Writing product and process in children with English as an additional language

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Abstract

Children draw on limited cognitive resources to write and these resources are under more demand when writing in English as an additional language (EAL). This study investigated the relationship between writing process measures along with two language measures, phonological awareness and lexical retrieval, and measures of writing product. Thirty-nine EAL children took part in the study and their writing was digitised so that execution speed, burst length, and the pattern of pauses were available for analysis. The results found that lexical retrieval was significantly associated, indirectly through execution speed and burst length, with the number of words, lexical richness, and writing quality. The results are discussed in the context of common underlying proficiency theory and lexical retrieval as part of the translation process of writing.

Keywords: EAL, writing, phonological awareness, RAN

Developing writing proficiency is a long and complex process that places substantial cognitive demands on the writer. For children writing English in their second language this process is particularly challenging as their limited proficiency in the language leads to constraints in their available cognitive capacity. However, as a group of writers less is known about their additional language proficiency and its relationship to writing outcomes.

Writing, which requires processing and storage of information, demands cognitive resources from a limited capacity as the act is carried out (McCutchen, 1996; 2006). These on-line resource demands are planning, translating, transcribing, and reviewing (Hayes & Flower, 1980; Chenoweth & Hayes, 2001). Children typically adopt a knowledge telling strategy where – in order to make best use of capacity limitations (Lambert, Alamargot, Larocque, & Caporossi, 2011; Just & Carpenter, 1992; Kellogg, 2001; McCutchen, 1996) – they focus on translating (McCutchen, 1996). In that they produce output that is linguistically accurate (Fitzgerald & Shanahan, 2000), from recall of relevant information in long term memory (McCutchen, 2000); with minimal consideration for the audience of the text (Bereiter & Scardamalia, 1987; Kellogg, 2008). As writers become more experienced, some of these resource demands become transferred to long term working memory (McCutchen, 2000). When this takes place these resources then occupy less on-line capacity. The result is that it frees the writer to employ higher order on-line processes, such as planning and reviewing, and to store more information in shorter term memory systems, so that these are readily accessible during writing (McCutchen, 2000). Writers who are able to do this generate more developed writing product. Depending on the nature of the task, this includes longer written texts, with more diverse language, and of a higher observed quality. However, a further capacity limitation for many individuals is whether they are writing in their first language (L1) or an additional language.

Writing in an additional language

Writing in an additional language places further resource demands on an individual. Following the framework set out in the context of second language learning (Skehan, 1998; Skehan & Foster, 1999), competition for cognitive resources might take the form of competition for fluency, accuracy, or language complexity. However, it is also likely that children can draw upon skills in their L1 to contribute to their writing in an additional language. The Common Underlying Proficiency theory (Cummins, 1984; 2000) puts forward that knowledge developed in one language can help another language that is being learnt. Few studies have looked at children's writing skills in an additional language context but studies of other literate skills, particularly reading (Furnes & Samuelsson, 2011; Moll et al., 2014), support the idea of a common underlying proficiency and this is likely to apply to other literacy skills as well. In these cross-linguistic studies it has been found that reading in different orthographies requires the acquisition of similar linguistic skills (e.g. Caravolas, Volín, & Hulme, 2005; McBride-Chang & Ho, 2005; Zhang, McBride-Chan, Wagner, & Chan, 2014). Moreover, that individual differences in children's experiences of the language environment itself – for example, time spent in school – is likely to play a role in the proficiency of an additional language. This, therefore, facilitates the ability to translate ideas, considered somewhat language free, into written language.

Resource demands in writing

Resource capacity limitations, and the on-line demands placed on this resource, lead to writers adopting different strategies to meet their goal, for example knowledge telling (Bereiter & Scardamalia, 1987; McCutchen, 1996). Writing under resource limitations are observable in the product of the written text. Bourdin and Fayol (1994) found that differences in the efficiency of translation processes partly explained slower writing in children compared with adults.

