Written language skills in children with specific language impairment

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Abstract

Background. Young children are often required to carry out writing tasks in an educational context. However, little is known about the patterns of writing skills that children with Specific Language Impairment (CwSLI) have relative to their typically developing peers.

Aims. The study aimed to assess the written language skills of CwSLI and compare these to typically developing peers. It also aimed to assess the relative contributions of reading and spelling skills to written language skills.

Methods & Procedures. Forty-five children took part in the study, 15 were CwSLI, 15 were a chronological age match, and 15 were a spelling age match. The children took part in a range of tasks that assessed writing, reading, and spelling abilities.

Outcomes & Results. In their written language and compared to typical age matched peers, CwSLI used a significantly less diverse range of words, had lower quality written compositions overall, and lower levels of organisation, unity and coherence. They also had a higher proportion of spelling errors. Overall, writing skills were strongly associated with reading skills.

Conclusions & Implications. The findings demonstrate the challenges CwSLI have in producing good quality written text and that these challenges are likely to be related to the linguistic skills profile shown by these children.

What is already known on this subject:

Previous research has shown that children with specific language impairment have difficulties with a range of literacy skills. It is known writing to a good standard involves strong linguistic skills and that writing is an expected part of a child's educational experience in the United Kingdom.

What this study adds:

When compared to a group of children who were chronologically age matched and a group who were matched by spelling age, the findings showed that the children with specific language impairment (SLI) had lower quality written language overall. Moreover, the text analysis indicated that children with SLI had difficulty organising coherent texts. The findings also highlighted the positive association between reading and writing skills.

Introduction

Children with specific language impairment (CwSLI) show poorer language skills compared with typical children of the same age (Leonard, 1998). This impairment is specific, in that these children do not have difficulties that would be associated with any other reason, such as a poor nonverbal ability or specific speech difficulties (Leonard, 1998). Recent research has highlighted how literacy skills are associated with oral language skills (Bishop & Snowling, 2004). As writing is a literate activity it can be expected that CwSLI may show marked differences in the quality of their writing compared to typical children. There is an educational motivation in exploring the writing of CwSLI. In the United Kingdom, for example, teachers are expected to "ensure that work in 'speaking and listening', 'reading' and 'writing' is integrated." (Department for Education, 2011). Children are expected to use their written language skills to demonstrate learning and understanding in assessments across the UK national curriculum (Ofsted, 2011). Yet relatively few studies have investigated both writing and spoken language cognitive skills in children with specific language impairment. Given the nature of the impairment CwSLI face and the expectations on educators, further research that explores the nature of the written language skills in CwSLI is needed and the study reported here seeks to address this.

Specific Language Impairment and Literacy Skills

Specific language impairment (SLI) is an umbrella term for a highly heterogeneous disorder (see Conti-Ramsden, 2008). While all children within this group share average or above average non-verbal reasoning, their language profiles may vary considerably. Impairments in grammatical processing have been highlighted as some of the prominent features of the disorder, with research demonstrating that school age CwSLI have a tendency to omit tense marking on regular verbs, in particular within the regular past tense for spoken language (e.g., Rice & Wexler, 1996). Moreover, weaknesses in vocabulary knowledge are

also a core difficulty for many CwSLI (e.g., Gray, 2004), possibly stemming from difficulties with both the semantic and phonological aspects of word learning (Nash & Donaldson, 2005). Language impairments in this population also extend to impairments in phonological skills (e.g., Briscoe, Bishop & Norbury, 2001). A robust phonological skills finding is that CwSLI have poor performance on phonological memory tasks in comparison to age matched and language level controls (Gathercole & Baddeley, 1990; Montgomery, 1995). Of the phonological memory tasks, non-word repetition is considered to be one of the most useful behavioural markers of SLI (Conti-Ramsden, Botting & Faragher, 2001).

As phonological skills are involved in literacy skills, it is generally accepted that CwSLI will be at a high risk of literacy difficulties and several longitudinal studies have highlighted the relatively poor literacy outcomes for this population (e.g., Catts, Fey, Tomblin & Zhang, 2002). CwSLI have been found to have poor spelling skills (Larkin & Snowling, 2008; Silliman, Bahr & Peters, 2006), decoding skills, and reading comprehension (Nation & Norbury, 2005) compared to their age matched peers. Moreover, phonologically based interventions for literacy difficulties have been shown to support CwSLI in their reading development (Gillon, 2000). While examining literacy skills at the word-based level is undoubtedly important, extra focus is needed on the prose writing skills of CwSLI. It is therefore vital that we extend our knowledge on both the nature of written language skills in CwSLI, and the relationship between spoken language and written language production.

Specific Language Impairment and Writing

Writing is a multi-component skill with a basis in language (Myhill & Fisher, 2010). Furthermore, language plays a central role in the not-so-simple view of writing (Berninger & Winn, 2006). This view is one of the main attempts to conceptualise the functions in the writing process. In this view there are three components: text generation, transcription, and executive function. In text generation the writing is generated in the mind and this would be

at three different levels, discourse, sentence, and word. For transcription, the information needs to be transcribed from what is held in the writer's mind to the paper or screen. The executive function is involved in goal monitoring and planning and, although it is not the focus of the study here, this third component serves to emphasise the need for a prompt to serve as a goal in writing. All three components interact with working memory so that writing can be carried out efficiently. Working memory is considered to be a temporary storage space so that written linguistic information can be stored and accessed by the three components. Kellogg (1999) has suggested that verbal working memory is particularly involved in translating, a process that is equivalent to text generation in Berninger & Winn's (2006) view.

