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The Impact of Specific Language Impairment on Adolescents' Written Text

JULIE E. DOCKRELL
Institute of Education, University of London

GEOFF LINDSAY
University of Warwick

VINCENT CONNELLY
Oxford Brookes University

ABSTRACT: *This study examined the writing performance of 58 students with a history of specific language impairment, assessing them at ages 8, 11, 12, 14, and 16 to evaluate longitudinal trajectories of writing performance and relationships with oral language, reading, and handwriting fluency. At age 16, participants continued to experience problems with oral language and literacy: Their writing evidenced short texts, poor sentence structure, and difficulties with ideas and organization. Concurrent measures of vocabulary and spelling were significant factors in explaining writing performance. Handwriting fluency remained a particular difficulty for the current cohort and directly affected writing performance. Path analysis indicated that previous levels of literacy mediated the impact of oral language skills.*

Creating written text is a major challenge for children who experience difficulties with the cognitive processes that underpin writing (Dockrell, in press); their texts are shorter, more error prone, and poorly organized compared to those of typically developing peers of the same age (Hooper, Swartz, Wakely, de Kruif, & Montgomery, 2002; McArthur & Graham, 1987). These difficulties often continue to challenge young people through their school career and beyond (Connelly, Campbell, MacLean, & Barnes, 2006; Riddick, Farmer, & Sterling, 1997). Establishing the ways in which barriers and mediators interact over time to influence the production of written text for specific profiles of learning difficulties is a prerequisite to the development of theory and evidence-based interventions. Using a longitudinal data set, we examined the relationships of language, literacy, and nonverbal ability with the written text production of a cohort of young people with a history of specific language impairment (SLI) at the end of compulsory education in the United Kingdom (age 16). Practitioners, policy makers, and researchers use a range of different terms to describe this population (see Dockrell, Lindsay, Letchford, & Mackie 2006;

see also Tomblin et al., 2003, for *primary language disorder*). Moreover, different terms are used in Europe (*dysphagia*) and North America (SLI in the US, dysphagia in parts of Canada). The population is heterogeneous, with the specific nature of their problems residing with one or more subcomponents of the language system. We use the term *specific language impairment* to reflect the most common usage in the literature.

Children with SLI experience problems with the acquisition and processing of oral language skills. The most commonly used core criterion to identify children with SLI is that their language problems cannot be explained in terms of other cognitive, neurological, or perceptual deficits (Leonard, 1998). Language problems are evident by a protracted rate of language development as well as difficulties with subcomponents of the language system (Leonard). Measurements that tap into children's proficiencies with phonological processing, sentence recall, nonword repetition, and tense marking have all demonstrated high levels of specificity and sensitivity in differentiating children with SLI from their typically developing peers (Conti-Ramsden, Botting, & Faragher, 2001; Ellis Weismer et al., 2000). Although conventionally identified by discrepancy criteria, children with SLI are heterogeneous in their profile of language impairments and in terms of nonverbal ability (Botting, Faragher, Simkin, Knox, & Conti-Ramsden, 2001). Patterns of performance also vary over time (Botting, 2005; Conti-Ramsden & Botting, 1999). For many young people with SLI, difficulties with spoken communication skills persist into adolescence (Beitchman, Wilson, Brownlie, Walters, & Lancee, 1996; Botting et al.; Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998) and adulthood (Clegg, Hollis, Mawhood, & Rutter, 2005; Johnson et al., 1999). Older students continue to experience difficulties with reduced vocabulary levels (Johnson et al.), accurate use of verb morphology (Clahsen, Bartke, & Göllner, 1997), and some syntactic structures (Norbury, Bishop, & Briscoe, 2001).

These linguistic deficits have marked effects on the processing of written text (Bishop & Snowling, 2004), resulting in difficulties in both word reading and comprehension (Catts, Fey, Tomblin, & Zhang, 2002; Stothard et al., 1998). As with linguistic performance there is considerable variability within the population on these measures, only some of which is explained by language competence and cognitive skills (Young et al., 2002). Variations in phonological and nonphonological language skills relate to different patterns of reading behavior (Bishop & Snowling). Phonological processing skills are closely related to reading decoding (Castles & Coltheart, 2004) and spelling (Caravolas, Hulme, & Snowling, 2001), whereas measures of receptive language have been associated with poor reading comprehension (Nation, Clarke, Marshall, & Durand, 2004). Both receptive and expressive vocabulary are related to reading performance (Ouellette, 2006; Tannenbaum, Torgesen, & Wagner, 2006; Wise, Sevcik, Morris, Lovett, & Wolf, 2007).

Specific relationships between oral language competence and the production of written text have been reported both for children with continuing and those with resolved language problems, leading to the hypothesis that written language can be conceptualized as a window into residual language problems (Bishop & Clarkson, 2003; Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004). Phonological processes directly impact children's spelling, a prerequisite to extended text generation (Berninger, Abbott, Whitaker, Sylvester, & Nolen, 1995). Wider oral language comprehension skills have been implicated as important factors in the children's text production (Bishop & Clarkson; Cragg & Nation, 2006; Dockrell, Lindsay, Connelly & Mackie, 2007). Vocabulary appears to provide a building block for written language (see Green et al., 2003). A range of lexical items provides children with the ability to build a text and provide the basic infrastructure of text meaning (see Berninger et al., 1997).

A recent comparative study of adolescents with dyslexia, those with language impairment, and typically developing matched adolescents demonstrated the ways in which different profiles of language skills can impact writing performance (Puranik, Lombardino, & Altman, 2007). Participants with SLI (but not dyslexia) produced fewer words and numbers of ideas than typically developing peers. In contrast, both students with dyslexia and students with language impairment produced more spelling and grammatical errors than their matched peers. Puranik and colleagues argued that the difference between the performance of these two groups was due to the difficulties experienced by the students with language impairment in the nonphonological dimensions of text production.

Difficulties with literacy compromise the developmental trajectories of children with SLI. The combined effect of language and literacy difficulties typically results in reduced educational attainments (Dockrell, Lindsay, Palikara & Cullen, 2007). However, the ways in which language and literacy interact to support writing require further clarification if theoretical models are to address the nature and extent of the children's difficulties and appropriately targeted interventions are to be developed.

Compared to studies examining the reading profiles of children with SLI (Kelso, Fletcher, Lee & Kelso, 2007; McArthur, Hogben, Edwards, Heath, & Mengler, 2000), investigations into their difficulties with writing are relatively recent. The few published studies that have examined the written texts of children with SLI provide a mixed picture of the factors that limit the production of written text. Between the ages of 7 and 11, children with SLI produce a high number of spelling errors (Bishop & Clarkson, 2003)—particularly phonological errors (Mackie & Dockrell, 2004)—and error patterns deviate from those of chronological age but not language-age-matched peers (Mackie & Dockrell). Children with SLI also show an increased level of grammatical errors in the written form (Gillam & Johnston, 1992; Scott & Windsor, 2000; Windsor, Scott, & Street, 2000). However, the most common associated problems are not grammatical difficulties but problems with spelling and punctuation, as well as poorer semantic content (Bishop & Clarkson).

