WRITTEN LANGUAGE IN CHILDREN WITH WEAK READING AND SPELLING SKILLS: THE ROLE OF ORAL LANGUAGE, PHONOLOGICAL PROCESSING, VERBAL WORKING MEMORY AND READING

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Abstract
This study investigated patterns of written language and the relation of oral language, phonological processing, verbal working memory and reading to written language in early writers with weak reading and/or spelling in grade 2 (n = 39). In grade 3, the students participated in an assessment of oral and written language. A resolved group with age-typical oral language, phonological processing and reading (n = 11) performed better than their unresolved peers (n = 28) on almost all written language measures. Spelling, text length, grammatical accuracy and vocabulary diversity were the most challenging aspects for the unresolved group. Oral language correlated significantly with the composite written language score, text length and vocabulary diversity, while phonological processing was related to grammatical accuracy and working memory to the composite written language score and spelling. Word reading and reading comprehension were not related to any written language measures. Regression analyses confirmed that oral language contributed significantly to the variation in the composite written language score, text length and vocabulary diversity. The results emphasize the importance of oral language for written language in early writers with (a history of) weak reading and/or spelling.

Keywords: writing, oral language, reading difficulties, Swedish, primary school

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1. INTRODUCTION

The ability to communicate messages, ideas and thoughts in written form is central to students' knowledge development and goal achievement. To develop writing skills, students need adequate support from teachers. This requires, among other things, knowledge about the underlying skills involved in early writing development. According to influential models of writing and writing development, oral language skills (e.g. vocabulary, semantics, morphology and grammar), reading skills (i.e. word reading and reading comprehension) and verbal working memory are among these underlying skills (e.g. Juel, Griffith & Gough, 1986; Berninger & Amtmann, 2003; Hayes, 2012). Previous research has confirmed that oral language, reading and working memory are crucial for writing development in students with and without learning difficulties (e.g. Dockrell, Lindsay, Connelly & Mackie, 2007; Kellogg, Whiteford, Turner, Cahill & Mertens, 2013; Kim, Al Otaiba & Wanzek, 2015; Williams, Larkin & Blaggan, 2013).

Writing is a challenge for many students, especially for students with language, reading and spelling difficulties (Dockrell, 2009). Students with reading difficulties (i.e. word reading and/or reading comprehension difficulties), who are the focus of this study, may have varying underpinning cognitive profiles regarding oral language, phonological processing and verbal working memory (Pennington & Bishop, 2009; Ramus, Marshall, Rosen & Van der Lely, 2013). Students with weak word reading tend to have restrictions in phonological processing (e.g. phonological awareness, short-term memory, processing speed), while students with weak reading comprehension tend to have oral language difficulties (e.g. vocabulary, grammar, listening comprehension) (Elwér, Keenan, Olson, Byrne & Samuelsson, 2013; Nation, Cocksey, Taylor & Bishop, 2010). Previous studies on students with reading difficulties have mainly focused on the relation between oral language, phonological processing and reading. Studies investigating reading difficulties in relation to writing have usually focused on spelling (e.g. Maughan et al., 2009; Sumner, Connelly & Barnett, 2013) although some studies have also examined composition (e.g. generation and organization of ideas, conversion of ideas into language and text revision) and written language (e.g. vocabulary, grammar and text length) (e.g. Berninger, Nielsen, Abbot, Wijsman & Raskind, 2008; Puranik, Lombardino & Altmann, 2007). The present study extends previous research by exploring written language in a group of early writers in Swedish with weak reading and/or spelling and by investigating the relation of oral language, phonological processing, verbal working memory and reading to written language. In this study, written language includes vocabulary diversity, grammatical complexity and accuracy, spelling accuracy and text length (see Berman, 2008; Johansson, 2009). The study aims to contribute new knowledge about possible barriers in writing development that students with learning difficulties may experience during early schooling.

1.1 Oral language and writing

Generating and organizing ideas and converting ideas into a language form (e.g. by selecting words and organizing them in an appropriate order) require knowledge about vocabulary, morphology, grammar etc. Lexical and grammatical knowledge have been shown to relate concurrently to descriptive and narrative writing quality in primary school (Berninger & Abbott, 2010; Coker, 2006; Olinghouse, 2008) and to writing fluency in Kindergarten (Kim et al., 2011). Children's lexical, morphological and syntactic skills in Kindergarten have also been found to predict narrative writing quality (e.g. development and organization of ideas) in Grades 1–3 (Kent, Wanzek, Petscher, Al Otaiba & Kim, 2014; Kim et al., 2015) and the quality of grammar and sentence structure accuracy in writing in Grades 3–5 (Hooper, Roberts, Nelson, Zeisel & Fannin, 2010). However, the relation of oral language to writing fluency is not unequivocal. For example, in Puranik and Al Otaiba (2012), oral language did not relate to writing fluency in Kindergarten, and in Kent et al. (2014), Kindergarten oral language did not predict writing fluency in Grade 1.

There is also evidence that the importance of oral language to writing quality increases from first grade (Berninger & Abbott, 2010; Kent et al., 2014). Kent et al. (2014) speculate that individual differences in writing quality become more evident from Grade 1 as students' writing becomes less constrained by limitations in lexical and grammatical knowledge.

Studies using structural equation modeling have identified both direct and indirect relations between oral language and writing. In Kent et al. (2014), Kindergarten oral language related directly to writing quality in Grade 1. Kim and Schatschneider (2017) found that discourse-level oral language (narrative and expository retelling quality) was directly related to writing, whereas foundational oral language (lexical and grammatical knowledge) was indirectly related to writing via discourse-level oral language. In their study, discourse-level oral language had the largest direct effect on writing.

