Delay or deficit? Spelling processes in children with Specific Language Impairment

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Abstract

Few studies have explored the phonological, morphological and orthographic spellings skills of children with specific language impairment (SLI) simultaneously. Fifteen children with SLI (mean age = 113.07 months, *SD* = 8.61) completed language and spelling tasks alongside chronological-age controls and spelling-age controls. While the children with SLI showed a deficit in phonological spelling, they performed comparably to spelling-age controls on morphological spelling skills, and there were no differences between the three groups in producing orthographically legal spellings. The results also highlighted the potential importance of adequate non-word repetition skills in relation to effective spelling skills, and demonstrated that not all children with spoken language impairments show marked spelling difficulties. Findings are discussed in relation to theory, educational assessment and practice.

1. Introduction

Children with specific language impairment (SLI) fail to develop language skills in line with their age, despite normal non-verbal ability, no known hearing, physical or emotional problems and being exposed to an adequate learning environment (Bishop, 1992). Furthermore, it is widely recognised that children with a history of SLI are at substantial risk of later literacy impairments (e.g., Goulandris, Snowling & Walker; 2000; Stothard, Snowling, Bishop, Chipchase & Kaplan, 1998). However, very few studies have explored the morphological, phonological and orthographic spelling skills of children with SLI in relation to chronological and spelling-level controls, and considered how oral language skills might predict different aspects of spelling performance. The present study seeks to address these research questions and reflects on the implications of the findings for classroom learning.

1.1. Oral language as a predictor of spelling performance

In order to begin making plausible spelling attempts, children need to be able to consolidate the links between speech sound representations and graphemic units (e.g., Bruck & Treiman, 1990). Using mappings between phonemes and graphemes to produce phonetically plausible spelling attempts can be considered to be a phonological spelling strategy. However, as children progress through the stages of spelling development (Frith, 1985, see Apel, Masterson & Niessen, 2004, for a discussion of a non-stage conceptualisation of spelling development), they begin to draw on their knowledge of orthographic rules and common letter sequences to enable

more rapid and accurate spelling production. Thus there tends to be a shift from using a predominately phonological spelling strategy to an orthographic spelling strategy (Ehri, 1997). Morphological spelling strategies (e.g. understanding that regular past tense verbs end with the spelling *–ed*) are contingent on understanding orthographic rules alongside having clear mappings between phonemes and graphemes, and can therefore be considered to be a more advanced spelling strategy. However, a number of studies have now shown that typically-developing children can use morphological spelling strategies from a relatively young age (Bourassa, Treiman & Kessler, 2006; Treiman & Cassar, 1996). Similarly, recent research has also highlighted the role of broader language skills outside of phonology in predicting spelling performance. Grammatical awareness (Kim, 2010; Muter & Snowling, 1997; Nagy, Berninger & Abbott, 2006; Ouellette & Sénéchal, 2008; Tong, McBride-Chang, Shu & Wong, 2009), expressive language (Gallagher, Frith & Snowling, 2000), vocabulary knowledge (San Francisco, Mo, Carlo, August & Snow, 2006), and phonological memory (Muter & Snowling, 1997) have been found to be key predictors of children's spelling development.

The language and cognitive deficits experienced by individual children with SLI vary considerably; yet significant difficulties with morphological awareness (e.g., Leonard, Caselli, Bortlini, McGregor & Sabbadini, 1992; Rice & Oetting, 1993) phonological memory (Botting & Conti-Ramsden, 2001; Ebbels, Dockrell & Van der Lely, 2012) and expressive language (Marchman, Wulfeck &Weismer, 1999) are frequently cited as being deficits of the disorder, particularly in English speaking children. Furthermore, many children with SLI seem to show global phonological awareness deficits (Briscoe, Bishop & Norbury, 2001; Claessen & Leitão, 2012), which would inhibit their ability to grasp the early stages of spelling development.

Considering the potential role of spoken language in spelling proficiency, and the range of oral language deficits seen in SLI, it is unsurprising that studies have found children with a history of SLI to be at risk for later spelling difficulties (Stothard, Snowling, Bishop, Chipchase & Kaplan, 1998).

Very few studies have explored how effectively oral language skills predict spelling performance in children with SLI. In one such recent longitudinal study, Weerdenburg, Verhoeven, Bosman and Balkom (2011) demonstrated that lexical-semantic skills, auditory perception, verbal-sequential processing and speech production each made a significant contribution to later spelling performance in Dutch children with SLI. The study by Weerdenburg *et al.* successfully highlights the impact of spoken language on spelling production in this population, but does not consider how oral language impacts on different spelling processes, for example, children's ability to produce phonetically plausible spellings. To our knowledge no study to date has explored the relative contribution of different aspects of spoken language to morphological and phonological spelling processes in a sample including children with SLI.