It is possible to observe the text generation and transcription functions in written text using the Word Expressions framework from the Weschler Objective Language Dimensions (WOLD; Rust, 1996). The framework consists of six elements, four of these: Ideas and development, Organisation, unity and coherence, Sentence structure and variety, and Vocabulary can broadly be seen as corresponding to text generation, while Grammar and usage and Capitalisation and punctuation can be seen as corresponding to transcription. The quality of each of these elements is rated on a scale from one to four.

With impairments in several areas of language functioning and weaknesses in working memory skills (Montgomery, 1995) it is likely that CwSLI will struggle with a number of aspects of the writing process. Limited vocabulary knowledge may impact on the ability to formulate ideas, and there may be a restricted variety of words used in the children's written output. In terms of transcription, poor spelling and grammar skills may constrain written output considerably and this may contribute to shorter texts than age-matched peers. Finally, weaknesses in verbal working memory skills may lead to difficulties in co-ordinating the text generation and transcription aspects of writing. It is possible that this will have an impact on the diversity of words used and the quality of the writing as children

attempt to compensate for the limited storage capacity available between the three components.

Previous studies have shown findings consistent with the idea that children with language impairments show difficulties in the components suggested by the not-so-simple view of writing. McFadden and Gillam (1996) studied a group of children who had typical nonverbal ability but had language impairments and compared these children to language, reading, and chronological age matched groups. They found that the overall writing quality and the writing complexity of the language impaired group were similar to the, younger, language and reading groups. Based on an existing twin study sample, Bishop and Clarkson (2003) identified a group of children with language impairments and compared them to a typical group of children that were of a similar age. Both groups wrote a story based on a series of narrative picture prompts and it was found that the children with language impairments tended to write stories with fewer ideas (semantic content) and poorer spelling and punctuation. However, the syntactic complexity of the stories was similar to that of the typical children. Fey, Catts, Proctor-Williams, Tomblin and Zhang, (2004) found children with language impairment showed an improvement in their writing quality between the second grade and fourth grade but produced shorter stories, poorer quality stories, and had poorer grammar in their writing compared with typical children. Moreover Freed, Adams, and Lockton (2011) found that CwSLI typically had poorer quality writing than would be expected for their age. In a two–year longitudinal study by Dockrell, Lindsay, Connelly, and Mackie (2007) 10 year old CwSLI were found to have poorly developed writing skills, characterised by short texts with basic sentence structures. Dockrell, Connelly, and Lindsay (2009) found that even 16 years olds with SLI continued to have markedly poor writing abilities. In terms of literacy skills associated with writing in CwSLI, Dockrell *et al.* (2007) found that vocabulary and reading skills were important factors in children's writing skills.

Furthermore, in a path analysis study of CwSLI across ages eight to 16, Dockrell *et al.* (2009) found that writing ability at 16 years of age was predicted by earlier literacy skills, such as reading, spelling and writing, at age 14 years. Botting (2007) also found significant associations between reading and oral narrative production, even after controlling for nonverbal intelligence.

The Present Study

In light of the previous research findings, the present study aims to explore the written language skills of CwSLI in comparison to chronological age-matched controls and an additional matched control group. In this study, the CwSLI were classified as such provided that their nonverbal ability was in the normal range but that they were impaired on two of three language measures. However, there has been considerable variation in how SLI has been classified in previous studies. Bishop and Clarkson (2003) classified CwSLI as having typical nonverbal and speech ability but impairments on one of four language measures: grammar ability, recalling sentences, expressive vocabulary, or nonword repetition. In Colozzo *et al.* (2011), the CwSLI had nonverbal ability that was in the normal range but they were one standard deviation or below on a range of formulated and recalling sentences measures. Other studies have recruited groups based on whether they attended a specialist language unit but had a nonverbal intelligence quotient of greater than 70 (Botting, 2007) or if the children in the sample had language difficulties that persisted from eight through to ten years of age (Dockrell *et al.*, 2007). Other studies have used a, more general, language impaired group, as measured by a composite of language measures (McFadden and Gillam , 1996; Fey *et al.*, 2004). By choosing a conservative selection criterion, we recruited children who had significant language difficulties across more than one domain for the present study.

In addition to the CwSLI group, a further consideration was the recruitment of the matched control group. Although a language-level matched control group would seem to be

the clear choice for further investigation of written language skills in CwSLI, this raises the question of which aspect of language to focus on. As writing is a broad and integrated language task, and CwSLI may experience a range of different language profiles, it did not seem appropriate to match controls on one or two aspects of spoken language as some studies have done in the past. Rather, we chose to match a control group on spelling age because spelling is a linguistic skill that CwSLI often find difficult. Moreover, spelling is a transcription process in Berninger and Winn's (2006) view of writing and has been shown to be a key component of an individual's ability to write in other studies (e.g., Juel, 1988). Matching on a transcription process would allow an assessment of the extent of any difference between CwSLI and CAMC in writing ability. To our knowledge, no study has previously used a spelling age matched control group to examine the pattern of prose writing skills in CwSLI. A second consideration was the relationship between spoken language skills and written language production. As part of the group selection criteria, every participant completed measures of receptive grammar, receptive vocabulary, expressive recall of sentences, and phonological memory. The relationship between these core aspects of spoken language and measures of written language production were explored.