The importance of language skills in writing has also been confirmed by studies on students with language difficulties. Language difficulties are a common characteristic of many disabilities but are the primary difficulty for students diagnosed with developmental language disorders (DLD) (Bishop, Snowling, Thompson, Greenhalgh & the CATALISE-2 consortium, 2017). Students with DLD produce shorter texts, have a lower vocabulary diversity, use a simpler syntax, make more grammatical errors and have weaker idea generation than students without DLD (e.g. Dockrell & Connelly, 2015; Puranik et al., 2007; Scott & Windsor, 2000; Williams et al., 2013).

A few studies have investigated the relation of language to writing in students with DLD (e.g. Dockrell et al., 2007; Dockrell & Connelly, 2015; Mackie, Dockrell & Lindsay, 2013). Dockrell et al. (2007) found that vocabulary and listening comprehension related to writing at the word-, sentence- and text-level. Vocabulary-related variables contributed significantly to explaining the variance in writing when controlling for other variables (phonological processing, reading and spelling) (see also

Dockrell & Connelly, 2015). Mackie et al. (2013) also found that receptive grammar and phonological fluency predicted writing complexity and writing productivity respectively. Children with DLD produced texts with shorter clauses and fewer coordinated clauses, and less vocabulary diversity.

1.2 Reading and writing

Evaluating and revising a written text require reading skills, i.e. word reading and reading comprehension following the Simple View of Reading (SVR) (Hoover & Gough, 1990; Tunmer & Greaney, 2010). Studies show that both word reading and comprehension relate to writing concurrently and longitudinally in Grades K–4 (e.g. Kim et al., 2015; Ahmed, Wagner & Lopez, 2014; Olinghouse, 2008; Kent et al., 2014). Longitudinally, Kim et al. (2015) found that word reading in Kindergarten predicted narrative and expository writing quality in third grade. Using latent change score modeling, Ahmed et al. (2014) explored longitudinal relations between reading and writing in Grades 1–4 and found that reading at the word- and sentence-level predicted later spelling and sentence writing respectively, and that text reading fluency predicted later writing fluency.

A few studies have investigated the relation of reading to writing in students with DLD (e.g. Dockrell et al., 2007; Williams et al., 2013). Dockrell et al. (2007) found that phonological processing and reading (word reading and comprehension) related to writing at the word-, sentence- and text-level. Reading-related variables contributed significantly to explaining the variance in writing. The relationship between word reading and writing was confirmed by Williams et al. (2013).

Research on students with reading difficulties provides further evidence of the importance of reading in early writing. Students with reading difficulties struggle with the production of written text. In a study of American students in Grades 1–4, Juel (1988) found that “poor readers tend to become poor writers” (p. 445). Difficulties with word reading, although a common feature of many disabilities, are the primary difficulty for students diagnosed with dyslexia (Elliott & Grigorenko, 2014). Students with dyslexia often have extensive phonological difficulties, primarily affecting their spelling (Berninger et al., 2008; Berninger et al., 2010; Puranik et al., 2007; Sumner et al., 2013). Whether dyslexia is also associated with lexical and syntactic difficulties in written composition is, however, largely unclear.

1.3 Verbal working memory and writing

Processes involved in the composition of a text and transcription (e.g. writing by hand, spelling and punctuation) are constrained by working memory capacity (e.g. Berninger, 1999; Gathercole, Lamont & Alloway, 2006; Bourke & Adams, 2010). In developing writers, processes involved in lower-level skills such as writing by hand,

spelling and punctuation demand more working memory capacity than in adult writers (Berninger, 1999; Bourdin & Fayol, 1994). Increased automation of transcription can release working memory resources for the higher cognitive processes that are involved in the composition of a text (Bourdin & Fayol, 1994; Kellogg et al., 2013).

Studies have shown that better working memory is associated with better spelling, higher vocabulary diversity and grammatical complexity, longer sentences and better text organization (Berninger et al., 2010; Kim & Schatschneider, 2017). For example, Berninger et al. (2010) investigated the contribution of word-level and sentence-level working memory to early writing and reading in typically developing American students in Grades 2, 4 and 6. Word-level working memory was found to predict spelling and reading from Grade 2 as well as letter, word, sentence and text writing in Grades 2 and 4. Sentence-level working memory, however, did not relate to writing at any grade. Using structural equation modeling, Kim and Schatschneider (2017) found that the relation of working memory to writing is mediated by discourse-level oral language and transcription, indicating that working memory is key to writing.

Given that students with language and reading difficulties often exhibit limitations in working memory capacity and spelling along with difficulties in oral language (Connelly, Dockrell, Walter & Critten, 2012; Lum, Conti-Ramsden, Page & Ullman, 2012; Montgomery, Magimairaj & Finney, 2010; Nation et al., 2010), it is a reasonable assumption that the production of written text is particularly challenging for these students. In fact, working memory capacity has been shown to predict writing quality and accuracy, text length and burst length in 10–11-year-old British students with DLD (Connelly et al., 2012; Mackie et al., 2013).

1.4 The current study

This study develops previous research in two ways. First, the focus on English-speaking students in previous studies raises questions about the generalizability of the association between reading and writing to other linguistic contexts. English has a rather opaque orthography with many inconsistencies and irregularities in the relation between phoneme and grapheme (Seymour, Aro & Erskine, 2003; Share, 2008). In a language like Swedish, for example, the relation between phoneme and grapheme is more regular than in English. Previous research shows that the relations between phonological processing and word reading are somewhat different in languages with opaque orthographies compared to languages with transparent orthographies (Furnes & Samuelsson, 2011; Moll et al., 2014). This is also true for reading development in the early school years. For example, Seymour et al. (2003) found that students who learn to read in a transparent orthography develop reading fluency faster than students who learn to read in an opaque orthography. Consequently, we hypothesize that word reading may not affect the revision of a text in a transparent orthog-

raphy to the same extent as in an opaque orthography during early writing development, and therefore written language may not be affected to the same extent either. To our knowledge, no studies have investigated this.

