Profiles of oral and reading comprehension in poor comprehenders

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Abstract

This study aimed to profile the sublexical, lexical, and text level language skills, and cognitive processes of a sub-group of children with poor reading comprehension known as poor comprehenders. An assessment protocol was developed to assess each of the components from Perfetti and Stafura's (2014) Reading Systems Framework. A comprehensive profile was obtained for 17 poor comprehenders in School Years 3-6 (aged 8-11 years), each assessed individually. Consistent with previous research, and irrespective of age, the poor comprehenders in this study did not have difficulty with sublexical and word reading skills overall. Unexpectedly, only two children had difficulty with the lower-level language tasks at the Lexicon and sentence sub-level of the Reading Systems Framework. In contrast, 15 poor comprehenders had difficulty with higher-level comprehension processes. All children had weak verbal working memory, supporting previous research findings. The study provides direction for clinical assessment tasks for use with this population.
Key words: reading comprehension, poor comprehenders, assessment, profiles

Introduction

Reading comprehension involves a complex set of knowledge and processes, any aspect of which can be a source of comprehension failure. Poor comprehenders are a subgroup of poor readers with weak reading comprehension who can be difficult to identify as they read accurately and fluently. Research exploring the underlying skills of poor comprehenders has been predominantly guided by the Simple View of Reading (SVR) which proposes that reading comprehension is the product of skills in two components: decoding (or word reading) and listening comprehension (Gough & Tunmer, 1986). The central claims of the SVR are that both components are of equal importance, skill in both is necessary for reading success, and the two components can be dissociated allowing for identification of three different subgroups of poor readers: poor comprehenders, poor decoders, and those who struggle with both decoding and comprehension (Hoover & Gough, 1990). Between 7-8% of children in the middle primary school years have been identified as poor comprehenders (e.g., Clarke et al., 2010; Nation et al., 2010), and this percentage has been found to increase across the year levels as decoding skills improve and listening comprehension becomes increasingly influential (e.g., Language and Reading Research Consortium [LARRC], 2015). The SVR, as originally conceptualised, does not specify subcomponents within each of these two

components instead provides “an overall framework for understanding the broad landscape of reading” (Kirby & Savage, 2008, p.75). Some longitudinal and prospective studies have used multiple measures to explore the profiles of poor comprehenders and the contribution of subcomponent skills to reading comprehension, (e.g., Cain & Oakhill, 2006; Catts et al., 2006; Kim, 2017; Nation et al., 2010). There has been high variability, however, in the type and range of language skills that have been assessed, limiting comparison of participant groups reported in the literature, necessitating a targeted procedure to profile the skills of this often hidden group of poor readers.

While a number of text and discourse comprehension models have been developed (for a review, see McNamara & Magliano, 2009), Perfetti and Stafura (2014) proposed that there was value in a framework that represented the components of reading more fully. The Reading Systems Framework (RSF: 2014) evolved from earlier work by Perfetti and colleagues (Perfetti 1999; Perfetti et al., 2005) and includes word-level processes alongside the higher-level processes focused on in much of the previous comprehension research, with the two components centrally connected by the lexicon, i.e., the knowledge of written word forms and their meaning. The RSF sought to identify key processes and knowledge sources that input into these component systems, along with wider cognitive system requirements such as visual input and memory skills, allowing for the development of hypotheses regarding the sources of reading comprehension difficulties (Perfetti & Stafura, 2014). By expanding on the two components of SVR, the RSF provides a more comprehensive framework for the creation of a theoretically informed test battery to profile the strengths and weaknesses of readers, including poor comprehenders.

To investigate how the RSF may achieve this aim, we first explore an expanded version of the SVR that has emerged since its initial conceptualisation over 30 years ago, through its use as a framework to guide research into reading comprehension. Using Hogan et al.’s (2011) visual representation of this expanded view, the characteristics of poor comprehenders as they are currently understood are then set out. Finally, how the more comprehensive framework of the RSF has guided the development of a theoretically informed assessment battery to profile the language skills of a group of poor comprehenders in this study, is explored.

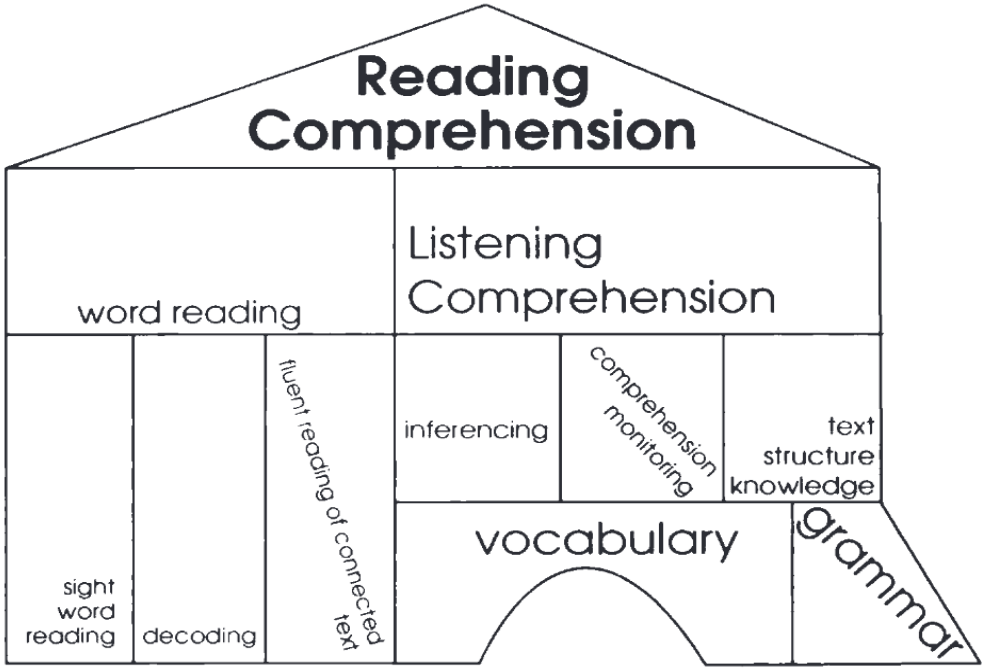
The Simple View of Reading

The two components of the SVR, decoding (also referred to as word reading) and listening comprehension, have been found to explain almost, if not all of the variance in

reading comprehension at different stages of development (e.g., Kim, 2017). They are "…upper-level skills that directly contribute to reading comprehension while they are predicted by a constellation of language and cognitive skills" (Kim, 2017, p.326). Figure 1 shows Hogan et al.'s (2011) representation of these upper-level and subcomponent skills within the SVR framework.

