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The Comprehension Problems of Children with Poor Reading Comprehension despite Adequate Decoding: A Meta-Analysis

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Abstract

The purpose of this meta-analysis was to examine the comprehension problems of children who have a specific reading comprehension deficit (SCD), which is characterized by poor reading comprehension despite adequate decoding. The meta-analysis included 86 studies of children with SCD who were assessed in reading comprehension and oral language (vocabulary, listening comprehension, storytelling ability, and semantic and syntactic knowledge). Results indicated that children with SCD had deficits in oral language ($d = -0.78$, 95% CI [−0.89, −0.68], but these deficits were not as severe as their deficit in reading comprehension ($d = -2.78$, 95% CI [−3.01, −2.54]). When compared to reading comprehension age-matched normal readers, the oral language skills of the two groups were comparable ($d = 0.32$, 95% CI [−0.49, 1.14]), which suggests that the oral language weaknesses of children with SCD represent a developmental delay rather than developmental deviance. Theoretical and practical implications of these findings are discussed.

Keywords

systematic review; meta-analysis; reading comprehension; poor comprehenders; oral language

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Reading comprehension, or the process of engaging text for the purpose of extracting and constructing meaning (Snow, 2002), has paramount importance to academic success and future life outcomes (National Institute of Child Health and Human Development [NICHD], 2000; Snow, 2002). Yet only about 36% of fourth graders and 34% eighth graders in the United States have reading comprehension scores at or above proficiency by the end of the academic year (U.S. Department of Education, 2015). Furthermore, nearly 31% of fourth graders and nearly 24% of eighth graders continue to attain reading comprehension scores that are below even the basic level. This indicates that a substantial proportion of fourth and eighth graders would have problems with more complex activities that extend beyond the text itself (e.g., comparing and contrasting ideas or making inferences beyond the text). This is particularly troubling given the importance of comprehension skills for success in school, in the workplace, and in daily life (e.g., understanding newspapers and forms and contracts to be signed).

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Given the importance of decoding to reading comprehension it is not surprising that decoding deficits often result in comprehension difficulties (Perfetti, 1985; Perfetti & Hart, 2001; Perfetti & Hogaboam, 1975; Perfetti, Landi & Oakhill, 2005; Shankweiler et al., 1999; Snow, Burns, & Griffin, 1998). However, it is estimated that between 10 and 15% of 7- to 8-year-old children have normal performance on decoding measures yet still experience deficits in reading comprehension (Nation & Snowling, 1997; Stothard & Hulme, 1995; Yuill & Oakhill, 1991); that is, these children are characterized as having a specific reading comprehension deficit (SCD). Although this estimate varies depending on the criteria used to identify children with SCD (see Rønberg & Petersen, 2015), large-scale identification studies have shown that the prevalence of SCDis most likely around 8% for children between the ages of 9 and 14 years (Keenan et al., 2014). Even an 8% prevalence rate would mean an average of two students in a classroom could meet the criteria for SCD.

Reading comprehension is a complex process, involving a variety of cognitive and linguistic skills. As a result, deficits in any cognitive ability important to the comprehension process can potentially lead to deficits in reading comprehension performance. Perfetti and colleagues (Perfetti et al., 2005; Perfetti & Stafura, 2014) provide a comprehensive framework for understanding the processes and skills involved in reading comprehension; deficits in comprehension could result from a variety of sources beyond decoding, including differences in sensitivity to story structure, inference making, comprehension monitoring, syntactic processing, verbal working memory, and oral language skills (Cain & Oakhill, 1996, 1999; Cain, Oakhill, Barnes, & Bryant, 2001; Nation, Adams, Bowyer-Crane, & Snowling, 1999; Nation & Snowling, 1998b, 1999; Oakhill, Hartt, & Samols, 2005; Pimperton & Nation, 2010a; Snowling & Hulme, 2012).

Existing studies of children with SCD show that they perform poorly on a range of oral language assessments (Cain, 2003; Cain, 2006; Cain et al., 2005; Cain & Oakhill, 1996; Carretti et al., 2014; Nation & Snowling, 2000; Oakhill et al., 1986; Stothard & Hulme, 1996; Tong, Deacon, & Cain, 2014; Tong, Deacon, Kirby, Cain, & Parrila, 2011; Yuill & Oakhill, 1991). However, relatively little is known about whether the comprehension problems of children with SCD are the result of their oral language deficits. Although it is possible that the documented deficits in oral language account for the observed deficits in reading comprehension, they may only be a contributing factor. A better understanding of the comprehension problems for children with SCD may be a first step towards better identification and remediation.

We briefly describe relevant theories of reading comprehension because existing theories may inform our understanding of the comprehension problems of children with SCD and understanding the comprehension problems of children with SCD in turn may inform theories of comprehension.

Theories of Reading Comprehension

Several theories of reading comprehension have emerged over the years. These include the bottom-up view, the top-down view, the interactive view, the metacognitive view, and the

simple view of reading comprehension. Each of these theories are relevant within the present context. Thus, we briefly discuss each theory below.

According to the bottom-up view of reading comprehension, readers move from an understanding of parts of language (e.g., letters, words) to an understanding of meaning or the whole (e.g., phrases, passages; Gough, 1972; Holmes, 2009; LaBerge & Samuels, 1974). Comprehension is thought to be a product of the acquisition of hierarchically arranged subskills (Dole et al., 1991). Thus, lower-level word recognition skills precede the development of more complex skills that lead to an eventual understanding of phrases, sentences, and paragraphs. Automaticity in processing and understanding written text is also thought to affect text comprehension (LaBerge & Samuels, 1974). Automaticity refers to the fact that proficient readers can read text automatically and that they do not need to focus consciously on lower-level word recognition. Thus, children with decoding problems allot greater cognitive resources to word recognition – and less to comprehension – whereas proficient readers are able to devote greater cognitive resources to higher-level cognitive processes (e.g., working memory; Daneman & Carpenter, 1980; Perfetti, 1985; Perfetti & Hogaboam, 1975).

Based on the top-down (i.e., conceptually-driven) view of reading comprehension, readers are moving from meaning down to the component parts of words as they engage with text (Rumelhart, 1980; Shank & Abelson, 1977). According to this view, a reader's mental frameworks or schemas are the driving force behind successful reading comprehension (Rumelhart, 1980). Readers are actively integrating new information that is encountered in the text with information that they have already stored within their previously established mental representations (i.e., background knowledge).

Top-down and bottom-up aspects are combined in the interactive view of reading comprehension. Based on this view, reading comprehension requires the reader to devote attentional resources to the more basic features of the text (e.g., letters, words) while simultaneously focusing on the more general aspects (e.g., syntax, semantics) and actively interpreting what is being read (Perfetti et al., 2005). Proficient readers are those who successfully engage with multiple sources of information provided within the text and information that is not readily available from the text (Kintsch, 1998; Perfetti & Stafura, 2014; van Dijk & Kintsche, 1983). Good readers are are able to recognize and interact with key features of the text, such as lexical characteristics, at the same time that they are more broadly identifying the purpose of a passage or a paragraph (Rayner, 1986; Rayner et al., 2001).

The simple view of reading asserts that reading comprehension is the product of decoding ability and language comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). The simple view also has substantial empirical validation. For example, decoding has emerged as a reliable predictor of reading comprehension ability in a variety of instances (e.g., Kendeou, van den Broek, White, & Lynch, 2009; Shankweiler et al., 1999). In fact, poor decoding skills are associated with reading comprehension problems (Perfetti, 1985). Additionally, oral language skills remain a robust and unique predictor of reading comprehension over and above word reading skills (Nation & Snowling, 2004).

Oral language is defined as the ability to comprehend spoken language (National Early Literacy Panel, 2008) and includes a wide variety of skills, such as expressive and receptive vocabulary knowledge, grammar, morphology, syntactic knowledge, conceptual knowledge, and knowledge about narrative structure (Beck, Perfetti, & McKeown, 1982; Bishop & Adams, 1990; Bowey, 1986; Perfetti, 1985; Roth, Speece, & Cooper, 2002). Oral language skills impact reading comprehension directly, such as through the understanding of the words presented in a text, as well as indirectly via other literacy-related skills (e.g., phonological awareness; NICHD, 2000; Wagner & Torgesen, 1987). Furthermore, the unique contribution of oral language to reading comprehension remains even after accounting for word recognition (Oullette, 2006).

The simple view provides a potential explanation for the reading comprehension problems of children with SCD that is consistent with their observed oral language deficits: Reading comprehension requires both adequate decoding and adequate oral language comprehension. This would explain the observation that children with SCD have adequate decoding but not adequate oral language comprehension. Catts, Adolf, and Weismer (2006) and Nation and Norbury (2005) applied this simple view of reading framework to identify different types of reading problems in eighth graders and 8-year-old children, respectively. According to this classification system, children with good decoding and good comprehension are adequate readers; children with poor decoding and poor comprehension are garden-variety poor readers; children with good comprehension and poor decoding meet criteria for dyslexia; and children with good decoding and poor comprehension have SCD. Thus, a mastery of both decoding and language comprehension is necessary for reading proficiency.

Developmental Delay or Developmental Deficit?

Developmental delay and developmental deficit are two hypotheses that are often discussed in relation to the nature of reading disability (e.g., dyslexia; see Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996). The developmental delay hypothesis asserts that poor reading performance results from a delayed acquisition of reading-related skills (Francis et al., 1996). However, these children follow the same developmental trajectory as typical readers (Francis et al., 1996). The developmental deficit hypothesis, on the other hand, states that the underlying skill shows a different or deviant developmental trajectory (Francis et al., 1996). For the case of reading disability, the underlying skill examined was phonological processing. We are interested in determining whether an oral language weakness represents a developmental delay or deficit for children with SCD. This hypothesis could be tested within studies that matched children with SCD to a younger group of typically-developing children (comprehension-age matching; see Cain, Oakhill, & Bryant, 2000). If children with SCD demonstrated similar performance to the comprehension-age matched group this would support developmental delay. If children with SCD had worse performance than the comprehension-age matched group, this outcome would support developmental deviance.

The importance of the distinction between developmental delay and developmental deficit is that a skill that is characterized as a developmentally deficit is more likely to be a contributing factor in the development of the reading problem. Developmental delay implies that the skill is consistent with the observed delay in reading and is therefore less likely to be

a contributing factor. To our knowledge, an empirical examination of these two hypotheses has not yet been conducted for the observed oral language deficits in children with SCD.

Identifying Children with SCD

Below, we describe a study conducted by Cain and Oakhill (2006) that has several characteristics that are typical of studies involving children with SCD. In this investigation, the authors were interested in the cognitive profiles of 7- to 8-year-old children with SCD; this age range is very common for investigations of children with SCD (e.g., Cain, 2003; Cain & Oakhill, 1996, 2007; Jerman, 2007; Oakhill, 1982). Children were selected based on their performance on measures of reading comprehension and word reading accuracy and were followed longitudinally. In this case, the Neale Analysis of Word Reading Ability was used to categorize children into groups of good and poor comprehenders. Age-appropriate word reading accuracy was defined as being between 6 (lower limit) and 12 months (upper limit) of their chronological age (e.g., Clarke, 2009). Poor reading comprehension was defined as a 12-month discrepancy between comprehension age and chronological age and their reading accuracy age and comprehension age (e.g., Nation & Snowling, 1999, 2000; Weekes, Hamilton, Oakhill, & Holliday, 2008). Typical readers are defined as attaining reading comprehension scores that are at or above word reading accuracy performance. Due to one-to-one matching and the low proportion of SCD in the population, final groups were small (23 children per group); this is typical of many studies involving children with SCD (e.g., Ehrlich & Remond, 1997; Geva & Massey-Garrison, 2012; Nation & Snowling, 1998a, 1998b). In this study, children were given a battery of assessments that included a combination of standardized and experimenter-created measures (e.g., Nation et al., 1999; Nation & Snowling, 2000). A unique aspect of this investigation is that children were followed longitudinally; many studies involving children with SCD are single time point studies (e.g., Cain & Oakhill, 1999; Oakhill, 1983).

SCD has been defined in a variety of ways across different studies. Although researchers tend to agree on the need for a discrepancy between an individual's decoding ability and their reading comprehension skills, individuals with SCD (also referred to as poor comprehenders or less-skilled comprehenders in the literature) have been identified using one of four criteria:

a. *A discrepancy between reading comprehension and decoding* (e.g., Isakson & Miller, 1976; Nation & Snowling, 1998a; Oakhill, Yuill, & Parkin, 1986; Pimperton & Nation, 2010a);

b. *A discrepancy between reading comprehension and decoding with an additional requirement that decoding skills are within the normal range* (e.g., Cain et al., 2001; Cataldo & Oakhill, 2000; Cragg & Nation, 2006; Torppa et al., 2009);

c. *Discrepancies between reading comprehension, decoding, and chronological age with an additional requirement that decoding skills are within the normal range* (Cain, 2003; Cain, 2006; Cain et al., 2000; Cain & Oakhill, 2006, 2011; Cain, Oakhill, & Elbro, 2003; Cain, Oakhill, & Lemmon, 2004; Cain & Towse, 2008; Clarke, 2009; Marshall & Nation, 2003; Nation & Snowling, 1997, 2000; Nation

et al., 2001; Oakhill et al., 2005; Spooner, Gathercole, & Baddeley 2006; Stothard & Hulme, 1995; Yuill, 2009; Yuill & Oakhill, 1991);

d. *A discrepancy between reading comprehension and word-level decoding with additional requirements that decoding skills are within the normal range and that comprehension scores fall below a given percentile or cut point* (Cain & Towse, 2008; Carretti, Motta, & Re, 2014; Catts et al., 2006; Henderson, Snowling, & Clarke, 2013; Kasperski & Katzir, 2012; Megherbi, Seigneuric, & Ehrlich, 2006; Nation, Clarke, Marshall, & Durand, 2004; Nation, Snowling & Clark, 2007; Nesi, Levorato, Roch & Cacciari, 2006; Pelegrina, Capodieci, Carretti, & Cornoldi, 2014; Pimperton & Nation, 2014; Ricketts, Nation, & Bishop, 2007; Shankweiler et al., 1999; Tong et al., 2011; Tong et al., 2014).

Despite the fact that differences in identification criteria influence the percentage of children identified as having SCD (see Rønberg & Petersen, 2015), children with SCD likely represent a small but significant proportion of struggling readers. Moreover, across studies included within the present review, SCD was identified using all of these different criteria. Therefore, our findings provide an overall estimate of the nature of children's comprehension problems regardless of identification method.

The purpose of the present meta-analysis is to better understand the comprehension deficits of children who have SCD. The framework for the present meta-analysis grew out of a recent investigation that tested three hypotheses regarding the nature of the comprehension problem in a large sample of over 425,000 first-, second-, and third graders with SCD (Spencer, Quinn, & Wagner, 2014). The three hypotheses tested whether comprehension problems for these children were largely specific to reading, general to oral language, or both (i.e., a mixture). Children were obtained from a statewide database, and prevalence of SCD was calculated based on percentile cutoffs. The results indicated that over 99 percent of children in each grade who had SCD also had deficits in vocabulary knowledge. This finding indicates that children's comprehension deficits were general to reading and at least one important aspect of oral language.