Second, previous studies on the relation of oral language, working memory and reading to writing in students with language- and reading-related difficulties have mainly focused on clinical populations, i.e. students diagnosed with DLD or dyslexia. From an educational perspective it is important to recognize the whole spectrum of language- and reading-related difficulties. In school, there are students with DLD and dyslexia as well as students whose language/reading difficulties are severe enough to impact negatively on the learning process without meeting the criteria for a diagnosis. Knowledge about the relation of oral language, phonological processing, verbal working memory and reading to early writing across the spectrum of language and reading difficulties is important for teachers to be able to effectively support writing development in all students. Therefore, we use a cut-off at z = –.8 when we define reading and spelling difficulties in this study in order to include students within the lower end of the distribution (i.e. the 21% weakest in reading and spelling in the age-group).

In this study, the primary questions were centered on exploring the patterns of written language (i.e. vocabulary diversity, grammar complexity and accuracy, spelling accuracy and text length) in a group of early writers in Swedish identified with weak reading and/or spelling in Grade 2, and analyzing how oral language, phonological processing, verbal working memory and reading were related to written language in this group in Grade 3.

2. METHOD

2.1 Participants

The participants were recruited from a group of 187 students in Grade 2 who participated in a screening of word reading, reading comprehension and spelling, carried out as a group assessment in the classroom by teachers in 14 schools in Sweden. The purpose of the screening was to identify students with reading and spelling difficulties at an early stage of compulsory schooling to enable recruiting participants for the current study.

The assessment of word reading included measures of sight- and pseudoword reading (Olofsson, 1998). In the sight word reading test, the students silently read pairs of words that sound alike (e.g. *taxi* - *taksi*) and marked the word with correct spelling (i.e. *taxi*). The test contains in total 139 pairs of words and the total score was the number of correctly marked words identified within two minutes. In the pseudoword reading test, the students silently read a string of three pseudowords (e.g. *belk —jus — sorf*) and then decided which one of them sounded like a real word in Swedish. Two of the pseudowords did not sound like real words (i.e. *belk* and *sorf*)

and one was a homophone sounding like a real word but with an incorrect spelling (*jus* sounds like *ljus* 'light'). The test contains in total 80 strings of pseudowords and the total score was the number of correctly marked words identified within two minutes.

In the reading comprehension test (Järpsten, 1999), the students silently read short paragraphs of text and then answered questions by selecting one out of four alternatives in a multiple-choice task. The score was the total number of correct answers within 30 minutes of reading (max 18 points).

In the spelling test (Järpsten, 1999), the students listened to a sentence and wrote the target word repeated by the teacher. The target words were mainly regularly spelled but with varying length (three to seven letters) and phonological complexity. The total score was the number of correctly spelled words (max 20 points).

Out of 66 students identified with reading and/or spelling difficulties in the screening in Grade 2, 39 students were given parental consent to participate in this study. The participating students displayed weak word reading, reading comprehension and/or spelling in the screening with results at or below z = –.8 on at least one measure. Scores on word reading, reading comprehension and spelling for the participants in this study (n = 39) and all participants in the screening (N = 187) are presented in Table 1. To allow comparisons across measures, z-scores are presented (points in brackets). Skewness ranged from –.25 to 1.44 for the participants in this study and from –.63 to .51 for all participants in the screening.

Table 1. Z-scores (points) for word reading, reading comprehension and spelling in Grade 2.

	Participants in the study (n = 39)				Participants in the screening (N = 187)			
Measures	Min	Max	*M*	*SD*	Min	Max	*M*	*SD*
Sight word reading (points)	–1.40 (3.00)	1.70 (39.00)	–.58 (12.87)	.66 (7.70)	–1.69 (0.00)	3.21 (57.00)	.01 (19.53)	.99 (11.61)
Pseudoword reading (points)	–1.80 (1.00)	2.10 (22.00)	–.66 (7.41)	.83 (4.42)	–1.85 (1.00)	3.20 (28.00)	–.01 (10.84)	1.00 (5.34)
Reading compr. (points)	–2.40 (2.00)	2.10 (18.00)	–.94 (7.13)	.91 (3.26)	–2.51 (1.00)	2.24 (18.00)	.14 (10.49)	1.00 (3.59)
Spelling (points)	–2.80 (9.00)	1.50 (20.00)	–.53 (14.72)	1.04 (2.70)	–2.63 (8.00)	1.48 (20.00)	.15 (16.11)	.87 (2.55)

A description of the participating 39 students' reading and spelling profiles based on the screening in Grade 2 is provided in table 2. The different types of reading difficulties following from the Simple View of Reading model were identified among the participants (Hoover & Gough, 1990; Tunmer & Greaney, 2010). Nine students were identified with sight- and/or pseudoword reading difficulties ($z \leq -.8$) in combination with good reading comprehension ($z \geq -.7$) (word reading difficulties in SVR). Among

these students, two also had spelling difficulties ($z \leq -.8$). Twelve students had reading comprehension difficulties ($z \leq -.8$) in combination with good word reading skills ($z \geq -.7$) (specific reading comprehension difficulties in SVR). Three of these students also had spelling difficulties. Fifteen students had a combination of weak word reading and reading comprehension (mixed difficulties in SVR). Out of these students, seven also had spelling difficulties. The remaining three students displayed spelling difficulties in combination with good word reading and reading comprehension. These students were included in the study considering their identified vulnerability in orthographic processing.