To date, studies of individuals with language impairment point to a delay in patterns of writing development, where the factors that constrain text production are similar to those experienced by younger typically developing children. Over time, for typically developing children, idea generation and the translation of those ideas into written text production become more automatic, allowing time for the cognitively demanding processes of planning and revision. In addition, the relationships between reading and writing change. Studies of the writing skills of students with SLI have failed to examine developmental changes. Important gaps remain in our understanding of the writing profiles of children with SLI and the factors that underpin difficulties in text production. Specifically, evidence examining the writing performance of adolescents with a history of SLI is missing and the ways in which earlier language and literacy skills contribute to the development of text production over time is unexplored. A further major omission, given the motor incoordination difficulties experienced by many children with SLI (Hill, 2004), is the lack of measures of handwriting fluency. Transcription skills uniquely predict compositional fluency throughout the elementary grades (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997) and motor incoordination can impact handwriting fluency (Graham, Struck, Richardson, & Berninger, 2006); students with a history of SLI may be disadvantaged in written text production by transcription skills, their semantic competence, and their literacy levels.

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PURPOSE

The current study aimed to address the ways in which measures of language, literacy, and processing limitations are related to writing, by studying a sample of adolescents with a history of SLI. No longitudinal data about the writing skills of students with SLI at this phase of education have previously been published. We predicted that, similar to other groups of children with learning disabilities, students with a history of SLI would continue to exhibit difficulties in producing written text in late adolescence. Given the processing demands of producing written text, performance would be differentially impaired in relation to oral language and reading. We expected their texts to be short and marred by both spelling and grammatical errors. Some relative growth in writing skills might be possible, given that previous studies have found a relative improvement in the production of written story composition towards the end of elementary school (Fey et al., 2004). This slow growth may continue into the secondary school years. However, we predicted that performance would be influenced both by previous levels of written language and by concurrent language abilities, as well as limitations in transcription skills. In addition, the relationships between oral language and reading (Wise et al., 2007) led us to predict that over time students' writing performance would be mediated by their levels of reading.

To test these predictions, a cohort of adolescents that had been identified with SLI at 8 years 3 months (and followed for the subsequent 8 years) completed a battery of language and literacy tests, cognitive measures, and a handwriting fluency measure at age 16. We assessed writing skill through the analytic scoring scale for the writing measure of the Wechsler Objective Language Dimensions (WOLD; Wechsler, 1996; Rust, 1996) and computed measures of text length given the relationships between text length and quality for elementary school students (Gansle, Noell, VanDerHeyden, Naquin, & Slider, 2002; Graham et al., 1997). We predicted that limited expressive language would reduce text length and thereby reduce the performance of older students with a history of SLI. We used hierarchical regression and path analysis to examine the pattern of relationships among language, literacy, and writing measures both concurrently and over time to produce a model of the factors supporting text production.

METHOD

Participants

Following a survey of educational provision in two local education authorities (LEAs) in the UK, our research team asked professionals (speech and language therapists, educational psychologists, and special educational needs coordinators) to identify children at age 8 who had a discrepancy between their level of functioning in the area of speech and language and that which would be expected given the child's functioning in other areas, and who were also experiencing significant language-based learning needs. This process identified a total of 133 children (Dockrell & Lindsay, 2000), from which we derived a subsample from each LEA ($N = 59$). We excluded children with any additional complicating factors that might preclude the diagnosis of SLI, and included children in two regional special schools for children with SLI in the study ($N = 10$).

The resulting participants ($N = 69$, 17 girls and 52 boys) had been identified as having SLI at a mean age of 8 years 3 months ($SD = 4$ months). All participants had English as their only language and were of white English background. Eleven percent of the total sample was eligible for free school meals, a measure of disadvantage in England (Strand & Lindsay, in press), comparable to the national school average of 14.3%. All participants required special education support to access the curriculum, and 54% had a statement of special educational needs (SEN) under the Education Act for England 1996. The SEN, similar to an individualized education program in the US, specifies the provision that must by law be made to meet the child's unique educational needs. This status is applied to about 3% of students in the UK, over half of whom attend mainstream schools.

Participants were assessed an additional four times as part of a wider longitudinal government-funded study charting the educational and social needs of children with SLI (Dockrell, Lindsay, Palikara, et al., 2007; see Table 1 for mean age at assessment and skills assessed). The longitudinal study also examined the students' production of written text at age 11 (Dockrell, Lindsay, Connelly, et al., 2007), 14, and 16—data reported here.

As Table 2 shows, at the end of formal education the students continued to experience difficulties with oral language and literacy. The continued specificity of their difficulty is evident from the statistically significant differences with nonverbal ability.

We attempted to contact all participants in their final year of compulsory education (age 16). Sixty-two students out of the original 69 agreed to complete formal assessments; 58 agreed to complete the writing task (15 girls and 43 boys).

TABLE 1

Assessment Points and Skills Assessed

Time	*Mean Age* (SD *in months)*	*Educational Phase UK*	*Equivalent Phase US*	*Skills Assessed*
1	8 years 3 months (4)	Year 3 (Key Stage 2)	Elementary school	Language, literacy, nonverbal ability
2	10 years 8 months (4)	Year 6 (Key Stage 2) Last year primary school	Elementary school	Language, literacy, writing, nonverbal ability
3	12 years 1 month (4)	Year 7 (Key Stage 3) Entry to secondary school	Junior high/middle school	Literacy, writing
4	13 years 11 months (5)	Year 9 (Key Stage 3)	Middle school/high school	Language, literacy, writing, nonverbal ability
5	15 years 10 months (4)	Year 11 (Key Stage 4) Final year compulsory education	High school	Language, literacy, writing

Note. A Key Stage is one of the set stages of the national curriculum in the UK.

Of the students who refused to write, 3 completed reading and language measures. Refusers typically achieved lower scores on language and literacy measures, but there were no statistically significant differences between the two groups.

The children who completed writing assessments were being educated in a variety of ways: 35 in mainstream classes, 8 in special units within mainstream schools, and 15 in special schools including residential schools for children with SLI. Over the previous 8 years, a significant proportion of the participants had moved between different types of provision. As was the case at previous points in the study (Dockrell & Lindsay, 2008) there were few differences between participants in different settings on the psychometric measures. Students in specialist settings scored significantly lower on measures of reading comprehension, $F(1, 57) = 6.112$, $p = .02$, $\eta\rho^2 = .10$, formulated sentences, $F(1, 57) = 4.498$, $p = .04$, $\eta\rho^2 = .08$, and nonverbal ability, $F(1, 57) = 4.995$, $p = .03$, $\eta\rho^2 = .08$, but not on any other language (vocabulary, receptive grammar, listening to paragraphs) or literacy (single word reading, fluency or spelling) measures.

MATERIALS

We identified measures to tap oral language skills, literacy, nonverbal ability, and written language, and selected tests that were age and culturally appropriate and standardized with measures of reliability and validity. All measures are commonly used for the identification and assessment of children with SLI in the UK. Measures of reliability and validity are reported for each scale on first mention, and unless otherwise stated information was gained from technical manuals and refers to the overall reliability and validity.