Although these results provide compelling evidence that comprehension problems are general to at least one aspect of oral language (i.e., vocabulary knowledge), three limitations of the study need to be noted. First, participants included mostly children attending Reading First schools, a Federal program for improving reading performance for students from low socioeconomic backgrounds. Because poverty is a risk factor for delayed development of oral language, the results may not generalize to students not living in poverty. Second, the assessments were brief and receptive vocabulary knowledge served as the only measure of oral language comprehension, when in fact, oral language is potentially comprised of a variety of different skills that might affect reading comprehension. Third, the study did not compare the relative magnitudes of the deficits observed in reading comprehension and vocabulary, a potentially important new source of data that could be used to compare alternative hypotheses about the nature of the comprehension problems of children with SCD.

These limitations suggest the need for a comprehensive review of the literature on the nature of the comprehension problems of children who have SCD. Such a review could incorporate results from studies with more representative samples and using a variety of measures. By examining magnitudes as well as the existence of deficits in reading versus oral-language comprehension, it would be possible to test a previously neglected hypothesis in Spencer et al. (2014), namely that children with SCD could have deficits in oral language that are not as severe as their deficits in reading comprehension.

Thus, in addition to testing two hypotheses from Spencer et al. (2014) – (a) Children with SCD have comprehension deficits are specific to reading, such that they demonstrate impaired reading comprehension but no impairments in oral language and (b) children with SCD have comprehension deficits are general to reading and oral language, such that they demonstrate equal impairment in reading comprehension and oral language – we also test a third hypothesis in the present meta-analysis, (c) children with SCD have comprehension deficits that extend beyond reading to oral language, but they demonstrate greater impairment in reading comprehension than in oral language.

Theoretical and Empirical Support for Alternative Hypotheses about the Nature of the Comprehension Problems for Children with SCD

Hypothesis one: children with SCD have comprehension problems that are specific to reading

Theoretical support for this hypothesis comes from the bottom-up view of reading comprehension and from the automaticity of reading (Gough, 1972; Holmes, 2009; LaBerge & Samuels, 1974). It is possible that children might have adequate decoding but their adequate decoding requires processing resources that are then not available for comprehension while reading. If this were the case, their comprehension would be impaired for reading comprehension because decoding is required but not impaired for oral language.

Empirical support for this hypothesis comes from studies that demonstrate the existence of individuals who have been identified as having SCD in the presence of intact or relatively intact vocabulary knowledge (Cain, 2006; Nation, et al., 2010). Moreover, some studies that compared children with and without SCD matched them on vocabulary performance (e.g., Cain, 2003, Cain, 2006; Spooner et al., 2006; Tong et al., 2014). That it was possible to do this match supports the possibility that comprehension problems are specific to the domain of reading.

Hypothesis two: children with SCD have comprehension problems that are general to reading and oral language

Several theoretical perspectives provide a rationale for this hypothesis, including the simple view, top-down view, and interactive views of reading comprehension. The simple view (Gough & Tunmer, 1986; Hoover & Gough, 1990) provides support for this hypothesis because it explains SCD as resulting from a deficit in oral language comprehension (Catts et al., 2006; Nation et al., 2004). The top-down and interactive views are in line with this hypothesis because both frameworks emphasize the readers' mental frameworks (Rumelhart,

1980; Shank & Abelson, 1977). The top down processing highlighted in both frameworks would affect comprehension regardless of whether the context is written or oral language.

Empirical support for this hypothesis comes from studies showing that oral language ability is a predictor of future reading comprehension success and failure (Nation & Snowling, 2004; Snow et al., 1998); children with reading comprehension problems tend to have deficits in oral language (Catts, Fey, Tomblin, & Zhang, 2002). For example, Catts, Fey, Zhang, and Tomblin (1999) investigated relations between oral language and reading comprehension skills in second graders. Results indicated that children with reading comprehension deficits were significantly more likely to have had oral language weaknesses in kindergarten compared to students with more typical comprehension development (see also Elwer, Keenan, Olson, Byrne, & Samuelsson, 2013).

The view that comprehension problems are general to oral language and reading is supported by multiple investigations. Children with SCD have demonstrated weaknesses related to a variety of oral language domains, such as semantic processing, listening comprehension, and syntactic ability (Carretti, Motta, & Re, 2014; Nation & Snowling, 2000; see Cain & Oakhill, 2011 and Justice, Mashburn, & Petscher, 2013 for longitudinal evidence). When compared to typical readers, these children also tend to perform significantly poorer on measures tapping verbal working memory skills (see Carretti, Borella, Cornoldi, & De Beni, 2009). Differences between typically-developing readers and individuals with SCD have also been reported using a wide variety of behavioral and EEG/ERP measures (e.g., Landi & Perfetti, 2007).

Hypothesis three: children with SCD have comprehension problems that extend to oral language but are less severe for oral language than for reading

Theoretical support for this hypothesis is provided by a combination of theoretical rationales discussed for the previous two hypotheses. Specifically, a deficit that is general to oral language as well as reading comprehension is assumed, combined with additional deficits that are specific to reading. For example, a deficit in vocabulary would impair performance in reading comprehension and oral language. Simultaneously, decoding and orthographic processing could require attention and cognitive resources that are not required by listening, such as visual processing. The combined result would be impairments in both oral language and reading comprehension, but the impairment would be greater for reading comprehension.

Empirical support for this hypothesis comes from studies showing that these children demonstrate differential performance across various oral language tasks (Cain, 2003; Cain, 2006; Cain, Oakhill, & Lemmon, 2005; Stothard & Hulme, 1992; Tong et al., 2014). For example, Cain (2003) examined language and literacy skills in children with SCD who were matched to typical readers based on vocabulary; however, these same children exhibited significantly poorer performance on other oral language tasks, such as listening comprehension and a story structure task. Similarly, Tong et al. (2014) included children with SCD who were vocabulary-matched to typical readers. Yet, children with SCD exhibited poor performance on a morphological awareness task. Therefore, it may be that

the comprehension problems of children with SCD affects some but not all aspects of oral language.

Inclusion of Potential Moderators

Additionally, we were interested in examining the effect of several potential moderators of effect size outcomes, specifically the effects of (a) publication type, (b) participant age, and (c) type of oral language measure. The rationale for these moderators are as follows: First, if publication type (e.g., published journal article versus unpublished dissertation) significantly predicts effect size outcomes, we would attribute this, at least partially, to publication bias. Thus, we wanted to include this variable within each meta-analysis. Second, we were interested in participant age as a moderator of effect sizes (Catts et al., 2006; Elwer et al., 2013; Nation, Cocksey, Taylor, & Bishop, 2010). Previous research has also indicated that younger children with SCD tend to have weaker reading comprehension skills compared to older children (Authors, 2017). We sought to investigate whether this finding would be replicated within a different sample and also whether these differences transfer to oral language skills as well. Finally, type of oral language measure was included as a potential moderator due to the fact that oral language measures vary greatly in the skills that they assess (Cain & Oakhill, 1999; Nation et al., 2004, 2010; Tong et al., 2011). For instance, a receptive vocabulary assessment is likely to be much less difficult for a child with SCD compared with a syntactic or morphological task. Therefore, examining the potential effects of type of oral language measure may provide additional insight into which tasks may be best to use for identifying children with SCD.

The Present Study

Across four decades, multiple systematic reviews of reading comprehension have been conducted. These reviews have examined a variety of topics, including an examination the component skills of reading comprehension and intervention research for struggling readers (e.g., Bus & van Ijzendoorn, 1999; Ehri, Nunes, Stahl, & Willows, 2001; Swanson, Tranin, Necoechea, & Hammill, 2003). In more recent years, there have been several narrative reviews focusing specifically on children with SCD (Hulme & Snowling, 2011; Nation & Norbury, 2005; Oakhill, 1993), but only one known meta-analysis to date has investigated the cognitive skills of these individuals (Carretti et al., 2009). However, Carretti et al. (2009) focused exclusively on working memory skills whereas the present investigation examines performance of children with and without SCD on a wide array of oral language tasks in addition to verbal working memory.

In the present review, we examine studies using five methods. First, we conducted between-group meta-analyses comparing the reading comprehension performance of children with SCD with the reading comprehension performance of typically-developing readers. Second, we conducted between-group analyses comparing the oral language performance (as indexed by measures of vocabulary, listening comprehension, storytelling ability, morphological awareness, and semantic and syntactic knowledge) of children with SCD with the oral language performance of typically-developing readers. Third and fourth, we conducted the same meta-analyses for reading comprehension and oral language performance for studies

that included a comprehension-age matched group (see Cain et al., 2000). The existence of such studies makes it possible to determine whether impaired oral language performance represents developmental delay (i.e., performance similar to younger normal comprehenders) or a developmental difference (i.e., performance different than that of younger normal comprehenders; Francis et al., 1996). Finally, we conducted a separate meta-analysis for studies reporting performance on standardized reading comprehension and oral language measures for the same participants (i.e., a within-child comparison of reading comprehension and oral language) because we were interested in the comparability of oral language skills to reading comprehension within children who have SCD.

Method

Study Collection

The current meta-analysis includes studies published in English from January 1, 1970 to February 20, 2016. Several electronic databases and keywords were used to locate relevant studies. These databases included *PsycINFO, ERIC, Medline,* and *ProQuest Dissertations.* In an effort to reduce the likelihood of publication bias within the present review, we also searched several gray literature databases (i.e., *SIGLE, ESRC,* and *Web of Science*). We used title-based keywords related to reading comprehension and reading disabilities (*specific comprehension deficit*, poor comprehender*, comprehension difficult*, less-skilled comprehen*, comprehension failure, reading difficult*, difficulty comprehending, poor comprehension, struggling reader*, specific reading comprehension difficult*, specific reading comprehension disabilit*, low comprehender*, weak reading comprehen*, reading comprehension disab*, poor reading comprehension*) in combination with other reading-related keywords (*reader*, reading, subtype*, subgroup*). Our search spanned peer-reviewed and non-peer-reviewed journal articles, dissertations and theses, book chapters, reports, and conference proceedings. The references of relevant articles were also hand searched, and we contacted researchers who had at least three relevant publications (first authored or not) as a way of including unpublished data within the present review. We conducted additional searches for these same researchers using author- and abstract-based keyword searches [au(*author*) AND ab(*comprehen**)].

Inclusionary criteria—Several inclusionary criteria were used to select studies to be included within the present synthesis. Studies were required to: (a) report original data (i.e., sample means, standard deviations, correlations, sample sizes, *t*-tests, and/or *F*-tests); (b) include native speakers of a language; (c) assess children between the ages of 4 and 12 years; (d) contain at least one measure of reading comprehension, decoding ability, and oral language; (e) include a sample of children with SCD based on their performance on measures of reading comprehension and decoding ability; and (f) include a typically-developing group of readers for comparisons[2].

We applied the language-based criterion because we wanted to be able to investigate the relation between poor reading comprehension and oral language skills separate from

[2]For some comparisons, this comparison included skilled comprehenders.

language status because language status is known to affect reading comprehension (e.g., Kieffer, 2008). However, studies could include monolingual samples that spoke a language other than English (e.g., Italian) provided that the study was reported in English. Acceptable measures of reading comprehension included assessments that measured individuals' comprehension of the text beyond word reading ability; acceptable measures of decoding ability included assessments that measured real word decoding, nonword decoding, and/or reading accuracy; and acceptable measures of oral language included tasks that assessed vocabulary knowledge, syntactic and semantic processing, listening comprehension, and/or storytelling ability.

Exclusionary criteria—Three exclusionary criteria were applied for studies included in the current meta-analysis: (a) teacher and parent ratings were not acceptable methods for identifying children with SCD, (b) samples of non-native speakers, and (c) samples could not also contain children characterized as having intellectual disability, attention deficit hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), aphasia, hydrocephalus, or hearing or vision impairments.

Final study selection—The initial search yielded approximately 3,050 results. After eliminating duplicates, studies that did not adhere to our inclusion/exclusion criteria, and studies reporting results from identical participants, a total of 86 studies remained.

A random sample of 10% of the studies was coded twice by the first author and a graduate student in order to establish inter-coder reliability; studies were coded based on study features (i.e., study type, sample size, operational definition of SCD, matching variables, language spoken, and sample age) and reading comprehension- and oral language-related constructs (i.e., reported reliabilities, correlations with oral language measures, means and standard deviations for each assessment, and reported t values or F ratios). We additionally coded participant age, type of oral language measure (i.e., vocabulary knowledge, narrative, listening comprehension, syntactic/grammar, semantic knowledge, and figurative language), and type of publication (i.e., journal article, book chapter, theses/dissertations, and unpublished data). Cohen's kappa was used to measure inter-coder reliability (96% for study features; 98% for reading comprehension-related constructs; 94% for the oral language-related constructs). The overall reliability exceeded acceptability of kappa ≥ .70 (kappa = 96%). Discrepancies were resolved through discussion or by referring to the article.

The final sample included 84 studies for between (k_{brc} = 152 effect sizes for reading comprehension; k_{bol} = 309 effect sizes for oral language) and within-group analyses (k_{wrc} = 97 effect sizes). The between-group analyses were twofold. One was a comparison of children with SCD to typical readers and another was a comparison of children with SCD to a comprehension-age matched group of children. Between-group comparisons of children with SCD to typical readers allowed for a test of the three hypotheses outlined previously: (a) children with SCD have comprehension problems that are specific to reading; (b) children with SCD have comprehension problems that are general to reading and oral language; or (c) children with SCD have comprehension problems that extend to oral language but are less severe for oral language than for reading. Between-group comparisons of children with SCD to a comprehension-age matched group allowed for a test of the delay

versus deficit hypotheses for the anticipated oral language difficulties. A subsample of the original study sample (*n* = 4) included comprehension-age matched groups for additional analyses (k_{brc} = 4 effect sizes for reading comprehension; k_{bol} = 30 effect sizes for oral language).

Within-child analyses require that both measures within a single study use the same scale. Thus, in order to be included within the within-child analysis, studies had to include standardized measures of reading comprehension and oral language and report standard scores, scaled scores, *z*-scores, or *t*-scores. Our within-child analyses allowed us to test the robustness of the pattern of results observed in the between-group comparison. That is, we were able to compare the reading comprehension and oral language skills *within children* who had SCD.

Meta-Analytic Methods

All analyses were conducted using Microsoft Excel (Version 14.0), and Metafor (Viechtbauer, 2010) and Robumeta packages in *R* (Fisher & Tipton, 2015). Effect sizes were calculated using Hedge's *g* (Hedges, 1981), which is Cohen's *d* (Cohen, 1977) after incorporating a correction for small sample sizes. Negative effect size values indicate that children with SCD had a lower group mean than typically developing readers. In several instances, groups were vocabulary-matched (i.e., children with SCD were selected on the basis of having average vocabulary performance compared to a group of typical readers).[3]

Average weighted effect sizes for each meta-analysis were calculated using random-effects models, which assume all parameters to be random as opposed to fixed (Shadish & Haddock, 2013). We used random-effects models in the present investigation because *Q* (i.e., homogeneity of effect size; Hedges & Olkin, 1985) was rejected across most comparisons. For one comparison, *Q* was not rejected; for this meta-analysis, we used a fixed-effects model. We also estimated I^2, which calculates the percentage of variance due to heterogeneity. We used random-effects models to calculate a 95% confidence interval (CI) in order to determine whether each calculated average weighted effect size was statistically significant (i.e., different from zero). A CI within random-effects models assumes systematic study variability (i.e., that differences across studies do not result from random sampling error; Shadish & Haddock, 2013). We additionally conducted an Egger test for funnel plot asymmetry within each meta-analysis as a means of testing whether publication bias was present (significant plot asymmetry) or absent (non-significant plot asymmetry; Egger, Smith, Schneider, & Minder, 1997).