Table 2. Reading and spelling profiles in Grade 2 for the 39 participants in the study (z-scores).

	Sight- and/or pseudoword reading difficulties		Reading compr. difficulties		Word reading + reading compr. difficulties		Spelling difficulties	
	n = 9		*n* = 12		*n* = 15		*n* = 3	
Measures	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Sight word reading	–.72	.23	–.02	.77	–1.10	.31	–.07	.40
Pseudoword reading	–1.28	.46	.02	.76	–1.03	.52	.33	.46
Reading compr.	.20	.82	–1.42	.40	–1.45	.45	.07	.29
Spelling	–.33	.78	.08	.85	–.85	1.02	–2.0	.69

In Grade 3, when the current study was conducted, the 39 students (24 girls), mean age 9:7 (range 8:11–10:3), participated in a speech and language therapy (SLT) assessment of oral language skills, phonological processing, verbal working memory and reading skills. The purpose of the SLT assessment in Grade 3 was to follow up students' reading skills, as well as other skills that have been shown to relate to reading and writing. At the end of Grade 3, the students participated in a writing assessment conducted by their teachers as a part of the National Assessment in Swedish. The students had Swedish as their mother tongue, normal hearing, normal or corrected vision, and normal nonverbal ability (M = 105.2, SD = 14.0). Nonverbal ability was assessed by using Raven's Coloured Progressive Matrices (Raven, 2008). There was no evidence of neurological disorders.

2.2 Measures

2.2.1 Assessment of oral language, phonological processing, working memory and reading in Grade 3

Oral language index (LOGOS —Vocabulary and Listening comprehension, Höien, 2007; TROG-2 —Test of Reception of Grammar, Bishop, 2009; Bus Story —Information score, Renfrew, 1997). In the vocabulary test, the students were asked to define 22 words orally. The listening comprehension test required the students to listen to a narrative story consisting of five paragraphs and orally answer three open questions after each paragraph. The test of receptive grammar assessed the comprehension of 20 grammatical constructions. The students listened to a sentence and were asked to select a picture (out of four pictures) that matched the sentence. In the Bus Story, the students listened to a short story about a naughty bus and were asked to retell the story with support of the pictures in the story. The oral language index was the calculated mean value based on the z-scores for the four tests. Cronbach's alpha for the four items was .62. The rather low Cronbach's alpha was probably due to the heterogeneous language profiles among the participants. However, we decided to keep the index considering its theoretical validity. Vocabulary, grammar and listening comprehension are commonly included measures of oral language skills (see Bishop, 1997; Hoover & Gough, 1990; Tunmer & Greaney, 2010).

Phonological processing index (LOGOS —Phoneme Synthesis, Phoneme Analysis, Digit Span and Rapid Automatized Naming, RAN, Höien, 2007; Nonword Repetition, Selin & Törnqvist, 2006). In the phoneme synthesis test, the students listened to a sequence of phonemes and were asked to blend them into a real word, e.g. b-i-l to *bil* 'car'. In the phoneme analysis test, the students listened to a word and were asked to identify the phonemes, e.g. *rum* 'room' to r-u-m. The digit span test required the students to listen to a sequence of digits and repeat them. The test ended after three incorrect responses. In the RAN test, the students named, as rapidly as possible, five different everyday objects presented in a sequence. The total time for naming all objects was used as a raw score. In the nonword repetition test, the students listened to 29 single nonwords of increasing length (2–5 syllables) and repeated them one at a time. The phonological processing index was the calculated mean value based on the z-scores for the five tests. Cronbach's alpha for the five items was .46. The low Cronbach's alpha was probably due to the varying individual profiles. However, we decided to keep the index considering that the five items may capture different aspects of phonological processing and therefore be a valid measure of the participating students' phonological skills (see Melby-Lervåg, Lyster & Hulme, 2012 for a description of implicit and explicit phonological processing skills).

Verbal working memory (LOGOS, Höien, 2007). The students listened to a sequence of 2–5 words and repeated the words in reverse order. The test ended after three incorrect responses (max 12 points).

Sight word reading (LOGOS—Orthographic Word Reading, Höien, 2007). The students read out loud real words of varying length and orthographic complexity. The words were presented one at a time on a computer screen. Each word was presented for only 200 milliseconds. The total score was a combined measure of accuracy and reading speed.

Pseudoword reading (LOGOS—Phonological Word Reading, Höien, 2007). The students read out loud pseudowords of varying length and phonological complexity. The words were presented one at a time on a computer screen without time-limit. The total score was a combined measure of accuracy and reading speed.

Reading comprehension (LOGOS—Reading Comprehension, Höien, 2007). The students read a story consisting of five short paragraphs and orally answered three open questions after each paragraph. The majority of the 15 questions were literal with only one or two questions being more inferential in character. The answers were coded following the guidelines in the manual with 1 point for each correct response (max 15 points).

2.2.2 Assessment of written language in Grade 3

Spelling accuracy. Spelling accuracy was measured as the percentage of misspelled words out of the total number of words (Puranik et al., 2007).

Vocabulary diversity. Vocabulary diversity was calculated using the CLAN program VocD (Vocabulary Diversity, MacWhinney, 2000). The texts were corrected for morphological and spelling errors prior to calculating VocD. VocD controls for text length in the calculation of Type Token Ratio (TTR) by randomly selecting 50 words on three separate occasions and calculating TTR while adjusting the outcome in relation to a prediction of how much TTR usually decreases with increasing text length (McKee, Malvern & Richards, 2000). We excluded four texts with fewer than 50 words from the analysis of VocD.