A final consideration is the relationship between reading, which is the third aspect of the UK Department for Education's expectations, and oral language, and writing. Research has shown that reading and writing skills are linked and there is a reciprocal improvement in ability over time (Juel, 1988). Reading like writing, is a multicomponent skill and a number of oral language abilities are known to be important in reading. Dockrell *et al.* (2007) found that oral language skills, as measured by receptive vocabulary, and reading were independently associated with writing skills in CwSLI but that grammar skills were not. Further exploration of this link between oral language, reading, and writing is important as it may have implications for the use of established reading interventions in helping children to

improve their writing skills. With this in mind, the present study aimed to assess whether potential relationships between spoken and written language skills were mediated by children's reading ability.

Another consideration is that of the writing prompt. Many studies have used different types of writing prompts for primary school age participants. For example, Bishop and Clarkson (2003) and Colozzo *et al* (2011) used picture prompts. However, it is possible that this type of visual prompt may limit the variation between participant's writing output, by providing a prescriptive framework for all writers to adopt. Dockrell *et al.* (2007), amongst other studies, has used a title prompt to focus children's writing. Although both approaches would fulfil the requirement for the executive function to maintain a goal (Berninger & Winn, 2006), it was decided a title prompt would allow a greater variation in writing ability profiles to emerge. In order to examine the quality of the text generation and transcription, the written texts were assessed using the six elements of the WOLD. In addition for this study, the number of nouns and the number of verbs in the text were also analysed as was the number of unique words (lexical diversity), again part of the text generation in the not-so-simple view of writing. Finally, the number of spelling errors and the number words in the passage was measured as an index of transcription.

Aims

Based on previous research findings, there were three aims to the study. The first aim was to explore the written production of CwSLI in comparison to age-matched controls. The second aim, with consideration to the likely impact that linguistic difficulties would have on writing, was to explore the differences between the CwSLI and the spelling-matched controls in written text and in particular the generation of ideas, lexical diversity, word length, proportion of spelling errors, grammar and usage, and overall quality of writing. The third aim, with consideration to the variation in ability, was to assess the relationships between

linguistic skills and the written measures and whether there were potential relationships between spoken and written language that were mediated by reading.

Method

Participants

The children were all from one school in the West Midlands of the United Kingdom, the school had a specialist unit for children with spoken language impairments. The school's approach to teaching writing for the typical children was in line with guidance from the UK national curriculum. For the children with language impairments, a range of linguistic, reading, writing, and spelling support interventions were used and these were specifically tailored to each child. These interventions were used with consideration to the UK national curriculum Key Stage progress targets. A hundred children were identified by the school as being either typical or showing signs of language impairment. These children were then screened using a series of language measures. The final sample consisted of 15 participants with SLI (4 females), 15 CAMC (5 females), and 15 SAMC (7 females). CwSLI were considered to meet the group criteria if they had a nonverbal ability score on the Matrices subtest from the British Ability Scales 2nd edition (BAS-II; Elliot, Smith, & McCulloch, 1996) within the normal range (T-score of 40 or above). Performance needed to be at least one-standard deviation below the mean published in the administration manual on two out of three different language test: Test for the Reception of Grammar 2 (TROG-2; Bishop, 2003), British Picture Vocabulary Scale III (BPVS-III; Dunn, Dunn, & Styles, 2009), and Recalling Sentences subtest from Clinical Evaluation of Language Fundamentals 4 (CELF-4; Wiig & Semel, 2006). These diagnostic tests were chosen based on the measures used by Norbury, Bishop and Briscoe (2001) and Bishop and Clarkson (2003). All 15 of the CwSLI were below the 1*SD* on the expressive test, which was the Recalling Sentences subtest, and 12 CwSLI were below 1*SD* on all three of the measures.

The chronological age control children were matched pair wise to the SLI participants within a maximum of 6 months. The spelling level matched control group were matched according to their age equivalent on the BAS-II spelling subtest, within 6 months of the SLI children's spelling ages. Three control children scored 1*SD* below the mean on one of the language measures, one each on the TROG-2, BPVS-III, and Recalling Sentences. In each case, they were close to the -1*SD* boundary. As the remainder of the children's language tests were within the normal range and they had no history of spoken language difficulties, these children were included in the study on the basis of allowing for test measurement error.

The ability measure scores for each group are summarised in Table 1 and a one-way ANOVA confirmed a significant difference for chronological age, $F(2, 42) = 29.60$, $MSE = 79.81$, $p < .01$, $\eta_p^2 = .59$, in which there was no significant difference between the CwSLI and the chronologically age matched children but there was a significant difference between these two groups and the SAMC. This pairwise comparison and the subsequent comparisons were Games-Howell corrected ($p < .05$). To confirm that the CwSLI were in line with the spelling age match children for spelling ability, the year and month information from the spelling test manual (Elliot *et al.*, 1996) was converted into months of age, a one-way ANOVA confirmed that there was a significant difference in the expected direction, $F(2, 42) = 18.40$, $MSE = 328.93$, $p < .01$, $\eta_p^2 = .47$, in that the spelling age of the SLI and the spelling age matched group were equivalent and that these ages were significantly lower than the chronological age match. The raw BAS-II spelling scores and the standard scores were also compared. The significant difference for the raw spelling scores, $F(2, 42) = 15.44$, $MSE = 114.15$, $p < .01$, $\eta p^2 = 0.42$, indicated that the CAMC had significantly higher scores than the CwSLI and the SAMC and these two groups had equivalent scores. Furthermore, there was a significant difference in the standard spelling scores, $F(2, 42) = 22.35$, $MSE = 135.5$, $p < .01$, $\eta_p^2 = 0.52$,

in which the CwSLI that scores were significantly below the CAMC and SAMC scores. There was no significant difference between the scores for the control groups.

