reading measures	sight word recognition subtest of the WRAT and oral reading subtest of the GORT
Higher level reading measures	silent reading passages from the TORC

APPENDIX B. Descriptions of the studies reviewed (continued)

Catts 1993

Design	Longitudinal; hierarchical fixed-order regression analyses
Participants	86 children- 56 speech language impaired and 30 with normal speech-language abilities; oral language measures were first tested in kindergarten and reading abilities were tested in Grade 1 and Grade 2
Oral language measures	PPVT-R, Token Test for Children, TOLD-2: P (grammatical understanding, sentence imitation and grammatical closure subtests), Expressive One-Word Picture Vocabulary Test, SPELT- II, RAN of colours, objects, and animals, syllable deletion, phoneme deletion, syllable blending, phoneme blending, and Goldman-Fristoe Test of Articulation (not entered into regression analysis)
Lower level reading measures	WRMT- form A (word identification and word attack subtests), GORT-R
Higher level reading measures	GORT-R

McCormick, Stoner, and Duncan (1994)

Design	Longitudinal; multiple regression analyses
Participants	38 children of middle socioeconomic whose oral language skills were assessed in kindergarten and whose reading skills were assessed in Grade 1
Oral Language measures	PPVT-R, consonant identification task
Lower level reading measures	Iowa Tests of Basic Skills, Early Primary Battery, Level 6
Higher level reading measures	Iowa Tests of Basic Skills, Early Primary Battery, Level 6
Other measures	The following predictor variables were used, but are not discussed in this manuscript as they extend beyond oral language skills- Developmental Test of Visual-Motor Integration, uppercase and lowercase letter identification, short-vowel identification test

Hurford, Schauf, Bunce, Blaich, and Moore (1994)

Design	Longitudinal; discriminant analysis
Participants	171 students followed from beginning of Grade 1 to the end of Grade 2. All language measures were administered four times over the two years to determine if they could predict reader-group membership.
Oral Language measures	phonological discrimination task, phonemic segmentation of initial and final consonants of real words and pseudowords, PPVT-R
Lower level reading measures	WRMT-R (word identification and word attack subtests)
Higher level reading measures	N/A

Snow, Tabors, Nicholson, and Kurland (1995)

Design	Longitudinal; bivariate correlations
Participants	84 children from low socioeconomic families tested in kindergarten and again in Grade 1.
Oral Language measures	PPVT- R, narrative production, picture description, definitions, story comprehension task, superordinates (a subtest of CAP), CELF-R (listening to paragraphs subtest)
Lower level reading measures	WRAT-R reading subtest, GORT-R
Higher level reading measures	GORT-R

APPENDIX B. Descriptions of the studies reviewed (continued)

Other measures	Subtests from the Early Childhood Diagnostic Instrument: The Comprehensive Assessment Program (scores were tallied and used as an emergent literacy score), spelling test

Muter and Snowling (1998)

Design	Longitudinal; fixed-order multiple regression analyses; discriminant analyses
Participants	34 children assessed at ages 4, 5, and 6 to determine if lower level reading skills could be predicted at age 9
Oral Language measures	Rhyme detection, deletion task- initial phoneme, and nonword repetition task
Lower level reading measures	Neale Analysis of Reading Ability- Revised and Graded Nonword Reading Test
Higher level reading measures	N/A
Other measures	Letter name knowledge was also a predictor variable

O'Connor and Jenkins (1999)

Design	Longitudinal; discriminant analyses
Participants	445 children followed from kindergarten to the end of Grade 1; three cohorts- the first cohort was used to calibrate a model for predicting reading acquisition problems. The second cohort was used to test the reliability of the model and refine scoring criteria. Tests were repeated on the third cohort.
Oral Language measures	PPVT-R, sound repetition, rapid letter naming, syllable blending, syllable deletion, syllable segmenting, blending phonemes, segmenting phonemes, first sound isolation, rhyme production
Lower level reading measures	WRMT-R (word identification and word attack subtests)
Higher level reading measures	WRMT-R (vocabulary and comprehension subtests)

Manis, Seidenberg, and Doi (1999)

Design	Longitudinal; hierarchical regression analyses
Participants	67 grade 1 children representing the full range of reading abilities followed for one year until the end of Grade 2
Oral Language measures	RAN of letters and numbers, deletion- syllables, deletion- phonemes (the two deletion tasks were combined into one score when entered into the regression analysis)
Lower level reading measures	WRMT-R (word identification and word attack subtests) and Exception-word reading task
Higher level reading measures	Silveroli Classroom Reading Inventory- Graded Oral Paragraphs

Catts, Fey, Zhang, and Tomblin (1999) and (2001)

Design	Longitudinal; hierarchical regression analyses (1999); stepwise logistic regression analyses (2001)
Participants	604 children were followed from kindergarten and reading was assessed in Grade 2; 328 children had language impairments or nonverbal impairments or both and 276 subjects were typically developing children

APPENDIX B. Descriptions of the studies reviewed (continued)

Oral Language measures	deletion task (syllable and phoneme), RAN of animals, TOLD-2:P (sentence imitation, grammatical completion, picture vocabulary, oral vocabulary and grammatical understanding subtests), Narrative story task
Lower level reading measures	WRMT-R (word identification and word attack subtests)
Higher level reading measures	WRMT-R passage comprehension subtest, GORT-R comprehension component, Diagnostic Achievement Battery reading comprehension subtest The authors used data from their 1999 study to predict the likelihood a child in kindergarten will have reading difficulties in Grade 2.

Badian (2001)

Design	Longitudinal; stepwise and hierarchical regression analyses
Participants	Oral language measures were assessed in kindergarten and reading abilities were assessed in Grades 1, 3, and 7. Ninety-six children participated in Grades kindergarten, 1 and 3. Seventy-nine participants remained by Grade 7.
Oral Language measures	rhyme detection and syllable segmentation
Lower level reading measures	Grade 1: SAT (word reading and word study skill subtests)
Higher level reading measures	Grade 1: SAT (word reading and word study skill subtests) Grade 3: SAT (vocabulary and comprehension subtests) Grade 7: SAT (vocabulary and comprehension subtests)
Other measures	The following predictive measures were also included in the paper, but are not the focus for this manuscript: parent questionnaire of the amount of words the child could read, verbal IQ, verbal memory, and orthographic processing; the authors also predicted spelling (Grade 7 only)