Grammatical complexity index (Mean length of T-units and Clausal density). The mean length of T-units (mltu) was measured as words per T-unit and clausal density as the percentage of subordinate clauses out of the total number of T-units (Puranik et al., 2007; Scott & Windsor, 2000). Hunt (1970, p. 4) defined a T-unit as "one main clause plus any subordinate clause or nonclausal structure that is attached to or embedded in it." This definition is well suited for analyzing monological texts consisting of syntactically complete sentences. As the texts in this study were narratives produced by beginning writers, many of which had strong dialogical elements and contained a large amount of syntactically incomplete sentences, Hunt's definition of T-units would have resulted in the exclusion of a considerable amount of data from the analysis. We therefore included a type of fragment of T-units (cf. Loman & Jörgensen, 1971), defined as a syntactically incomplete clause containing a verb or a participle, for example subordinate clauses lacking a main clause matrix (e.g. *That it is light there*) and sentences with an omitted subject (e.g. *Now goes*). Considering

the novelty of including fragments of T-units in calculating mltu and clausal density, a bivariate correlation was conducted in order to determine the relation between T-units and fragments of T-units. Mltu including fragments of T-units correlated with mltu excluding fragments of T-units (r = .93, p < .001). Also, clausal density including fragments of T-units correlated with clausal density excluding fragments of T-units (r = .99, p < .001). Thus, henceforth 'T-units' will be used as a generic term for complete T-units and fragments of T-units. The grammatical complexity index was the calculated mean value based on the z-scores for the two different tasks. Cronbach's alpha for the two items (mltu and clausal density) was .85.

Grammatical accuracy. Grammatical accuracy was measured as the percentage of morphological and syntactic errors out of the total number of T-units. Morphological and syntactic errors included, among other things, incorrect inflections (noun, verb and pronoun), omitted words, incorrect additions of words, incorrect use of prepositions or pronouns, subordinate clauses incorrectly lacking a main clause matrix and word order errors.

Text length. Text length was measured by calculating the number of words per text.

Composite written language score. As a measure of overall written language, a composite written language score was calculated by using the following measures: VocD, number of adjectives, number of content words (nouns, verbs and adjectives), mean length of T-units, number of subordinate clauses, number of grammatical errors (reversed score) and total number of words. The composite written language score was the calculated mean value based on the z-scores for the seven measures. Cronbach's alpha for the seven items was .67. Despite the low Cronbach's alpha, we decided to keep the index considering its theoretical validity. Measures of vocabulary diversity, distribution of word classes and grammar are commonly used measures of linguistic aspects in written language (Berman, 2008; Johansson, 2009).

2.3 Procedure

The participating students with reading and spelling difficulties were identified in the screening of word reading, reading comprehension and spelling in Grade 2. Their reading skills as well as other reading- and writing-related skills were followed up in the SLT assessment in Grade 3. The SLT assessment was conducted individually in a quiet room at the local hospital or at the students' school by an experienced speech and language therapist (first author). The SLT assessment took place from September to June in Grade 3. Informed consent from parents, students and schools was provided prior to the assessment. The students were allowed to terminate the session at any time. The administration of the tests followed the standard procedures in the manuals.

The assessment of written language was based on the narrative writing task in the Swedish National Test. The task was conducted by the teacher and in accordance with the instructions in the guidelines. The students were given in total 60 minutes,

including time for teacher instructions, to write a story about a self-experienced or fictive adventure. The students received three supportive questions in both written and oral form before starting writing: How does the story start? What happens? How does it end? The narrative writing task took place from March to May in Grade 3.

2.4 Transcription and reliability procedure

The hand-written texts were typed in the Word 2010 program and converted to the CHAT format (Codes for the Human Analysis of Transcripts) in order to enable analyses using CLAN programs (Computerized Language Analysis) (MacWhinney, 2000).

The inter-rater reliability for the written language measures was established on a random sample of nine texts (22%) that were assessed by both authors. Pearson's product-moment correlation was used to assess inter-rater reliability. Inter-rater reliability ranged from .93 to 1.0 for all measures, except for fragments of T-units (.25) and grammatical errors (.19). The first outcome was due to an inconsistency in the categorization of fragments of T-units and complete T-units. However, as fragments and complete T-units have been collapsed into one category in the data analysis, incorrect categorizations do not affect the study's results. The second outcome was due to an inconsistency in the categorization of expressions that were morphologically or syntactically acceptable in the students' dialect. In order to reach a consensus for the analysis, the assessment criteria were adjusted so that only the morphological and syntactic deviations that violated both spoken and written standards were categorized as errors.

3. RESULTS

The results are presented in three sections. The first section presents the students' results in oral language, phonological processing, verbal working memory and reading. The second section examines the students' written language. The third section presents the relations of oral language, phonological processing, working memory and reading to written language.

3.1 Oral language, phonological processing, working memory and reading

Table 3 provides the descriptive statistics for the measures of oral language, phonological processing, verbal working memory and reading in Grade 3. All measures were normally distributed (skewness ranging from –.89 to .27). Data points more than 3 SD from mean were considered as outliers and removed. Mean values for the whole group were well within age-norms.

Eleven students, of whom only two were boys, scored at $z \geq -.7$ on oral language, phonological processing, working memory and reading in Grade 3. These students'

reading skills have developed positively from Grade 2 to 3 (resolved group). The remaining 28 students displayed difficulties ($z \leq -.8$) in oral language, phonological processing, working memory and/or reading in Grade 3 (unresolved group), with significantly lower mean values in oral language, phonological processing, working memory and sight- and pseudoword reading than the resolved group. All students in both groups performed within age-norms in reading comprehension in Grade 3; reading comprehension did not differ significantly between the two groups.