A series of one-way ANOVAs were also carried out to look at the profiles of ability across the three groups. For nonverbal ability, there was no significant difference between the three groups, $F(2, 42) = 0.42$, $MSE = 107.11$, $p = .66$, $\eta_p^2 = .02$. For vocabulary, $F(2, 42) = 37.04$, $MSE = 58.50$, $p < .01$, $\eta_p^2 = .64$, grammar ability, $F(2, 42) = 28.23$, $MSE = 94.16$, $p < .01$, $\eta_p^2 = 0.57$, recall of sentences, $F(2, 42) = 53.36$, $MSE = 2.67$, $p < 0.01$, $\eta_p^2 = 0.72$, reading ability, $F(2, 41) = 27.02$, $MSE = 123.96$, $p < .01$, $\eta_p^2 = 0.57$, and nonword repetition, $F(2, 42) = 37.63$, $MSE = 981.07$, $p < .01$, $\eta_p^2 = .64$, the CwSLI had significantly lower scores than the CAMC and the SAMC while the CAMC and the SAMC had equivalent scores.

Insert Table one around here

Materials

For vocabulary, reading ability, spelling ability, nonverbal ability, grammar skills, recalling sentences, and nonword repetition, the administration, cut-off points, and scoring followed the procedures outlined by the instruction manual. Where appropriate, the scores were converted into T- (Nonverbal ability), standard (Vocabulary, Grammar ability, Reading ability, and Spelling ability), or scaled scores (Recalling sentences).

Writing task. Children were invited to produce a piece of writing with the following prompt; "Imagine that you could go anywhere you wanted for one day. You could go anywhere at all, and you could take one friend along. Write a letter to that friend, inviting him or her to go with you. In the letter, tell your friend where you will go for this one day and what you will do there." The prompt was in line with those provided by the WOLD (Rust, 1996) and similar to prompts in Dockrell *et al.* (2007) and Olive *et al.* (2009). The children were given fifteen minutes to complete the writing activity.

The WOLD scoring system has six elements that can be used to measure a piece of writing. They are (1) Ideas and development, (2) Organisation, unity, and coherence, (3) Vocabulary, (4) Sentence structure and variety, (5) Grammar and usage, (6) Capitalisation and punctuation. Between one and four points can be awarded for each measure and four points would indicate an excellent example of the measure. In addition to the six elements, a total WOLD score was also calculated by adding together the scores for each of the six elements for each participant. All written passages were scored by one author and then the second author scored a randomly selected sample of 25% of the passages. The inter-rater reliability was .85. In addition to the WOLD a range of lexical measures for each passage were calculated. These were as follows: The total number of words in the passage, the number of unique words in the passage (lexical diversity), the proportion of nouns and the proportion of verbs in the passage, and proportion of spelling errors. The total number of words in the passage was the raw number of tokens in the text with the punctuation removed. Where apostrophes were used to contract two words, the contraction was counted as a single word. Moreover two words separated by a hyphen were counted as a single word. However, it was very rare for children to contract or hyphenate words. With regard to the lexical diversity, it was possible that diversity would be increased if children spelt a single word incorrectly in several different ways, however children tended to make the same spelling error throughout a text or an error on a word that they only used once. Therefore uncorrected texts were used to calculate word count and lexical diversity.

Vocabulary. BPVS-III (Dunn, Dunn, & Styles, 2009). The participants were asked to indicate which one of four pictures represented a word spoken aloud by the researcher. Participants were awarded one point for each correct answer and once a number of errors had been reached in a block the task ended.

Reading ability. Word reading card from the BAS-II (Elliot *et al.*, 1996). The participants were presented with a card that had words they were expected to be familiar with at the start and as the series of word progressed, they became more difficult. Children read aloud until they reached a cut-off point and one point was awarded for each correct word read. One child with SLI did not complete this task due to time constraints.

Spelling ability. Spelling subtest from the BAS-II (Elliot *et al.*, 1996). This measure is a robust and reliable measure of spelling ability and has been used across a wide range of research studies in the past (e.g. Deavers & Brown, 1997 and Wood, 2002). The initial words are familiar and regular in their orthography (e.g. "go") and as the task progresses later words are less familiar and more irregular (e.g. "magician"). The measure does not attempt to provide information on specific spelling skills; instead it provides a general measure of spelling ability. In line with the manual, the researcher read aloud from a series of words. First the word in isolation was said, then in the context of a sentence, and finally again in isolation. The participant was required to write the word down, thereby providing an accurate spelling of the word. Participants continued with words until their errors reached a cut-off point and one point was awarded for each correctly spelt word. The scores were also converted into age equivalent scores for the spelling age match comparison.

Nonverbal ability. Matrices subtest from the BAS-II (Elliot *et al.*, 1996). The participants were shown an abstract pattern that had part of the pattern missing. The participant then had to choose, from six options, the correctly matching part of the pattern. One point was awarded for each correct choice and the cut-off point was three or more incorrect responses in a bock.

Grammar skills. TROG-2 (Bishop, 2003). For each item, the participants were provided with a an array of pictures that described different actions or scenarios, the researcher read aloud the target sentence, for example "The girl is sitting", and the participant

was required to point to the picture that matched the action. For each item there was a different array of pictures. The number of correct blocks passed (each block had four items) was the measurement and the cut-off point was five blocks failed in a row.