Children who have language difficulties, and therefore are less likely to have translation resources available when writing, have a range of poorer writing output compared with typically developing children of the same age (Dockrell & Connelly, 2012; Williams, Larkin & Blaggan, 2013). In a series of experiments with adults, Chenoweth and Hayes (2003) manipulated the demands of writing by using an articulatory suppression paradigm. In doing so they sought to affect the translation process in writing. They found under articulatory suppression writers were then slower and made more errors when producing their text. Moreover, Ransdell, Levy, and Kellogg (2002), using a dual task paradigm, found that asking participants to add working memory load, by having to remember a series of numbers while writing, affected the quality and sentence length of the text produced. Dual task experiments in writing, more generally (Olive, 2004), have shown that where the resources of capacity, for example in the context of working memory, are put under pressure writing product is then affected. Particularly where the secondary task is linguistic it affects the production of writing and translating while visual or spatial dual task conditions often affect planning (Olive, 2004). Where the secondary task, instead of the writing product, has been the focus of the measurement, which allows researchers to investigate whether writing affected verbal, visual and/or spatial processes (for example Olive, Kellogg, & Piolat, 2008). They found even though writing product was consistent across all the conditions, against a baseline without writing, the secondary task performance was poorer for verbal and visual conditions but not for spatial conditions (see also Kellogg, Olive, & Piolat, 2007).

These studies, often of writing product, are important as they have allowed a window into the demands writing places on cognitive resources. However, they rarely account for the on-line writing process itself. Typically, the process of writing is divided into the pauses a writer makes

and periods of writing activity (Kaufer, Hayes, & Flower, 1986). Pauses offer a writer an opportunity to use cognitive resource to translate, without transcribing, along with an opportunity to engage in planning and revising processes (Kaufer et al., 1986; Olive, Alves, & Castro, 2009). These are typically operationalised in recording software (e.g. Eye and Pen 2; Alamargot, Chesnet, Dansac, & Ro, 2006) as durations where the writer has lifted the pen from the digitizer. As such the longer or more frequently a writer pauses, the more that writing has placed higher demands on a limited cognitive capacity to complete the task (Lambert et al., 2011).

Resource demands can also be observed during the writing process. Writers, who have been asked to devote more resources to transcription level process by, for example, writing in an unfamiliar handwriting style demonstrate slower writing, with longer more frequent pauses, compared with writers who have more available cognitive resources (Olive et al., 2009). Periods of writing activity, however, are periods where the production of text is uninterrupted. Adults writing in their L1 typically produce bursts of, on average, seven words (Kaufer et al., 1986; cf. Chenoweth & Hayes, 2001), where these bursts are separated by pauses of two seconds or more (Alves & Limpo, 2015; Chenoweth & Hayes, 2001; Connelly, Dockrell, Walter, & Critten, 2012; Kaufer et al., 1986). For children writing in their first language – Portuguese – older children wrote more words per burst (Alves & Limpo, 2015). Moreover, the words per burst measure reported in the study was associated with the quality of the writing, especially for children in higher school grades. A different method of measuring the writing activity is through execution speed (Sumner, Connelly, & Barnett, 2012), in essence the speed of writing measured without taking into account the pauses made. In Sumner et al. (2012), researchers found that execution speed between children with reading difficulties and typical children was equivalent, whereas

their pause patterns differed. As such, both measures – words per burst and execution speed – will be taken of writing activity.

Language skills involved in writing

When children write in their first language (Babayiğit & Stainthorp, 2010; Babayiğit & Stainthorp, 2011; Williams & Larkin, 2013) research has found that children draw on spelling and phonological awareness skills along with their ability to retrieve lexical information fluently, the latter often measured by rapid automatized naming (RAN; Powell, Stainthorp, Stuart, Garwood, & Quinlan, 2007; Wolf & Bowers, 1999).

Whereas there is less information on the roles that both phonological awareness and lexical retrieval play in writing. For reading, research has shown phonological awareness facilitates a child's access to the linguistic information that makes up a word. Children's phonological awareness is associated with later reading ability (de Jong, Seveke, & van Veen, 2000; de Jong & van der Leij, 1999). Moreover, children with reading difficulties often have difficulties with phonological processing (Mann & Foy, 2007). From these language skills, children employ phonological awareness skills in their spelling attempts. Therefore, as they write words, or make attempts at unfamiliar words, phonological skills play a role (Caravolas & Bruck, 1993; Caravolas, 2004) and accurate representations of phonology then reduces the cognitive demands of spelling, therefore facilitating writing outcomes.