Eight students scored at $z \leq -.8$ on oral language, six students on phonological processing, 16 students on verbal working memory, seven students on sight word reading and 16 students on pseudoword reading. Sixteen of the students in the unresolved group scored at $z \leq -.8$ on two or more measures. Six students in the unresolved group were diagnosed with DLD and 10 with dyslexia.

Table 3. Z-scores for oral language, phonological processing, working memory and reading in Grade 3.

Measures	All participants *n* = 39 *M* (*SD*)	Resolved group *n* = 11 *M* (*SD*)	Unresolved group *n* = 28 *M* (*SD*)	Significance (*t*-test)	Hedges' g[1]
Oral language	–.32 (.61)	.09 (.36)	–.48 (.62)	t (37) = 2.82, p = .008	1.01
Phonological processing	–.26 (.64)	.08 (.44)	–.39 (.67)	t (37) = 2.12, p = .04	.76
Working memory	–.50 (1.02)	.43 (.77)	–.86 (.87)	t (37) = 4.29, p = .000	1.53
Sight word reading	–.22 (.72)	.33 (.77)	–.44 (.58)	t (36) = 3.37, p = .002	1.20
Pseudoword reading	–.38 (.82)	.11 (.55)	–.59 (.83)	t (36) = 3.03, p = .005	.92

Did the students in the resolved group in Grade 3 perform better than the students in the unresolved group on the reading and spelling tests already in Grade 2? A comparison of the reading and spelling profiles in Grade 2 for the resolved and unresolved group in Grade 3 is presented in table 4. The table reveals that pseudoword reading and spelling did not differ significantly. However, the resolved group performed significantly better than the unresolved group on sight word reading and reading comprehension.

Table 4. Reading and spelling profiles in Grade 2 for the resolved and unresolved group in Grade 3 (z-scores).

Measures	All participants *n* = 39 *M* (*SD*)	Resolved group *n* = 11 *M* (*SD*)	Unresolved group *n* = 28 *M* (*SD*)	Significance (*t*-test)	Hedges' *g*[1]
Sight word reading	–.58 (.66)	–.23 (.62)	–.72 (.64)	*t* (37) = 2.21, *p* = .03	.77
Pseudoword reading	–.66 (.83)	–.41 (.84)	–.75 (.82)	*t* (37) = 1.17, *p* = .25	.41
Reading comprehension	–.94 (.91)	–.20 (.99)	–1.23 (.70)	*t* (37) = 3.68, *p* = .001	1.30
Spelling	–.53 (1.04)	–.14 (1.22)	–.69 (.94)	*t* (37) = 1,48, *p* = .15	.54

[1] Correction for Cohen's *d* when different sample sizes (Lakens, 2013)

3.2 Patterns of written language

Table 5 presents the descriptive statistics for the written language measures in Grade 3. All measures were normally distributed (skewness ranging from –.71 to .65). Data points more than 3 SD from mean were considered as outliers and removed. The unresolved group scored significantly below the resolved group on spelling accuracy, text length and the composite written language score. The effect sizes (Hedges' *g*) indicated that spelling, text length, grammatical accuracy and vocabulary diversity (VocD) were the most challenging aspects of writing for the unresolved group.

Table 5. Z-scores and raw scores for the written language measures in Grade 3.

Measures	All participants *n* = 39 *M* (*SD*)	Resolved group *n* = 11 *M* (*SD*)	Unresolved group *n* = 28 *M* (*SD*)	Significance (*t*-test)	Hedges' *g*[1]
Spell. accuracy[2] (z)	.11 (1.01)	.69 (.54)	–.11 (1.07)	*t* (34) = 3.08, *p* = .004	.84
Spelling errors (%)	11.21 (7.08)	7.18 (3.76)	12.79 (7.50)		
VocD (z)	–.05 (.97)	.27 (1.06)	–.19 (.91)	*t* (33) = 1.32, *p* = .20	.48
VocD	54.40 (17.64)	60.15 (19.30)	51.77(16.59)		
Gram. compl. (z)	–.06 (.89)	–.01 (.85)	–.08 (.92)	*t* (35) = .21, *p* = .84	.08
MItu (words/T-unit)	5.99 (1.27)	6.09 (1.20)	5.96 (1.31)	*t* (36) = .27, *p* = .79	.10
Clausal density (%)	18.94 (12.48)	21.38 (15.40)	17.95 (11.27)	*t* (36) = .76, *p* = .45	.27
Gram. accuracy[2] (z)	.09 (.96)	.50 (.79)	–.08 (.99)	*t* (36) = 1.73, *p* = .09	.62
Gram. accuracy (%)	5.47 (5.77)	3.00 (4.75)	6.48 (5.92)		
Text length (z)	–.03 (.99)	.48 (1.11)	–.25 (.87)	*t* (36) = 2.17, *p* = .04	.77
Text length (words)	131.47 (65.98)	166.18 (73.90)	117.33 (58.11)		
Writ. lang. score (z)	–.01 (1.00)	.73 (1.14)	–.30 (.79)	*t* (37) = 3.25, *p* = .002	1.15

[1] Correction for Cohen's *d* when different sample sizes (Lakens, 2013) [2] The z-scale is reversed

Table 6. Correlations between oral language, phonological processing, working memory, reading and written language (Pearson's).