Across meta-analyses, there were several instances in which a single study resulted in multiple effect size estimates. We used robust variance estimation with the small sample size correction to handle dependent effect sizes (Hedges, Tipton, & Johnson, 2010; Tipton, 2015). This relatively recent approach has advantages over alternative approaches to handling dependent effect sizes such as including only one effect size per study, creating an average effect size, or using multivariate approaches to model the dependency. Robust

[3]Although groups were matched, correlations for the same measure between the two groups were not reported in most instances; thus, independent effect sizes were calculated.

variance estimation allows one to use all effect sizes including multiple ones from the same sample in the meta-analysis for estimating average weighted effect sizes and for testing possible moderators, then corrects for the effects of the dependencies in the significance testing. Although robust variance estimation can be implemented in macros to common statistical packages such as SPSS, an efficient way of doing so is by using the Robumeta package available in R (Fisher & Tipton, 2015). We carried out meta-regressions analyses of potential moderators using Robumeta when there were dependent effect sizes. For meta-analyses that did not demonstrate dependency among effect size estimates (i.e., between group comparison of reading comprehension for children with SCD and comprehension-age matched children), we calculated the average weighted effect size estimate using traditional methods in Metafor.

Results

A total of 86 independent studies were included within the analyses. Effect sizes for each comparison are reported in Table 1 (see also Appendices A, B, and C). A substantial portion of studies included English-speaking samples (Study $n = 72$). Fourteen studies included children who spoke Italian ($n = 5$), French ($n = 3$), Finnish ($n = 1$), Hebrew ($n = 1$), Chinese ($n = 2$), Portuguese ($n = 1$), and Spanish ($n = 1$). Across studies, children were between the ages of 4 and 12 years.

Effect Size Analyses

Comparisons of children with SCD to typical readers—We compared children with SCD to typical readers on measures of reading comprehension and oral language. These analyses served as a means to test whether: (a) children with SCD have comprehension problems that are specific to reading; (b) children with SCD have comprehension problems that are general to reading and oral language; or (c) children with SCD have comprehension problems that extend to oral language but are less severe for oral language than for reading.

Reading comprehension: One hundred and fifty-two comparisons were made for the reading comprehension of children with SCD and typically-developing readers (Study $n = 84$). Across studies, there were 17,600 children with SCD ($M = 209.53$; $SD = 703.14$; range: 7-3,236) who were compared with 155,874 typically developing children ($M = 1{,}855.64$; $SD = 6{,}737.96$; range: 8-29,676). The average weighted effect size was negative, large, and statistically significant (random-effects robust variance estimation: $d = -2.78$, 95%CI [−3.01, −2.54]). Because the CI does not include zero, this indicates that the effect size estimate is significantly different from zero. This suggests that children with SCD performed substantially poorer on measures of reading comprehension compared to their typically developing peers, which was expected. Study-specific effect sizes for reading comprehension, participant ages, and sample sizes for these comparisons are reported in Appendix A; effect sizes are reported in descending order. There was a large variability in effect size estimates across studies due to heterogeneity, $I^2 = 94.39$ (see Table 1). Sensitivity analyses indicated that varying values of rho (ρ) from 0 to 1 in .20 increments did not affect tau squared (τ^2), the subsequent weights, and the average weighted effect size estimate. This outcome suggests that the observed effect size is fairly robust. An Egger test of funnel plot

asymmetry was significant, $z = -7.09$, $p < .0001$ (see Figure 1), indicating asymmetry in effect size estimates across studies.

Oral language: Three hundred and nine comparisons were made for the oral language skills of children with SCD and typically-developing children, (Study $n = 76$). There were 16,494 children with SCD ($M = 219.93$; $SD = 706.39$; range: 7-3,016) who were compared with 144,857 typically developing children ($M = 1{,}931.43$; $SD = 6{,}676.47$; range: 8-28,970). The average weighted effect size was also negative, large, and statistically significant (random-effects robust variance estimation: $d = -0.78$, 95% CI [−0.89, −0.68]). Thus, when compared to children without comprehension problems, children with SCD additionally exhibit difficulty completing oral language tasks; however this deficit was not as severe as for reading comprehension. Study-specific effect sizes for oral language, participant ages, and sample sizes for these comparisons are reported in Appendix A; effect sizes are reported in descending order. Variability due to heterogeneity was large across studies, $I^2 = 85.55$ (see Table 1). Sensitivity analyses indicated that the observed effect size is fairly robust; varying values of ρ resulted in no differences. An Egger test of funnel plot asymmetry was significant, $z = -2.11$, $p < .05$ (see Figure 1), suggesting some asymmetry in estimates. Additionally, we also examined verbal working memory for studies that were already included in the analysis, which added 91 additional comparisons to the analysis. The average weighted effect size remained negative, large, and statistically significant (random-effects robust variance estimation: $d = -0.77$, 95% CI [−0.87, −0.67]; $I^2 = 85.12$; see Table 1).

It is important to note that across comparisons of reading comprehension and oral language, different studies were available for analyses; however, when we analyzed only overlapping studies (Study $n = 74$), the effects for reading comprehension (random-effects robust variance estimation: $d = -2.80$, 95% CI [−3.05, −2.55]; $I^2 = 94.68$) and oral language were nearly identical (random effects robust variance estimation: $d = -0.79$, 95% CI [−0.90, −0.68]; $I^2 = 85.50$).

Comparisons of children with SCD to comprehension-age matched readers— Given that we found evidence that children with SCD do exhibit deficits in oral language, we were additionally interested in how such deficits were best characterized. Thus, we conducted a between-groups meta-analysis that compared the performance of children with SCD to younger comprehension-age matched readers. Children in the comprehension-age matched group were selected on the basis of having performance equivalent to children with SCD (see Cain et al., 2000).[4] Across studies, children within the comprehension-age matched group were approximately two years younger than children with SCD.

Reading comprehension: Four comparisons were made for the reading comprehension skills of children with SCD and comprehension-age matched control children (Study $n = 4$). There were 73 children with SCD ($M = 18.25$; $SD = 7.23$; range: 14-29) compared with 68 typically-developing children across studies ($M = 17.00$; $SD = 6.78$; range: 14-27). Study-specific effect sizes for reading comprehension, participant ages, and sample sizes for these

[4]Although groups were matched, correlations for the same measure between the two groups were not reported in most instances; thus, independent effect sizes were calculated.

comparisons are reported in Appendix B; effect sizes are reported in descending order. The average weighted effect size was moderate and negative, but it was not statistically significant (fixed-effects: $d = -0.31$, 95% CI [−0.31, 0.02)]; $Q(3) = .38$, $p = .94$, $I^2 = <1\%$; see Table 1). This outcome was expected given that the two groups were matched for reading comprehension performance. An Egger test of funnel plot asymmetry was non-significant, $z = -.13$, $p = .90$ (see Figure 1).

Oral language: Thirty comparisons were made for the oral language skills of children with SCD and children within comprehension-age matched groups (Study $n = 4$). There were 73 children with SCD ($M = 18.25$; $SD = 7.23$; range: 14-29) and 68 typically-developing children across studies ($M = 17.00$; $SD = 6.78$; range: 14-27). The average weighted effect size was moderate and in favor of comprehension age-matched readers, but it was not statistically significant (random-effects robust variance estimation: $d = 0.32$, 95% CI [−0.49, 1.14]). These findings suggest that the oral language performance of children with SCD is similar to the performance of younger typical readers. In other words, there is a developmental delay in the oral language skills of children with SCD. Study-specific effect sizes for oral language, participant ages, and sample sizes for these comparisons are reported in Appendix B; effect sizes are reported in descending order. Across studies, the variability due to heterogeneity was relatively high, $I^2 = 77.13$ (see Table 1). Sensitivity analyses indicated that the observed effect size was quite robust; varying values of ρ resulted in a .02 difference (τ^2 =.402 when ρ = 0; .423 when ρ = 1), which was minimal. However, because the degrees of freedom for these analyses were less than four, it is important to interpret these results cautiously (Fisher & Tipton, 2015). An Egger test of funnel plot asymmetry was non-significant, $z = -0.71$, $p = .48$ (see Figure 1).

Within-child comparisons of reading comprehension and oral language for children with SCD—In addition to comparing the language and literacy skills of children with SCD to typically-developing readers and comprehension age-matched readers, we also compared the oral language skills to reading comprehension within children who have SCD. The aim of this meta-analysis was so test to robustness of the results (i.e., would the same pattern of findings emerge if comparisons were made for the same group of children [within-group] as opposed to comparisons across different groups [between-group]). Thus, we additionally conducted analyses that examined the reading comprehension and oral language skills within individuals.

Ninety-seven comparisons were included within the analysis (Study $n = 32$). There were 12,711 children with SCD ($M = 397.22$; $SD = 822.21$; range:7-2,830). Because these analyses included children with SCD, we corrected correlations for range restriction using Thorndike's (1949) correction equation.[5] The average weighted effect size was moderate, negative, and statistically significant (random-effects robust variance estimation: $d = -0.84$, 95% CI [−1.06, −0.62]), which indicates that the reading comprehension skills of children with SCD are significantly weaker than their oral language skills. These results can be found in Table 1. Study-specific effect sizes, participant ages, and sample sizes for these

[5]In several instances, studies did not report correlations. For these studies, an estimated correlation was substituted.

comparisons are reported in Appendix C; effect sizes are reported in descending order. Across studies, the variability due to heterogeneity was substantial, $I^2 = 96.06$. However, sensitivity analyses indicated that the observed effect size was fairly robust; varying values of ρ resulted in no difference in estimates of τ^2. An Egger test of funnel plot asymmetry was non-significant for these comparisons, $z = 1.33$, $p = .18$ (see Figure 1).

It is important to note that different sets of studies were included within our analyses of between-group and within-child comparisons. This may explain why the difference between reading comprehension and oral language performance within children ($d = -0.84$) was not equivalent to the differences found between groups for reading comprehension and oral language (effect size difference between −2.78 and −0.78 was −2.00). We empirically tested this by analyzing only those studies that were included within the between-group reading comprehension (random-effects robust variance estimation: $d = -2.73$, 95% CI [−3.05, −2.42]; $I^2 = 96.82$) and oral language comparisons (random-effects robust variance estimation: $d = -0.95$, 95% [CI −1.06, −0.83]; $I^2 = 91.00$) and the within-child comparisons. Applying this method, we achieved anoticeable reduction in the effect size differences across comparisons (effect size difference between −2.73 and −0.95 was 1.78). This outcome may be a partially due to the absence of publication bias within the within-group comparisons relative to the potential presence of publication bias within the reading comprehension and oral language comparisons.

Moderator Analyses

Metaregressions of study type, age, and oral language measures for comparisons of children with SCD to typical readers—Due to the substantial amount of heterogeneity across studies, we were interested in examining three possible moderators – age, type of oral language measure, and study type (i.e., published journal article, book chapter, thesis/dissertation, unpublished data) – that may explain effect size differences among various studies (see Table 1 and Appendices D and E). Due to the dependency of effect sizes across studies, we used robust variance estimation to conduct moderator analyses for the present comparisons.

Study type, $\beta = .14$, $p > .05$, $t(11.8) = 1.05$, was not a significant moderator of differences in effect size estimates for reading comprehension for comparisons of children with SCD to typical readers. However, age, $\beta = -.47$, $p < .05$, $t(23.9) = -2.53$, was a significant moderator of effect size differences. Next, we examined moderators for comparisons of oral language. Neither study type nor age were significant moderators of differences in effect size outcomes for oral language, $\beta = -.04$, $p > .05$, $t(17) = -0.77$ for study; $\beta = -.06$, $p > .05$, $t(20.1) = -0.85$ for age. Because oral language was assessed using different measures across studies, we also conducted a metaregression to examine the potential for differences in oral language measures to be a moderator of effect size outcomes. Because oral language varied both within and across studies, it is important to include both the mean (i.e., between-study covariate) and mean-centered predictors (i.e., within-study covariate) within the moderator analyses to account for the potentially hierarchical structure of the effect size dependencies (Fisher & Tipton, 2015). Using this method, type of oral language measure was not a

significant moderator of effect size across studies, $\beta_m = -.05$, $p > .05$, $t(16.5) = -0.91$; $\beta_{mc} = .00$, $p > .05$, $t(16.9) = 0.02$.

Metaregressions of study type, age, and oral language measures for comparisons of children with SCD to comprehension-age matched readers— We also examined potential moderators within our reading comprehension age-matched comparisons (see Table 2). Similar to our between group comparisons, the type of oral language measure, $\beta_m = -.10$, $p > .05$, $t(1.08) = -0.18$; $\beta_{mc} = -.23$, $p > .05$, $t(1.20) = -1.05$, was not a significant moderator of effect size for the oral language comparisons.[6] However, because the degrees of freedom were less than four, this finding should be interpreted cautiously. Study type and the age range of participants was constant across studies, thus negating the need to conduct moderator analyses for these constructs for the reading comprehension and oral language comparisons.

Metaregressions of study type, age, and oral language measures for within-child comparisons—We examined the moderators of study type, age, and oral language measure within our within-group comparisons as well, which are summarized in Table 2. Study type was a significant predictor of differences in effect size, $\beta = -.24$, $p < .01$, $t(15.3) = -2.77$. Similarly, type of oral language measure was a significant predictor at the mean, $\beta_m = .20$, $p < .01$, $t(15.40) = 2.35$; $\beta_{mc} = -.03$, $p > .05$, $t(8.30) = -0.85$. Age, however, was a non-significant predictor in the model, $\beta = -.00$, $p > .05$, $t(12.9) = -0.02$.

Discussion

The aim of the present meta-analysis was to determine the nature of the comprehension problems for children with SCD. This investigation was guided by three competing hypotheses: (a) children with SCD have comprehension deficits that are specific to reading; (b) children with SCD have comprehension deficits that are general to reading and oral language; or (c) children with SCD have comprehension problems that extend beyond reading but are more severe for reading than for oral language. The findings of the present meta-analysis support the third hypothesis. Children's weakness in oral language was substantial ($d = -0.78$), but not as severe as their deficit in reading comprehension ($d = -2.78$). The effects size estimates for oral language were comparable regardless of whether verbal working memory was included in the analysis ($d = -0.77$). Within-child comparisons also indicated that performance in reading comprehension was worse than for oral language ($d = -0.84$). The pattern of poorer performance in reading comprehension compared to oral language was consistent across all analyses.

When compared to comprehension age-matched readers, children with SCD tended to have comparable oral language ($d = 0.32$, *ns*) and reading comprehension skills ($d = -0.31$, *ns*). The fact that older children with SCD did not differ from younger normal readers on reading comprehension was expected rather than informative because the groups were matched on reading comprehension. However, the fact that they did not differ in oral language is

[6]We also conducted moderator analyses for type of oral language measure without accounting for hierarchical structure and the results remained the same [β #x0003D; −0.31, $p > .05$, t(1.40) = −0.98].

informative. It supports the idea that the oral language weaknesses for children with SCD are best characterized as arising from a developmental delay as opposed to a developmental deviance (Francis et al., 1996). A developmental deviance would have been supported had the oral language performance of the older children with SCD been worse than that of the younger comprehension-age matched normal readers.