Figure 1

Visual representation of the Simple View of Reading



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The 'upper-level skill' of word reading is underpinned by sight word reading, decoding and fluent reading, while the subcomponents of listening comprehension are divided into what are sometimes referred to as lower and higher-level language skills or factors (e.g., Hogan et al., 2011; Perfetti et al., 2005). The lower-level language skills of vocabulary and grammar knowledge support the understanding of individual words and sentences in a text. They are used to construct the literal meaning of a text, or *textbase* (Kim, 2017; Kintsch & Kintsch, 2005). These lower-level skills provide a foundation for the higher-level skills of (a) integration and inferencing, (b) comprehension monitoring, and (c) text structure knowledge, each required to construct a *situation model*, or mental model of the situation described in an oral or written text (Hogan et.al., 2011; Kintsch & Kintsch, 2005).

Word reading skills in poor comprehenders

With respect to word reading skills, problems have not been identified in poor comprehenders in any of the three word reading subcomponents identified in Hogan et al.'s (2011) visual representation of the SVR. Yuill and Oakhill (1991) provide an overview of earlier work where poor comprehenders, when matched with good comprehenders for word reading accuracy on an early version of the Neale Analysis of Reading Ability (NARA[1]: Neale, 1997), were shown to be able to (1) read and sort pairs of rhyming and non-rhyming word pairs into groups, and (2) read nonwords and both high and low frequency real words, as rapidly as the controls. Further, training to increase decoding speed was not found to impact on comprehension levels (Yuill & Oakhill, 1991). Later research with poor comprehenders, using stricter group selection criteria, provided further support for appropriately developed phonological processing and word reading skills across a range of tasks such as rhyme judgement and fluency, phoneme deletion, nonword repetition, and timed and untimed real and nonword reading (Adlof & Catts, 2015; Cain et al., 2000; Catts et al., 2006; Nation et al., 2004; Nation et al., 2010; Nation & Snowling, 1998). Nation and Snowling (1998), however, found that while the 8-9 year old poor comprehenders in their study read high frequency words and those with regular spellings at an equivalent level of accuracy and speed to control children, they were less accurate and efficient reading low frequency and irregularly spelt words, a finding replicated by Ricketts et al. (2007).

Nation and Snowling proposed that these difficulties were the result of weaknesses in knowledge of word meanings which can be used, along with letter-sound mappings, to support word recognition. Support for this proposal was provided by Tunmer and Chapman (2012) who, in a study of 122 children aged 7 years, found that while vocabulary knowledge impacted directly on reading comprehension, it also impacted indirectly on word recognition. These semantic weaknesses are suggestive of broader language processing issues, leading researchers to turn their attention to other language subcomponents in their attempts to explain the difficulties underlying poor reading comprehension.

Listening comprehension skills in poor comprehenders

With respect to listening comprehension skills (see Figure 1), vocabulary and grammar provide a foundation for the higher-level skills (text structure knowledge, inferencing and comprehension monitoring) which, when combined with a reader's prior

[1] Where different versions of the same test are cited, the version used in the most recent study is referenced

knowledge, allow for the construction of a mental model of a text's meaning (Hogan et al., 2011; Perfetti et al., 2005). These will now be explored in more detail.

Lower-level language skills

Vocabulary. While it is widely accepted that weak vocabulary skills will impact on reading comprehension, the findings for the influence of vocabulary in poor comprehenders are variable. In many of Oakhill and colleagues' studies (e.g., Cain et al., 2000; Cain et al., 2004; Yuill & Oakhill, 1991), the Gates-MacGinitie Vocabulary subtest (MacGinitie & MacGinitie, 1989), a single-word reading vocabulary measure requiring matching one of four written words to a picture, was used in the selection and matching of their groups of good and poor comprehenders. Other studies have used the British Picture Vocabulary Scale (BPVS; Dunn et al., 1997) in the selection and matching process (e.g., Cain et al., 2004), showing that receptive vocabulary was not an area of deficit for the poor comprehenders in these studies. In a different study with 9-10 year old children, Cain et al. (2004), using both the BPVS and Gates-MacGinitie, identified one group of poor comprehenders with weak vocabulary skills and one without. The findings of studies that have assessed receptive vocabulary, but not used the tasks as a selection measure, have varied. Cain and Oakhill (2006) found that 7-8 year old poor comprehenders scored significantly below good comprehenders on the BPVS, although most still scored at an age-appropriate level, but not on the Gates-MacGinitie. Other studies using the Peabody Picture Vocabulary Test (PPVT: Dunn & Dunn, 2007) have found poor comprehenders to have weak receptive vocabulary (Adlof & Catts, 2015; Catts et al., 2006).

Tests of receptive vocabulary measure vocabulary breadth, the number of words a person knows, while other tasks measure vocabulary depth, knowledge about words and relations and associations between them (Oakhill et al., 2015). Nation and Snowling (1998) found that while the 8-9 year old poor comprehenders in their study performed as well as normal readers on a rhyme fluency task, they produced fewer words on a semantic fluency task. Not all poor comprehenders, however, have been found to perform poorly on semantic fluency tasks (Cain et al., 2004). The poor comprehenders in Nation and Snowling's (1998) study also scored poorly compared with controls on all the other semantic tasks assessing both vocabulary breadth (synonym judgement) and depth (word definitions, multiple meaning words). Subsequent studies found further support for poor comprehenders having difficulty on tasks of vocabulary depth such as word definitions and explaining how words go together (Nation et al., 2004; Nation et al., 2010; Nation et al., 2007), learning the meanings

of new words (Nation et al., 2007), and on the Clinical Evaluation of Language Fundamentals (CELF-4: Semel et al., 2006) Word Classes task which involves identifying and explaining word relationships (Adlof & Catts, 2015).

Grammar. Knowledge of word meanings alone is insufficient to understand sentences; knowledge of syntactic structure is also important. Yuill and Oakhill (1991) found that their groups of poor comprehenders were just as aware of semantic and syntactic constraints in sentences, were able to repeat back meaningful sentences verbatim, and understood grammatical constructions on the Test for Reception of Grammar (TROG: Bishop, 2003), as well as the good comprehenders matched for vocabulary and word recognition. Cain and Oakhill (2006) also found 7-8 year old poor comprehenders performed as well as controls on the TROG, but this finding has not been consistently supported (e.g., Nation et al., 2004). Several studies have also found that poor comprehenders have greater difficulty than controls with verbatim recall of sentences on the CELF Recalling Sentences subtest (Adlof & Catts, 2015: Nation et al., 2004; Nation et al., 2007; Nation et al., 2010), and with other subtests from the CELF involving grammatical knowledge such as Concepts and Directions (Adlof & Catts, 2015; Catts et al., 2006) and Sentence Structure (Nation et al., 2010). While the results on tests of receptive grammar such as the TROG have been inconsistent, other studies have found poor comprehenders perform below good comprehenders on certain experimental tasks of morphosyntax even when semantic factors were controlled (Adlof & Catts, 2015; Nation et al., 2004).