Recalling Sentences. The recalling sentences subtest from the CELF-4 (Wiig & Semel, 2006) was one of two memory measures. The task consisted of a series of sentences that the researcher read aloud and the participant repeated back. Points were awarded, to a maximum of three, depending on how few errors there were in the response from the participant. The cut-off point was five consecutive items awarded zero points.

Nonword Repetition. Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was used as the second of the memory measures. Initial nonwords were short and easy to repeat and, as the task continued, additional nonwords were longer and more complex. A point was awarded for each correct response from the participant. As the norms for this test only extend to 8 years of age, raw scores were used rather than standardised scores.

Procedure

Data collection was carried out on a one-to-one basis with the tasks split over two 40 minute sessions. The tasks were administered in a fixed order, and breaks were provided as necessary.

Results

The first and second aims were to assess whether there were any differences between the three groups on the writing measures. The total number of words, the lexical diversity, the proportion of nouns, the proportion of verbs, and the proportion of spelling errors were analysed separately as one-way ANOVAs, with post-hoc pairwise comparisons (Games-Howell, $p < .05$), and the descriptive statistics are reported in Table 2. There was a significant difference for lexical diversity, $F(2, 42) = 3.47$, $MSE = 271.17$, $p = .04$, $\eta_p^2 = 0.14$, in which

the CwSLI used a significantly less diverse range of words than the CAMC. The SAMC were not significantly different to the SLI and CAMC. It is possible that using only the number of types of words provides an incomplete picture of the lexical diversity, therefore Guiraud's index of lexical richness was also calculated (Vermeer, 2000) and the subsequent significant ANOVA, $F(2, 42) = 5.92$, $MSE = 1.31$, $p < .01$, $\eta p^2 = .22$, had the same pattern of pairwise comparisons (CwSLI $M = 4.06$, $SD = 1.29$; CAMC $M = 5.45$, $SD = 0.86$; SAMC $M = 4.43$, $SD = 1.24$). There was a significant difference in the proportion of spelling errors, $F(2, 42) = 4.79$, $MSE = 0.04$, $p = 0.01$, $\eta_p^2 = 0.19$, in which the SLI group and the SAMC had similar proportions and both had significantly higher proportions compared with the CAMC. The three groups showed no significant difference in the number of words they wrote, $F(2, 42) = 1.9$, $MSE = 718.59$, $p = .16$, $\eta_p^2 = 0.08$. There was no significant difference between the three groups in the proportion of nouns, $F(2, 42) = 0.02$, $MSE = 0$, $p = .98$, $\eta_p^2 = 0$, nor the proportion of verbs, $F(2, 42) = 0.85$, $MSE = 0$, $p = .43$, $\eta_p^2 = .04$.

For the overall WOLD score (see Table 2), the significant difference, $F(2, 42) = 5.56$, $p < .01$, $\eta_p^2 = .21$, found indicated that the CwSLI scored in line with the SAMC, $F(2, 42) = 5.56$, $p < .01$, $\eta_p^2 = .21$, and these two groups had significantly lower WOLD scores than the CAMC. The six separate WOLD elements showed a range of differences. There were significant differences for organisation, unity and coherence, $F(2, 42) = 4.73$, $MSE = 1.62$, $p < 0.01$, $\eta p^2 = 0.18$., and grammar and usage, $F(2, 42) = 6.05$, $MSE = 3.27$, $p < 0.01$, $\eta p^2 = 0.22$. However, the pairwise comparisons yielded different patterns for these two elements. In organisation, unity and coherence, the CAMC had a significantly higher score than the CwSLI but there was no significant difference for the SAMC compared to the other two groups. In grammar and usage, the CAMC had a significantly higher score compared with the SAMC but the CwSLI were not significantly different to either group. The difference between the groups for Sentence structure and variety approached significance, $F(2, 42) =$

3.06, *MSE* = 1.4, $p = 0.057$, $\eta_p^2 = 0.13$, in this the CAMC had a marginally higher score than the CwSLI ($p = .065$) but the SAMC were not significantly different to the CAMC ($p = .28$) nor the CwSLI ($p = .67$). There was no significant difference between the groups for Ideas and Development, $F(2, 42) = 1.47$, *MSE* = 0.62, $p = 0.24$, $\eta_p^2 = 0.07$, Vocabulary, $F(2, 42) = 1.07$, *MSE* = 0.47, $p = 0.35$, $\eta_p^2 = 0.05$, nor for Capitalisation and Punctuation, $F(2, 42) = 2.9$, *MSE* = 1.76, $p = 0.07$, $\eta_p^2 = 0.12$.

With respect to the second aim, it can be seen that the CwSLI tended to be in line with the SAMC on generation of ideas, lexical diversity, word length, proportion of spelling errors, grammar and usage, and overall quality of writing.

Insert Table 2 around here

The third aim was to look at the relationship between the standardised measures and the written language measures for the three groups overall. For these analyses the three groups were considered together and the raw scores were used for the standardised measures with the exception of memory. As there were two measures of memory (nonword repetition and recall of sentences) and there was a significant correlation between them ($r = .55$, $p < .01$), a composite measure of memory was produced for the purposes of the regression. The composite memory measure used the mean of the z scores of both memory measures. Although the WOLD had six separate elements, a factor analysis involving all participants indicated that these elements loaded onto one construct. Therefore only the total WOLD score was used in the regression analyses.