Nonverbal Ability. The British Ability Scales II (BAS II) Matrices subtest (Elliott, Murray, & Pearson, 1997), presents children with a set of patterns where one pattern is incomplete. There is a choice of six responses and children are required to point to the missing piece: reliability, .85; validity with the Wechsler Intelligence Scale for Children (WISC-III; Wechsler, 1991) performance scale, .47.

Receptive Vocabulary. In the British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton, & Burley, 1997), children are shown four line drawings and asked to point to the one that best illustrates a word spoken by the investigator: reliability, .89; validity with the Expressive One-word Vocabulary test (Gardner, 1980), .72.

Grammar. In the Test of Reception of Grammar (TROG; Bishop, 1983), children are shown four pictures and the investigator reads a sentence. The child selects a picture that matches the

TABLE 2

Mean Z Scores and Standard Deviations for Language and Literacy Measures at Ages 14 and 16

Competency Assessed	*Student Age*	*Mean*	SD	*Difference With Nonverbal Ability*
Nonverbal ability (BAS *z* score)	14	–.81	.6	
Receptive vocabulary (BPVS *z* score)	16	–1.23	1.12	$F(1, 56) = 9.03$, $p = .004$, $\eta\rho^2 = .14$;
Formulated sentences (CELF *z* score)	14	–2.4	.35	$F(1, 56) = 174.48$, $p < .0005$, $\eta\rho^2 = .76$
Listening comprehension (CELF *z* score)	16	–1.14	.66	$F(1, 56) = 5.90$, $p = .018$, $\eta\rho^2 = .10$;
Single word reading (BAS *z* score)	16	–1.79	.99	$F(1, 55) = 60.49$, $p < .0005$, $\eta\rho^2 = .53$;
Reading comprehension (WORD z score)	16	–1.59	.73	$F(1, 56) = 60.85$, $p < .0005$, $\eta\rho^2 = .71$
Spelling (BAS z score)	16	–1.69	1.07	$F(1, 53) = 43.70$, $p < .0001$, $\eta\rho^2 = .45$

Note. BAS = British Ability Scales II (Elliott, Murray, & Pearson, 1997), BPVS = British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Burley, 1997), CELF = Clinical Evaluation of Language Fundamentals (Peers, Lloyd, & Foster, 1999), WORD = Wechsler Objective Reading Dimensions (Wechsler, 1993).

sentence structure: reliability, .88; validity with the Clinical Evaluation of Language Fundamentals: Revised UK Edition (CELF-R^{UK}; Peers, Lloyd, & Foster, 1999), .53.

The CELF-R^{UK} (Peers et al., 1999) Formulated Sentences subtest requires a child to produce a sentence in response to an orally presented single word or two-word combination: reliability, .82; validity with other CELF-R^{UK} expressive subscales, .43–.49. The Listening to Paragraphs subtest requires the child to attend to a short paragraph and answer specific questions related to the content: reliability, .74; validity with other receptive scales, .30–.43

Reading Decoding. The BAS II Word Reading scale (Elliott et al., 1997) assesses recognition and oral reading of single words: reliability, .93; validity with Wechsler Objective Reading Dimensions reading scale, .71 (WORD; Wechsler, 1993). The Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999) contains two subtests. The Sight Word Efficiency (SWE) subtest assesses the number of real printed words that can be accurately read within 45 sec, and the Phonetic Decoding Efficiency (PDE) subtest measures the number of pronounceable printed nonwords that can be accurately decoded within 45 sec: interscorer reliability, .99; test-retest reliability, .90 and above; validity, .92–.94 SWE and .89–.91 PWE (Woodcock Reading Mastery Scales-Revised, Woodcock, 1987).

Reading Comprehension. The WORD Reading Comprehension scale (Wechsler, 1993) measures the student's understanding of short written passages of text. With this test, the child reads a passage out loud or silently and then answers comprehension questions posed orally by the examiner. The measure has a split-half reliability for children age 15 to 16 of .82

Spelling. The BAS II Spelling scale (Elliott et al., 1997) provides a number of phonetically regular and irregular words to assess the child's ability to produce correct spellings. Each item is first presented in isolation, then within the context of a sentence, and then again in isolation. The child has to respond by writing the word: reliability, .91; validity with WORD Spelling (Wechsler, 1993), .63.

Written Language. The WOLD Writing Expression test (Wechsler, 1996; Rust, 1996) requires children to write a letter describing their ideal house. Children are allowed 15 min to complete the task. The written output can be scored either holistically or analytically: reliability, .89, correlation with Woodcock-Johnson Psycho-Educational Battery-Revised (Mather & Jaffe, 1996) Dictation = 0.72. The analytic scale comprises six dimensions, each rated on a 4-point scale, which are scored independently of each other: ideas and development; organization, unity and coherence; vocabulary; sentence structure and variety; grammar and usage; and capitalization and punctuation.

Writing Fluency. Our handwriting fluency task (based on Berninger, Mizokawa, & Bragg, 1991) requires students to write out the letters of the alphabet, in lower case, in order, as quickly as possible in 1 min. Letters are only counted towards a total number of letters per minute if the letters are in the correct order and legible. The task has an interrater reliability of $r = 0.97$ (Berninger et al., 1997). It has been incorporated into the Process Assessment of the Learner™ (PAL™) Test Battery (Berninger, 2001), where it has been shown to conform fully with psychometric standards of reliability and validity.

Procedure

Schools, parents, and participants provided informed consent prior to any testing. A qualified educational psychologist assessed each student individually in a quiet room at school over 3 days. The first session involved a familiarization with the assessor and a discussion about the longitudinal study. Participants were allowed to terminate the session or opt out of a test if they wished. All tests were administered using the standard procedures in the manuals. Participants received a certificate of merit for participation in the study.

For the writing measure (WOLD; Wechsler, 1996), assessors noted the time taken to produce the written text was noted in seconds and participants were asked to read back their written texts to prevent penalizing children who were poor spellers; Unclear words were noted on a separate sheet. Two research assistants performed reliability checks for the six dimensions of the analytical scoring of the WOLD. In the case of an interrater disagreement, the scores were further discussed with the research team and informed the final scoring of the texts. Mean interrater reliability for a randomly selected 36 ratings was 80% with a Kappa score of .66. The research assistants counted spelling errors and the total number of words produced, excluding numerals. There was 100% agreement between raters for these measures.

Results

We report data only for children completing the writing measure at age 16 ($N = 58$). To normalize performance on the test we transformed each standard score, the centile or T score, to a z score to provide a common metric for analysis. In this section, we first examine student performance in written text production, both on the total analytic score of the WOLD (Wechsler, 1996) and in terms of words written and errors produced. We then describe the relationships between language and literacy and the total analytic score on the WOLD. To consider further the different relationships between the variables, we present two path analysis models to examine the magnitude and significance of the relationships between literacy, language, and written text production concurrently and over time.

Student Performance in Written Language at 16

As a group, the participants performed poorly on the total analytic scale of the WOLD (Wechsler, 1996) with a mean z score of –2.20 ($SD = 1.14$); this pattern of performance did not vary by gender (girls $M = -2.34$, $SD = .89$; boys $M = -2.15$, $SD = 1.21$; $t = 0.58$, $df = 56$, *ns*) or special and mainstream settings (mainstream $M = -2.00$, $SD = 1.21$; special $M = -2.50$, $SD = .98$; $t = 1.6$ $df = 56$, *ns*). As such, all further analyses treat the participants as one group.