In summary, the results of studies investigating lower-level language skills highlight that, while poor comprehenders have oral language difficulties and not just difficulties specific to reading, not all poor comprehenders have difficulty across all measures of semantics and syntax/grammar. Given the variability in profiles, and the fact that some poor comprehenders appear to have both adequate word level processing and semantic/syntactic skills, a third level of focus has been on higher-level language skills and discourse level comprehension.

Higher-level language skills

Integration and inference. To create an accurate mental model of a text the reader (or listener) needs to go beyond the information that is explicitly stated and integrate information and ideas across sentences and subsequent parts of the text, as well as make inferences and connect information in the text to their prior knowledge. These skills comprise the inferencing subcomponent in Figure 1. In a series of studies using experimental tasks,

Oakhill and colleagues found 7-8 year old poor comprehenders had difficulty making inferences at the word, sentence and text level. Oakhill (1983) investigated children's ability to make word meaning inferences to assist recall of auditorily presented sentences. Poor comprehenders' recall was weaker than good comprehenders, despite both groups having the required knowledge to infer specific meanings of words based on the sentence context. Oakhill also found that poor comprehenders had greater difficulty making cohesive inferences in sentences, such as understanding pronoun referents and verb phrase ellipsis, even when directly questioned about what these stood for, and with the text available as support (Yuill & Oakhill, 1991). Bowyer-Crane and Snowling (2005), in contrast, found that their group of poor comprehenders across school Years 2-6 were able to answer questions requiring a cohesive inference on reading comprehension tests.

In another series of studies using experimental tasks, Oakhill and colleagues (Cain & Oakhill, 1999; Cain & Oakhill, 2006; Oakhill et al., 1986; Yuill & Oakhill, 1991) found poor comprehenders had greater difficulty than good comprehenders in integrating information to make inferences in texts. This occurred both in texts where information was explicitly provided and where information was implied, requiring text-connecting (cohesive) and gap-filling (knowledge-based) inferences respectively (Cain & Oakhill, 1999). These findings suggested that poor comprehenders do not actively construct meaning from the text spontaneously in the same way as good comprehenders. In addition, they are less likely to integrate relevant general knowledge with information provided in the text to make inferences, even when they possess the knowledge and are directed to the required information (Cain & Oakhill, 1999). As a result, they do not form a coherent representation of the meaning of the text which, in turn, may assist their recall (Yuill & Oakhill, 1991). Cain and Oakhill (1999) suggested that good comprehenders are more likely to make inferences and monitor their comprehension as they strive for coherence in a text, unlike poor comprehenders who tend to focus more on word reading accuracy (e.g., Yuill & Oakhill, 1991).

Comprehension monitoring. A second higher-level subcomponent is comprehension monitoring (see Figure 1). Readers (or listeners) who strive for coherence in their text representation need to monitor whether comprehension has been successful, and initiate repair strategies when comprehension fails. Poor comprehenders have been found to have difficulties detecting anomalies in text and in monitoring their comprehension (Cain & Oakhill, 2006; Oakhill et al., 2005; Yuill & Oakhill, 1991). Oakhill et al. (2005) found that poor comprehenders aged 9-10 years were less likely to identify nonsense words and jumbled

phrases in passages, say that a passage did not make sense, and answer comprehension questions correctly. In further studies, poor comprehenders had difficulty recognising that passages did not make sense and then identifying the contradictory statements, particularly if the inconsistent information was separated by several sentences, suggesting performance decreases as the memory load increases (Cain & Oakhill, 2006; Oakhill et al., 2005). Cataldo and Cornoldi (1998) also found that poor comprehenders had difficulty answering questions when the required information was separated from the question. When explicitly instructed to use a search strategy, performance did improve, leading Cataldo and Cornoldi to conclude that the poor comprehenders were able to search the text but failed to use the skill until instructed to do so, as found in the inference making research.

Text structure knowledge. Knowledge of text structure and coherence, the third higher-level language subcomponent in Figure 1, can help with identification and integration of important information to understand texts. As poor comprehenders had been found to have difficulty understanding stories they had heard (Oakhill et al., 1986), as well as those they read, Oakhill and colleagues investigated whether they also had difficulty producing structurally coherent narratives. In several early studies, Yuill and Oakhill (1991) found that poor comprehenders were less consistent in their use of text cohesion features, such as connectives and referential ties (e.g., pronouns), than good comprehenders. When asked to tell a story from a picture sequence, poor comprehenders tended to produce picture-by-picture rather than integrated stories. In a later study, Cain and Oakhill (1996) found poor comprehenders did not differ from controls in their use of conventional story features such as settings and endings but had difficulty producing causally related narratives.

To summarise, in research largely carried out by Oakhill, Cain and colleagues, poor comprehenders have been found to experience difficulties across each of the three higher-level language areas that contribute to the ‘upper-level skill’ of listening comprehension. It is proposed that poor comprehenders do not spontaneously form a coherent representation of a text and that their comprehension difficulty compounds as memory load increases. The role played by memory in reading comprehension is not addressed by the SVR, as is evident in Hogan et al.’s representation in Figure 1, however, the RSF acknowledges that reading comprehension takes place within a broader cognitive system. The building of a coherent mental model of the situation described by a text places heavy demands on working memory, a limited capacity system (Kintsch & Kintsch, 2005). It is therefore reasonable to hypothesise a relationship exists between working memory and reading comprehension difficulties.

Verbal memory skills in poor comprehenders

Poor comprehenders do not perform as well as good comprehenders on verbal working memory tasks where both storage and processing are required. In a meta-analysis of studies involving poor comprehenders, Carretti et al. (2009) identified difficulties on verbal complex span measures compared with good comprehenders, but not on verbal simple span or visual-spatial complex span measures. For example, poor comprehenders were able to recall lists of numbers of increasing length (e.g., Cain, 2006; Cain et al., 2004; Pimperton & Nation, 2010), complete nonword repetition tasks (e.g., Catts et al., 2006), and repeat back groups of concrete words and nonwords of increasing length (e.g., Cain, 2006), as well as good comprehenders matched for age and reading accuracy. In contrast, poor comprehenders experienced difficulty with complex verbal working memory tasks, such as tasks involving recalling the last digit in groups of number triplets (e.g., Oakhill et al., 2005), word suppression tasks (Cain, 2006; Pimperton & Nation, 2010), and listening span tasks involving completing sentences or stating whether they were true/false, then recalling last words in the correct order in sets of sentences of increasing number (e.g., Cain, 2006; Cain et al., 2004).