1.2. Spelling skills in children with SLI

Although several studies have recently focused on the output produced by children with SLI in free writing tasks (e.g., Dockrell, Lindsay, Connelley & Mackie, 2007; Fey, Catts, Proctor-Williams, Tomblin & Zhang, 2004; Puranik, Lombardino & Altmann, 2006; Williams, Larkin & Blaggan, 2013), we still know relatively little about the pattern of spelling development in children with SLI. Specifically, it is unclear whether children with SLI tend to follow a delayed yet typical pattern of

spelling development, or exhibit more qualitative deficits in their spelling processes. This is largely because very few studies have included both age-matched and spelling-level matched control groups. If the children's spelling difficulties are a product of developmental delay, they will be impaired relative to the chronological-age controls but show a similar pattern of performance to a younger spelling-level matched control group. However, if the SLI group are making qualitatively different types of spelling attempts to younger children who are spelling at the same level, this indicates an atypical pattern of spelling development. Previous research which has included a spelling-level control group suggests English-speaking children with language impairments may be making qualitatively different spelling attempts to both age matched and spelling age matched control groups, indicating that their difficulties extend beyond a model of developmental delay. These qualitative deficits seemed to be particularly striking when the children were spelling inflectional morphemes, such as the English regular past tense morpheme *–ed* (Silliman, Bahr & Peters, 2006).

Inflectional morphemes tend to be omitted in the spelling attempts of children with SLI (Rubin, Patterson & Kantor, 1991; Silliman et al., 2006; Windsor, Scott & Street, 2000), for example the target word *raced* may be spelled as *race*. These errors are likely to be a reflection of the children's spoken language skills since it is well established that children with SLI tend to omit inflectional morphemes in spoken language, particularly the regular past tense (e.g. Gopnik & Goad, 1997; Rice & Wexler, 1996). Researchers have proposed three theories to explain this pattern of behaviour. The Surface Hypothesis (Leonard, 1989; 1992) suggests these errors are due to the low phonetic salience and short duration of particular morphemes and phonemes when spoken out loud. In contrast, the Extended Optional Infinity (EOI) theory argues the children with SLI are still engaged in an optional tense marking

stage of development (Rice, Wexler & Cleave, 1995), while Ullman and Gopnik (1994) advocated difficulty in acquiring the implicit rules of grammar. Whereas the third theory, outside of the linguistic domain, argues that the poor working memory skills often seen in children with SLI (e.g., Lum, Conti-Ramsden, Page & Ullman, 2011; Montgomery, 2003) may explain their difficulties with spelling inflectional morphemes. A child relying on a phonological spelling approach (Frith, 1985) would need to be able to store the phonetic sequence of the target word in working memory, segment the item into constituent phonemes, and allocate those phonemes to plausible graphemic units. The word would then need to be transcribed, drawing on letter knowledge and motor skills, before the final morpheme decayed from working memory. Similarly, a child who is able to draw on existing orthographic or morphological knowledge to aid their spelling attempt would need to store the target word in working memory, while drawing information from the mental lexicon. It is quite possible that by the time they have transcribed the first morpheme (e.g. *race* from *raced*), the representation of the inflectional morpheme may have decayed from the phonological loop, resulting in omission of the *–ed* morpheme in the spelling attempt. Critically, it is important to establish whether the phonological, morphological, and orthographic spelling skills of children with SLI are qualitatively different from younger typically developing children who are spelling at the same level. This will allow us to establish whether we are viewing a developmental delay in literacy skills, or whether the children's spoken language difficulties are leading to an atypical spelling deficit, providing specific implications for intervention.

1.3. Variability in the spelling performance of children with SLI

Despite the impact of broader language skills and phonology on spelling development, it appears that not all children with SLI show impairments in literacy development. For instance, Bishop and Clarkson (2003) found that it was primarily children with language impairments who underperformed on a non-word repetition task who showed marked difficulties in written language skills, possibly due to weaknesses in segmenting phonological input effectively. Additional studies, which have explored adequate literacy skills in SLI, have tended to focus on reading outcomes rather than spelling and these studies also suggest that it is children with reasonable phonological skills who will be unimpaired (Catts, Adlof, Hogan & Weismer, 2005; Kelso, Fletcher & Lee, 2007). Bishop, McDonald, Bird and Hayiou-Thomas (2009) added that if a child with impaired language has intact rapid serial naming skills their decoding may be unimpaired, yet they are still likely to develop weak reading comprehension skills. Decoding skills rely primarily on well-specified phonological representations and efficient mappings between phonemes and graphemes. Considering that spelling draws heavily on broader language skills outside of phonology, particularly morphological awareness, it is possible that, while some children with SLI are unimpaired in decoding they will still show weaknesses in spelling and written language.