Performance on the written language measure was significantly poorer than the students' nonverbal ability scores ($t = 9.12$, $df = 56$, $p < .0005$, Cohen's $d = 1.31$). We examined the extent to which performance in writing was commensurate with language and literacy assessments through a series of repeated measures ANOVAs. Performance on the written language measure was poorer than performance on the oral language measures, $F(3, 168) = 51.89$, $p < .0005$, $\eta\rho^2 = .48$. Post hoc comparisons, adjusting for multiple comparisons, indicated that performance on the written language measure was significantly poorer than both vocabulary and listening to paragraphs ($p < .0005$), but did not differ significantly from the expressive language measure, recalling sentences. We also considered the literacy measures of spelling, reading decoding, and reading comprehension in relation to writing. There was a significant effect of literacy measure, $F(3, 159) = 8.336$, $p < .0005$, $\eta\rho^2 = .14$. Post hoc comparisons adjusting for multiple comparisons indicated that performance on the written language measure was significantly poorer than spelling ($p = .001$), reading decoding ($p = .005$), and reading comprehension ($p < .0005$). Participants thus experienced significant difficulties in the production of written text; the degree of impairment for writing, as measured by norm-referenced tests, was significantly greater than their difficulties with receptive oral language and other aspects of literacy.

We examined written texts in terms of text length, writing time, and spelling errors. Participants produced short texts; the mean length of texts produced was 86 words (range 12–182). Of the 15 min allocated for the task, participants wrote for an average of 10 min (range 2–15). There were high and statistically significant relationships between text length and writing time ($r = .55$, $p < .0005$) and between text length and the WOLD (Wechsler, 1996) *z* score ($r = .66$, $p < .0005$). On average, participants produced 9 words per minute ($SD = 4.5$). Spelling errors in the text were frequent ($M = 5.5$, $SD = 4.2$; range 0–17) but there were no significant correlations between the numbers of spelling errors and the numbers of words written ($r = –.10$, *ns*) or WOLD total score ($r = .04$, *ns*).

Participants produced a mean rate of 53.75 ($SD = 27.61$) letters per minute for the handwriting fluency measure. The mean number of letters per minute produced was equivalent to that of children between 8 and 9 years old (Grade 3 $M = 47.3$; Grade 4 $M = 63.26$; Graham, Berninger, Weintraub, & Schafer, 1998). Handwriting fluency at 16 years was significantly and positively correlated ($r = .54$, $p = .002$) concurrently with the WOLD reading and spelling *z* scores, and at 14 with the reading, spelling and nonverbal ability *z* scores. Writing fluency was significantly correlated with both the numbers of words written ($r = .54$, $p < .0005$) and WOLD *z* score ($r = .42$, $p < .0005$), but there was no relationship with the numbers of spelling errors produced ($r = .18$, *ns*).

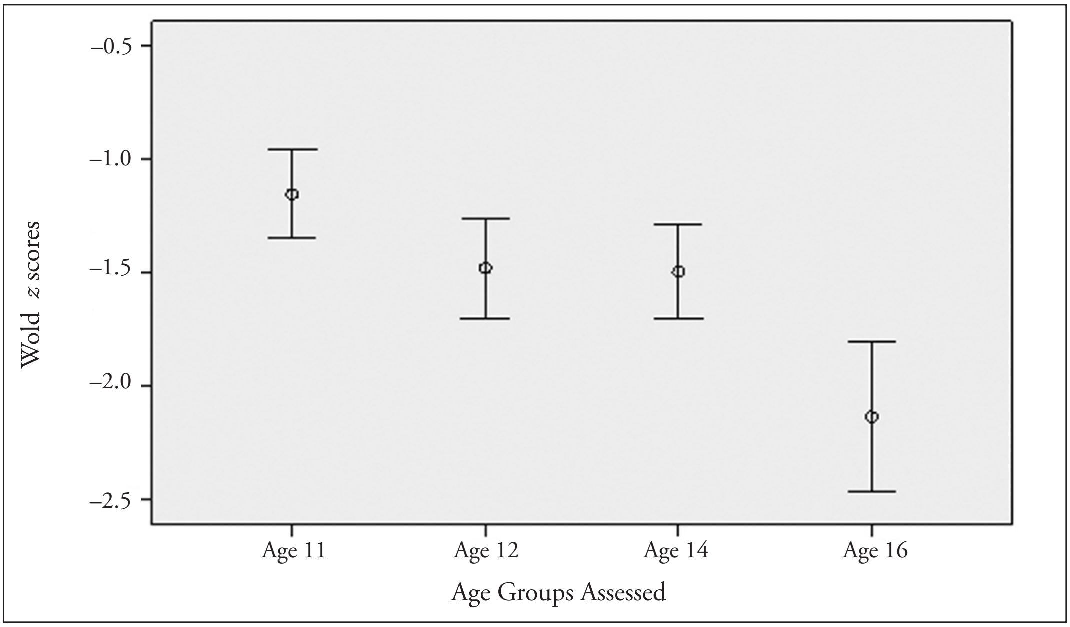
Analytic Scores. To identify specific patterns of difficulties, we examined the analytic scores of WOLD (Wechsler, 1996) subtests. The best performances were on measures of grammar ($M = 1.71$, $SD = .88$) and capitalization ($M = 1.67$, $SD = .85$), although both means were still at the lower end of the scale. The poorest performance was on the measure of sentence structure ($M = 1.45$, $SD = .73$), a score indicative of poor sentence structure containing many errors that inhibit clarity or fluency (Rust, 1996). Measures of ideas and development ($M = 1.5$, $SD = .73$), vocabulary ($M = 1.47$, $SD = .73$), and organization and coherence ($M = 1.57$, $SD = .79$) were also in the low range. A Freidman's Analysis indicated that the scores differed statistically significantly across the subtests ($X^2 = 25.86$, $df = 5$, $p < .0005$). Measures of grammar and capitalization did not differ from each other ($z = .564$, *ns*). There were significant differences between grammar compared with organization and coherence ($z = –2.138$, $p = .03$), ideas and development ($z = –2.558$, $p = .01$), vocabulary ($z = –3.500$, $p < .0005$), and sentence structure ($z = –3.638$, $p < .0005$). Scores for capitalization were significantly better than vocabulary ($z = –2.683$, $p = .007$) and sentence structure ($z = –3.153$, $p = .002$), but did not differ statistically from the measures of ideas and development ($z = –1.908$, *ns*) or organization and coherence ($z = –1.414$, *ns*). The measure of organization and coherence was significantly better than vocabulary ($z = –2.121$, $p = .03$) but did not differ from ideas and development ($z = –1.00$, *ns*) or sentence structure ($z = –1.748$, *ns*). Ideas and development, vocabulary, and sentence structure did not differ significantly from each other ($z = –.577$, *ns*; $z = –.832$, *ns*; $z = –.302$ *ns*).