A new perspective on assessment: The Reading Systems Framework

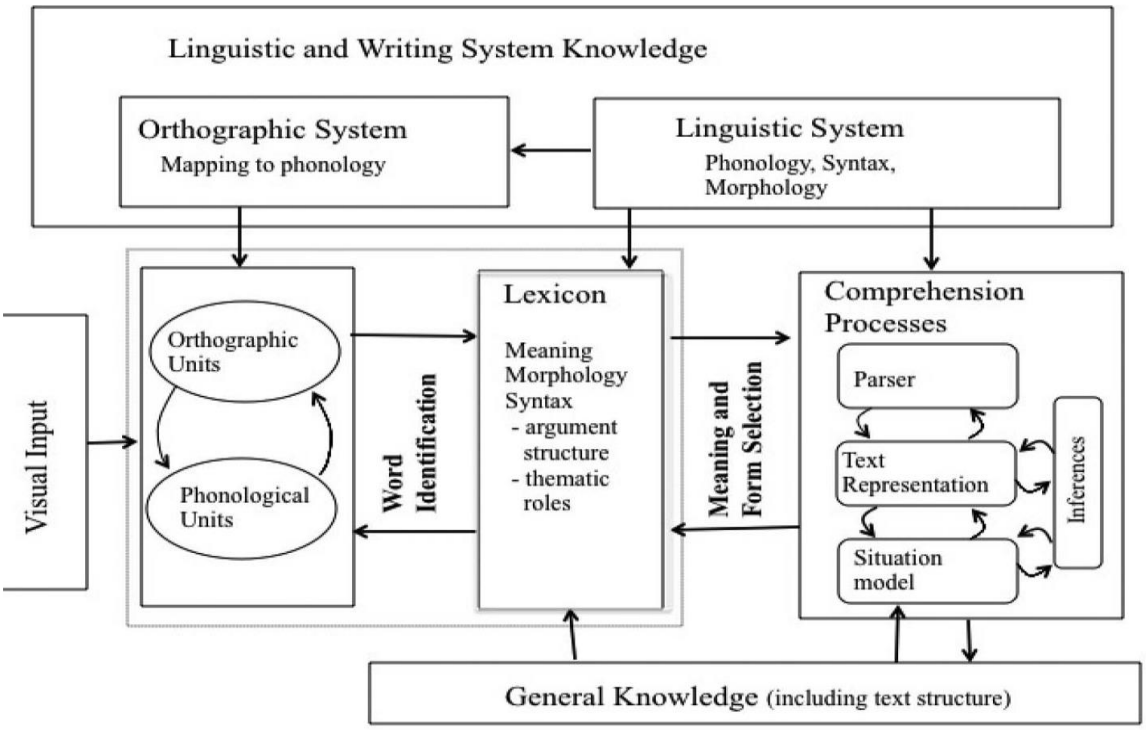
While the SVR has been influential in providing a framework for exploring reading comprehension, it does not explain how the complex set of cognitive and linguistic factors operate during the process of constructing meaning from a text (Nation, 2019). The RSF developed by Perfetti and Stafura (2014) supports a more detailed examination of the subcomponents of reading comprehension (see Figure 2). The word identification system set out in the RSF connects knowledge of the orthographic and phonological units (or sublexical processes), that are activated by the visual input, to allow for the decoding of words. This system is unique to printed words. The higher-level text comprehension system, involving the sentence parser, text representation and situation model, and drawing on linguistic and general knowledge, relates to oral as well as written language. Connecting these two systems is the lexicon/word knowledge, which has been found to play a role in both word identification and text comprehension (Tunmer & Chapman, 2012). These processes take place within a limited capacity memory system (Kintsch & Kintsch, 2005).

By setting out the sequential and reciprocal nature of interaction between the subcomponent skills and processes that underpin the ‘upper-level skills’ represented in the SVR, word reading and listening comprehension, the RSF provides the potential to develop a theoretically informed test battery that will allow for detailed profiling that may further our

understanding of the strengths and weaknesses of poor comprehenders. To date, no studies have used a theoretical framework such as the RSF to do this.

Figure 2

The Reading Systems Framework



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The current study

The aim of this study was to profile the oral and written language, and cognitive processes, of a group of poor comprehenders using a theoretically informed test battery guided by the RSF. A comprehensive assessment battery, drawn from tasks readily accessible to clinicians, was compiled to enable detailed examination of the profiles of strengths and weaknesses of poor comprehenders at each of the sublexical, lexical and text comprehension levels set out in the RSF. We hypothesised that this group of children would demonstrate appropriately developed word reading skills, but that two subtypes of poor comprehenders would emerge in approximately equal proportions. These would include children with lower- and higher-level language difficulties, and children whose difficulties were limited to higher-level discourse comprehension processes. It was anticipated that the findings of this study would both, inform our understanding of the language skills of poor comprehenders, and

identify key tasks for inclusion in a clinically manageable assessment battery that would guide intervention for subtypes of poor comprehenders.

Method

The participants recruited to the study were part of a larger research programme investigating the identification and profiling of poor comprehenders. This study focused on the profiling of those identified as poor comprehenders. Ethical approval was granted by Curtin University Human Research Ethics Committee (RDHS-183-15) and by the Government of Western Australia Department of Education. Written consent was obtained from participating school principals, teachers, students, and their parents/guardians.

Participants

Participants were identified in a two-phase process involving initial testing using a phonological awareness and a listening comprehension task, followed by confirmation testing using measures of nonword reading, reading comprehension and nonverbal IQ (Kelso et al., 2020). The initial testing was carried out on 218 children in School Years 3–6, aged 7;8 –12;1 years (at the time of initial testing) who attended one of two local primary schools serving a predominantly middle to upper-middle socioeconomic strata (SES) in inner metropolitan Perth, Western Australia. Twenty four children were confirmed as poor comprehenders and, from this subgroup, 17 children (eight boys and nine girls) aged 8;6-11;9 years completed the comprehensive assessment protocol reported here. Of the 24, four did not complete the full protocol as, despite nonword reading being well within the average range, their text reading accuracy score on the York Assessment of Reading for Comprehension-Primary, Australian Edition (YARC-P: Snowling et al., 2012) was either at the same level or weaker than their comprehension score. As such, reading accuracy could not be ruled out as a factor that was impacting on comprehension. A further two children withdrew consent during this phase, and testing was not completed on another child due to time constraints within the child's schedule and consent from parents was not provided to complete testing outside school hours.