1.4. The present study

In response to the limited findings currently available on spelling and oral language skills in SLI using age-matched and spelling-age matched comparison groups, the present study seeks to address two research questions. The first question: to what extent do oral language skills predict spelling performance across all

participants? Specifically, it will address whether understanding of spoken grammar, expressive language skills, vocabulary knowledge, and non-word repetition scores account for substantial variance in children's phonological and morphological spelling skills. The second question: to what extent are the spelling difficulties seen in children with SLI fit in with a pattern of developmental delay? In order to address this question the spelling performance of the children with SLI will be compared to the performance of both chronological-age matched and spelling-age matched control children. Caution is needed in interpreting the findings because matched designs such as this cannot account for plateaus in language and literacy development, but it should provide useful information on which to base future research studies.

2. Method

2.1 Participants

The children were all from one school in the West Midlands of the United Kingdom, which included a specialist unit for children with spoken language impairments. The children took part in a comprehensive study of spelling and narrative writing; only the spelling measures are reported in this paper. The sample consisted of 15 participants with SLI (11 males, mean age 9 years 5 months; *SD* = 8.61 months), 15 chronological age matched children (10 males, mean age 9 years 5 months; *SD* = 8.44 months), and 15 spelling age matched children (8 males, mean age = 7 years 7 months, *SD* = 9.70 months). Reports from the school indicated that the children all had hearing within the normal range. Moreover, the children with SLI had previously been assessed by educational psychologists as having this disorder.

They were considered to meet the group criteria if they had a nonverbal ability score on the Matrices subtest from the British Ability Scales II (Elliot, Smith, & McCulloch, 1996) within the normal range (T-score of 40 or above). The children's performance needed to be at least one-standard deviation below the mean on two out of three different language tests: Test for the Reception of Grammar 2 (TROG-2) (Bishop, 2003), British Picture Vocabulary Scale III (BPVS-3) (Dunn, Dunn, Sewell & Styles, 2009), and Recalling Sentences subtest from Clinical Evaluation of Language Fundamentals 4 (Wiig & Semel, 2006). These diagnostic tests were chosen as the test battery had been used to validate an SLI group in a study by Norbury, Bishop & Briscoe (2001). Together these criteria allow consideration of both receptive and expressive language skills. Selecting children who were impaired on at least two out of three language measures ensured that the children with SLI were likely to be experiencing a range of language difficulties rather than a deficit in just one area of spoken language (e.g., grammatical SLI subgroup; Van der Lely, Rosen & McClelland, 1998). In this group, all of the children had a Recalling Sentences score one standard deviation below the mean, while 13 children had TROG-2 and 14 children had BPVS-III scores more than one standard below the mean. Twelve children were impaired on all three measures while three were impaired on two 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 British Ability Scales II spelling subtest, within 6 months of the SLI children's spelling ages. The control children did not show deficits on the spoken language measures, with the exception of three of the age matched control children who each scored just below one standard

deviation on a single language measure. As all other language tests were within the normal range, these children were included in the study on the basis of allowing for test measurement error, and that they had no history of spoken language difficulties.

Table 1 displays the descriptive statistics for the background measures in relation to group. One-way ANOVAs were carried out to look at the profiles of ability across the three groups using the T-scores or standard scores as appropriate. For nonverbal ability, there was no significant difference between the three groups. For vocabulary, grammar skills, recall of sentences, spelling ability, and nonword repetition the children with SLI had significantly lower scores than the chronological age and spelling age matched groups while the chronological age and spelling age matched groups had equivalent scores.

Insert Table 1 around here

2.2 Measures of Language and Non-verbal ability

The test manual instructions were followed for each of the measures and the cut-off points, for example the numbers of errors in a block, were used as outlined in the instructions.

2.2.1. Vocabulary

The British Picture Vocabulary Scale 3 (Dunn *et al.*, 2009) was used and, in the task, the participants were presented with a choice of four pictures on each item card. For a correct answer they pointed to the picture that depicts a word spoken by the experimenter.

2.2.2 Spelling ability

The spelling subtest from the British Ability Scales II (Elliot *et al.*, 1996) was used. The researcher read aloud from a series of words. For each item, the word was also provided in a sentence context following which participants were required to write the word down. One point was awarded for each item spelled correctly. The scores were converted to standard scores for analysis and age equivalent scores in order to compare the spelling age of the different groups.

2.2.3. Nonverbal ability

The matrices subtest from the British Ability Scales II (Elliot *et al.*, 1996) was administered. The participants were shown a series of abstract patterns; each pattern had a piece missing. The participants were asked to select the correct piece to complete each pattern, from a choice of six.

2.2.4. Grammar skills

The test for Reception of Grammar 2 (Bishop, 2003) was used. 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, the participants were provided with four pictures that depicted different actions or scenarios. The number of correct blocks passed (each block had four items) was recorded.

2.2.5. Recalling sentences

The recalling sentences subtest from the Clinical Evaluation of Language Fundamentals 4 (Wiig & Semel, 2006) was used. The researcher read aloud the

sentence and the participant repeated the sentence back to the experimenter. Points were awarded depending on the number of errors in the repeated sentence and there was a maximum of three points for each item.