We computed a factor analysis to investigate further the pattern of subtest relationships. The factor analysis met all the necessary statistical assumptions; we considered only those factors with eigenvalues greater than 1.0. The analysis generated a single factor solution accounting for 83% of the variance. There were large and significant loadings (.87) for all of the WOLD (Wechsler, 1996) subtests.

Writing Trajectories Over Time. Data for the total analytic score of the WOLD (Wechsler,

FIGURE 1

WOLD z Scores Over the Four Age Groups



Note. WOLD = Wechsler Objective Language Dimensions (Wechsler, 1996).

1996) were available for 51 participants at four time points (ages 11, 12, 14, and 16). Four participants had refused to write at 11, and data were missing for 1 student at age 12 and 2 participants at age 14. There was no significant difference between writing scores at age 16 for participants with missing data (M = –2.66) and those with data for all four time points (M = –2.14, t = 1.159, df = 56, *ns*). As Figure 1 shows, there was a significant decrease in relative performance as measured by z scores, $F(3, 150) = 23.888$, $p < .0005$, $p^2 = .32$. Post hoc comparisons of z scores adjusting for multiple comparisons indicated that the participants' writing performance at age 11 was significantly better than their performance at age 12 (p = .002), 14 (p = .002), and 16 ($p < .0005$). Performance at age 12 and age 14 did not differ whereas there was a significant decline in performance again at age 16 ($p < .0005$ for both ages 12 and 14).

Although the mean drop between ages 11 and 16 was one *SD* (M = 1.0), patterns of change varied across participants. A change score was computed where the z score at age 11 was subtracted from the z score at age 16, thereby providing a pattern of change across 5 years, where positive scores would indicate a relative increase in writing performance. Table 3 presents the relationships between literacy, language, and nonverbal abilities and change scores. Using a Bonferroni correction of .004 for multiple correlations there were significant relationships between WOLD change score handwriting fluency (r = .54, $p < .0005$; Wechsler, 1996) and spelling (r = .38, p = .006). There were no significant relationships with nonverbal ability, vocabulary, reading decoding, and reading comprehension. We examined this pattern of relationships using multiple regression. In all cases residuals were normally distributed. The extent of the relationship between gain score and handwriting fluency was confirmed with a multiple regression controlling for nonverbal ability which revealed a significant model, $F(2, 49) = 9.689$, $p < .0005$) accounting for 29% of the variance. Fluency was the only significant predictor in the model (β = .479); the less fluent students were in producing the alphabet the more likely were their writing scores to decrease (in relation to their peers) over time.

TABLE 3

Correlations Between WOLD Change Score, Language, Literacy, Cognitive Measures, and Writing at Time 4 and Time 5

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
WOLD change score											
WOLD *z* score (T5)	.81*										
Nonverbal *z* score (T4)	.23	.42*									
Formulated sentences *z* score (T4)	.23	.37*	.31*								
BPVS *z* score (T5)	.25	.55*	.52*	.54*							
Listening to paragraphs *z* score (T5)	.36	.47*	.25	.40*	.47*						
TROG *z* score (T5)	.20	.31	.26	.31	.41*	.14					
BAS word reading *z* score (T5)	.34	.59*	.51*	.38*	.51*	.19	.34				
TOWRE – word reading efficiency *z* score	.35	.57*	.44*	.41*	.50*	.28	.29	.55*			
Word comprehension *z* score (T5)	.23	.45*	.63*	.43*	.56*	.27	.29	.54*	.62*		
Spelling *z* score (T5)	.38*	.65*	.46*	.18	.30	.08	.32	.75*	.58*	.41*	
Writing fluency *z* score	.54*	.54*	.47*	.40*	.43*	.23	.32	.41*	.57*	.51*	.41*

au: decimal correct in column "2" before 59 and 57? Not on ms.

Note. WOLD = Wechsler Objective Language Dimensions (Wechsler, 1996), BPVS = British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Burley, 1997), TROG = Test of Reception of Grammar (Bishop, 1983), BAS = British Ability Scales II (Elliott, Murray, & Pearson, 1997), TOWRE = Test of Word Reading Efficiency (Torgesen, Wagner, & Rashotte, 1999).
*p = .004 with Bonferonni correction.

RELATIONSHIPS BETWEEN LANGUAGE, LITERACY, AND THE WOLD

There were statistically significant correlations for the WOLD *z* score (Wechsler, 1996) at age 16 and all the predictor variables apart from the TROG (Bishop, 1983). As expected, the literacy measures of spelling, reading decoding, and reading comprehension were significantly related to writing. In addition, the language measures of vocabulary (BPVS; Dunn et al. 1997) and formulated sentences were statistically significantly related and each correlated with reading decoding and comprehension.

We predicted that the most significant influence on students' writing would be previous levels of writing, but that vocabulary and reading levels would account for additional variance (Dockrell, Lindsay, Connelly, et al., 2007). Three sequential multiple regression analyses examined prediction of WOLD writing (Wechsler, 1996) at age 16. In the first analysis, we entered writing at age 14 into the model as the first step to control for previous written language performance. On the second step, we entered vocabulary, resulting in a significant increase in R^2 (significant F Change, $p = .001$); on the third step, single word reading again resulted in a significant increase in R^2 (significant F Change, $p = .005$). The full model R^2 is shown in Table 4 and was significant, $F(3, 57) = 20.624$, $p < .0005$, adj $R^2 = .53$.

TABLE 4

Predicting WOLD Writing at Age 16: The Role of Word Reading Accuracy

Predictor	*R^2 Change*	β	*P*
WOLD *z* score at age 14	.326	.353	.001
Vocabulary *z* score at age 16	.134	.266	.018
Single word reading *z* score at age 16	.074	.322	.005

Note. WOLD = Wechsler Objective Language Dimensions (Wechsler, 1996).

TABLE 5

Predicting WOLD Writing at Age 16: The Role of Word Reading Efficiency

Predictor	*R^2 Change*	*β*	*P*
WOLD *z* score at age 14	.326	.381	.001
Vocabulary *z* score at age 16	.134	.243	.031
Word reading efficiency *z* score at age 16	.081	.333	.003

Note. WOLD = Wechsler Objective Language Dimensions (Wechsler, 1996).

The second sequential multiple regression used word reading efficiency (TOWRE; Torgesen et al., 1999) as the predicting literacy variable. We reasoned that for later literacy, fluency in word reading and phonological decoding were likely to have greater impacts on the production of written text than untimed measures of single word reading. There was no statistically significant difference between the participants' performance on single word reading efficiency and phonemic decoding efficiency (reading efficiency $M = 69$, $SD = 27$; phonemic decoding efficiency $M = 71$, $SD = 30$, $t = -1.871$, $df = 58$, *ns*). As in the previous analysis, writing at age 14 was entered into the model to control for previous written language performance, followed by vocabulary. In this case, entering the TOWRE as the third step resulted in a significant increase in R^2 (significant *F* Change, $p = .003$). The full model R^2 is shown in Table 5 and was significant, $F(3, 57) = 21.624$, $p < .0005$, adj $R^2 = .52$, with all variables having significant effects. Thus, the impact on writing of both reading fluency and single word decoding reading measures was similar.