Overall, our results are consistent with previous investigations. Children with SCD perform poorly on a range of oral language assessments including receptive and expressive vocabulary knowledge, listening comprehension, story structure, knowledge of idioms, awareness of syntactic structure, and morphological awareness among others (Cain, 2003; Cain, 2006; Cain & Oakhill, 1996; Cain et al., 2005; Carretti et al., 2014; Nation & Snowling, 2000; Oakhill et al., 1986; Stothard & Hulme, 1996; Tong et al., 2011, 2014; Yuill & Oakhill, 1991). These weaknesses emerged despite children's adequate decoding and seemingly intact phonological processing abilities (Nation & Snowling, 2000; Nation et al., 2007; Stothard & Hulme, 1992). Yet, this pattern makes sense given that phonological processing appears to underlie decoding ability (Nation et al., 2007; Shankweiler et al., 1999; Stothard & Hulme, 1996).

Explanations for Greater Deficits in Reading Comprehension than in Oral Language

A number of possible explanations for the observed discrepancies between reading comprehension and oral language exist. Although it is not possible to test alternative explanations in the context of the present meta-analysis, they could be tested in future studies.

A latent decoding deficit—At first glance, it seems counterintuitive that a decoding deficit would explain comprehension differences in children with SCD. However, in several studies, only decoding accuracy was used to categorize children (e.g., Cain & Oakhill, 2006). It is possible to be adequate in decoding accuracy yet inadequate in decoding fluency. In fact, this is a common outcome of intervention studies (e.g., de Jong & van der Leij, 2003; Torgesen & Hudson, 2006). The effortful application of phonics rules or other decoding strategies can result in accurate but slow decoding. This could impair reading comprehension because children's reading would be less automatic (LaBerge & Samuels, 1974) and/or because fewer cognitive resources would be available for comprehension (e.g., Perfetti, 1985). This possible explanation could be tested in future studies by using measures of decoding fluency as well as accuracy. A dual-task paradigm could also be used to determine whether the cognitive resources required by decoding were comparable for children with and without SCD.

Differences between written and oral language—Written language differs from oral language in important ways (Perfetti et al., 2005). Written language oftentimes contains more complex sentence structures and more difficult vocabulary than spoken language (Akinnaso, 1982; Halliday, 1989). Thus, if children are having difficulty completing tasks that require the use of syntactic knowledge, for instance, they will most likely have difficulty reading grammatically complex texts. Fundamental differences between written and spoken text may also extend to increased demands on background knowledge (e.g., Wolfe &

Woodwyck, 2010). Background knowledge has been identified as a critical component within several models of reading comprehension (Kintsch, 1988; Kintsch, & van Dijk, 1983; Rumelhart, 1980). For instance, Kintsche and van Dijk's (1983) situation model describes the comprehension process as arising from an interaction of three mental models: the reader's text representation, semantic or meaning-based representation, and situational representation (i.e., prior knowledge, experiences, and interest).

There is also empirical evidence for the importance of background knowledge in reading comprehension (e.g., Stahl, Hare, Sinatra, & Gregory, 1991). This may explain why children with SCD also have problems with elaborative inference making and comprehension monitoring (Cain et al., 2001; Oakhill, 1984, 1993; Oakhill & Yuill, 1996). Further, differences in the amount of background knowledge required across oral language and reading comprehension tasks may explain the present pattern of skill deficits. This explanation could be tested in future studies by having children perform reading comprehension and listening comprehension tasks on identical passages and have the tasks counterbalanced across two groups. However, deficits in background knowledge may not sufficiently explain why children have SCD. In some instances, children with SCD continue to perform below expectations even after background knowledge is controlled (e.g., Cain & Oakhill, 1999; Cain et al., 2001).

Regression to the mean—Another potential explanation for the discrepancy between the reading comprehension and oral language skills of children with SCD is regression to the mean. Across studies, children were selected on the basis of poor reading comprehension. This design can lead to an over-representation of children whose observed reading comprehension score is below their true score. Consequently, they will regress to their true score on almost any subsequent measure that is correlated with the original measure. In the present context, children who were selected on the basis of poor reading comprehension may perform less poorly on oral language due to regression to the mean. Future studies could test this hypothesis by administering a second reading comprehension measure and then comparing performance on this measure to oral language. Using another design that does not involve selection based on poor reading comprehension performance would also be helpful to rule out this explanation.

Theoretical and Practical Implications of the Findings

We began this article with a review of theories of reading comprehension. We now consider the implications of our results for the theories that we reviewed. We first consider our results within the simple view of reading framework. (Gough & Tunmer, 1986; Hoover & Gough, 1990). Based on this framework, the view is that reading comprehension is the product of decoding and oral language comprehension. Our results are not consistent with the common version of the simple view in which reading comprehension is predicted by additive effects (i.e., main effects) of decoding and oral language comprehension. If the simple view is operationalized as the *interaction* (i.e., multiplicative effects) between decoding and oral language comprehension, however, the results could be considered consistent with this framework. Essentially, the oral language deficit of children with SCD interacts with their decoding to produce reading comprehension that is more impaired than would be accounted

for by the simple main effects. This same logic would apply to interactive activation models of reading to the extent that the interactive activation is truly interactive.

As is emphasized by the simple view and interactive models of reading comprehension, oral language is a critical component of reading comprehension. This assertion is supported by the current findings and previous studies (Kendeou et al., 2009; Roth et al., 2002). For instance, two studies included within the present meta-analysis, Catts et al. (2006) and Nation et al. (2004), found that a substantial portion of children who are identified as having specific language impairment (SLI) also have coexisting reading comprehension difficulties. In both investigations, 30% or one-third of children with SCD were eligible for SLI identification. Even children who were not identified as having SLI were identified as having subclinical levels of poor language comprehension (Catts et al.). Children with SCD had very poor performance on the vocabulary measure and grammatical understanding task. Catts et al. and Nation et al. referred to this subclinical poor language comprehension as hidden language impairment because these children are not typically classified as having SLI. Yet, these impairments could still potentially lead to the comprehension problems observed in these children.

If we allow for the possibility of a latent decoding problem, then nearly all of the theories of reading comprehension could account for the pattern of results that were obtained. Similarly, if we allow for the possibility of differences between written and oral language, the results would be consistent with multiple theories of reading. It will be important to carry out research to determine the best explanation for the pattern of a greater deficit in reading comprehension than in oral language. The outcome of this research will potentially affect implications for theories of reading. For example, if the pattern of a greater deficit in reading comprehension than in oral language is found when (a) groups are matched on decoding fluency as well as accuracy, (b) the reading and oral language tasks are for equivalent material, and (c) the study design eliminates the possible confound of regression to the mean, the results would only be consistent with a theory of reading that had an interactive component in addition to whatever main effects might be represented.

The implications for practice are threefold. First, the results suggest that early oral language measures may serve as a means of identifying children who are at risk for later reading comprehension problems (Cain & Oakhill, 2011; Justice et al., 2013; Kendeou et al., 2009; Nation & Snowling, 2004; Nation et al., 2010; Roth et al. 2002). Oral language weaknesses for children with SCD are evident fairly early on, are relatively stable over time, and are predictive of future reading comprehension performance (e.g., Cain & Oakhill, 2011; Justice et al., 2013; Nation et al., 2010). Thus, oral language measures can potentially serve as a screening method to identify which children have weaknesses in language skills. However, this must be approached cautiously because not all oral language measures are equally predictive of a child's future reading comprehension status. For instance, Tong et al. (2011) gave children with SCD morphological tasks that assessed derivational morphological awareness. Performance of readers with SCD in Grade 3 did not significantly differentiate children with SCD from those with normal reading comprehension in Grade 5. Yet, performance on this morphological task in Grade 5 did result in significant differences between the two groups. This suggests that measures of derivational morphological

awareness, for instance, may not be ideal for assessing early oral language skills (see Nippold & Sun, 2008). Consequently, it is important to consider this when selecting potential screening measures.

Second, the findings suggest that children with deficits in critical oral language skills should receive targeted oral language instruction and intervention. Intervention studies focusing specifically on children with SCD have indicated that interventions containing an oral language component are more effective. For example, Clarke, Snowling, Truelove, and Hulme (2010) randomly assigned three groups of 8- and 9-year-olds with SCD to receive three different types of interventions: text comprehension training, oral language training (without reading or writing), and a combined text comprehension-oral language training format. All three groups showed reliable and statistically significant gains in reading comprehension compared to the control group; however, the group that received the oral language training maintained the greatest gains after an 11-month follow up (for a review, see Snowling & Hulme, 2012). These outcomes are also aligned with the findings of the present review. Thus, classroom instruction and intervention that incorporate elements that encourage comprehension proficiency, such as reading fluency (NICHD, 2000) and oral language (Snow et al., 1998), will likely be more effective at remediating reading comprehension difficulties.

Third, the current investigation highlights the need to develop a consistent operational definition of SCD (see Rønberg & Petersen, 2015). For studies included in the present investigation, there were multiple ways in which children with SCD were identified. Differences in identification criteria are potentially problematic because it can lead to over- or under-identification. Such differences can also potentially lead to different groups of children being identified as having SCD over time. Yet, variability in identification criteria is not exclusive to the present population of poor readers. There remains much discourse about this issue more broadly within the field of learning disabilities (Mellard, Deshler, & Barth, 2004).

Limitations and Future Directions

There are several limitations of the present meta-analysis that must be addressed. First, the present review focused specifically on monolingual school-age children. Consequently, the results may not apply to second-language learner or adult populations. Second, several studies included in the present review used the Neale Analysis of Reading to assess reading comprehension and decoding ability without incorporating an additional measure of either skill. This is potentially problematic because both decoding and comprehension scores are obtained simultaneously as children read passages. Decoding problems could therefore affect comprehension scores (see Spooner et al., 2004). Third, we did not examine the effect of IQ on the obtained effect size estimates. It may be the case that variability in IQ may affect effect size outcomes. Fourth, it is important to acknowledge the potential presence of some publication bias for the between-group comparisons of reading comprehension and oral language. This may contribute to the larger deficits seen between these skills.

Another limitation of this meta-analysis is that it does not address possible causal relations between the deficits in oral language and reading comprehension. It is certainly possible that

poor oral language skills may contribute to the deficits in reading comprehension; children must know a substantial portion of the words in a text in order to comprehend it (Hu & Nation, 2000; Kendeou et al., 2009). However, it is also possible that poor reading comprehension constrains future vocabulary growth because text reading provides a basis for incidental word learning (Cain et al., 2004). These relations may also be reciprocal (e.g., Wagner, Muse, & Tannenbaum, 2007). Additionally, the general absence of longitudinal data did not allow for a more comprehensive examination of the developmental delay versus deficit hypotheses. A final limitation of the present study is that it was limited to children who were monolingual speakers of their native language. It is increasingly common for children to know more than one language. Would the results of the present meta-analysis generalize to children who were second-language learners? We decided to answer this question by carrying out a similar meta-analysis of children with poor reading comprehension yet adequate decoding, but for children who were second-language learners (Authors, 2017). Sixteen studies were identified that met inclusionary and exclusionary criteria. Hedge's *g* was used as the effect-size measure, random-effects models were used, and robust variance estimation was used to correct significance testing for dependent effect sizes. The results were remarkably consistent with those of the present meta-analysis. A deficit in oral language was replicated with an average weighted effect size of -0.80. The pattern of the deficit in oral language being only about a third as large as the deficit in reading comprehension was also replicated, with an average weighed effect size of -2.47. In summary, the pattern of results found in the present meta-analysis of studies whose participants were monolingual children generalize to children who are second language learners.

In conclusion, children who have SCD are typically impaired in oral language, but not to the degree they are impaired in reading comprehension. Consequently, the oral language impairment is not sufficient to explain the impairment in reading comprehension. Possible explanations for this pattern of results were considered, including a latent decoding deficit, differences between written and oral language, regression to the mean, and interactive effects. Testing these alternative explanations and others that might be considered represents a critical next step to advance our understanding of an important problem in reading.

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Appendix A

Study descriptions and effect size estimates for children with specific reading comprehension deficits and typical readers (Study $n = 86$).

Authors	Participant Age	Study *N* (SCD; TR)	RC Effect Size (*d*)	OL Effect Size (*d*)
Aaron, Joshi, & Williams (1999)	Grade 3; Grade 6	7; 8	−3.15	−3.10
Bishop (unpublished)	6 – 9	25 – 41; 142 – 197	−4.55	−1.72, −1.66, −1.61, −1.59, −1.49, −1.31, −1.07
Cain (1996); Cain & Oakhill (1996); Oakhill & Cain, 2000; Oakhill, Cain, & Yuill (1998)	7 – 8	16; 12	−3.77	−1.29, −0.95, −0.46, −0.29, −0.28, −0.24, −0.24, −0.22, −0.15, −0.15, 0.02, 0.07, 0.09, 0.11, 0.21, 0.23, 0.43, 0.45, 0.90
Cain (1999)	7 – 8	16; 16	−4.61	−0.13
Cain (2003); Cain & Oakhill (2008)	7 – 8	14; 12	−3.88	−2.03, −1.92, −1.50, −1.19, −0.81, −0.45, −0.44, −0.42, −0.06, −0.04, 0.00
Cain (2006)	9 – 10	13; 13	−3.72	−0.48, −0.13
Cain & Oakhill (1998; 1999); Oakhill & Cain (2000); Oakhill & Cain (2007)	7 – 8	29; 24	−3.77, −0.52	−0.23
Cain & Oakhill (2006); Kyle & Cain (2015)	7 – 11	23; 23	−2.81, −1.99	−1.21, −0.91, −0.81, −0.58, −0.45, −0.32
Cain & Oakhill (2011)	8 – 11	17; 14	−3.74, −2.03	−1.18, −1.03, −0.45, −0.25
Cain & Towse (2008)	9 – 10	15; 15	−3.46	−1.16, −1.06, −0.79, −0.66, −0.52, −0.32, −0.13, −0.05, 0.14, 0.17
Cain, Oakhill, & Bryant (2000)	8 – 10	12; 1010 – 12; 10 – 12	−3.77, −3.13, −3.09, −2.99	−0.64, −0.14, −0.05, 0.13
Cain, Oakhill, & Elbro (2003)	7 – 8	15; 15	−3.00	0.13
Cain, Oakhill, & Lemmon (2004)	9 – 10	12; 1213; 12	−3.72, −3.24	−0.74, −0.42, −0.36, −0.16
Cain (2009); Cain, Oakhill, & Lemmon (2005)	9 – 10	14; 14	−0.45	−1.00, −0.87, −0.64, −0.61, −0.57, −0.55, −0.53, −0.51, −0.41, −0.24, −0.20, −0.11, −0.08, −0.03, 0.14
Cain, Oakhill, Barnes & Bryant (2001)	7 – 8	13; 13	−3.14	−1.01, −0.62, −0.20
Carretti, Motta, & Re (2014)	8 – 10	12; 12	−5.87	−1.79, −1.67, −1.18, −0.97, −0.86, −0.32, −0.27
Carretti, Re, & Arfe (2011)	8 – 10	38; 38	−4.60	−0.25
Cataldo & Oakhill (2000)	*M* = 10.33	12; 12	−3.92, −1.33, −0.93, −0.90, −0.31	−0.52
Catts, Adlof, & Weismer (2006)	Grade 2; Grade 4	57; 98	−1.65, −0.96	–