2.2.6. Nonword repetition

The Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was used. For each item, the researcher played a tape with the item named aloud. The participant immediately repeated the nonword. Each correct item scored one point.

2.3. Experimental spelling tasks

2.3.1. Non-word spelling task

The non-word spelling task was used to assess the children's ability to spell unfamiliar items in a phonetically plausible manner. The ten spelling items (/ϖ{μ/, /λα≤/, /πΕλι/, /β≅/μιρ≅/, /τ≤ςμ/, /γ{□κ/, /φλοπ/, /μ{κτ/, /δΙλə·/, /'στεvο/) used in this task were designed by Treiman and Bourassa (2000) to include several components of words that children typically find challenging to spell (e.g. final consonant clusters). The items have been used with both typically developing children (6 – 8 years) and older children with dyslexia (7 – 14 years) (Bourassa & Treiman, 2003), thus they were considered appropriate for the children taking part in the present study. To maximise engagement with the task, the children were given a double-sided sheet depicting cartoon pictures of familiar animals. The researcher explained that these animals had unusual names, and asked the child to write down each animal's name as it was said out loud by the researcher. Each non-word was said out loud twice, and was repeated an additional time on request from any participants. The children were

not asked to repeat the non-word before spelling the item, to avoid expressive phonological difficulties confounding the children's spelling attempts.

The phonetic plausibility scale developed by Caravolas, Hulme and Snowling (2001) was used to score each spelling attempt. This system was chosen as it provides a fine-grained assessment of children's ability to apply phoneme-to-grapheme correspondences effectively. Each target item is broken down into its constituent phonemes, and awarded a score (out of a maximum of four) for the manner in which each phoneme is represented in the child's spelling attempt. A score of four is awarded if the child provides a phonetically plausible representation of the target phoneme, irrespective of conventional orthographic rules, such as letter sequence constraints. Three points are awarded if the grapheme used represents a phoneme one phonetic feature removed from the target phoneme (e.g. the letter p is used for the phoneme /b/). Two points if half a digraph is represented, or if the phoneme is correctly represented alongside an adjacent implausible phoneme. One point is awarded for an implausible representation of the phoneme, and zero points if there is no representation of the target phoneme. The scores are then turned into a percentage of phonetic plausibility for each item. Thirty percent of the spellings were independently rescored by the second author, providing a reliability rating of $r = .995$.

In order to provide a measure of orthographic spelling ability, the orthographic skeleton coding system (Treiman & Bourassa 2000) was also applied to the non-word spelling task. This provided an index of the children's ability to apply orthographic rules to unfamiliar items. Each spelling attempt was awarded one point if the orthographic sequence was legal in English spelling, providing a maximum score of 10.

2.3.2. Morphological spelling task

This morphological spelling task assessed children's ability to spell inflectional morphemes correctly. The children spelled six one-morpheme verbs (sail, chase, race, puff, kick and bake) as stems (e.g. sail), with the regular past tense morpheme *-ed* (e.g. sailed), with the progressive *–ing* morpheme (e.g. sailing) and with the third person singular form *–s* (e.g. sails). The 24 items were randomly presented in one spelling list. Each item was present in isolation, in a sentence context, and in isolation again. A final repetition of each item was allowed if the child requested it. The participants were not requested to repeat the words before attempting the spellings. The number of stem words, *-ed* morphemes, *-ing* morphemes and *–s* morphemes spelled correctly was calculated. The children's spelling errors of the inflectional morphemes were further scored as being phonetically plausible, implausible or omissions.

2.4. Procedure

Data collection was carried out on a one-to-one basis by a trained research assistant. The tasks (including a written language task which is not reported in this paper) were split over two 40 minute sessions. The tasks were administered in a fixed order, and breaks were provided as often as necessary.

3. Results

3.1. Do spoken language skills predict spelling performance?

In order to provide enough power to address this research question, the analyses were collapsed across participant groups. Multiple regression analyses were

used to address whether spoken language skills (vocabulary, understanding of grammar, non-word repetition and recalling sentences tasks) predict phonological and morphological spelling performance. The number of correct spellings of inflectional morphemes was chosen as an index of morphological spelling skill, while scores on the phonetic plausibility scale provide the index of phonological spelling performance. Table 2 shows the correlations between the spoken and written language measures. It can be seen that there are moderate to strong correlations between all of the spoken language measures and both the spelling tasks.