	1	2	3	4	5	6	7	8	9	10	11	12
1 Oral language	1											
2 Phonological processing	.14	1										
3 Working memory	.22	.26	1									
4 Sight word reading	.13	.19	.13	1								
5 Pseudoword reading	–.03	.05	.15	.65**	1							
6 Reading comprehension	.32	–.08	.18	.07	.20	1						
7 Spelling accuracy	.00	.11	.35*	.30	.29	.12	1					
8 VocD	.49**	.30	.14	.00	–.14	–.23	–.16	1				
9 Grammatical complexity	–.17	.01	.10	.04	–.01	.28	–.01	–.10	1			
10 Grammatical accuracy	.25	.34*	.20	.08	.14	.17	.05	.08	–.12	1		
11 Text length	.49**	.10	.17	.23	.20	.07	.04	.52**	–.14	.10	1	
12 Written language score	.44**	.23	.36*	.21	.16	.11	–.01	.69**	.14	.32*	.81**	1

*$p < .05$ **$p < .01$

Multiple regression analysis was used to further examine the relations of oral language, phonological processing and working memory to written language. Word reading and reading comprehension were not included as predictors in the model due to the lack of correlations with written language measures. A model including oral language, phonological processing and working memory reached significance in explaining the variance in the composite written language score, text length and vocabulary diversity. The three predictors accounted for 22% of the variance in the composite score of written language (R^2 = .22, F (3,35) = 4.53, p < .01) and in vocabulary diversity (R^2 = .22, F (3,31) = 4.30, p < .05), and 18% of the variance in text length (R^2 = .18, F (3,34) = 3.69, p < .05). As shown in Table 7, oral language was the only significant predictor of the composite written language score, text length and vocabulary diversity. By contrast, oral language, phonological processing and verbal working memory only explained 6% of the variance in spelling accuracy (R^2 = .06, F (3,35) = 1.74, p = .18), 9% of the variance in grammatical accuracy (R^2 = .09, F (3,34) = 2.20, p = .11) and none of the variance in grammatical complexity (R^2 = –.04, F (3,33) = .55, p = .65).

Table 7. Regressions predicting composite written language score, text length and vocabulary diversity.

Predictor	*B*	Standard error *B*	β	*T*	*p*
Written language score					
Oral language	.62	.24	.374	2.53	.02
Phonological processing	.17	.23	.110	.74	.46
Working memory	.24	.15	.248	1.64	.11
Text length					
Oral language	.77	.25	.475	3.10	.004
Phonological processing	.03	.24	.017	.11	.91
Working memory	.06	.15	.063	.39	.69
Vocabulary diversity					
Oral language	.73	.25	.459	2.96	.006
Phonological processing	.36	.24	.242	1.54	.13
Working memory	–.02	.15	–.023	–.14	.89

4. DISCUSSION

This study explored the patterns of written language in Swedish early writers with (a history of) weak reading and/or spelling and examined how oral language, phonological processing, verbal working memory and reading were related to written language. All students (n = 39) were identified with weak reading and/or spelling in Grade 2. Their oral language, phonological processing, working memory, reading and written language were followed up and assessed in Grade 3. As previous studies of writing among children with language and reading difficulties have mainly focused on clinical populations, the current study extends the findings to a group of early

writers with (a history of) reading and/or spelling within the lower range of the normal distribution.

The findings revealed that 28 students had difficulties in Grade 3, scoring below the age-related norms on oral language, phonological processing, verbal working memory and/or reading (unresolved group). However, eleven students showed a positive development in reading from Grade 2 to 3 (resolved group) and scored significantly better than the unresolved group on oral language, phonological processing, working memory and sight- and pseudoword reading in Grade 3. This indicates that growth in reading ability is not uncommon during the limited time of a school-year for students in the lower range of the normal distribution. Future research needs to investigate longitudinally the development of reading and spelling skills in these students.

In line with previous research on students with reading difficulties (Elwér et al., 2013; Ramus et al., 2013), the unresolved students displayed a variety of cognitive profiles in oral language, phonological processing, working memory and word reading. Some students performed poorly on oral language while others were challenged only by tasks in phonological processing and/or word reading. Sixteen students had more severe difficulties (six students with DLD and ten with dyslexia).

The unresolved students scored significantly below the resolved students on spelling and the composite written language score, with spelling, text length, grammatical accuracy and vocabulary diversity posing the greatest challenges in the writing task in Grade 3. These results support previous research showing that students with oral language and/or reading difficulties produce shorter texts and often struggle with spelling, vocabulary and grammar in writing (e.g. Connelly et al., 2012; Dockrell & Connelly, 2015; Puranik et al., 2007; Sumner et al., 2013).

The findings also revealed that oral language correlated positively with and independently predicted overall written language, text length and vocabulary diversity. This confirms the importance of oral language in developing writing skills for early writers with and without language and reading difficulties (e.g. Coker, 2006; Dockrell et al., 2007; Dockrell & Connelly, 2015; Kim et al., 2011; Olinghouse, 2008).

Verbal working memory has been shown to relate to text composition, written language and transcription (e.g. Berninger et al., 2010; Connelly et al., 2012). In this study, verbal working memory was found to correlate with the composite written language score and spelling accuracy; however, the regression analysis did not confirm that working memory contributed significantly to explaining the variance. A possible explanation may be that the generous allocation of time for the writing task (60 minutes), in combination with the narrative genre, did not put a sufficient load on the working memory to reveal relations between working memory processes and written language.