For each hierarchical regression chronological age and vocabulary were controlled in the first step. These were chosen as there was a range of ages across the 45 participants, and vocabulary is often associated with writing quality (Babayiğit & Stainthorp, 2010). In the second step the following variables were entered separately into the model: grammar skills, memory, nonverbal ability, reading, and spelling. There were five outcome measures that

represented different measures of writing: the total WOLD score, lexical diversity, the proportion of nouns, the proportion of verbs, and the proportion of spelling errors. Table 5 summarises the correlations between the written measures and the language skills. Only significant results are reported in full (*$p < .05$, **$p < .01$). After controlling for age and vocabulary, grammar skills accounted for 6.2% of the variance of the total WOLD score, $F(3,41) = 11.98$, $MSE = 5.57$, $p < .01$; $\beta = 0.434$*, and a small but significant 1.5% of the variance of lexical diversity, $F(3,41) = 9.12$, $MSE = 194.18$, $p < .01$; $\beta = 0.213$*. Memory accounted for 8.7% of the variance in total WOLD score, $F(3,41) = 13.2$, $MSE = 5.31$, $p < .01$; $\beta = 0.423$*. Reading ability accounted for 31% of the total WOLD score, $F(3,40) = 29.5$, $MSE = 3.07$, $p < .01$; $\beta = 0.7$**, 8.7% of the variance in the number of words, $F(3,40) = 9.8$, $MSE = 452.1$, $p < .01$; $\beta = 0.371$*, 10.9% of the variance in lexical diversity, $F(3,40) = 11.64$, $MSE = 168.01$, $p < .01$; $\beta = 0.416$**, 15.4% of the variance in the proportion of verbs, $F(3,40) = 3.82$, $MSE = 0.01$, $p < .05$; $\beta = 0.494$**, and 20.8% of the variance in the proportion of spelling errors, $F(3,40) = 14.93$, $MSE = 0.03$, $p < .01$; $\beta = -0.573$**. Spelling ability accounted for 16.1% of the variance in total WOLD score, $F(3,41) = 17.83$, $MSE = 4.53$, $p < .01$; $\beta = 0.545$**, 6% of variance in the number of words, $F(3,41) = 9.99$, $MSE = 463.8$, $p < .01$; $\beta = 0.333$*, 6.6% of the variance in lexical diversity, $F(3,41) = 11.24$, $MSE = 177.61$, $p < .01$; $\beta = 0.349$*, and 8.1% of the variance in the proportion of spelling errors, $F(3,41) = 9.69$, $MSE = 0.03$, $p < .01$; $\beta = -0.387$*.

Insert Table 5 around here

It appears that single word reading has a particularly powerful association with children's written language ability. However, as can be seen in Table 5, there were also substantial correlations between grammatical awareness and total WOLD score, and vocabulary knowledge and total WOLD score. In line with the procedure outlined by Baron and Kenny (1986) a final set of regression analyses was conducted to explore whether the relationship

between spoken language and written language is mediated by children's single word reading ability. The spoken language measures used for these analyses were the raw scores from the BPVS-III and TROG-2, thus indexing receptive vocabulary knowledge and the understanding of spoken grammar. Simple linear regressions indicated that without controlling for any other variables, reading accounts for 64.8% of the variance in WOLD total scores, while vocabulary knowledge accounts for 34.5% variance in total WOLD scores, and 34.8% variance in reading scores. A multiple regression in which reading and vocabulary were entered simultaneously produced a model that accounted for 65.6% of the variance ($F(2,41)=39.13$, $MSE=3.31$, $p < .005$) in total WOLD scores. Critically, while reading continues to have a highly significant association with writing performance ($\beta = .740$**), vocabulary knowledge was no longer significant ($\beta =.111$, p=.335). This indicates that there is a total mediation of the relationship between vocabulary knowledge and written language production by children's reading ability. A similar picture emerges with spoken grammar; TROG-2 raw scores account for 31.9% of the variance in WOLD total scores, and 31.9% of the variance in reading. A multiple regression in which TROG-2 raw scores and reading are entered simultaneously leads to a model which accounts for 64.8% of the variance in WOLD total scores ($F(2,41)=37.82$, $MSE = 3.38$, $p < .005$). Once again, reading continues to have a strong relationship with written language ability ($\beta = .795$**) whereas knowledge of grammar no longer accounts for any unique variance ($\beta =.019$, $p =.868$).

Discussion

The study compared CwSLI with typical children, who were either chronological age matches or spelling age matches, on the quality of their writing along with other written language measures. Furthermore, patterns of relationships were compared between a series of standardised measures and writing output measures. The written work that the CwSLI produced was marked by a significantly less diverse use of words, more spelling errors, it

was of lower quality overall, and had poorer organisation, unity and coherence when compared to children of a similar chronological age. However, the CwSLI tended to have scores in line with the children matched by spelling age. Three CwSLI scored a one for organisation, unity and coherence but the majority, eleven children, scored a two. A score of one on this element refers to text that is incoherent whereas a score of two indicates that there was little connection between writer's ideas throughout the text. Finally, there was a tendency for the work to have a poorer sentence structure and variety. The majority of CwSLI (10 children) scored a one on this element indicating that their use of sentence structure limited the clarity of the text.