Insert Table 2 around here

As the pattern of correlations remains constant after controlling for chronological age, age was not entered as a predictor in the regression analyses. A multiple regression was carried out with phonetic plausibility score as the dependent variable, and the four predictors (TROG 2, non-word repetition, BPVS III and recalling sentences) were entered simultaneously. The overall model was significant ($F(4,40) = 14.16$, MSE = 69.69, $p = .001$), accounting for 58.6% of the variance in phonological spelling skill. Examination of the contribution of the different language measures showed that non-word repetition was a significant unique predictor ($\beta = .527$, $p = .001$), and TROG 2 was approaching significance ($\beta = .386$, $p = .055$). Neither the vocabulary measure ($\beta = -.214$, $p = .261$) nor the recalling sentences task ($\beta = .139$, $p = .414$) were significant predictors of phonological spelling performance in this analysis. It was possible that the different groups showed different correlation patterns in relation to non-word repetition and TROG 2. Correlations by group suggested that this was the case. Only the SLI group showed a significant

relationship between non-word repetition and phonological plausibility in spelling (r = .551, p < .05) whereas the age (r = .224, p = .421) and spelling control groups (r = -.133, p = .636) had non-significant correlations. However both the age matched groups had significant associations between grammar and phonological spelling (r = .668, p < .01 and r = .564, p < .05 respectively for age and spelling controls) and the SLI group showed no significant association (r = .199, p = .477).

An identical multiple regression analysis was carried out with number of inflectional morphemes spelled correctly as the outcome variable. The model was a reasonable fit, accounting for 36.6% of the variance (F(4,40) = 5.78, MSE = 17.80, p = .001). Non-word repetition was the only variable to account for a significant amount of unique variance (β = .445, p = .015) the remaining variables were non-significant: recalling sentences (β = .062, p = .299), TROG 2 (β = .379, p = .125), and vocabulary (β = -.241, p = .305). However when divided by group, nonword repetition showed non-significant associations in the children with SLI (r = .459, p = .086), the age control group (r = .134, p = .633) and the spelling control group (r = .271, p = .328).

3.2. Do the spelling skills of children with SLI follow a pattern of developmental delay?

3.2.1. Phonological spelling

The non-word spelling task was initially scored using the Caravolas *et al.* (2001) phonetic plausibility scale. A one-way ANOVA demonstrated a significant main effect of Group (F(2,42) = 13.68, MSE = 97.08, p = .001, ηp^2 = 0.65). Games

Howell post hoc tests confirmed that the children with SLI were significantly poorer at phonological spelling than the age-matched control (SLI mean = 79.94, *SD* = 16.04; Age control mean = 96.95, *SD* = 3.13; *p* = .003, *d* = 1.47) and the spelling-age matched control (spelling-age mean = 95.41, *SD* = 4.90; *p* = .006, *d* = 1.35). There appears to be a considerable amount of variability in the phonological spelling skills of the children with SLI. To examine this heterogeneity further, children with SLI were classified as being competent at phonological spelling if they scored above 85% (n = 8, mean age = 113.88 months) on the phonetic plausibility scale, and poor if they scored below 85% (n = 7, mean age = 112.14 months). Independent t-tests were then used to compare the spoken language test scores of these two subgroups. It was found that the poor SLI group had significantly lower raw scores on the non-word repetition task (competent SLI mean = 21.25, *SD* = 6.63; poor SLI mean = 12.57, *SD* = 6.32; *t* (13) =2.59, *p* = .023, *d* = 1.34), while the subgroups were comparable on all other spoken language measures.

3.2.2. Orthographic spelling

Descriptive statistics showed that the two control groups were performing close to ceiling on the orthographic skeleton score (Age-matched control mean = 9.53, *SD* = .640; spelling-age matched mean = 9.67, *SD* = .617), while there was slightly more variability in the performance of the SLI group (mean = 8.80, *SD* = 1.52). A one-way ANOVA demonstrated a marginal effect of Group on orthographic spelling score ($F(2,42) = 3.16$, MSE = 3.27, $p = .053$, $\eta p^2 = 0.15$), however Games-Howell post hoc tests revealed no significant differences between the three participant groups. Further exploration of the spread of scores within the SLI group highlighted

that the majority of the children were using orthographic rules effectively, gaining scores of at least 8 out of 10. In contrast, two of the children gained lower scores of 5 and 6 out of 10. These participants performed particularly poorly on all of the spelling tasks administered.

3.2.3. Morphological spelling

There was a significant main effect of Group on the accuracy of stem word spellings ($F(2,42) = 8.56$, MSE = 3.90, $p = .001$, $\eta p^2 = 0.29$). The age-matched controls spelled significantly more stem words correctly (e.g., kick, bake) than the children with SLI (age control mean = 4.87, *SD* =1.92; SLI mean = 1.93, *SD* = 1.91; $p=.001$, $d = 1.53$) and the spelling-age controls (mean = 2.93, *SD* =2.09, $p = .035$, $d = 0.25$). There was no significant difference between the performance of the SLI group and the younger spelling control group.

Spellings of the three types of inflectional morpheme (*-ed, -ing and –s*) were classified as correct, phonetically plausible, omitted or implausible. Spellings were classified as omissions if there was a reasonably plausible spelling of the stem word, with no attempt to spell the inflectional morpheme. Table 3 shows the pattern of spellings across all three morpheme categories. It can be seen that the majority of the Age control group are able to competently spell these inflectional morphemes correctly. There is however considerably more variability in the spellings produced by the SLI group and the spelling-age control group.