In contrast to much previous research on children with language and reading difficulties (e.g. Berninger et al., 2010; Dockrell et al., 2007; Dockrell & Connelly, 2015; Puranik et al., 2007; Sumner et al., 2013; Williams et al., 2013), word reading efficiency (sight- and pseudoword reading), which included both speed and accuracy,

was not found to correlate with any written language measures. This supports our hypothesis that the relations between reading and writing may not be the same in a transparent orthography as in an opaque orthography. Students who learn to read in a transparent orthography (like Swedish) develop reading fluency faster than students who learn to read in an opaque orthography (like English) (Caravolas, Lervåg, Defior, Seidlová Málková & Hulme, 2013; Seymour et al., 2003). In a transparent orthography, students are not expected to struggle with accuracy to the same extent as students learning to read in an opaque orthography (due to the greater correspondence between phoneme and grapheme in transparent orthographies). The degree of transparency also seems to affect the pattern of word reading difficulties experienced by children with dyslexia. In opaque orthographies, it is more common to struggle with word reading accuracy, while word reading speed is a challenge regardless of transparency (Landerl, Wimmer & Frith, 1997). Our findings suggest that word reading ability does not affect written language in a transparent orthography to the same extent as in an opaque orthography during the early writing development. Not even the measure of sight word reading, which depends heavily on word reading speed, was related to any of the measures of writing. More research is needed to confirm this finding and to explore whether this is due to word reading not interfering with the text revision process or to word reading being associated with other aspects of writing.

Reading comprehension was not significantly related to any of the measures of written language. This was surprising considering that previous research has found significant reciprocal connections between reading comprehension and text composition (Abbott, Berninger & Fayol, 2010). Some previous studies also indicate that students with poor reading comprehension may find writing challenging (Carretti, Motta & Re, 2016; Cragg & Nation, 2006). The lack of significant correlations between reading comprehension and writing in this study may be due to the construction of the reading comprehension task in Grade 3. The questions were mainly literal in character and the linguistic content of the text was oriented towards an everyday language with mostly high-frequency words. None of the participating students scored below $z = -.8$ despite rather severe difficulties in oral language and word reading, indicating that the reading comprehension task did not sufficiently capture the individual variations in reading comprehension in this group of students. This is in line with some previous research pointing out the importance of task construction when assessing reading comprehension and how different types of tasks may capture different aspects of comprehension (see Cutting & Scarborough, 2006; Keenan & Meenan, 2014).

4.1 Limitations

The current study contributes to our understanding of written language in relation to oral language, phonological processing, working memory and reading in students

with (a history of) weak reading and/or spelling who are learning to write in a language with a transparent orthography. Four limitations need to be considered when interpreting the findings: Firstly, although the small sample size allowed more detailed analyses of the student texts, we are aware that it also limits the magnitude of the statistical analyses that we have conducted. In order to address the small sample size, we reported effect sizes for the independent sample *t*-tests (see Field, 2013, p. 85). Also, due to the small sample size we were not able to explore how oral and written language measures were related directly and indirectly using structural equation modeling or to include subsamples representing different types of reading difficulties (word reading difficulties, reading comprehension difficulties or mixed difficulties) in the analyses. Such analyses could potentially contribute valuable insights into how different types of reading difficulties in Grade 2 relate to/predict different aspects of writing in Grade 3. We leave such explorations to future studies. However, we also believe that using the sample as a whole in the analyses means that our findings more accurately (although not completely) represent the student groups that school teachers deal with on a daily basis. Teachers deal with all students regardless of their language and reading profiles. The sample used in this study represents a larger variation in language and readings skills and not only clearly defined clinical populations including only a small part of the students in school classes.

Secondly, the study lacked a control group of students with age-typical reading skills. Although the resolved group performed within the age-related norms on reading in Grade 3, we do not consider the resolved group to be a typically-developing control group due to, among other things, the history of reading difficulties among these students. Including a control group would have contributed valuable knowledge about the particular challenges in writing that students with (a history of) reading and/or spelling difficulties experience.

Third, this study focused on writing products. To also investigate the processes of writing, both regarding time on task and the writing process itself in revision and editing, would have been valuable. Future research should, therefore, examine what aspects of narrative writing, focusing on both the products and processes of writing, are most challenging for students with persistent and resolved reading difficulties as well as different learning disability groups through comparisons with matched control groups.

Fourth, the study did not include a measure of handwriting speed. As handwriting speed has been shown to contribute to explaining the variance in writing (e.g. Alves & Limpo, 2016; Dockrell, Ricketts, Charman & Lindsay, 2014; Olinghouse, 2008), this limitation needs to be considered when interpreting the significant difference in text length between the resolved and the unresolved group. The difference in text length between the groups might simply relate to the fact that the resolved group had better handwriting skills than the unresolved group. Increased automation of handwriting skills can release working memory capacity for processes involved in the composition of a text (e.g. Berninger, 1999; Bourdin & Fayol, 1994; Kellogg et al., 2013). However, the generous allocation of time for the writing task in the national test

offered the students ample time for text generation, thereby potentially reducing the effects of handwriting speed on text length. We speculate that automatized handwriting skills may be more important for the generation of text in writing tasks with a tighter timeframe than in the task used in this study. This speculation needs to be confirmed by future studies. We therefore suggest that future research addresses the relationships between handwriting speed, time allocation and text length.

5. CONCLUSION

This study confirms the importance of oral language skills for early writing development. Weak oral language skills are likely to result in shorter texts with a lower vocabulary diversity. The findings indicate that beginning writers with weak oral language skills are at high risk of developing writing difficulties. In order to effectively support early writing development in all students, oral language needs to be considered in writing instruction, especially when students experience weak oral language and reading skills. Future research needs to explore how interventions targeting oral language can support early writing development in students with and without language- and reading-related difficulties. This study also indicates that the relation between reading and writing in a transparent orthography may not be the same as in an opaque orthography, at least not during the early writing development. However, more research is needed to confirm this finding and to explore potential relations in more detail.

AUTHORS' NOTE

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