The two key differences between the written text of the CwSLI and CAMC were in terms of the overall quality of the composition and the organisation, unity and coherence, both measured by the WOLD. That the CwSLI had poorer overall quality supports previous studies (e.g. Bishop & Clarkson, 2003; Freed *et al.*, 2011; and Fey *et al.*, 2004). Of the WOLD measures, Organisation, unity and coherence distinguished the CwSLI from the CAMC and indicated that the written text produced by the CwSLI had a less coherent flow and less evidence of planning. With reference to the not-so-simple view of writing (Berninger & Winn, 2006), it is likely that both executive (planning) and text generation (organisation at the language level of discourse) processes are involved. These two functions would interact with working memory to organise ideas into a coherent form for text generation at lower language levels so that transcription could be carried out. It can be seen that working memory impairments, as assessed by a composite measure of nonword repetition and recall of sentences, were a feature of the CwSLI in this sample (see also Montgomery, 1995) and working memory was associated with the overall WOLD score. Therefore the difficulty in managing the information flow under the task demands, of writing to a prompt, is likely to

have contributed to the lower organisation, unity and coherence scores that were a feature of the CwSLI's writing.

The CwSLI were poorer than the CAMC in both the proportion of spelling errors in the written text and in the standardised spelling measure. This is in line with a number of previous findings, for example Bishop and Clarkson (2003) and Silliman *et al.* (2006). As spelling is a transcription process in writing (Berninger & Winn, 2006), it is likely that the less accurate spelling constrained the ability of CwSLI to produce a good standard of writing compared with their peers, even though the ideas that CwSLI had in the text were of equivalent quality. A second feature was that CwSLI employed a much narrower range of words in their written composition than CAMC, even though there was only a slight difference in the length of the written texts. From the correlational analysis it was found that vocabulary and lexical diversity were strongly associated with each other. Furthermore in the comparison of the vocabulary levels, the CwSLI had a significantly smaller vocabulary than the CAMC (see Gray, 2004). It would be plausible to consider that the limited vocabulary would lead to the use of a less diverse range of words in writing for CwSLI. However, it was found that vocabulary did not constrain the ideas and development that CwSLI had in their writing. The CwSLI had a significantly poorer vocabulary but these children were equivalent to CAMC in the WOLD assessment of ideas and development. Although the CwSLI had lower vocabulary levels and less lexical diversity, they were no different in their use of vocabulary as measured by the WOLD. This would suggest that it is possible to employ a narrower range of words and still meet the demands of a writing prompt, with respect to the overall quality of the vocabulary used.

As with WOLD vocabulary quality, the CwSLI had written grammar scores in line with the CAMC. Therefore, there was no replication of previous findings that CwSLI had poorer written grammar than would be expected for their age. Where grammar has been

assessed in the past it has tended to be at the level of the individual word. For example Bishop and Clarkson (2003) classified grammar errors at the word or, in the case of verbs and pronouns, sentence level. It is beyond the scope of this paper to assess errors at the word level. However, even if CwSLI might have made errors in their grammar at the word level in this study, at the level of the text as a whole the findings suggest that their use of grammar was not noticeably different to that of typical peers.

A key finding from the regression models was the range of associations that reading ability had with the overall WOLD score, the numbers of words, lexical diversity, and the proportion of verbs. These were all positively associated with reading ability, while the proportion of spelling errors was negatively associated. In line with the findings of Dockrell *et al.* (2007), it seems that the relationship between spoken language and written language skills were mediated by children's reading ability. This would coincide with previous research that has demonstrated strong relationships between reading and vocabulary acquisition (e.g. Aguiar & Brady, 1991), and morphological awareness skills and reading development (Jarmulowicz, Hay, Taran & Ethington, 2000). The findings reinforce the notion that reading ability is an important and concurrent skill that supports writing and that reading interventions should be considered alongside any potential writing interventions for CwSLI. It is likely that the link between reading and writing is reciprocal in nature, as shown by Shanahan and Lomax (1986), who suggested that both draw on similar skills (see also Abbott, Berninger, & Fayol, 2010; Berninger, Abbott, Abbott, Graham, & Richards, 2002; Berninger *et al.*, 2006; Juel, 1988). In terms of educational implications, the findings support the notion that reading and writing should be taught in an integrated fashion, as currently articulated by the UK national curriculum (Department for Education, 2011; Ofsted, 2011).

There are several issues that may limit the generalisability of the findings. The first issue is that the task demands may be different depending on the type of prompt used. A title

prompt was used in this study in a similar way to Dockrell *et al.* (2007). This is in comparison to other studies, such as Colozzo *et al.* (2011) and Bishop and Clarkson (2003), who have used picture prompts. However unlike spelling, where there are only a few strategies available to spell a word correctly (Silliman *et al.*, 2006), it is likely that there are a number of strategies that young writers could use to produce a written text that meets the requirements of a prompt. The not-so-simple view of writing (Berninger & Winn, 2006) highlights the importance of the task's goal to the writer and the prompt used here may not have been sufficient to show a differentiation between the chronological age matched children and the CwSLI in some measures. The second issue is that as the CwSLI were part of a school with a specialist concern for this disorder, the children benefitted from the enhanced curriculum and that this resulted in writing that was equivalent, in some measures, to typical children of the same age. It is further recognised that the sample size used in the present study is small; however it is in line with a number of similar research studies (e.g. Colozzo *et al.*, 2011; Freed *et al.*, 2011; Gillam & Johnston, 1992; Norbury, Bishop & Briscoe, 2001). Moreover, the criteria for inclusion as a participant with SLI resulted in a group with a clear impairment in language ability. Although there were differences between the CwSLI and the CAMC in their quality of writing, as measured by the WOLD, it is possible that as each WOLD element only had a four point scale, the individual elements were not able to sufficiently discriminate between the groups. Many children scored either a one or a two and no children scored a four on any element. The WOLD elements have been used in a number of other studies (e.g., Dockrell *et al.*, 2007) and, even if there was a constraint on the variation in scores or a potential for floor effect in this study, differences were found in particular aspects of the writing quality for CwSLI that are consistent with difficulties that would arise from a language impairment.