Both the differential correlations between spelling and the other variables and analyses highlighting the importance of writing fluency indicated that their relative roles in writing performance should be considered. Thus, we employed a third sequential multiple regression analysis to examine the impact of these variables. As in the previous models, WOLD writing (Wechsler, 1996) at age 14 was entered into the model followed by vocabulary and reading. On the fourth step, we added writing fluency but this did not significantly change the model R^2 (*F* Change, $p = .24$). On the fifth and final step, we entered spelling, which resulted in significant increase in R^2 (significant *F* Change, $p = .001$). The full model R^2 was significant, $F(5, 58) = 18.891$, $p < .0005$, adj $R^2 = .61$. As Table 6 shows, reading efficiency and writing fluency did not have a significant partial effect in the full model, but previous WOLD score, vocabulary, and spelling did have significant partial effects.

Path Analyses

The regression analyses clarified the relationships between language, literacy, and writing. We tested two path analysis models in order to examine the relative importance of oral language and literacy on the participants' writing scores. The regression analyses had indicated that large effect sizes were to be predicted and that, with appropriate parameter estimates and tests of alternative models, the

TABLE 6

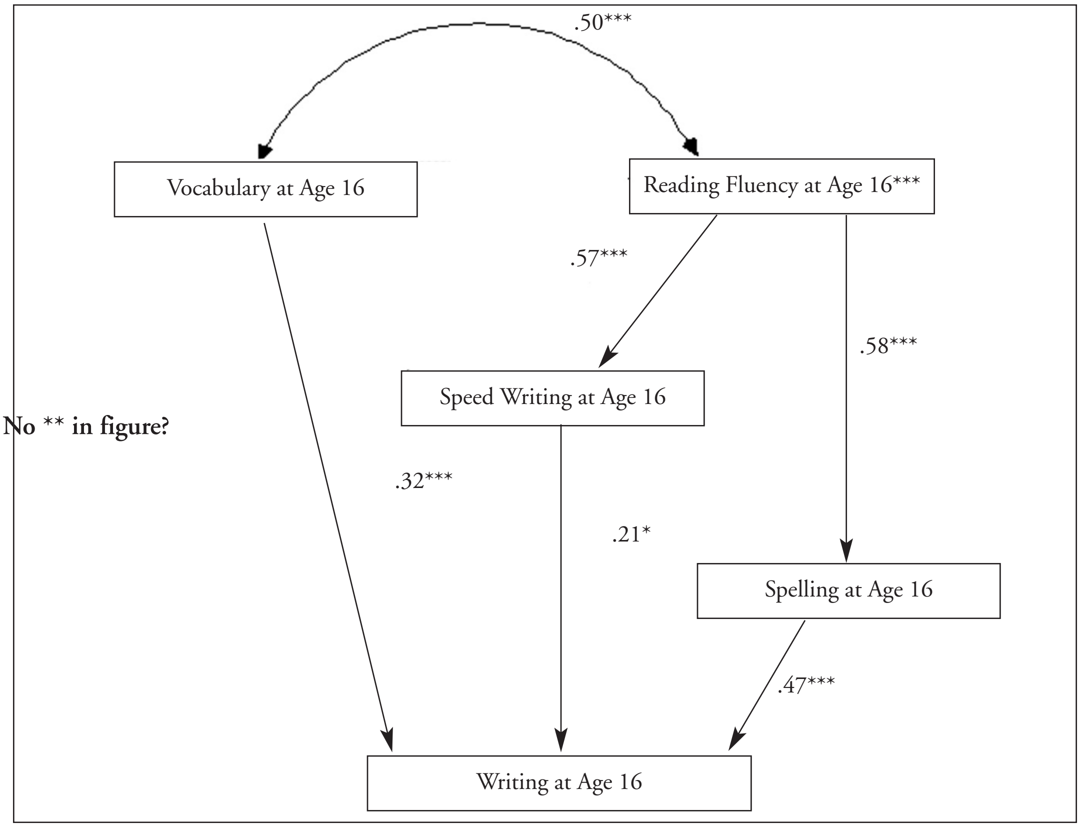
Predicting WOLD Writing at Age 16: The Role of Reading, Writing, and Spelling

Predictor	*R^2 Change*	*β*	*P*
WOLD *z* score at age 14	.335	.264	.01
Vocabulary *z* score at age 16	.114	.232	.03
Word reading efficiency *z* score at age 16	.075	.041	.746
Writing fluency	.024	.154	.167
Spelling *z* score at age 16	.093	.395	.001

Note. WOLD = Wechsler Objective Language Dimensions (Wechsler, 1996).

FIGURE 2

Path Analysis Examining Concurrent Contributions of Literacy and Language to Writing at Age 16



AU: No ** in figure?

***$p < .001$, **$p < .01$, *$p < .05$.

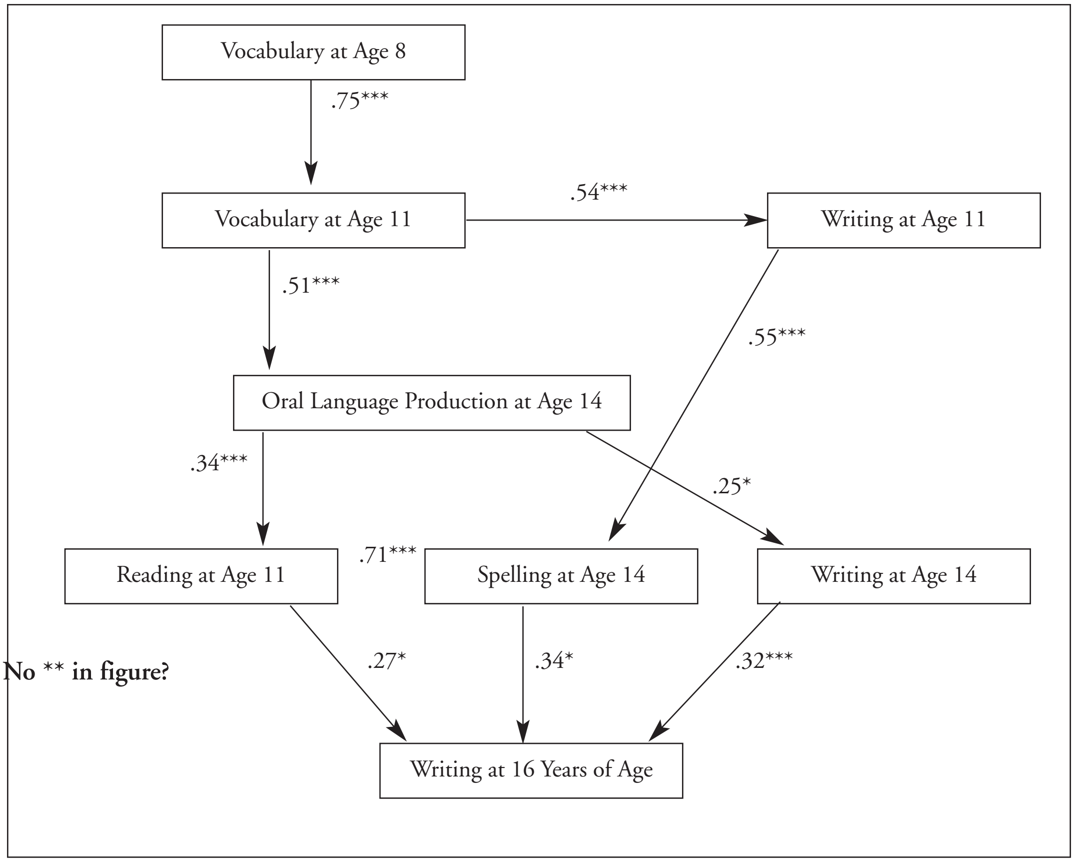
small sample could be used to build an exploratory path model using maximum likelihood estimation (Ullman, 1996). The stronger the correlations, the more power there is to detect an incorrect model, and this would reduce Type 1 errors in the models.