Insert Table 3 around here

Collapsed across all morpheme types, there was a significant main effect of Group on number of omissions ($F(2,42) = 8.44$, MSE = 2.78, $p = .001$, $\eta p^2 = 0.29$) and number of morphemes spelled correctly ($F(2,42) = 7.90$, MSE = 19.44, $p = .001$, $\eta p^2 = 0.27$). There was also a significant main effect of Group on the number of phonetically plausible morpheme spellings ($F(2,42) = 5.05$, MSE = 3.08, $p = .011$, $\eta p^2 = 0.19$), and the number of incorrect morpheme spellings ($F(2,42) = 8.91$, MSE = 5.84, $p = .001$, $\eta p^2 = 0.30$). Only significant or near-significant post-hoc comparisons are reported.

Games-Howell posthoc tests demonstrated that the SLI group made marginally more omissions than the spelling age control group on the *–ed* morphemes ($p = .054$) and the –ing morphemes ($p = .053$). Similarly, the larger number of *–s* omissions made by the SLI group compared to the age matched control approached significance ($p = .053$). The SLI group made fewer correct spellings than the age matched control for the *–ed* morphemes ($p = .013$) and the –ing morphemes ($p =$. 041). Fewer correct spellings of the *–s* morpheme were made by the SLI group in comparison to both age matched ($p = .002$) and spelling age matched controls ($p =$ .034). Post hoc tests further showed that for the phonetic spellings the only difference approaching significance was between the spelling age control and the age-matched control ($p = .054$), with the younger spelling-age participants producing more phonetically plausible *–ed* morpheme spellings. Finally, in terms of incorrect or implausible morpheme spellings, the SLI group produced more implausible spellings of the *–ed* morpheme than the age matched control ($p = .011$), and more implausible spellings of the *–s* morpheme ($p = .003$). The SLI group also produced marginally

more implausible spellings of the *–s* morpheme than the spelling-age control group (p = .051).

Overall the findings seem to indicate a pattern of delay rather than difference in the SLI children's spelling attempts of these inflectional morphemes. The SLI group are not making any more omissions than the younger spelling level matched control, although their accuracy for spelling the *–s* morpheme is significantly weaker.

4. Discussion

The present study has extended the limited evidence on the spelling skills of children with SLI. Overall, the findings demonstrate a mixture of delay and deficit for English speaking children with SLI in their spelling ability. The initial research question considered whether spoken language skills were useful predictors of the children's phonological and morphological spelling performance. The results provide further evidence of a strong relationship between oral language skills and spelling performance (e.g., Kim, 2010; Muter & Snowling, 1997; Nagy, Berninger & Abbott, 2006; Ouelette & Sénéchal, 2008; Tong, McBride-Chang, Shu & Wong, 2009). Moderate to strong correlations were observed between all the spoken language measures and phonological and morphological spelling skills. Furthermore, these relationships were retained after controlling for chronological age. Non-word repetition was found to be the most useful language predictor for both morphological and phonological spelling, as it accounted for significant unique variance outside of vocabulary knowledge, grammatical awareness and recalling sentences.

It is likely that nonword repetition assesses the storage capacity of phonological information in the phonological loop (Gathercole & Baddeley, 1990)

and that it is important in learning new words (Baddeley, 2003). Moreover, previous research with typical children has shown a link between phonological awareness skills and nonword repetition errors (Stuart & Masterson, 1992). In a classroom context, children are often asked to spell words that have been presented verbally or they are required to generate correct spellings when writing text. Therefore, the ability to store more phonological information and/or better quality information allows a child to have better phonological representations available of those words as spelling activities are carried out. It is also possible that the reverse is the case, in that the ability to spell a wide range of words accurately, particularly complex and longer words that appear less frequently, would help foster better phonological memory capacity and result in higher nonword repetition scores. The interactive nature of working memory and other language and cognitive processes has previously been highlighted by Baddeley (2003). As such, memory factors are likely to contribute to the profile of ability, delay and deficit that children with SLI show in their academic studies. Deficits in non-word repetition are a well-documented characteristic of SLI (Gathercole & Baddeley, 1990), yet this is one of only a few studies to highlight the potential link between non-word repetition impairments and written language difficulties in English speaking children with SLI.

The second research aim was to address whether children with SLI show a pattern of deficit or developmental delay in their spelling performance. As a group, they showed a significant deficit in using phonological spelling strategies, in that they were poorer than both the age-matched and spelling-age matched controls. However, closer inspection of the data highlighted that it was those children with weak non-word repetition skills who were underperforming on this aspect of spelling development. These findings coincide with previous studies that have suggested

children with SLI who have reasonable phonological skills will be relatively unimpaired on literacy tasks (e.g., Catts, Adlof, Hogan & Weismer, 2005; Kelso, Fletcher & Lee, 2007). Bishop and Clarkson (2003) also found non-word repetition to be a specific protective factor for the written language skills of children with a history of language difficulties. Yet as the present study did not include further measures of phonological awareness or processing, it is unclear from the current data whether it is non-word repetition in particular that plays a key role in children's phonological spelling, as opposed to broader phonological skills. Further studies controlling for phonological awareness and phonological processing are needed to isolate the potentially critical role of non-word repetition in children's spelling development.