Procedure

Individual testing was carried out by the first author with all children at their school, in a room away from their classroom. Testing was completed over six sessions, each containing a mix of oral and written tasks.

Table 1

Oral and written assessment tasks mapped to the Reading Systems Framework

Component of Model	Verbal Task (oral)	Written Task (reading)
Sublexical a) Orthographic-Phonological Mapping	• CTOPP-2 Elision • CTOPP-2 Phoneme Isolation	• CTOPP-2 Rapid Letter Naming • CTOPP-2 Rapid Digit Naming • WIAT-II Pseudoword Decoding • TOWRE-2 Phonemic Decoding Efficiency
b) Word Identification		• WIAT-II Word Reading • TOWRE-2 Sight Word Efficiency
Lexicon	• PPVT-4 • CELF-4 Receptive & Expressive Word Classes • CELF-4 Word Associations	• WRMT-III Word Comprehension
Comprehension Processes a) Sentence Level/ Parser	• TROG-2 • CELF-4 Concepts and Following Directions	• CELF-4 Sentence Assembly • New Salford Sentence Reading & Comprehension Cards
b) Text Representation	• Test of Narrative Language (TNL) • CELF-4 Understanding Spoken Paragraphs	• YARC-P (Australian) • PROBE 2 fiction & non-fiction task
c) Situation Model	• TOPS-3 • CASL Inference	NOTE: These tasks tap into Text Representation and Situation Model levels

	• CASL Nonliteral Language	

Note. CTOPP-2 = Comprehensive Test of Phonological Processing-2; WIAT-II (Australian) = Wechsler Individual Achievement Test-II – Australian Standardised Edition; TOWRE-2 = Test of Word Reading Efficiency-2; PPVT-4 = The Peabody Picture Vocabulary Test-4; CELF-4 = Clinical Evaluation of Language Fundamentals-4 – Australian Standardised Edition; WRMT-III = Woodcock Reading Mastery Tests-III; TROG-2 = The Test for Reception of Grammar-2; YARC-P (Australian) = York Assessment of Reading Comprehension-Primary - Australian Edition; TOPS-3 = Test of Problem Solving-3; CASL = Comprehensive Assessment of Spoken Language.

Measures

A battery of tests was used to assess both oral and written language input skills within each of the three components of the RSF model (Sublexical, Lexicon, Comprehension Processes: see Table 1), along with assessments of verbal memory. Where standardised norm-referenced tests were not available, the battery included criterion referenced tasks. Each standardised measure reported good psychometric properties. A description of each measure is provided in Supplemental Material.

Sublexical component

Two oral input tasks were included to assess phonological awareness: Elision and Phoneme Isolation from the Comprehensive Test of Phonological Processing–2nd edition (CTOPP-2: Wagner et al., 2013). Six visual input tasks were completed to assess orthographic-phonological mapping and word recognition: two rapid naming (RN) tasks (CTOPP-2 Rapid Letter and Rapid Digit Naming), two nonword and two real word reading tasks, one each of which was timed and the other untimed. The timed tasks were Phonemic Decoding Efficiency and Sight Word Efficiency from the Test of Word Reading Efficiency-2nd edition (TOWRE-2: Torgesen et al., 2012), and the untimed tasks were Pseudoword Decoding and Word Reading from the Wechsler Individual Achievement Test-2nd edition, Australian Standardised Edition (WIAT–II: Wechsler, 2007).

Lexicon component

Four oral input vocabulary tasks were included. Vocabulary breadth was assessed using the PPVT-4, and vocabulary depth using the CELF-4 (Australian) Receptive and Expressive Word Classes and Word Associations tasks. One written input task of vocabulary depth was administered, the Woodcock Reading Mastery Tests – 3rd edition (WRMT-III) Word Comprehension subtest (Woodcock, 2011).

Comprehension processes component

Two oral input tasks were completed at each of the sentence and text representation subcomponent levels of the RSF, and three at the situation model subcomponent level. At the sentence sub-level, grammatical knowledge was assessed on the TROG-2 (Bishop, 2003) and the CELF-4 Concepts and Following Directions task. The text representation tasks assessed understanding and production of narratives using the Test of Narrative Language (TNL: Gillam & Pearson, 2004) and oral text comprehension using the CELF-4 Understanding Spoken Paragraphs. Inferencing skills were assessed at the situation model sub-level using selected subtests from the Test of Problem Solving–3rd edition (TOPS-3: Bowers et al.,

2005), and the Inference and Nonliteral Language subtests from the Comprehensive Assessment of Spoken Language (CASL: Carrow-Woolfolk, 1999).

Sentence sub-level written input tasks included the CELF-4 Sentence Assembly as a reading task, and the New Salford Sentence Reading (NSSR) & Comprehension Cards (McCarty & Lallaway, 2012). Text reading was assessed using two measures that assessed both reading accuracy and comprehension, tapping into the text representation and situation model sub-levels. These tests were the YARC-P (Australian) and PROBE-2 Reading Comprehension Assessment (Parkin, & Parkin, 2011).

Verbal memory

Five memory tasks were completed. Phonological memory was assessed on the CTOPP-2 Nonword Repetition task, digit span and working memory span on the CELF-4 Number Repetition Forwards and Backwards task, listening span using the Competing Language Processing Task (Gaulin, & Campbell, 1994), and verbatim sentence recall on the CELF-4 Recalling Sentences. This last task also draws on grammatical knowledge.

Results

A detailed profile of each child's oral and written language skills within each of the three components of the RSF model was obtained, along with their nonverbal IQ[2] and verbal memory performance. To provide consistency in reporting of scores between the different norm-referenced tasks, the criterion of a score below the 25th percentile (Standard Score <90; Scaled Score <8) was set as reflecting a relative weakness or 'below average' score for the profiles (shaded in Tables 2-5). Criteria for criterion referenced tasks are reported in the footnotes for the relevant tables.

Results of the oral and written Sublexical component tasks and the reading accuracy tests are reported first, followed by the results in each of the areas of the Lexicon, Comprehension Processes, and verbal memory.