Authors	Participant Age	Study *N* (SCD; TR)	RC Effect Size (*d*)	OL Effect Size (*d*)
Clarke (2009)	8 – 10	14 – 20; 13 – 22	−2.31, −2.31, −2.26, −2.24, −2.21, −2.15, −1.19, −0.95, −0.84, −0.37	−1.11, −1.08, −1.07, −1.06, −1.00, −0.91, −0.89
Corso, Sperb, & Salles (2014)	9 – 12	19; 58	–	−0.76, 0.48
Cragg & Nation (2006)	9 – 11	11; 19	−4.40, −1.14	−0.81
Ehrlich & Remond (1997); Ehrlich, Remond, & Tardieu (1999)	9 – 10	23; 23	−4.51	−0.20
Elwer et al. (2015)	*M* = 4.92 – 10.5	56; 56	−4.30, −0.86, −0.55	−1.58, −1.52, −1.42, −1.40, −1.27, −1.05
FDE PMRN Database 2003 (unpublished)	Grade 2	2,830 – 2,861; 15,221 – 15,297	−2.75	−0.92
FDE PMRN Database 2003-2005 (unpublished)	Grades 1 – 2	1,689 – 3,732; 15,917 – 26,052	−2.36, −2.62	−0.65, −0.94
FDE PMRN Database 2004-2006 (unpublished)	Grades 1 – 2	1,825 – 4,199; 19,876 – 28,586	−2.09, −2.59	−0.66, −0.96
FDE PMRN Database 2005-2007 (unpublished)	Grades 1 – 2	2,242 – 3,835; 28,064 – 30,067	−2.10, −2.56	−0.67, −0.95
FDE PMRN Database 2006-2008 (unpublished)	Grades 1 – 2	2,102 – 3,212; 27,680 – 31,253	−2.11, −2.51	−0.69, −1.05
FDE PMRN Database 2008 (unpublished)	Grade 1	1,369 – 1,379; 28,970 – 29,412	−2.09	−0.73
Geva & Massey-Garrison (2012); Massey-Garrison (2010)	Grade 5	7; 23	–	−2.05, −1.72, −1.12
Gifford (2013)	8.08 – 9.50	26; 225	−2.21	−1.49, −1.44
Henderson, Snowling, & Clarke (2012)	9 – 11	17; 17	−2.68	−1.20, −1.02, −0.85, −0.80, −0.64, −0.64, −0.50, −0.42, −0.41, −0.39, −0.36, −0.36, −0.28, −0.20, −0.17, 0.00, 0.00
Isakson & Miller (1976)	Grade 4	24; 24	−4.95	−1.07
Justice, Mashburn, & Petscher (2013)	4; Grade 5	14 – 15; 32	−3.87	−1.22, −0.86
Kasperski & Katzir (2012)	9.3 – 10.4	18; 21 – 31	−6.53, −3.55	−0.91, −0.87
Leach, Scarborough, & Rescorla (2003)	9.1 – 12	12; 95	−2.29	−0.65, −0.54
Lesaux, Lipka, & Siegel (2006)	*M* = 9.81 – 9.85	65; 314	−2.95	−0.59
Marshall & Nation (2003)	9 – 11	21; 20	−3.92	−1.05
Megherbi & Ehrlich (2006); Megherbi, Seigneuric, & Ehrlich (2006)	6.2 – 8.6	18; 31\15; 29	−5.20, −4.30	−2.06, −1.96
Nation & Snowling (1997)	7 – 10	17; 17	−2.84	−3.08

Authors	Participant Age	Study *N* (SCD; TR)	RC Effect Size (*d*)	OL Effect Size (*d*)
Nation & Snowling (1998a)	7 – 10	13; 13	−3.02	−2.94
Nation & Snowling (1998b); Nation, Adams, & Bowyer-Crane (1999)	8.5 – 9.5	16; 16	−3.56	−2.65, −1.88, −1.84, −0.75, −0.71, −0.47
Nation & Snowling (1999)	*M* = 10.69 – 10.77	16; 16	−3.21	–
Nation & Snowling (2000)	*M* = 9.20 – 9.30	15; 15	−3.64	−1.65, −1.49, −1.25, −1.09, −0.87
Nation, Clarke, & Snowling (2002)	7 – 9	25; 24	−3.46	−1.59, −1.44
Nation, Clarke, Durand, & Marshall (2004)	7.75 – 9.25	11 – 23; 9 – 22	−3.44	−1.75, −1.69, −1.45, −1.42, −1.31, −0.95, −0.85, −0.77, −0.77, −0.61
Nation, Cocksey, Taylor, & Bishop (2010)	5 – 8	15; 15	−3.57, −2.05, −0.92, −0.76	−1.78, −1.20, −1.13, −1.07, −0.99, −0.98, −0.93, −0.82, −0.78, −0.77, −0.75, −0.74, −0.74, −0.60, −0.22
Nation, Marshall, & Altmann (2003)	10 – 12	11; 11	−2.97	−2.55, −1.81, −1.63, −0.88
Nation, Marshall, & Snowling (2001)	*M* = 8.75 – 8.86	10; 10	−5.90	−1.60, −1.44, −1.06, −0.81
Nation, Snowling, & Clarke (2005)	7.1 – 9	20; 20	−3.79	−1.96, −1.88, −1.49, −1.35, −0.69, −0.67, −0.65, −0.64, −0.62, −0.51
Nation, Snowling, & Clarke (2007)	8 – 9	12; 12	−3.30	−2.14, −1.65, −1.25, −1.00, −0.88
Ndlovu (2010)	9 – 12	7; 20	−3.35, −1.00, −0.51	−1.98, −1.44, −0.81, −0.78
Nesi, Chiara,Levorato, Roch, & Cacciari (2006)	7.3 – 10.2	13; 85\27; 72	−4.11, −2.81	–
Oakhill & Patel (1991)	9	11; 11	−3.98	–
Oakhill, Hartt, & Samols (2005)	9 – 10	12; 12	−3.03, −2.45, −1.62	−0.42
Oakhill, Yuill, & Donaldson (1990)	7 – 8	12; 12	−1.61	−0.09
Pelegrina, Capodieci, Carretti, & Cornoldi (2014)	*M* = 9.53	18; 20	−3.10	–
Pimperton (2010); Pimperton & Nation (2010a, 2010b)	7 – 8	14 – 16; 14 – 16	−3.09, −2.98	−1.15, −0.73, −0.22, 0.08
Re & Carretti (2016)	8 – 10	18; 18	−5.89	−0.48
Ricketts (unpublished)	7.75 – 8.65	15; 15	−3.39	−0.80, −0.50
Ricketts, Nation, & Bishop (2007); Ricketts, Bishop, & Nation (2008); Ricketts, Sperring, & Nation (2014)	8 – 10	15; 15	−5.24, −1.92	−1.93, −1.81, −1.81, −1.51
Shankweiler et al. (1999)	7.5 – 9.5	17; 114	−2.51, −1. 94, −1,86	–
Spooner, Gathercole, & Baddeley (2004)	7 – 8	16; 16\29; 51	−4.68, −4.41, −1.33\−0.30	−0.44

Authors	Participant Age	Study *N* (SCD; TR)	RC Effect Size (*d*)	OL Effect Size (*d*)
Spooner, Gathercole, & Baddeley (2006)	7 – 8	16; 16\16; 16\16; 16	−4.06, −1.17, −1.08	−0.13
Stothard (1992); Stothard & Hulme (1992, 1995, 1996)	7 – 8	14; 14	−4.40	−2.15, −1.39, −1.17, −0.97, −0.25
Swanson & Berninger (1995)	*M* = 11.25	30; 34	−6.20	−1.49
Tong, Deacon, & Cain (2014)	9 – 10	15; 15	−2.46, −1.53	−1.23, −0.99, −0.35, −0.03
Tong, Deacon, Kirby, Cain, & Parrila (2011)	*M* = 8.72 – 8.79	18; 18	−1.16	−0.87, −0.60, −0.43, −0.27, −0.08, 0.00, 0.45
Torppa et al. (2006)	5 – 8	16 – 167; 27 – 637	−3.49, −3.08, −1.69, −1.60, −1.43, −0.96	−1.20, −0.97, −0.91, −0.87, −0.75, −0.50, −0.50, −0.29
Yuill (1998)	7 – 8	9; 9	−2.54, −2.25	0.14, 0.43
Yuill (2009)	7 – 9	12; 12	−1.26	0.00
Yuill & Oakhill (1988a)	7 – 8	6 – 7; 6 – 7	−3.16, −2.35, −2.29, −1.32	−0.49, −0.25, 0.07, 0.34
Yuill & Oakhill (1988b)	7 – 8	16; 16	−3.46	−0.05
Yuill & Oakhill (1991); Garham, Oakhill, & Johnson-Laird (1982); Oakhill (1982, 1983, 1984, 1993, 198, 1994); Oakhill, Cain, & Yuill (1998); Oakhill & Yuill (1986 Oakhill & Yuill (1998b); Oakhill, Yuill, & Parkin (1986); Yuill & Joscelyne (1988)	7 – 8	4 – 96; 4 – 96	−3.14, −3.00, −2.61, −2.45, −2.45, −2.35, −2.32, −2.32, −2.06, −1.71, −1.43, −1.26, −1.16, −1.07, −1.00, −0.58	−1.30, −1.22, −1.14, −0.59, −.046, −0.38, −0.36, −0.29, −0.16, −0.08, −0.07
Yuill, Pearce, Kerawall, Harris, & Luckin (2009)	7 – 9	8; 8	−2.05	–
Yuill, Oakhill, & Parkin (1989); Oakhill, Cain, & Yuill (1998)	7 – 8	42; 42	−2.87, −2.12	−0.09, 0.00
Zhang et al. (2014)	4 – 10	22 – 30; 22 – 30	−3.50, −3.23, −2.95, −2.53	−1.22, −1.16, −1.05, −0.94, −0.91, −0.91, −0.83, −0.78, −0.74, −0.69, −0.67, −0.67, −0.64, −0.58, −0.58, −0.45, −0.44, -0.35, −0.28, −0.22, −0.21, −0.12

Note. RC = Reading comprehension; OL = Oral language; SCD = Children with specific reading comprehension deficits; TR = Typical readers.

Appendix B

Study descriptions and effect sizes for children with specific reading comprehension deficits compared with comprehension-age matched readers (Study *n* = 4).

Authors	Age	Study *N* (SCD; TD)	RC Effect Size (*d*)	OL Effect Size (*d*)
Cain (1999, Cain (2003); Cain, Oakhill, & Bryant (2000)	6 – 8	14; 12	−0.27	−0.99, −0.32, −0.27, −0.05, 1.17

Authors	Age	Study *N* (SCD; TD)	RC Effect Size (*d*)	OL Effect Size (*d*)
Cain & Oakhill (1996)	6 – 8	16; 15	−0.50	−0.81, −0.47, −0.38, −0.18, −0.12, −0.12, −0.11 −0.07, 0.02, 0.02. 0.12. 0.15, 0.18, 0.20, 0.23, 0.25, 0.34, 0.62, 0.77
Cain & Oakhill (1999)	6 – 8	29; 27	−0.27	0.99
Stothard & Hulme (1992, 1995, 1996)	6 – 8	14; 14	−0.21	−0.26, 0.02, 0.08, 0.19, 1.33

Note. RC = Reading comprehension; OL = Oral language; SCD = Children with specific reading comprehension deficits; TR = Typical readers.

Appendix C

Study descriptions and effect size estimates for within-child comparisons (Study *n* = 32).

Authors	Age	Study *N*	Effect Size (*d*)
Aaron, Joshi, & Williams (1999)	Grade 3; Grade 6	7	− 0.63
Bishop (unpublished)	6 – 9	25 – 41	− 1.12, − 1.08, − 1.03, − 0.89, − 0.82, − 0.79, − 0.75
Cain (2006)	13	13	− 1.55
Cain, Oakhill, & Lemmon (2004)	9 – 10	12	− 1.75
Clarke (2009)	8 – 10	14 – 15	− 1.80, − 1.77, − 0.43, − 0.35, − 0.23, − 0.22
Cragg & Nation (2006)	9 – 11	11	− 0.07
Elwer et al. (2015)	*M* = 4.92 – 10.5	56	− 0.33, − 0.26, 0.54, 0.60, 0.64, 0.77
FDE PMRN Database 2003 (unpublished)	Grade 2	2,830	− 1.29
FDE PMRN Database 2003-2005 (unpublished)	Grades 1 – 2	1,689 – 2,273	− 1.31, − 1.01
FDE PMRN Database 2004-2006 (unpublished)	Grades 1 – 2	1,825 –2,312	− 1.69, − 1.39
FDE PMRN Database 2005-2007 (unpublished)	Grades 1 – 2	2,175 – 2,242	− 1.37, − 1.00
FDE PMRN Database 2006-2008 (unpublished)	Grades 1 – 2	1,379 – 2,102	− 1.44, − 1.01
FDE PMRN Database 2008 (unpublished)	Grade 1	1,369	− 1.42
Gifford (2013)	8.08 – 9.50	26	− 0.54
Justice, Mashburn, & Petscher (2013)	4; Grade 5	14 – 15	− 0.15, 0.01
Leach, Scarborough, & Rescorla (2003)	9.1 – 11	12	− 2.48, − 0.62
Marshall & Nation (2003)	9 – 12	21	0.28
Nation, Clarke, Durand, & Marshall (2004)	7 – 9	23	− 1.27, − 0.52, − 0.06, 0.18
Nation, Clarke, & Snowling (2002)			− 0.99, −.39
Nation, Cocksey, Taylor, & Bishop (2010)	5 – 8	15	− 1.04, − 0.74, − 0.70, − 0.67, − 0.63, − 0.57, − 0.43, − 0.23, − 0.16, − 0.03, 0.03, 0.03, 0.15, 0.15, 0.17, 0.26, 0.51, 0.60
Nation, Marshall, & Altmann (2003)	10 – 12	11	− 0.52, − 0.31, − 0.10, 0.20
Nation & Snowling (1998b); Nation, Adams, Bowyer-Crane, & Snowling (1999)	8.5 – 9.5	16	− 0.98, − 0.66

Authors	Age	Study *N*	Effect Size (*d*)
Nation, Snowling, & Clarke (2005)	7.1 – 9	20	− 1.21, − 0.48, 0.00, 0.57
Nation, Snowling & Clarke (2007)	8 – 9	12	− 0.54, − 0.42, − 0.40, 0.28
Ricketts (unpublished)	7.75 – 8.65	15	− 0.58, − 0.41
Ricketts, Sperring, & Nation (2014); Ricketts, Nation, & Bishop (2007)	8 – 10	15	− 0.57, − 0.52, − 0.35, − 0.34
Shankweiler et al. (1999)	7.5 – 9.5	17	− 1.95, − 0.92, − 0.78, − 0.58, − 0.28, − 0.20, − 0.14
Spooner, Gathercole, & Baddeley (2006)	7 – 8	16	− 2.18
Stothard & Hulme (1992)	7 – 8	14	− 1.44
Swanson & Berninger (1995)	*M* = 11.25	30	− 1.75
Zhang et al. (2014)[a]	4 – 10	30; 22	− 1.55, − 1.29, − 1.23, − 0.64

[a]Different participants across two experiments.

Appendix D

Coding scheme for study type, participant age, and type of oral language measure.

Construct	Type	Code
Study Type	Journal article	1
	Thesis/Dissertation	2
	Unpublished data	3
	Book chapter	4
Age		
	Predominantly including participants who were 6 years and below	1
	Predominantly including participants who were 6 to 8/9 years (if including years 7-9)	2
	Predominantly including participants who were 8/9 years and above (if including years 10-12)	3
Oral Language		
	Vocabulary	1
	Narrative (e.g., storytelling)	2
	Listening Comprehension	3
	Syntactic/Grammar	4
	Semantic Knowledge (e.g., morphological awareness)	5
	Figurative Language (e.g., idioms, expressions)	6
	Verbal working memory (e.g., verbal recall)	7

Appendix E

Types of oral language skills assessed across studies (Study $n = 86$).