In contrast to phonological spelling, there were no significant group differences found in orthographic spelling skills. However, this must be interpreted with caution considering the ceiling effects in the data. The data do allow us to conclude that nearly all of the children with SLI were using orthographically legal spelling patterns. These results coincide with the findings of Silliman et al. (2006), who found that children with spoken language difficulties performed comparably to age and spelling age controls on the orthographic legality of their spellings. According to traditional stage models of spelling (e.g. Frith, 1985), children draw on orthographic awareness skills after mastering phoneme-to-grapheme correspondences. However, the present data suggests that children with impaired phonological spelling skills are performing reasonably well on orthographic spelling patterns, possibly as a consequence of orthographic awareness being developed through reading. This suggests that orthographic and phonological spelling skills are separate strategies, and that orthographic awareness may not be dependent on first establishing competent

phonological spelling skills. This interpretation is supported by the analysis of deaf children's spellings (e.g., Aaron, Keetay, Boyd, Palmatier & Wacks, 1998), where children with limited phonological skills were able to use visual memory for letter patterns to produce orthographically legal spelling attempts.

Interpreted conservatively, the results from the morphological spelling task suggest a pattern of delay rather than a qualitatively different deficit in spelling performance. This is because whilst the children with SLI underperformed on their ability to spell inflectional morphemes compared to age-controls, clear significant differences rarely emerged between the children with SLI and the spelling-age controls. A possible exception is that the children with SLI tended to omit the inflectional morphemes from their spelling attempts, notably the –ed and –ing morphemes. The –ed inflection in particular is low on phonetic salience, so it is plausible that the children with SLI with poor phonological skills struggled to access and store this morpheme, in line with the surface hypothesis proposed by Leonard and colleagues (Leonard et al., 1992). We can hypothesise that the –ing morpheme is more likely to be omitted due to storage limitations in the phonological loop, as reflected by the poor non-word repetition performance of many of the children with SLI.

Previous research has often shown that, over time, children with SLI show improvements in their ability to apply endings such as –ed in spoken language. In Rice, Tomblin, Hoffman, Richman & Marquis (2004), children with SLI tended to show few past tense errors in spoken language by the end of Grade Four, around nine to 10 years of age, whereas at Kindergarten, children with SLI showed poorer performance in applying tenses. Moreover, young children with SLI rarely have difficulties with –ing in spoken language (Rice & Wexler, 2001). However, far less

research has been carried out into children with language impairments and patterns of spelling (Larkin & Snowling, 2008; Silliman et al., 2006). An implication of the findings in this study is that problems with inflectional morphology persist and might be more widespread in newly acquired literacy skills such as spelling. It is worth noting that the present study only considered inflectional morphology and although this study did not consider derivational morphology, this may also pose additional challenges for children with SLI. In particular, words which incorporate a phonological change (e.g. magic – magician) may be difficult for children with weaknesses in phonological memory skills.

There are several issues to take into account that might limit the findings. In order to produce a sample with a clear SLI profile and to match this group closely to spelling and chronological age matches so that delay and deficit could be explored, the resulting sample size might have affected the power of the analyses. This can be seen, to some extent, in some of the correlational analyses. Although these were generally in the same direction for each group, the different correlational strengths underline the complexities of the relationship between oral language and spelling ability. Some of the challenges in matching groups can be seen in the variety of ability in the typical children. Although all of the SLI children met the previously defined criteria and most performed poorly on all of the classification measures, three of the chronological age matched typical children were on the borderline with regard to a language measure. This highlights that typical children can still sometimes experience subtle difficulties in language skills. Finally, the focus of this study was English speaking children with SLI and English might have different linguistic and cognitive demands compared to other languages, for example English has an opaque orthography. As such there is the possibility that the patterns of spelling skills, and

the relationships between these skills and linguistic and cognitive process, in children with SLI with different languages are different. Future studies exploring these areas would help contribute to the current understanding of SLI.

Two further measures could form the basis of develop future research based on the findings of this study. The first is that, although there were no reported hearing problems, an independent measure of hearing ability might help rule out this possibility, especially with regard to investigating the phonetic salience of inflectional morphemes. Second, as previous studies have found links between nonword repetition and working memory (Gathercole and Baddeley, 1990), using a measure of this nature would help explore the issue of short term storage capacity as a contributor to spelling skills.

In summary, group-based comparisons suggest children with SLI show a qualitative deficit in using phonological spelling strategies, a delay in spelling inflectional morphemes and a possible area of strength in orthographic skills. However, detailed exploration of children's individual patterns of performance indicates two subgroups of children; those who spell reasonably well and those who have quite severe difficulties. In the current dataset, non-word repetition performance seems to be the protective factor that sets these two groups apart, but this requires further exploration with a larger sample of children with SLI.