[2] TONI-4 administered in identification study (Kelso et al., 2020)

Table 2

Results for each poor comprehender on the phonological processing and reading accuracy measures

Child	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Year Level	4	3	5	3	5	3	6	4	4	4	6	4	4	4	5	6	5
Sublexical - Oral Tasks																	
CTOPP-2 Elision # [a]	9	12	13	12	9	15	9	13	13	9	9	13	13	10	13	11	9
CTOPP-2 PI [a]	10	7	13	8	9	10	8	11	12	9	10	13	9	12	9	10	9
Sublexical - Written Tasks																	
CTOPP-2 RN Letters [a]	8	7	10	8	11	11	10	10	11	8	10	10	13	11	10	9	10
CTOPP-2 RN Total [b]	104	88	95	88	107	113	116	104	104	95	104	98	119	116	104	92	110
WIAT-II Pseudoword # [b]	95	113	109	109	100	114	108	109	114	99	99	95	112	103	110	106	105
WIAT-II Word [b]	92	109	113	107	94	120	99	101	115	95	105	98	105	101	116	103	109
TOWRE-2 PDE [b]	91	108	111	101	96	130	125	111	119	97	97	87	130	124	111	110	107
TOWRE-2 SWE [b]	94	115	107	108	82	123	111	105	105	82	108	91	131	103	102	93	110
Sentence and Text Level Reading Accuracy Tasks																	
Child	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Year Level	4	3	5	3	5	3	6	4	4	4	6	4	4	4	5	6	5
New Salford Accuracy [b]	96	130+	122	100	98	130+	100	130+	130+	101	94	89	130+	124	100	92	127
YARC-P Form A Accuracy [b]	89	102	101	89	93	109	98	97	103	95	104	91	101	103	103	100	107
PROBE-2 Fiction Accuracy [c]	97	99	98	99	99	100	99	100	99	98	99	97	100	99	98	98	99

PROBE-2 Nonfic Accuracy [c]	93	98	99	99	96	100	99	100	99	96	97	95	98	99	98	97	99

Note. See Table 1 Notes for test names; PI = Phoneme Isolation; RN = Rapid Naming; Pseudoword – Pseudoword Decoding; Word = Word Reading; PDE = Phonemic Decoding Efficiency; SWE = Sight Word Efficiency; Nonfic = Nonfiction.
# = identification task - criterion set at Scaled Score ≥ 9; Standard Score ≥ 95 (i.e. 37th percentile)
a = Scaled Score (ScaleS); b = Standard Score (SS); c = percentage correct [Pass criterion = 96% accuracy]

Table 3

Results for each poor comprehender on the lexicon and sentence level measures

Child	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Year Level	4	3	5	3	5	3	6	4	4	4	6	4	4	4	5	6	5
Lexicon - Oral Tasks																	
PPVT-4 [b]	110	113	109	111	85	99	96	100	99	85	113	103	103	108	104	103	123
CELF-4 WC Receptive [a]	10	11	10	12	8	12	12	10	11	12	13	9	10	13	13	10	13
CELF-4 WC Expressive [a]	10	12	12	12	10	11	12	9	11	10	13	11	7	12	8	9	11
CELF-4 Word Associations [c]	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lexicon - Written Tasks																	
WRMT-III– Word Comp [b]	84	118	109	114	73	115	102	93	98	84	96	86	104	110	113	99	102
Child	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Year Level	4	3	5	3	5	3	6	4	4	4	6	4	4	4	5	6	5
Comprehension Processes: Sentence Level – Oral Tasks																	
TROG-2 [b]	95	104	111	104	83	104	97	102	109	90	97	69	99	111	83	106	106
CELF-4 Concepts & Directions [a]	9	12	10	12	4	12	10	6	12	5	9	8	9	14	10	9	11
Comprehension Processes: Sentence Level – Written Tasks																	
CELF-4 Sentence Assembly [a]	8	10	14	na	6	na	13	5	8	10	10	7	12	6	14	8	13
New Salford Comprehension [b]	99	119	105	104	95	113	91	98	114	94	98	93	110	112	95	101	114

Note. See Table 1 Notes for test names; WC = Word Classes; Word Comp = Word Comprehension
a = Scaled Score (ScaleS); b = Standard Score (SS); c = Pass/Fail criterion CELF-4 manual; na = age below available norms for task

Sublexical oral and written tasks, and text reading accuracy

The majority of participants had little or no difficulty on the phonological processing and word reading tasks (see Table 2). All 17, with only one exception (P2), achieved a score at the 25th percentile or above on the CTOPP-2 phonological awareness and rapid naming tasks. Table 2 shows most participants scored in the average range for accuracy on all single word reading tasks. On the NSSR sentence reading task, only one participant (P12) scored below the 25th percentile for accuracy, while two (P1, P4) scored below this for text reading accuracy on the YARC-P. No participant fell below the pass criterion of 96% accuracy on the PROBE-2 fiction task, while two (P1, P12) did not reach criterion on the non-fiction task.

Lexicon oral and written tasks

Of the five vocabulary measures in the Lexicon component, most participants scored in the average range or above on all tasks, and only two (P5, P10) were found to have weak skills on more than one task (see Table 3). Both scored below the 25th percentile on the oral vocabulary breadth task (PPVT-4) and the written vocabulary depth task (WRMT-III Word Comprehension). In addition, P5 was the only child who did not pass the criterion for their age on the semantic fluency task (CELF-4 Word Associations). Two further participants (P1, P12) scored below the 25th percentile on the written vocabulary depth task.

Comprehension processes – sentence level oral and written tasks

The findings for each participant on the oral and written input tasks at the sentence subcomponent level are also seen in Table 3, with only three having difficulty on more than one task (P5, P8, P12). Of the oral input tasks, three scored below the 25th percentile on the TROG-2 (P5, P12, P15) and three on the CELF-4 Concepts and Following Directions (P5, P8, P10). Two of these (P5, P10) were the same children who had weak skills on more than one Lexicon component task (PPVT-4 and WRMT-III Word Comprehension), as well as on the TOWRE-2 timed real word reading task. No participant scored below the 25th percentile on the NSSR Comprehension written input task, while four had difficulty on the CELF-4 Sentence Assembly (P5, P8, P12, P14), but a score could not be obtained for two School Year 3 children on the second task as they were too young for the available norms. P12 had also scored below the 25th percentile on the Lexicon written vocabulary breadth task (WRMT-III Word Comprehension) and three of the reading accuracy tasks (see Table 2).