	Type of Oral Language Measure Assessed						
Authors	Vocabulary Knowledge	Narrative Skills	Listening Comprehension	Syntax/ Grammar	Semantic Knowledge	Figurative Language	Verbal WM
Aaron, Joshi, & Williams (1999)			X				

Authors	Type of Oral Language Measure Assessed Vocabulary Knowledge	Narrative Skills	Listening Comprehension	Syntax/ Grammar	Semantic Knowledge	Figurative Language	Verbal WM
Bishop (unpublished)	X		X	X	X		X
Cain (1996); Cain & Oakhill (1996); Oakhill, Cain, & Yuill (1998)	X	X					
Cain (1999)	X						
Cain (2003); Cain & Oakhill (2008)	X	X	X				
Cain (2006)	X						X
Cain & Oakhill (1998; 1999); Oakhill & Cain (2000)	X						
Cain & Oakhill (2006); Kyle & Cain (2015)	X		X	X	X		X
Cain & Oakhill (2011)	X						
Cain & Towse (2008)	X				X	X	
Cain, Oakhill, & Bryant (2000)	X						X
Cain, Oakhill, & Elbro (2003)	X						
Cain, Oakhill, & Lemmon (2004)	X				X		X
Cain (2009); Cain (2011); Cain, Oakhill, & Lemmon (2005)	X				X	X	X
Cain, Oakhill, Barnes & Bryant (2001)	X		X			X	X
Carretti, Motta, & Re (2014)	X	X		X			X
Carretti, Re, & Arfe (2011)	X						X
Cataldo & Oakhill (2000)	X						X
Catts, Adlof, & Weismer (2006)	--						
Clarke (2009)	X		X		X		
Corso, Sperb, & Salles (2014)			X		X		X
Cragg & Nation (2006)				X			X
Ehrlich & Remond (1997); Ehrlich, Remond, & Tardieu (1999)	X						
Elwer et al. (2015)	X		X	X			X
FDE PMRN Database 2003-2004 (unpublished)	X						
FDE PMRN Database 2004-2005 (unpublished)	X						
FDE PMRN Database 2005-2006 (unpublished)	X						
FDE PMRN Database 2006-2007 (unpublished)	X						
FDE PMRN Database 2007-2008 (unpublished)	X						
Geva & Massey-Garrison (2012); Massey-Garrison (2010)	X		X	X			
Gifford (2013)	X		X				

	Type of Oral Language Measure Assessed						
Authors	**Vocabulary Knowledge**	**Narrative Skills**	**Listening Comprehension**	**Syntax/ Grammar**	**Semantic Knowledge**	**Figurative Language**	**Verbal WM**
Henderson, Snowling, & Clarke (2012)	X						X
Isakson & Miller (1976)	X						
Justice, Mashburn, & Petscher (2013)		X	X				
Kasperski & Katzir (2012)	X						X
Leach, Scarborough, & Rescorla (2003)	X		X				
Lesaux, Lipka, & Siegel (2006)				X			X
Marshall & Nation (2003)					X		
Megherbi, Seigneuric, & Ehrlich (2006)			X				
Nation & Snowling (1997)			X				
Nation & Snowling (1998a)			X				
Nation & Snowling (1998b)	X				X		
Nation & Snowling (1999)	--						
Nation & Snowling (2000)				X			
Nation, Clarke, & Snowling (2002)	X				X		
Nation, Clarke, Durand, & Marshall (2004)	X	X	X	X	X	X	
Nation, Cocksey, Taylor, & Bishop (2010)	X		X	X	X		
Nation, Marshall, & Altmann (2003)	X		X		X		
Nation, Marshall, & Snowling (2001)					X		
Nation, Snowling, & Clarke (2005)	X		X	X	X		
Nation, Snowling, & Clarke (2007)	X		X		X		X
Ndlovu (2010)	X		X				
Nesi, Chiara,Levorato, Roch, & Cacciari (2006)	--						
Oakhill & Patel (1991)	--						
Oakhill, Hartt, & Samols (2005)	X						
Oakhill, Yuill, & Donaldson (1990)	X						
Pelegrina, Capodieci, Carretti, & Cornoldi (2014)	X						X
Pimperton (2010); Pimperton & Nation (2010a, 2010b)	X		X				X
Re & Carretti (2016)	X						
Ricketts (unpublished)	X				X		
Ricketts, Nation, & Bishop (2007); Ricketts, Bishop, & Nation (2008); Ricketts, Sperling, & Nation (2014)	X						
Shankweiler et al. (1999)	--						

	Type of Oral Language Measure Assessed						
Authors	**Vocabulary Knowledge**	**Narrative Skills**	**Listening Comprehension**	**Syntax/ Grammar**	**Semantic Knowledge**	**Figurative Language**	**Verbal WM**
Spooner, Gathercole, & Baddeley (2004)			X				
Spooner, Gathercole, & Baddeley (2006)	X						X
Stothard (1992); Stothard & Hulme (1992, 1995, 1996)	X		X	X	X		X
Swanson & Berninger (1995)					X		X
Tong, Deacon, & Cain (2014)	X			X	X		
Tong, Deacon, Kirby, Cain, & Parrila (2011)	X				X		
Torppa et al. (2007)	X		X		X		
Yuill (1998)	X						
Yuill (2009)						X	
Yuill & Oakhill (1988a)	X						
Yuill & Oakhill (1988b)	X						
Yuill & Oakhill (1991); Yuill & Oakhill (1991); Garham, Oakhill, & Johnson-Laird (1982); Oakhill (1982, 1983, 1984, 1993, 198, 1994);; Oakhill, Cain, & Yuill (1998); Oakhill & Yuill (1986 Oakhill & Yuill (1998b); Oakhill, Yuill, & Parkin (1986); Yuill & Joscelyne (1988)	X			X		X	X
Yuill, Pearce, Kerawall, Harris, & Luckin (2009)	--						
Yuill, Oakhill, & Parkin (1989); Oakhill, Cain, & Yuill (1998)	X						
Zhang et al. (2014)	X			X	X		

Note. For some studies, oral language was assessed but not explicitly reported.

References

References marked with an asterisk indicate studies included in the meta-analysis. The in-test citations to studies selected for meta-analysis are not preceded by asterisks.

*. Aaron PG, Joshi M, Williams KA. Not all reading disabilities are alike. Journal of Learning Disabilities. 1999; 32(2):120–137. DOI: 10.1177/002221949903200203 [PubMed: 15499713]

Authors (2017)

Akinnaso FN. On the differences between spoken and written language. Language and Speech. 1982; 25:97–125. DOI: 10.1177/002383098202500201

Beck I, Perfetti C, McKeown M. Effects of long-term vocabulary instruction on lexical access and reading comprehension. Journal of Educational Psychology. 1982; 74:506–521. DOI: 10.1037/0022-0663.74.4.506

*. Bishop DVM. Language and literacy achievement in elementary-aged children: Data from a twin database. Unpublished raw data. 2014

Bishop DVM, Adams C. A prospective study of the relationship between specific language impairment, phonological disorders and reading retardation. Journal of Child Psychology and Psychiatry. 1990; 31:1027–1050. DOI: 10.1111/j.1469-7610.1990.tb00844.x [PubMed: 2289942]

Bowey JA. Syntactic awareness in relation to reading skill and ongoing reading comprehension monitoring. Journal of Experimental Child Psychology. 1986; 41:282–299. DOI: 10.1177/0022219410371676

Bus AG, van IJzendoorn MH. Phonological awareness and early reading: A meta-analysis of experimental training studies. Journal of Educational Psychology. 1999; 91:403–414. DOI: 10.1037/0022-0663.91.3.403

*. Cain, K. Doctoral Dissertation. 1994. An investigation into comprehension difficulties in young children. Retrieved from ETHOS. (240660)

*. Cain, K. Story knowledge and comprehension skill. In: Cornoldi, C., Oakhill, J., editors. Reading comprehension difficulties: Processes and intervention. Mahwah, NJ: Lawrence Erlbaum; 1996. p. 167-192.

*. Cain K. Ways of reading: How knowledge and use of strategies are related to reading comprehension. British Journal of Developmental Psychology. 1999; 17:293–309. DOI: 10.1348/026151099165285

*. Cain K. Text comprehension and its relation to coherence and cohesion in children's fictional narratives. British Journal of Developmental Psychology. 2003; 21:335–351. DOI: 10.1348/026151003322277739

*. Cain K. Individual differences in children's memory and reading comprehension: An investigation of semantic and inhibitory deficits. Memory. 2006; 14:553–569. DOI: 10.1080/09658210600624481 [PubMed: 16754241]

*. Cain K. Making sense of text: Skills that support text comprehension and its development. Perspectives on Language and Literacy. 2009; 35:11–14.

*. Cain K, Oakhill J. The nature of the relationship between comprehension skill and the ability to tell a story. British Journal of Developmental Psychology. 1996; 14:187–201.

*. Cain K, Oakhill J. Inference making ability and its relation to comprehension failure in young children. Reading and writing. 1999; 11:489–503. DOI: 10.1023/A:1008084120205

*. Cain K, Oakhill J. Profiles of children with specific reading comprehension difficulties. British Journal of Educational Psychology. 2006; 76:683–696. DOI: 10.1348/000709905×67610 [PubMed: 17094880]

*. Cain, K., Oakhill, J. Children's comprehension problems in oral and written language: A cognitive perspective. New York, NY: Guilford Press; 2008.

*. Cain, K., Oakhill, J. Comprehension skill and inference-making ability: Issues of causality. In: Hulme, C., Joshi, RM., editors. Reading and spelling: Development and disorders. Mahwah, NJ: Lawrence Erlbaum; 1998. p. 329-342.

*. Cain K, Oakhill J. Matthew effects in young readers reading comprehension and reading experience aid vocabulary development. Journal of Learning Disabilities. 2011; 44:431–443. DOI: 10.1177/0022219411410042 [PubMed: 21772058]

*. Cain K, Oakhill J, Barnes MA, Bryant PE. Comprehension skill, inference-making ability, and the relation to knowledge. Memory & Cognition. 2001; 29:850–859. DOI: 10.3758/BF03196414 [PubMed: 11716058]

*. Cain K, Oakhill J, Bryant P. Phonological skills and comprehension failure: A test of the phonological processing deficit hypothesis. Reading and Writing. 2000; 13:31–56. DOI: 10.1023/A:1008051414854

*. Cain K, Oakhill J, Elbro C. The ability to learn new word meanings from context by school-age children with and without language comprehension difficulties. Journal of Child Language. 2003; 30:681–694. DOI: 10.1017/S0305000903005713 [PubMed: 14513473]

*. Cain K, Oakhill J, Lemmon K. Individual differences in the inference of word meanings from context: the influence of reading comprehension, vocabulary knowledge, and memory capacity. Journal of Educational Psychology. 2004; 96:671–681. DOI: 10.1037/0022-0663.96.4.671

*. Cain K, Oakhill J, Lemmon K. The relation between children's reading comprehension level and their comprehension of idioms. Journal of Experimental Child Psychology. 2005; 90:65–87. DOI: 10.1016/j.jecp.2004.09.003 [PubMed: 15596077]

*. Cain K, Towse AS. To get hold of the wrong end of the stick: Reasons for poor idiom understanding in children with reading comprehension difficulties. Journal of Speech, Language, and Hearing Research. 2008; 51:1538–1549. DOI: 10.1044/1092-4388(2008/07-0269

Carretti B, Borella E, Cornoldi C, De Beni R. Role of working memory in explaining the performance of individuals with specific reading comprehension difficulties: A meta-analysis. Learning and Individual Differences. 2009; 19:245–251. DOI: 10.1016/j.lindif.2008.10.002

*. Carretti B, Motta E, Re AM. Oral and written expression in children with reading comprehension difficulties. Journal of Learning Disabilities. 2014; 46:87–96. DOI: 10.1177/0022219414528539

*. Carretti B, Re AM, Arfè B. Reading comprehension and expressive writing: A comparison between good and poor comprehenders. Journal of Learning Disabilities. 2011; 46:87–96. DOI: 10.1177/0022219411417876 [PubMed: 21940461]

*. Cataldo MG, Oakhill J. Why are poor comprehenders inefficient searchers? An investigation into the effects of text representation and spatial memory on the ability to locate information in text. Journal of Educational Psychology. 2000; 92:791–799. DOI: 10.1037/0022-0663.92.4.791

*. Catts HW, Adlof S, Weismer SE. Language deficits in poor comprehenders: A case for the simple view of reading. Journal of Speech, Language, and Hearing Research. 2006; 49:278–293. DOI: 10.1044/1092-4388(2006/023)

Catts HW, Fey ME, Tomblin JB, Zhang X. A longitudinal investigation of reading outcomes in children with language impairments. Journal of Speech, Language and Hearing Research. 2002; 45:1142–1157. DOI: 10.1044/1092-4388(2002/093

Catts HW, Fey ME, Zhang X, Tomblin JB. Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. Scientific Studies of Reading. 1999; 3:331–361. DOI: 10.1207/s1532799xssr0304_2

*. Clarke, L. Inference generation and reading disability. University of York; UK: 2009.

Clarke PJ, Snowling MJ, Truelove E, Hulme C. Ameliorating children's reading comprehension difficulties: A randomized controlled trial. Psychological Science. 2010; 21:1106–1116. DOI: 10.1177/0956797610375449 [PubMed: 20585051]

Cohen, J. Statistical power analysis for the behavioural sciences. New York, NY: Academic Press; 1977.

*. Cragg L, Nation K. Exploring written narrative in children with poor reading comprehension. Educational Psychology. 2006; 26:55–72. DOI: 10.1080/01443410500340991

Daneman M, Merikle PM. Working memory and language comprehension: A meta-analysis. Psychonomic bulletin & review. 1996; 3(4):422–433. DOI: 10.3758/BF03214546 [PubMed: 24213976]

de Jong PF, van der Leij A. Specific contributions of phonological abilities to early reading acquisition: Results from a Dutch latent variable longitudinal study. Journal of Educational Psychology. 1999; 91:450–476. DOI: 10.1037/0022-0663.91.3.450

Department of Education, Institute of Education Sciences, National Center for Education Statistics. National Assessment of Educational Progress (NAEP) data files. 2013. Retrieved from http://www.nationsreportcard.gov/science_2011/summary.aspx

Dole JA, Duffy GG, Roehler LR, Pearson PD. Moving from the old to the new: Research on reading comprehension instruction. Review of Educational Research. 1991; 61:239–264. DOI: 10.3102/00346543061002239

Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. Bmj. 1997; 315(7109):629–634. DOI: 10.1136/bmj.315.7109.629 [PubMed: 9310563]

Ehri LC, Nunes SR, Stahl SA, Willows DM. Systematic phonics instruction helps students learn to read: Evidence from the National Reading Panel's meta-analysis. Review of Educational Research. 2001; 71:393–447. DOI: 10.3102/00346543071003393

*. Ehrlich MF, Remond M. Skilled and less skilled comprehenders: French children's processing of anaphoric devices in written texts. British Journal of Developmental Psychology. 1997; 15:291–309. DOI: 10.1111/j.2044-835X.1997.tb00522.x

*. Ehrlich MF, Remond M, Tardieu H. Processing of anaphoric devices in young skilled and less skilled comprehenders: Differences in metacognitive monitoring. Reading and Writing. 1999; 11:29–63. DOI: 10.1023/A:1007996502372

*. Elwér Å, Gustafson S, Byrne B, Olson RK, Keenan JM, Samuelsson S. A retrospective longitudinal study of cognitive and language skills in poor readingcomprehension. Scandinavian journal of psychology. 2015; 56:157–166. DOI: 10.1111/sjop.12188 [PubMed: 25581078]

Elwér Å, Keenan JM, Olson RK, Byrne B, Samuelsson S. Longitudinal stability and predictors of poor oral comprehenders and poor decoders. Journal of Experimental Child Psychology. 2013; 115:497–516. DOI: 10.1016/j.jecp.2012.12.001 [PubMed: 23528975]

Fisher Z, Tipton E. Robumeta: Robust variance metaregression R package (Version 1.6). 2015

*. Florida Department of Education. Unpublished raw data. 2015. Florida PMRN Data.