Finally although the focus of this study was on writing skills in SLI, exploring a broader range of oral language skills, for example oral narrative production and their link to written language, may help develop this field of research further. Moreover to our knowledge, studies of the cognitive components of writing a first language have primarily involved English writing. Regarding other languages, Babayiğit and Stainthorp (2010; 2011) studied typically developing children who wrote in Turkish, which has a transparent orthography (as opposed to English which is considered to have an opaque orthography). Babayiğit and Stainthorp, (2011) demonstrated that oral language skills were also important in written texts in Turkish, and their findings were in line with the not-so-simple view of writing's account of these processes (Berninger & Winn, 2006). Further studies that explore other transparent and opaque languages would help develop the field's understanding of both writing in typical and atypical development.

Conclusion

In conclusion, the pattern was consistent with the position that vocabulary and working memory both play a role in written language production and that these both constrain some of the written language abilities in CwSLI. However at the text level, CwSLI were observed to have written language grammar levels similar to typical children of a comparable age, even though the overall quality of their writing was lower than that of the SAMC. In the regression models that were used to analyse the data, the findings reinforce the close association between reading and writing skills.

Table 1. Means, standard deviations, and sample alphas (Cronbach's alpha) for the standardised measures and age.

	CwSLI (*n* = 15)			CAMC (*n* = 15)			SAMC (*n* = 15)			
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	α
Age in months	113.07	8.61	99 - 127	112.67	8.44	97 - 125	91.13	9.70	77 - 110	-
Spelling age in months	93.60	12.17	73 - 117	129.87	26.42	88 - 189	95.87	12.78	76 - 123	-
Spelling ability standard scores	84.27	13.11	63 - 107	110.53	13.77	87 - 132	106.80	6.80	98 - 117	-
Spelling ability raw scores	23.80	9.56	8 - 39	41.80	12.65	18 - 60	22.33	9.55	11 - 41	.96
Nonverbal ability T-score	52.73	10.59	40 - 80	49.47	12.39	27 - 73	50.13	7.47	41 - 68	.90
Vocabulary standard score	75.40	6.37	70 - 86	97.00	9.34	81 - 121	95.33	6.90	86 - 112	.96
Grammar ability standard score	73.47	10.88	55 - 95	98.33	8.85	81 - 113	94.13	9.27	81 - 111	.76
Recalling sentences scaled score	3.07	1.75	1 - 6	8.33	1.40	6 - 11	8.47	1.73	6 - 12	.82
Reading ability standard scores	80.21	11.91	60 - 96	107.93	12.62	84 - 129	105.27	8.49	91 - 119	.98
Nonword repetition raw scores	17.20	7.69	4 - 31	30.93	2.71	27 - 37	31.47	3.42	24 - 37	.91

Table 2. Comparisons for the lexical writing measures and the WOLD scores.

	CwSLI (*n* = 15)			CAMC (*n* = 15)			SAMC (*n* = 15)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Number of words	38.27	30.70	5 - 106	55.67	20.91	18 - 97	40.20	27.85	6 - 96
Lexical diversity	25.93	17.99	5 - 61	40.87	13.21	16 - 69	28.80	17.75	6 - 69
Proportion spelling errors	0.20	0.15	0 - 0.5	0.09	0.06	0.02 - 0.21	0.32	0.32	0.06 - 0.9
Total WOLD score	10.87	2.59	6 - 15	13.73	2.63	8 - 19	10.67	3.27	6 - 15
Proportion of nouns	0.21	0.05	0.11 - 0.3	0.22	0.06	0.13 - 0.34	0.22	0.12	0 - 0.5
Proportion of verbs	0.17	0.04	0.08 - 0.26	0.21	0.04	0.17 - 0.29	0.20	0.12	0 - 0.41
WOLD Ideas and development	1.80	0.68	1 - 3	2.20	0.56	1 - 3	1.93	0.70	1 - 3
WOLD Organisation, unity and coherence	1.87	0.52	1 - 3	2.47	0.52	2 - 3	1.93	0.70	1 - 3
WOLD Vocabulary	1.67	0.72	1 - 3	2.00	0.53	1 - 3	1.73	0.70	1 - 3
WOLD Sentence structure and variety	1.40	0.63	1 - 3	2.00	0.76	1 - 3	1.60	0.63	1 - 3
WOLD Grammar and usage	2.20	0.77	1 - 3	2.67	0.62	2 - 4	1.73	0.80	1 - 3
WOLD Capitalisation and punctuation	1.93	0.80	1 - 3	2.40	0.91	1 - 4	1.73	0.59	1 - 3

Table 3. Zero order correlations for the language measures, writing measures, spelling (*N* = 45), and reading (*N* = 44).

	Total WOLD score	Number of words	Lexical diversity	Proportion of nouns	Proportion of verbs	Proportion of spelling errors
Age in months	.480**	.430**	.406**	0.055	0.138	-.502**
Vocabulary	.588**	.568**	.601**	0.111	0.264	-.479**
Grammar skills	.521**	.434**	.484**	0.083	0.204	-.391**
Nonverbal ability	.401**	.310*	.296*	0.026	0.107	-.444**
Memory	.466**	.373*	.450**	0.057	0.255	-0.219
Reading ability	.805**	.583**	.625**	0.146	.469**	-.675**
Spelling ability	.725**	.587**	.607**	-0.001	0.267	-.589**

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

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