We used Amos 7.0 to test the models. Model 1 examined concurrently the relative contribution of language, literacy, and writing speed at age 16. Model 2 examined the longitudinal effects of language and literacy from age 8 to age 16. A variety of fit indices are available with Amos. The overall fit of the final model was assessed by ^{2} and by root mean square error of approximation (RMSEA). Following Hu and Bentler (1999), who recommend joint criteria to retain a model, we only considered models a good fit if the χ^2 was not significant, RMSEA < .06 and CFI > .96 (RMSEA and CFI being a more sensitive fit index with small sample sizes; Fan, Thompson, & Wang, 1999).

For the concurrent model we predicted that spelling, vocabulary and speed of writing would have direct effects on writing at age 16, with reading revealing an indirect effect at this point through spelling. We also predicted that both vocabulary and reading would be associated. As predicted, the path analysis in Figure 2 indicates a direct relationship between vocabulary and writing ($\beta = .32$), speed of writing ($\beta = .21$) and spelling ($\beta = .47$). Reading fluency revealed an indirect effect on writing through both spelling ($\beta = .58$) and speed of writing ($\beta = .57$). The goodness of fit measures indicated a good fit: $X^2(4) = 3.602$, $p = .46$, RMSEA = .00, *CF1* = 1.000. We also tested models, including nonverbal ability and reading comprehension, to elimi-

FIGURE 3

Path Analysis Examining Predictions of Literacy and Language to Writing at Age 16



AU: No ** in figure?

***$p < .001$, **$p < .01$, *$p < .05$.

nate potentially relevant factors. These models failed to provide a fit with the data.

For the exploratory predictive path analysis, we considered measures assessed at ages 8, 11, and 14 and writing at age 16. We predicted that vocabulary and reading at age 8 would be significant factors in supporting writing at age 11 and that from age 11 writing, itself, would show the strongest relationships with subsequent writing performance. No model including reading at age 8 or reading at age 11 fit the data; however, a longitudinal model including vocabulary at age 8 having an indirect effect on writing provided a good fit. The path analysis in Figure 3 indicates direct effects of reading (β = .27), spelling (β = .34), and writing (β = .32) at age 14 with writing at age 16. Oral language skills had an indirect effect through reading at age 14 (β = .34) and writing at age 14 (β = .25). Vocabulary at age 8 revealed indirect effects on writing through vocabulary at age 11 (β = .75). Moreover, vocabulary at age 11 revealed indirect effects on writing at age 16 through oral language at age 14 (β = .51). Importantly, the indirect effect of writing at age 11 was evident through spelling at age 14 (β = .55) but not, as predicted, writing at age 14 (β = .16). The goodness of fit measures indicated a good fit: X^2 (16) = 11.350, p = .79, RMSEA= .00, *CF1* = 1.000. We also tested models examining alternative directions of effect and models including nonverbal ability and reading comprehension to explore a better fit. These alternative models did not provide a fit with the data.

DISCUSSION

We examined longitudinally the writing skills of a cohort of students with a history of SLI to age 16. We examined measures of language and literacy assessed both longitudinally and concurrently to establish their relative contribution to written text production. The students in this study continued to experience specific difficulties with language and literacy. Production of written text continued to be an area of marked vulnerability, with writing scores being the lowest standardized score of the receptive language and literacy measures. Moreover, during their teenage years the students' writing skills decreased relative to standardized norms. Thus, the current data contrast with data in the elementary years for children with SLI where a relative improvement in the production of written story composition has been noted (Fey et al., 2004). These differences are important to address. The decreases in student performance on written measures may reflect specific language difficulties. For typically developing children, increasing language and literacy skills support later development of writing; for those with continued difficulties these resources are not available. In conjunction it is important to consider the specific support provided to children when developing their written language skills. This decrease in writing skills occurred at the time (age 11) when, in the UK, it is expected that students have mastered the basic skills in reading and writing, have moved towards the analysis of genres, are writing with technical accuracy, and able to organize text into planned and coherent sequences (Department for Children, Schools and Families, n.d.)—a major challenge for the students in this study.

WOLD (Wechsler, 1996) provided the tool for comparing performance on writing dimensions over time. Results on the WOLD subscales at age 16 were consistent with assessments at previous points in development (Dockrell, Lindsay, Connelly, et al., 2007, Mackie, 2007): Performance was reduced across all subscales, but the poorest performance was evident in measures of sentence structure, ideas and development, and vocabulary. The factor analysis of the WOLD subscales provided evidence that at this point in development, the students' written work could be captured by a single dimension. This differs from the patterns at age 11 (Dockrell, Lindsay, Connelly, et al., 2007) and age 14 (Dockrell & Connelly, 2007), where two different dimensions underpinned performance on the WOLD: semantics and rules. This single factor for the WOLD is, however, consistent with data for younger (age 11) typically developing children (Connelly & Dockrell, in preparation, 2008) and suggests that for students with a history of SLI the coordination of idea generation and sentence production and grammar is an extended developmental process.

For typically developing children, increasing language and literacy skills support later development of writing; for those with continued difficulties these resources are not available.

Despite the apparent coordination of the two dimensions, difficulties in relation to form (spelling and handwriting), and content generation still posed major difficulties for the students in our study. Texts produced were short with frequent spelling errors. Previous research has failed to consider writing fluency for students with SLI, and current data indicate that shorter texts are associated with reduced levels of handwriting fluency. Indeed, the cohort's handwriting fluency was equivalent to the average obtained for students some 7 years younger (Graham et al., 1998). This is consistent with slow production of text, as evidenced by words produced per minute. The less fluent students were also more likely to show decreases in their writing standard scores over time.

Regression analyses revealed that at age 16 the significant concurrent predictors of text production were spelling and vocabulary. The importance of vocabulary as a key predictor of text production at this age extends work with younger students which has identified limitations in text generation and reduced levels of word use and lexical diversity (Fey et al., 2004; Scott & Windsor, 2000) and semantic content (Bishop & Clarkson, 2003) as critical limiting factors for children with SLI. The continuity of the importance of vocabulary as a determinant of text quality for this cohort of children (Dockrell, Lindsay, Palikara, et al., 2007) adds further weight to the view that vocabulary provides a building block for written language.