Comprehension processes – text representation and situation model oral tasks

Results from oral input tasks at the text representation and situation model subcomponent levels are shown in Table 4. All participants scored below the 25th percentile on the CELF-4 Understanding Spoken Paragraphs, the oral text comprehension task used in the identification study (see Kelso et al., 2020). Of the 17 participants, 10 scored at the 9th percentile or below. In contrast, only two participants (P3, P5) scored below the 25th percentile on the second task at the text representation level, the TNL comprehension measure, one of whom was P5 who presented with weaknesses on Lexicon and sentence level tasks. Six participants, however, performed poorly on the TNL narrative production measure, again including P5. At the situation model subcomponent level, 15 participants scored below the 25th percentile on the TOPS-3 Inferences task, 10 on the Predicting task, including the two who scored in the average range on the Inferences task, and only two on the Problem Solving task (P2, P8). On the CASL tasks at this level, seven scored below the 25th percentile on the Inference task and only one (P5) on the Nonliteral Language task.

Comprehension processes – text representation and situation model written tasks

Reading comprehension task results are presented in Table 4. Five children scored between the 25th and 75th percentile (SS = 90-110) on the YARC-P Comprehension, however, no participant reached the comprehension criterion of 70% of questions correct on the PROBE-2 nonfiction passage for their age, and only three (P14, P15, P17) achieved this on the fiction task. Overall, 11 participants had weaker scores on all three of the text reading comprehension tests, including the two children (P5, P10) who had achieved weaker scores on comprehension tasks at each of the other levels of the RSF.

Verbal memory

Results on the verbal memory tasks varied across the participants and tasks. Only three participants (P2, P6, P14) scored above the mean for their age on the complex working memory task, the CLPT (see Table 5). Difficulties with phonological memory were also evident on the CTOPP-2 Nonword Repetition task, with only three children (P3, P4, P17) scoring at the 25th percentile or above. In contrast, 13 participants scored at the 25th percentile or above on both the digit span and working memory span tasks from the CELF-4 (Number Repetition Forwards and Backwards), and only two (P1, P12) scored below the 25th percentile on both tasks. In addition, 14 of the 17 participants performed well on the CELF-4 Recalling Sentences. One child (P12) scored below the cut-off on all memory tasks.

Table 4

Results for each poor comprehender on the text representation and situation model tasks

Child	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Year Level	4	3	5	3	5	3	6	4	4	4	6	4	4	4	5	6	5
Comprehension Processes: Text Representation Level – Oral Tasks																	
CELF-4 USP # [a]	5	6	5	5	5	7	7	4	7	4	7	4	7	5	3	5	7
TNL Comprehension [a]	9	12	7	12	5	11	11	9	10	10	12	9	10	10	10	10	12
TNL Narration [a]	9	6	7	9	4	12	9	7	10	9	8	6	9	13	6	8	11
Comprehension Processes: Situation Model Level – Oral Tasks																	
CASL Nonliteral Language [b]	95	112	97	103	70	107	97	98	100	91	102	93	103	112	104	93	100
CASL Inference [b]	89	109	78	112	71	107	94	87	104	76	103	87	98	99	81	97	100
TOPS-3 Inferences [b]	82	82	80	83	83	85	93	88	80	81	85	82	81	81	88	81	97
TOPS-3 Prob Solving [b]	104	88	98	95	91	102	93	86	102	96	106	98	95	98	95	91	100
TOPS-3 Predicting [b]	76	85	75	90	85	100	80	85	85	85	85	80	100	95	85	100	85
TOPS-3 Total [b]	86	86	85	92	81	94	92	81	86	86	92	81	85	91	86	86	94
Comprehension Processes: Text Representation/Situation Model Levels – Written Tasks																	
YARC-P Form A Comp # [b]	88	85	85	85	75	93	77	86	85	84	91	71	94	94	80	71	92
PROBE-2 Fiction Comp [c]	50	25	30	50	20	50	50	30	30	50	60	10	50	70	70	40	50
PROBE-2 Nonfic Comp [c]	30	62.5	20	38	0	38	10	20	60	20	60	0	40	30	30	20	50

Note. See Table 1 Notes for test names; USP = Understanding Spoken Paragraphs; Prob Solving = Problem Solving; Comp = Comprehension; Nonfic = Nonfiction
# = selection task -(see Kelso et al., 2020)
a = Scaled Score (ScaleS); b = Standard Score (SS); c = percentage correct [Pass criterion = 70% comprehension questions correct]

Table 5

Results for each poor comprehender on the memory tasks

Child	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Year Level	4	3	5	3	5	3	6	4	4	4	6	4	4	4	5	6	5
CLPT [b]	38	62	55	57	43	62	52	52	52	43	52	52	55	76	60	62	55
CTOPP-2 NW Repetition [a]	6	2	10	9	6	7	6	6	3	7	4	3	3	6	7	2	9
CELF-4 Number Forwards [a]	6	9	15	14	14	10	7	10	12	12	11	7	10	14	18	10	13
CELF-4 Number Backwards [a]	7	13	12	13	9	14	11	9	12	9	7	7	12	16	13	11	13
CELF-4 Recalling Sentences [a]	9	8	11	12	8	8	8	8	9	7	10	5	7	14	11	13	12

Note. See Table 1 Notes for test names; CLPT = The Competing Language Processing Task; NW = Nonword.
a = Scaled Score (ScaleS); b = percentage correct – shaded if score below the mean for age

Discussion

This study sought to extend our understanding of the often hidden group of poor readers, known as poor comprehenders. A protocol, consistent with the broad framework of the SVR but informed by the interactional model of component systems offered by the RSF, was used to profile the oral and written language comprehension and cognitive skills of children identified as poor comprehenders.

As predicted, the poor comprehenders in this study did not have difficulty with tasks assessing phonological processing, rapid naming and single word reading skills at the Sublexical component level of the RSF, consistent with the profile of this subgroup of poor readers. Additionally, tasks assessing sentence and text level reading accuracy highlighted the word reading strengths of the participants with only two children scoring below the cut-off on two of the four reading tasks at these levels. Overall, these results support the findings of previous research that poor comprehenders have intact phonological and word reading skills, and that by the middle primary school years the influence of phonological skills on reading comprehension has diminished (e.g., Nation, 2019).

The cognitive and language profiles of the participants revealed some unexpected findings, particularly on the Lexicon component vocabulary tasks and sentence subcomponent level or grammar tasks. The implications of these findings for assessment for reading comprehension difficulties, intervention and future directions for research are discussed below.