Francis DJ, Shaywitz SE, Stuebing KK, Shaywitz BA, Fletcher JM. Developmental lag versus deficit models of reading disability: A longitudinal, individual growth curves analysis. Journal of Educational Psychology. 1996; 88:3–17. DOI: 10.1037/0022-0663.88.1.3

*. Geva E, Massey-Garrison A. A comparison of the language skills of ELLs and monolinguals who are poor decoders, poor comprehenders, or normal readers. Journal of Learning Disabilities. 2012; 46:387–401. DOI: 10.1177/0022219412466651 [PubMed: 23213049]

*. Gifford DB. Identifying specific comprehension deficits in children (Order No 3566599). 2013 Available from ProQuest Dissertations & Theses Full Text. (1417048050).

Gough, PB. One second of reading. In: Kavanagh, JF., Mattingly, IG., editors. Language by ear and by eye. Cambridge, MA: MIT Press; 1972. p. 331-358.

Gough PB, Tunmer WE. Decoding, reading, and reading disability. Remedial and Special Education. 1986; 7:6–10. DOI: 10.1177/074193258600700104

Halliday, MA. Spoken and written language. New York, NY: Oxford University Press; 1989.

Hedges LV. Estimation of effect size from a series of independent experiments. Psychological Bulletin. 1982; 92:490–499.

Hedges, LV., Olkin, I. Statistical methods for meta-analysis. Orlando, FL: Academic; 1985.

Hedges LV, Tipton E, Johnson MC. Robust variance estimation in meta-regression with dependent effect size estimates. Research Synthesis Methods. 2010; 1:39–65. [PubMed: 26056092]

*. Henderson L, Snowling M, Clarke P. Accessing, integrating, and inhibiting word meaning in poor comprehenders. Scientific Studies of Reading. 2013; 17:177–198. DOI: 10.1080/10888438.2011.652721

Holmes VM. Bottom-up processing and reading comprehension in experienced adult readers. Journal of Research in Reading. 2009; 32:309–326. DOI: 10.1111/j.1467-9817.2009.01396.x

Hoover WA, Gough PB. The simple view of reading. Reading and Writing. 1990; 2:127–160.

Hu M, Nation ISP. Unknown vocabulary density and reading comprehension. Reading in a Foreign Language. 2000; 13:403–430.

Hulme C, Snowling MJ. Children's reading comprehension difficulties: Nature, causes, and treatments. Current Directions in Psychological Science. 2011; 20:139–142. DOI: 10.1177/0963721411408673

*. Isakson RL, Miller JW. Sensitivity to syntactic and semantic cues in good and poor comprehenders. Journal of Educational Psychology. 1976; 68:787–792.

*. Justice L, Mashburn A, Petscher Y. Very early language skills of fifth-grade poor comprehenders. Journal of Research in Reading. 2013; 36:172–185. DOI: 10.1111/j.1467-9817.2011.01498.x [PubMed: 25620819]

*. Kasperski R, Katzir T. Are confidence ratings test-or trait-driven? Individual differences among high, average, and low comprehenders in fourth grade. Reading Psychology. 2013; 34:59–84. DOI: 10.1080/02702711.2011.580042

Keenan JM, Hua AN, Meenan CE, Olson RK, Pennington BF, Willcutt EG. Issues in identifying poor comprehenders. L'année Psychologique/Topics in Cognitive Psychology. 2014; 114:753–777. DOI: 10.4074/S0003503314004072

Kendeou P, Van den Broek P, White MJ, Lynch JS. Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. Journal of Educational Psychology. 2009; 101:765.doi: 10.1037/a0015956

Kieffer MJ. Catching up or falling behind? Initial English proficiency, concentrated poverty, and the reading growth of language minority learners in the United States. Journal of Educational Psychology. 2008; 100:851–868. DOI: 10.1037/0022-0663.100.4.851

Kintsch W. The role of knowledge in discourse comprehension: a construction-integration model. Psychological Review. 1988; 95:163–182. DOI: 10.1037/0033-295X.95.2.163 [PubMed: 3375398]

*. Kyle FE, Cain K. A comparison of deaf and hearing children's reading comprehension profiles. Topics in Language Disorders. 2015; 35:144–156. DOI: 10.1097/TLD.0000000000000053

LaBerge D, Samuels SJ. Toward a theory of automatic information processing in reading. Cognitive Psychology. 1974; 6:293–323. DOI: 10.1016/0010-0285(74)90015-2

Landi N, Perfetti CA. An electrophysiological investigation of semantic and phonological processing in skilled and less-skilled comprehenders. Brain and Language. 2007; 102:30–45. DOI: 10.1016/j.bandl.2006.11.001 [PubMed: 17188346]

*. Leach JM, Scarborough HS, Rescorla L. Late-emerging reading disabilities. Journal of Educational Psychology. 2003; 95:211–224. DOI: 10.1037/0022-0663.95.2.211

*. Massey-Garrison A. Oral language development in ESL and EL1 students with and without reading disabilities (Order No MR85583). 2010 Available from ProQuest Dissertations & Theses Full Text. (1328155175).

*. Marshall CM, Nation K. Individual differences in semantic and structural errors in children's memory for sentences. Educational and Child Psychology. 2003; 20:7–18.

*. Megherbi H, Seigneuric A, Ehrlich MF. Reading comprehension in French 1st and 2nd grade children: Contribution of decoding and language comprehension. European Journal of Psychology of Education. 2006; 21:135–147. DOI: 10.1007/BF03173573

Mellard DF, Deshler DD, Barth A. LD identification: It's not simply a matter of building a better mousetrap. Learning Disability Quarterly. 2004; 27:229–242. DOI: 10.2307/1593675

Microsoft. Microsoft Excel [computer software]. Redmond, Washington: Microsoft; 2010.

*. Nation K, Adams JW, Bowyer-Crane C, Snowling MJ. Working memory deficits in poor comprehenders reflect underlying language impairments. Journal of Experimental Child Psychology. 1999; 73:139–158. DOI: 10.1006/jecp.1999.2498 [PubMed: 10328862]

*. Nation K, Clarke P, Snowling MJ. General cognitive ability in children with reading comprehension difficulties. British Journal of Educational Psychology. 2002; 72:549–560. DOI: 10.1348/00070990260377604 [PubMed: 12495566]

*. Nation K, Clarke P, Marshall CM, Durand M. Hidden language impairments in children: Parallels between poor reading comprehension and specific language impairment? Journal of Speech, Language and Hearing Research. 2004; 47:199–211. DOI: 10.1044/1092-4388(2004/017)

*. Nation K, Cocksey J, Taylor JSH, Bishop DVM. A longitudinal investigation of early reading and language skills in children with poor reading comprehension. Journal of Child Psychology and Psychiatry. 2010; 51:1031–1039. DOI: 10.1111/j.1469-7610.2010.02254.x [PubMed: 20456536]

*. Nation K, Marshall CM, Altmann GT. Investigating individual differences in children's real-time sentence comprehension using language-mediated eye movements. Journal of Experimental Child Psychology. 2003; 86:314–329. DOI: 10.1016/j.jecp.2003.09.001 [PubMed: 14623215]

*. Nation K, Marshall CM, Snowling MJ. Phonological and semantic contributions to children's picture naming skill: Evidence from children with developmental reading disorders. Language and Cognitive Processes. 2001; 16:241–259. DOI: 10.1080/01690960042000003

Nation K, Norbury CF. Why reading comprehension fails: Insights from developmental disorders. Topics in Language Disorders. 2005; 25:21–32. DOI: 10.1097/00011363-200501000-00004

*. Nation K, Snowling MJ. Assessing reading difficulties: The validity and utility of current measures of reading skills. British Journal of Educational Psychology. 1997; 67:359–370. DOI: 10.1111/j.2044-8279.1997.tb01250.x [PubMed: 9376312]

*. Nation K, Snowling MJ. Individual differences in contextual facilitation: Evidence from dyslexia and poor reading comprehension. Child Development. 1998a; 69:996–1011. DOI: 10.1111/j.1467-8624.1998.tb06157.x [PubMed: 9768483]

*. Nation K, Snowling MJ. Semantic processing and the development of word recognition skills: Evidence from children with reading comprehension difficulties. Journal of Memory and Language. 1998b; 39:85–101. DOI: 10.1006/jmla.1998.2564

*. Nation K, Snowling MJ. Developmental differences in sensitivity to semantic relations among good and poor comprehenders: Evidence from semantic priming. Cognition. 1999; 70:B1–B13. DOI: 10.1016/S0010-0277(99)00004-9 [PubMed: 10193058]

*. Nation K, Snowling MJ. Factors influencing syntactic awareness skills in normal readers and poor comprehenders. Applied Psycholinguistics. 2000; 21:229–241.

Nation K, Snowling MJ. Beyond phonological skills: Broader language skills contribute to the development of reading. Journal of Research in Reading. 2004; 27:342–356. DOI: 10.1111/j.1467-9817.2004.00238.x

*. Nation K, Snowling MJ, Clarke P. Production of the English past tense by children with language comprehension impairments. Journal of Child Language. 2005; 32:117–137. DOI: 10.1017/S0305000904006555 [PubMed: 15779879]

*. Nation K, Snowling MJ, Clarke P. Dissecting the relationship between language skills and learning to read: Semantic and phonological contributions to new vocabulary learning in children with poor reading comprehension. International Journal of Speech-Language Pathology. 2007; 9:131–139. DOI: 10.1080/14417040601145166

National Early Literacy Panel. Developing early literacy: Report of the National Early Literacy Panel Executive Summary. Washington, DC: National Institute for Literacy; 2008.

National Institute of Child Health and Human Development. Report of the National Reading Panel Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction (NIH Publication No 00-4769). Washington, D.C.: U.S. Government Printing Office; 2000.

*. Ndlovu, K. Unpublished doctoral dissertation. Toronto, ON, Canada: University of Toronto; 2010. Story-writing development from Grades 4 to 6: Do language status and reading profile matter?.

*. Nesi B, Levorato MC, Roch M, Cacciari C. To break the embarrassment: Text comprehension skills and figurative competence in skilled and less-skilled text comprehenders. European Psychologist. 2006; 11:128–136. DOI: 10.1027/1016-9040.11.2.128

Nippold MA, Sun L. Knowledge of morphologically complex words: A developmental study of older children and young adolescents. Language, Speech, and Hearing Services in Schools. 2008; 39:365–373. DOI: 10.1044/0161-1461(2008/034

*. Oakhill J. Constructive processes in skilled and less skilled comprehenders' memory for sentences. British Journal of Psychology. 1982; 73:13–20. DOI: 10.1111/j.2044-8295.1982.tb01785.x [PubMed: 7059748]

*. Oakhill J. Instantiation in skilled and less skilled comprehenders. The Quarterl Journal of Experimental Psychology A: Human Experimental Psychology. 1983; 35:441–450. DOI: 10.1080/14640748308402481

*. Oakhill J. Inferential and memory skills in children's comprehension of stories. British Journal of Educational Psychology. 1984; 54:31–39. DOI: 10.1111/j.2044-8279.1984.tb00842.x

*. Oakhill J. Children's difficulties in reading comprehension. Educational Psychology Review. 1993; 5:223–237. DOI: 10.1007/BF01323045

*. Oakhill, J. Individual differences in children's text comprehension. In: Gernsbacher, MA., editor. Handbook of psycholinguistics. London: Academic Press; 1994. p. 821-848.

*. Oakhill J, Cain K. Children's difficulties in text comprehension: Assessing causal issues. Journal of Deaf Studies and Deaf Education. 2000; 5:51–59. DOI: 10.1093/deafed/5.1.51 [PubMed: 15454517]

*. Oakhill, J., Cain, K., Yuill, N. Individual differences in children's comprehension skill: Toward an integrated model. In: Hulme, C., Joshi, RM., editors. Reading and spelling: Development and disorders. Mahwah, NJ: Lawrence Erlbaum; 1998. p. 343-367.

*. Oakhill J, Hartt J, Samols D. Levels of comprehension monitoring and working memory in good and poor comprehenders. Reading and Writing. 2005; 18:657–686. DOI: 10.1007/s11145-005-3355-z

*. Oakhill J, Patel S. Can imagery training help children who have comprehension problems? Journal of Research in Reading. 1991; 14:106–115. DOI: 10.1111/j.1467-9817.1991.tb00012.x

*. Oakhill J, Yuill N. Pronoun resolution in skilled and less-skilled comprehenders: Effects of memory load and inferential complexity. Language and speech. 1986; 29:25–37. DOI: 10.1177/002383098602900104

*. Oakhill, J., Yuill, N. Higher order factors in comprehension disability: Processes and remediation. In: Cornoldi, C., Oakhill, J., editors. Reading comprehension difficulties: Processes and intervention. Mahwah, NJ: Lawrence Erlbaum; 1996. p. 69-92.

*. Oakhill J, Yuill N, Donaldson ML. Understanding of causal expressions in skilled and less skilled text comprehenders. British Journal of Developmental Psychology. 1990; 8:401–410. DOI: 10.1111/j.2044-835X.1990.tb00854.x

*. Oakhill J, Yuill N, Parkin A. On the nature of the difference between skilled and less-skilled comprehenders. Journal of Research in Reading. 1986; 9:80–91. DOI: 10.1111/j.1467-9817.1986.tb00115.x

Ouellette GP. What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. Journal of educational psychology. 2006; 98(3):554.doi: 10.1037/0022-0663.98.3.554

*. Pelegrina S, Capodieci A, Carretti B, Cornoldi C. Magnitude representation and working memory updating in children with arithmetic and reading comprehension disabilities. Journal of Learning Disabilities. 2014; :1–11. DOI: 10.1177/0022219414527480

Perfetti, CA. Reading ability. New York, NY: Oxford University Press; 1985.

Perfetti, CA., Hart, L. The lexical basis of comprehension skill. In: Gorfein, DS., editor. On the consequences of meaning selection: Perspectives on resolving lexical ambiguity. Washington, DC: American Psychological Association; 2001. p. 67-86.

Perfetti CA, Hogaboam T. Relationship between single word decoding and reading comprehension skill. Journal of Educational Psychology. 1975; 67:461.doi: 10.1037/h0077013

Perfetti, CA., Landi, N., Oakhill, J. The acquisition of reading comprehension skill. In: Snowling, MJ., Hulme, C., editors. The science of reading: A handbook. Malden, MA: Blackwell Publishing; 2005. p. 227-247.