The poor spelling skills of the participants were evident both in their written text productions and when assessing their single word spellings. At age 11, the participants' writing levels were mediated by their reading levels. The point of fracture has moved, and on the surface appears similar to difficulties exhibited by young adults with dyslexia (Connelly et al., 2006), where writing was constrained by transcription skills (in the form of poor spelling and slow handwriting). However, the Connelly et al. population was different from the current cohort in that they could produce compositions that were age appropriate in terms of ideas and development, sentence structure and organization, unity, and coherence scales of the WOLD (Wechsler, 1996)—all areas of weakness for the students described here. As shown by Puranik et al. (2007, with a younger cohort), problems with spelling and transcription combined with wider problems with language led to very poor performance in writing.

Given the relationships between the different variables and the predictions derived from previous studies, we used path analysis to provide estimates of the magnitude and significance of hypothesized causal connections between sets of variables. Our first model explored the potential interactions between concurrent measures. The best-fit model included direct effects of vocabulary, spelling, and writing fluency, with reading fluency (a timed measure of reading decoding) having an indirect effect through spelling and writing fluency. The concurrent model confirms both the effects of semantic factors (as measured by vocabulary) and phonological factors (as measured by spelling), and suggests an independent contribution of writing fluency.

There has been a longstanding concern about the information processing constraints experienced by children with SLI (Ellis Weismer & Hesketh, 1996; Montgomery, 2000), and their reduced performance on tasks requiring quick and accurate performance (Leonard et al., 2007). Measures of speed of writing and reading fluency are both significantly related— either directly or indirectly—to text production. These deficits may reflect reduced performance in both verbal working memory (reading fluency) and processing speed (speed of writing; see Leonard et al.). Yet the highly significant relationship in the current study between the two (.57) suggests that the underlying factor may be the ability to coordinate and efficiently manage different information, and this limits children's text production. This interpretation would also be consistent with the difficulties experienced by children with language impairment in monitoring and editing their written productions (Scott, 1999). As long as translating continues to place heavy cognitive demands on writing, management of planning will be impaired.

In our second model we explored the longitudinal predictors for the participants' writing performance at age 16. This model identified direct effects of reading, spelling, and writing at age 14 on writing at age 16. These data demonstrate the ways in which both phonological and morphological literacy measures come to the fore in the writing performance for these students. As in the regression models, nonphonological factors were also evident and, unlike the literacy measures, their impact was traced back to age 8. Vocabulary appears to provide an indication of the semantic knowledge which supports both writing at age 11 and sentence formulation at age 14. Over time, both reading and writing skills mediate the impact of oral language.

The concurrent and the longitudinal models both provide evidence to support specific student-based factors that impinge on the production of written text, and offer scope for targeted and strategic interventions (Troia, 2006) and interventions which could compensate for text production difficulties (MacArthur, in press). It is unlikely that these factors alone explain the relative decline in writing performance. As the change scores demonstrate, only writing fluency predicted change—and this factor accounted for 29% of the variance. An important question remains about the support in writing that is provided once students enter secondary school, both to maintain current levels of text production and to enhance their capacity to produce texts closer to expected targets. Support for those who struggle at this phase of education in England is "uneven" (Office for Standards in Education, Ofsted, 2007, ¶ 75, page 311), and differentiation of the curriculum often involves simplifying activities (Dockrell & Lindsay, 2007). Government initiatives to improve skills at this stage have not been successful, with less able children being left behind and catch-up classes for those who struggled in primary school failing to bring students up to the expected standard (Ofsted). Typically these interventions focus on word reading and are provided for most students ages 12–14.Thus, given evidence from both the school reports for these students (Dockrell, Lindsay, Palikara, et al., 2007) and the current educational context, it is unlikely that students with SLI are receiving the support they require to develop their writing skills. A lack of appropriate interventions and support resources further disadvantages these struggling writers. This lack of support has been highlighted in other educational systems (see Moni et al., 2007; Troia & Maddox, 2004).

Study Limitations

Investigations of written language are complex and subject to a number of limitations. The current study is limited by the small sample, the use of a single writing measure, and the lack of information on the children's wider information processing skills. Given the purported importance of vocabulary a more detailed examination of the students' competence in this area is needed. It is not clear the extent to which the vocabulary measure is tapping the breadth of the children's knowledge, the depth of their semantic representations, or the efficiency of lexical retrieval. There is increasing evidence that measures of depth and breadth of vocabulary may have differential effects on reading, and we expect similar patterns to be evident in writing (see, e.g., Ouellette, 2006; Tannenbaum et al., 2006). Future work should pay specific attention to the nature of the evidence for interventions provided to support writing, including the skills that underpin performance in writing and the strategies provided for coordination of these skills.

Care also needs to be taken in generalizing performance on our writing task. The decline in writing scores could be explained by a lack of emphasis on this kind of writing in secondary school. Studies of more complex writing tasks demanded by the secondary school system might lead to fewer problems. However, the very poor level of the participants' performance on English exams suggests that this is unlikely to be the case (Dockrell, Lindsay, Palikara, et al., 2007). Although the data suggest widespread failure with writing tasks in relation to peers, the importance of examining writing profiles and predictors of writing performance across genres remains an important avenue of further research.

Educational Implications

The current study highlights the importance of phonological and nonphonological dimensions of oral language as important factors in supporting (or limiting) the production of written text. In addition, we identified writing fluency as a particular problem for these students. Further automating the processes involved in transcription is an important consideratio; a recent UK-based intervention to improve the spelling of subject-specific words by students with dyslexia (Sterling, Ertubey, Brownfield, O'Reilly, & Noyce, 2004) seems a step in the right direction. Other schemes that have been used successfully with other children—those that do not advocate lower-level writing instruction at the expense of higher-level writing skills—could also be potentially adapted for use with students with SLI (see Berninger et al., 1997). We have shown that the writing produced by these students is directly related to literacy level; schemes to improve literacy levels, particularly spelling, should also have a long-term benefit provided they are embedded within interventions that support the coordination of text production and meaning generation.

In addition, there is a need to consider the vocabulary that these students possess to support idea generation. Previously we have argued that the development of semantic skills may be seen as a compensatory mechanism to support the writing instruction for students with SLI (Dockrell, et al., 2007). The data presented here confirm that this is a continuing issue as children become older. Students with poor vocabulary skills will need explicit support with vocabulary to generate ideas; this dimension is particularly important because we identified no changes in the participants' relative vocabulary across their education (Dockrell, Lindsay, Connelly, et al., 2007).

Finally, an important consideration for students who have experienced such a history of failure to write will be motivation. Interventions will need to be developed which both address the major limitations with basic skills and motivate the young people within an empowering educational environment. This remains a major challenge.

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ABOUT THE AUTHORS

JULIE E. DOCKRELL, Professor, Institute of Education, University of London, England; **GEOFF LINDSAY,** Professor and Director, Centre for Educational Development, Appraisal and Research, University of Warwick, Coventry, England; **VINCENT CONNELLY,** Senior lecturer, Department of Psychology, Oxford Brookes University, England.

Address correspondence to Julie E. Dockrell, Institute of Education, University of London, 20 Bedford Way, London WC1H OAL, United Kingdom (e-mail: j.dockrell@ioe.ac.uk).

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