5. Conclusion

The findings from this study suggest that a 'one size fits all' approach to spelling provision for children with SLI is unlikely to be effective. Group effects can mask individual language profiles; children with SLI may experience relatively

typical spelling development, or they may experience marked difficulties in all aspects of spelling. Assessment needs to take into account the phonological and morphological patterns of spelling errors, and further consider a child's ability to access different spelling strategies, rather than measure only the accuracy of a particular spelling test. The present data strongly suggests that a child's spelling skills will hinge on their spoken language development, particularly in terms of non-word repetition and spoken grammar. Support should be tailored to individual children's spoken language profiles, with written and spoken language intervention being interlinked wherever possible.

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Table 1. Means, standard deviations, sample alphas (Cronbach's alpha), and the comparisons of groups (one way ANOVAs) for the standardised measures and age.

	SLI			Age control			Spelling control					
Variable	Mean	SD	N	Mean	SD	N	Mean	SD	N	α	ANOVA	Difference
Age in months	113.07	8.61	15	112.67	8.44	15	91.13	9.7	15	-	$F(2, 42) = 29.60$, $MSE = 79.81$, $p < .01$, $\eta p^2 = .59$	SC < AC = SLI
Spelling age in months	93.6	12.17	15	129.87	26.42	15	95.87	12.78	15	-	$F(2, 42) = 18.40$, $MSE = 336.45$, $p < .01$, $\eta p^2 = .47$	SLI = SA = AC
Nonverbal ability T-score	52.73	10.59	15	49.47	12.39	15	50.13	7.47	15	0.9	$F(2, 42) = 0.42$, $MSE = 107.11$, $p = .66$, $\eta p^2 = .02$	SLI = SA = AC
Vocabulary standard score	75.4	6.37	15	97	9.34	15	95.33	6.9	15	0.96	$F(2, 42) = 37.04$, $MSE = 58.50$, $p < .01$, $\eta p^2 = .64$	SLI < AC = SC

Grammar skills standard score	73.47	10.88	15	98.33	8.85	15	94.13	9.27	15	0.76	$F(2, 42) = 28.23$, $MSE = 94.16$, $p < .01$, $\eta p^2 = 0.57$	SLI < AC = SC
Recall. sent. scaled score	3.07	1.75	15	8.33	1.4	15	8.47	1.73	15	0.82	$F(2, 42) = 53.36$, $MSE = 2.67$, $p < .01$, $\eta p^2 = 0.72$	SLI < AC = SC
Reading ability standard scores	80.21	11.91	14	107.93	12.62	15	105.27	8.49	15	0.98	$F(2, 41) = 27.02$, $MSE = 123.96$, $p < .01$, $\eta p^2 = 0.57$	SLI < AC = SC
Spelling ability standard scores	84.27	13.11	15	110.53	13.77	15	106.8	6.8	15	0.96	$F(2, 42) = 22.35$, $MSE = 135.5$, $p < .01$, $\eta p^2 = 0.52$	SLI < AC = SC
Nonword rep. raw scores	17.2	7.69	15	30.93	2.71	15	31.47	3.42	15	0.91	$F(2, 42) = 37.628$, $MSE = 26.07$, $p < .01$, $\eta p^2 = 0.64$	SLI < AC = SC

Table 2. Bivariate (above the diagonal) and partial (controlling for age) correlations between spoken language measures, morphological spelling and phonological spelling

	Ph.Spell	M.Spell	Vocabulary	Grammar	Non-word rep.	Recalling Sentences
Ph.Spell	1	.823**	.521**	.614**	.709**	.626**
M.Spell	.875**	1	.386**	.482**	.555**	.471**
Vocabulary	.504**	.463**	1	.820**	.613**	.686**
Grammar	.603**	.534**	.813**	1	.571**	.736**
Non-word rep.	.703**	.652**	.577**	.549**	1	.663**
Recalling Sentences	.616**	.568**	.655**	.726**	.626**	1

Note: ***p*<.01. Ph. Spell = phonetic plausibility scale; M.Spell = number of inflectional morphemes spelled correctly; Vocabulary = *BPVS II*; Grammar = *TROG 2*; Non-word rep = *Children's Test of Non-word Repetition*.

Table 3. Categorising spellings of inflectional morphemes in relation to group (*SD*)

	SLI	Age control	Spelling control
Correct (max =18)	10.47(6.13)	16.87 (2.33)	13.73 (3.92)
Phonetic (max = 18)	1.40 (1.06)	0.73 (1.49)	2.73 (2.43)
Omission (max = 18)	2.40 (2.77)	0.27 (0.70)	0.20 (0.41)
Implausible (max = 18)	3.73 (3.51)	.067 (0.26)	1.33 (2.26)