Perfetti C, Stafura J. Word knowledge in a theory of reading comprehension. Scientific Studies of Reading. 2014; 18:22–37. DOI: 10.1080/10888438.2013.827687

*. Pimperton, H. An incomplete understanding: Clarifying some causes and consequences of the ‘poor comprehender’ profile. 2010. Retrieved from: http://ora.ox.ac.uk/objects/uuid:2487e001-b05a-49d2-bc41-528d2810a5fe

*. Pimperton H, Nation K. Suppressing irrelevant information from working memory: Evidence for domain-specific deficits in poor comprehenders. Journal of Memory and Language. 2010a; 62:380–391. DOI: 10.1016/j.jml.2010.02.005

*. Pimperton H, Nation K. Understanding words, understanding numbers: An exploration of the mathematical profiles of poor comprehenders. British Journal of Educational Psychology. 2010b; 80:255–268. DOI: 10.1348/000709909×477251 [PubMed: 19857376]

*. Pimperton H, Nation K. Poor comprehenders in the classroom: teacher ratings of behavior in children with poor reading comprehension and its relationship with individual differences in working memory. Journal of Learning Disabilities. 2014; :1–9. DOI: 10.1177/0022219412454172

Rayner K. Eye movements and the perceptual span in beginning and skilled readers. Journal of Experimental Child Psychology. 1986; 41:211–236. DOI: 10.1016/0022-0965(86)90037-8 [PubMed: 3701249]

Rayner K, Foorman BR, Perfetti CA, Pesetsky D, Seidenberg MS. How psychological science informs the teaching of reading. Psychological Science in the Public Interest. 2001; 2:31–74. DOI: 10.1111/1529-1006.00004 [PubMed: 26151366]

*. Re AM, Carretti B. Further evidence of poor comprehenders' difficulty with expressive writing: Exploring the role of inferences. Research in Developmental Disabilities. 2016; 51:145–152. DOI: 10.1016/j.ridd.2016.01.004 [PubMed: 26826466]

*. Ricketts J. Language and literacy skills of poor comprehenders and typical readers. Unpublished raw data. 2014

*. Ricketts J, Bishop DV, Nation K. Investigating orthographic and semantic aspects of word learning in poor comprehenders. Journal of Research in Reading. 2008; 31:117–135. DOI: 10.1111/j.1467-9817.2007.00365.x

*. Ricketts J, Nation K, Bishop DV. Vocabulary is important for some, but not all reading skills. Scientific Studies of Reading. 2007; 11(3):235–257. DOI: 10.1080/10888430701344306

*. Ricketts J, Sperring R, Nation K. Educational attainment in poor comprehenders. Frontiers in Psychology. 2014; 5:1–11. DOI: 10.3389/fpsyg.2014.00445 [PubMed: 24474945]

Rønberg LF, Petersen DK. How specific are specific comprehension difficulties? An investigation of poor reading comprehension in nine-year-olds. Scandinavian Journal of Educational Research. 2015; :1–18. DOI: 10.1080/00313831.2014.996594

Roth FP, Speece DL, Cooper DH. A longitudinal analysis of the connection between oral language and early reading. The Journal of Educational Research. 2002; 95:259–272. DOI: 10.1080/00220670209596600

Rumelhart, DE. Schemata: The building blocks of cognition. In: Spiro, RJ.Bruce, BC., Brewer, WE., editors. Theoretical issues in reading comprehension. Hillsdale, NJ: Erlbaum; 1980. p. 33-58.

Shadish, WR., Haddock, CK. Combining estimates of effect sizes. In: Cooper, H.Hedges, LV., Valentine, JC., editors. The handbook of research synthesis and meta-analysis. 2nd. New York, NY: Russell Sage; 2013. p. 257-277.

Shank, RC., Abelson, R. Scripts, plans, goals, and understanding. Hillsdale, NJ: Erlbaum; 1977.

*. Shankweiler D, Lundquist E, Katz L, Stuebing KK, Fletcher JM, Brady S, et al. Shaywitz BA. Comprehension and decoding: Patterns of association in children with reading difficulties. Scientific Studies of Reading. 1999; 3(1):69–94. DOI: 10.1207/s1532799xssr0301_4

Snow, C. Reading for understanding: Toward an R&D program in reading comprehension. Santa Monica, CA: RAND; 2002.

Snow, C., Burns, MS., Griffin, P. Preventing reading difficulties in young children. Washington, DC: National Academy Press; 1998.

Snowling MJ, Hulme C. Interventions for children's language and literacy difficulties. International Journal of Language & Communication Disorders. 2012; 47:27–34. DOI: 10.1111/j.1460-6984.2011.00081.x [PubMed: 22268899]

Spencer M, Wagner RK, Quinn JM. Specific reading comprehension disability: Major problem, myth, or misnomer? Learning Disabilities Research and Practice. 2014; 29:3–9. DOI: 10.1111/ldrp.12024 [PubMed: 25143666]

*. Spooner AL, Baddeley AD, Gathercole SE. Can reading accuracy and comprehension be separated in the Neale Analysis of Reading Ability? British Journal of Educational Psychology. 2004; 74(2):187–204. DOI: 10.1348/000709904773839833 [PubMed: 15130187]

*. Spooner AL, Gathercole SE, Baddeley AD. Does weak reading comprehension reflect an integration deficit? Journal of Research in Reading. 2006; 29:173–193. DOI: 10.1111/j.1467-9817.2006.00284.x

Stahl SA, Hare VC, Sinatra R, Gregory JF. Defining the role of prior knowledge and vocabulary in reading comprehension: The retiring of number 41. Journal of Reading Behavior. 1991; 23:487–508. DOI: 10.1080/10862969109547755

*. Stothard, SE. Doctoral Dissertation. 1992. Reading difficulties in children: Problems of decoding and comprehension. Retrieved from ProQuest Dissertations & Theses. (304045821)

*. Stothard SE, Hulme C. Reading comprehension difficulties in children: The role of language comprehension and working memory skills. Reading & Writing. 1992; 4:245–256. DOI: 10.1007/BF01027150

*. Stothard SE, Hulme C. A comparison of phonological skills in children with reading comprehension and children with decoding difficulties. Journal of Child Psychology and Psychiatry. 1995; 36:399–408. DOI: 10.1111/j.1469-7610.1995.tb01298.x [PubMed: 7782404]

*. Stothard, SE., Hulme, C. A comparison of reading comprehension and decoding difficulties in children. In: Cornoldi, C., Oakhill, J., editors. Reading comprehension difficulties: Processes and intervention. New York, NY: Routledge; 1996. p. 93-112.

*. Swanson HL, Berninger V. The role of working memory in skilled and less skilled readers' comprehension. Intelligence. 1995; 21(1):83–108. DOI: 10.1016/0160-2896(95)90040-3

Swanson HL, Trainin G, Necoechea DM, Hammill DD. Rapid naming, phonological awareness, and reading: A meta-analysis of the correlation evidence. Review of Educational Research. 2003; 73:407–440. DOI: 10.3102/00346543073004407

Tipton E. Small sample adjustments for robust variance estimation with meta-regression. Psychological Methods. 2015; 20:375–393. [PubMed: 24773356]

Thorndike, RL. Personnel selection: Test and measurement techniques. New York, NY: Wiley; 1949.

*. Tong X, Deacon SH, Cain K. Morphological and syntactic awareness in poor comprehenders another piece of the puzzle. Journal of Learning Disabilities. 2014; 47:22–33. DOI: 10.1177/0022219413509971 [PubMed: 24306458]

*. Tong X, Deacon SH, Kirby JR, Cain K, Parrila R. Morphological awareness: A key to understanding poor reading comprehension in english. Journal of Educational Psychology. 2011; 103:523–534. DOI: 10.1037/a0023495

Torgesen, JK., Hudson, R. Reading fluency: critical issues for struggling readers. In: Samuels, SJ., Farstrup, A., editors. Reading fluency: The forgotten dimension of reading success. Newark, DE: International Reading Association; 2006. p. 130-158.

*. Torppa M, Tolvanen A, Poikkeus AM, Eklund K, Lerkkanen MK, Leskinen E, Lyytinen H. Reading development subtypes and their early characteristics. Annals of Dyslexia. 2007; 57:3–32. DOI: 10.1007/s11881-007-0003-0 [PubMed: 17849214]

Van Dijk, TA., Kintsch, W. Strategies of discourse comprehension. New York, NY: Academic Press; 1983.

Viechtbauer W. Conducting meta-analyses in R with the metafor package. Journal of Statistical Software. 2010; 36(3):1–48.

Wagner, RK., Muse, AE., Tannenbaum, KR. Vocabulary acquisition: Implications for reading comprehension. New York, NY: Guildford Press; 2007.

Wagner RK, Torgesen JK. The nature of phonological processing and its causal role in the acquisition of reading skills. Psychological Bulletin. 1987; 101(2):192–212. DOI: 10.1037/0033-2909.101.2.192

Weekes BS, Hamilton S, Oakhill JV, Holliday RE. False recollection in children with reading comprehension difficulties. Cognition. 2008; 106:222–233. DOI: 10.1016/j.cognition.2007.01.005 [PubMed: 17349990]

Wolfe MB, Woodwyk JM. Processing and memory of information presented in narrative or expository texts. British Journal of Educational Psychology. 2010; 80:341–362. DOI: 10.1348/000709910×485700 [PubMed: 20128958]

*. Yuill N. Reading and riddling: The role of riddle appreciation in understanding and improving poor text comprehension in children. Cahiers de Psychologie Cognitive. 1998; 17:313–342.

*. Yuill N. The relation between ambiguity understanding and metalinguistic discussion of joking riddles in good and poor comprehenders: Potential for intervention and possible processes of change. First language. 2009; 29:65–79. DOI: 10.1177/0142723708097561

*. Yuill N, Joscelyne T. Effect of organizational cues and strategies on good and poor comprehenders' story understanding. Journal of Educational Psychology. 1988; 80:152.doi: 10.1037/0022-0663.80.2.152

*. Yuill N, Oakhill J. Effects of inference awareness training on poor reading comprehension. Applied Cognitive Psychology. 1988a; 2:33–45. DOI: 10.1002/acp.2350020105

*. Yuill N, Oakhill J. Understanding of anaphoric relations in skilled and less skilled comprehenders. British Journal of Psychology. 1988b; 79:173–186. DOI: 10.1111/j.2044-8295.1988.tb02282.x

*. Yuill, N., Oakhill, J. Children's problems in text comprehension: An experimental investigation. New York, NY: Cambridge University Press; 1991.

*. Yuill N, Oakhill J, Parkin A. Working memory, comprehension ability and the resolution of text anomaly. British journal of psychology. 1989; 80:351–361. DOI: 10.1111/j.2044-8295.1989.tb02325.x [PubMed: 2790393]

*. Yuill N, Pearce D, Kerawalla L, Harris A, Luckin R. How technology for comprehension training can support conversation towards the joint construction of meaning. Journal of Research in Reading. 2009; 32:109–125. DOI: 10.1111/j.1467-9817.2008.01384.x

*. Zhang J, McBride-Chang C, Wong AMY, Tardif T, Shu H, Zhang Y. Longitudinal correlates of reading comprehension difficulties in Chinese children. Reading and Writing. 2014; 27(3):481–501. DOI: 10.1007/s11145-013-9453-4

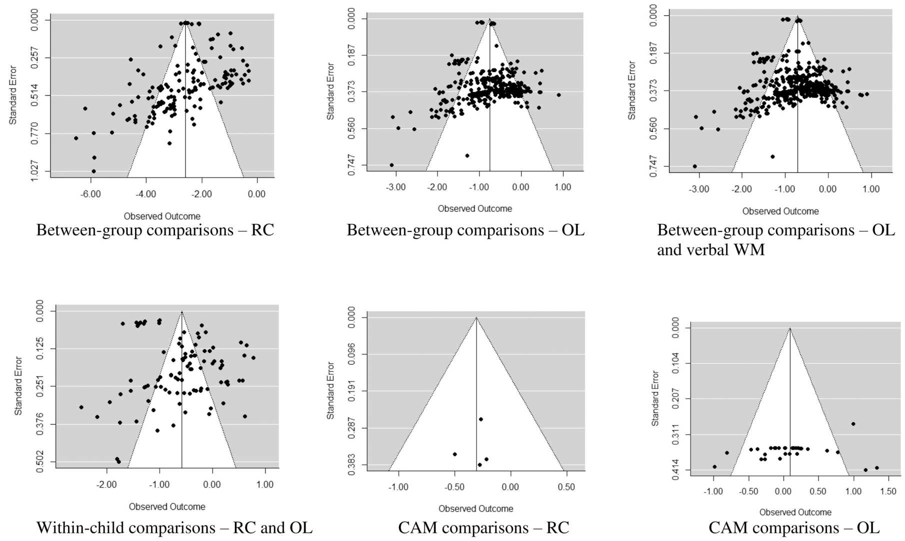

Figure 1.

Funnel plots for between- and within-group comparisons. *Note*. RC = Reading comprehension; OL = Oral language; WM = Working memory; CAM = Reading-comprehension age-match.

Table 1

Average Weighted Effect Size Estimates, 95% Confidence Intervals, and Heterogeneity Statistics for Comparisons of Reading Comprehension and Oral Language Performance

		Effect Size			
Comparisons	**Variables**	***k***	***d***	**95% CI**	***I*²**
SCD and typical readers	Reading comprehension	152	−2.78	[−3.01, −2.54]	94.39*
	Reading comprehension[a]	137	−2.80	[−3.05, −2.55]	94.68*
	Reading comprehension[b]	57	−2.73	[−3.05, −2.42]	96.82*
	Oral language	309	−0.78	[−0.89, −0.68]	85.55*
	Oral language[a]	304	−0.79	[−0.90, −0.68]	85.50*
	Oral language[b]	133	−0.95	[−1.06, −0.83]	91.00*
	Oral language[c]	400	−0.77	[−0.87, −0.67]	85.12*
SCD and comprehension-age match	Reading comprehension	4	−0.31	[−0.63, 0.02]	<1.00
	Oral language	30	0.32	[−0.49, 1.14]	77.13*
SCD Only					
	Reading comprehension, oral language	97	−0.84	[−1.06, −0.62]	96.06*

Note. k = Number of effect sizes; *d* = Average-weighted effect size estimate; CI = Confidence interval; SCD = Children with specific reading comprehension deficits;

[a]Same studies included across between-group comparisons.

[b]Same studies included across between-group and with-child analyses.

[c]Including verbal working memory.

*$p < .05$.

Table 2

Metaregression Analyses Examining the Effects of Study Type, Participant Age, and Type of Oral Language Measure as Moderators of Effect Size

Comparisons	Constructs	Moderators	β	*t*
SCD and typical readers				
	Reading comprehension			
		Study type	.14	1.05
		Age	−.47 *	−2.53
	Oral language			
		Study type	−.04	−0.77
		Age	−.06	−0.85
		Oral language measure[a]	−.05	−0.91
		Oral language measure[b]	.00	0.05
SCD and comprehension-age match				
	Reading comprehension			
		Age[c]	–	–
		Study type[c]	–	–
	Oral language			
		Age[c]	–	–
		Study type[c]	–	–
		Oral language measure[a]	−.10	−0.18
		Oral language measure[b]	−.23	−1.05
SCD Only	Reading comprehension, oral language			
		Study Type	−.24 **	−2.77
		Age	−.00	−.02
		Oral language measure[a]	.20 **	2.35
		Oral language measure[b]	−.03	−0.85

Note. SCD = Children with specific reading comprehension deficits;

[a]Mean;

[b]Mean centered;

[c]Moderator was a constant.

* $p < .05$

** $p < .01$.