Lower-level language skills - Lexical profile

Within the Lexicon component of the RSF, only two participants (P5, P10) scored below the 25th percentile on more than one task: the oral input vocabulary breadth task (PPVT-4) and the written input vocabulary depth task (WRMT-III Word Comprehension). These two also performed poorly on one of the oral input sentence sub-level tasks (CELF-4 Concepts and Direction), and both scored below average on the timed real word reading task (TOWRE-2 Sight Word Efficiency), suggesting reading fluency may be an issue. One of these children (P5) had difficulty with the majority of lexical and sentence sub-level tasks, therefore presented with the weakest lower-level language skills. All participants scored in the average range on the CELF-4 Word Classes Receptive and NSSR Comprehension, and only one scored below the 25th percentile on each of CELF-4 Word Associations (P5) and

CELF-4 Word Classes Expressive (P13), suggesting that these tasks were less sensitive or useful measures to identify and profile poor comprehenders.

The finding that only two participants had difficulty on multiple vocabulary tasks was unexpected, as weak vocabulary skills are frequently cited as impacting on reading comprehension. This finding may have arisen from a lack of sensitivity of the standardised tests selected for our assessment battery, compared to more specific experimenter designed tasks. Equally, it may reflect the variable findings reported in previous research that suggest heterogeneity amongst poor comprehenders, or even be an artefact of the range of measures employed. While the participants in this study were not selected based on their receptive vocabulary, the finding that the majority did not have difficulty on the PPVT-4 is consistent with this not being an area of difficulty in the groups of poor comprehenders selected to have vocabulary in the average range by Oakhill, Cain and colleagues. That some poor comprehenders have been found to have receptive vocabulary difficulties in other studies may be indicative of the level of severity of their oral language difficulties, particularly in the cohorts described by Catts and colleagues (e.g., Catts et al., 2006) who were initially identified as being at risk due to language difficulties at age 4-5 years. This was evident in the current study, with the two participants who performed poorly on the PPVT-4 being the ones with the more pervasive oral language difficulties.

Higher-level language skills - Comprehension profile

The predominant profile for the participants in this study was difficulty with inferencing skills, which are required to construct a mental or situation model of a text. These children had little or no difficulty on the lower-level language tasks but were consistently challenged by higher-level tasks, paralleling the profile identified by Oakhill, Cain and colleagues in their studies with poor comprehenders. Interestingly, while all children scored below the 25th percentile on the CELF-4 Understanding Spoken Paragraphs (listening comprehension) task, only two scored below this on the second oral input comprehension measure at the text representation level of the RSF, the TNL Comprehension. Six of the 17 participants, however, had difficulty with narrative retelling and production, perhaps suggesting greater difficulty with free recall. While it is acknowledged that awareness of text structure is likely to help with text comprehension, the TNL was not found to be especially sensitive in identifying weaknesses in this area, in this group of poor comprehenders. In contrast, the TOPS-3 Inferences and Predicting subtests were considerably more sensitive to difficulties with higher-level oral language, with 15 and 12 of the 17 participants having

difficulty on these tasks respectively at the situation model level of the RSF. The PROBE-2 Reading Comprehension Assessment, particularly non-fiction age level reading tasks, also added value to the assessment battery in identifying the comprehension difficulties of this group of poor comprehenders. Unfortunately, as no commercially available tests of comprehension monitoring were identified, this area was not explored, but warrants further exploration in the future.

Verbal memory

With respect to the cognitive skills included in the test battery, all participants performed well within the average range on the nonverbal IQ task. On the verbal memory tasks, a finding consistent with previous research was the majority of the participants scoring below the mean for their age on the complex verbal working memory task, but not on the simple verbal span task (number repetition). One participant who had difficulty on the simple span task was P12, who encountered difficulty with all memory tasks. Contrary to previous findings, few participants had difficulty with verbatim recall of sentences on the CELF-4 Recalling Sentences, which other researchers have included as a grammar task (e.g., Adlof & Catts, 2015; Nation et al., 2010), while the majority had difficulty on the phonological memory task, CTOPP-2 Nonword Repetition (cf. Catts et al., 2006; Nation et al., 2004; Nation et al., 2010). Why this unexpected finding occurred on the phonological memory task is unclear, but possible reasons may relate to participants having difficulty with the sound quality of the CD audio-recording and/or accommodating to the accent of the presenter, to the different task (non-standardised) used in the Catts et al. (2006) and Nation et al. (2004) studies, or due to the children in the current study being generally older than those in Nation et al.'s (2010) study.

Limitations

There are several limitations to this study. Participants were recruited from only two schools which narrowed the range of socio-economic backgrounds; combined with the relatively small number of participants, this reduces generalisability of the findings. Limitations in the use of standardised measures to identify specific weaknesses in language skills is also acknowledged, however, an important consideration in task selection was to use measures that were readily available to clinicians and provided normative or criterion referenced scores.

Conclusion

As hypothesised, this study identified two subgroups of poor comprehenders, one with lower-level vocabulary/lexicon and grammar/sentence level difficulties in addition to higher-level language comprehension difficulties, and one with predominantly higher-level difficulties, particularly with inferencing. Unexpectedly, there were few children with lower-level language difficulties, possibly indicating a lack of sensitivity to vocabulary and grammar difficulties on standardised tests. These poor comprehenders had appropriately developed word reading skills which supports previous research for this profile. The findings also support the heterogeneity of poor comprehenders, with not all children performing poorly on all tasks. Nevertheless, certain tasks presented as being more sensitive in identifying the poor comprehenders than others. In particular, separate assessments of word reading accuracy and reading comprehension are suggested as integral to identifying poor comprehenders, however, examination of the responses to different types of open-ended questions may be more indicative of language weaknesses than test scores alone on a reading comprehension test. Further exploration is required to examine this.

This study also provides direction for clinical assessment tasks for use with this population, drawing on the comprehensive protocol of tests in each of the components of the RSF used in this study. Certain language tasks presented as being more sensitive to identifying the weaknesses of poor comprehenders and could be included in a more manageable test battery. These included the PPVT-4, which assesses vocabulary breadth, and the WRMT-III Word Comprehension, which assesses vocabulary depth, in the Lexicon component of the RSF, and the CELF-4 Concepts and Directions, or equivalent tasks from the updated CELF, at the sentence sub-level of the framework. The most indicative higher-level language tasks at the text representation and situation model levels of the RSF were the CELF-4 Understanding Spoken Paragraphs and the TOPS-3 Inferences and Predicting subtests. A test of complex verbal working memory, such as a listening span task, should also be included in the modified battery. Assessing another group of children on this reduced test battery to determine its effectiveness would be a valuable future direction.

Finally, our findings highlight the need to carry out more detailed testing of a child's language skills, beyond a single reading comprehension test, which will in turn better inform intervention. While it is important to know what to target in intervention in groups of poor readers with word reading difficulties, or both word reading and listening comprehension difficulties, it is equally important to tailor the intervention with poor comprehenders to their specific needs to maximise effectiveness.

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