In L1 writing Babayiğit and Stainthorp (2011) found that phoneme awareness – measured as a nonword phoneme deletion task – was not significantly associated with writing fluency nor text quality. It was, however, significantly associated with spelling ability yet spelling itself was not a significant contributor to writing quality in their subsequent structural equation model. However, in Hooper, Roberts, Nelson, Zeisel, and Kasambira Fannin's (2010) study, children

were asked to identify the missing phonemes from words they heard, and this phonological awareness measure was associated with their writing output. Moreover, in Williams and Larkin (2013) their measure of phonological fluency – the ability to produce words beginning with a particular phoneme – was significantly associated with writing outcomes.

If phonological awareness has a role in the accuracy of linguistic information, fluency of lexical retrieval, as measured by RAN is also required for efficient reading (Bowers & Newby-Clark, 2002; Wolf, Bowers, & Biddle, 2000). Typically RAN requires participants to read an array of letters as quickly and as accurately as possible. RAN reduces the emphasis on phonology – by using well-rehearsed lexical items – but draws on resources that access linguistic information quickly (Powell et al., 2007). RAN has been found to contribute to spelling (Savage, Pillay, & Melidona, 2008), writing (Babayiğit & Stainthorp, 2011; Williams & Larkin, 2013), and independently of phonological awareness to reading (Savage et al., 2008; Wolf, Bally, & Morris, 1986). Children with dyslexia often have difficulties with RAN (Denckla & Rudel, 1976; Jones, Branigan, & Kelly, 2009). The implication is that the fluency of lexical retrieval affects the cognitive capacity available to a child when writing. Taken together, both phonological awareness and lexical retrieval, respectively, relate to the accuracy of phonological information and the speed by which lexical information can be accessed. No study to date has investigated the role lexical retrieval might have in writing activity of children with English as an additional language (EAL) but it is predicted that, as with phonological awareness, lexical retrieval fluency will be associated with on-line writing processes.

Spelling accuracy in writing

In addition to translating ideas into language (Chenoweth & Hayes, 2003), transcribing information that is in the cognitive system onto the page requires the ability to spell words

accurately. In Juel's (1986) view of writing it is spelling, along with idea generation that results in writing. Underpinning spelling in children with high proficiency in English is the orthographic information that individuals learn through their engagement with text. English is an opaque orthography (Ellis & Hooper, 2001) and therefore it is necessary to develop considerable knowledge of the spelling rules and the grapheme to phoneme correspondences of words (Caravolas et al., 2005) in order to spell accurately and quickly when writing. Frith's (1985) theory of spelling development puts forward that individuals learning to spell go through an alphabetic stage, between holding a visual representation of the spelling information and a fully orthographic knowledge of word spellings. As children with EAL are still developing their knowledge of the language it is expected that, in an equivalent way to reading (Koda, 1998), phonological awareness will play a role in their spelling product.

Aims

The aim of the study was to investigate the contribution of writing process measures to five writing products, number of words, lexical richness, number of sentences, spelling accuracy, and writing quality, in a group of children with EAL. Moreover, the study sought to take into account measures of two language skills, phonological awareness and lexical retrieval.

Method

Participants

Thirty-nine participants (31 Males and 8 Females) were recruited from a primary and a secondary school in the West Midlands of the United Kingdom. Sixteen participants (12 males and 4 females) were recruited from the primary school, their mean age was 10 years and 3 months (*SD* = 5.2 months). Twenty-three participants (19 males and 4 females) were recruited from the secondary school, with a mean age of 13 years and 4 months (*SD* = 1 years and 5

months). All participants were classified as having EAL by their school, based on school records, and had learnt at least one other language before acquiring English. Although children with EAL were the focus of participant recruitment, in the United Kingdom, around 21% of children in the state education system to have an EAL classification (Department of Education, 2017).

Sixty-seven per cent of children had at least one parent who spoke English at home. Children reported speaking the following languages: Punjabi (28.4%), Italian (9%), Hindi (7.5%), Czech (6%), Slovak (6%), Romanian (4.5%), Latvian (3%), Portuguese (3%), Urdu (3%), a further 15 languages (22.4%) had one report of being spoken. It was not unusual for children to report speaking more than one language aside from English, 15.4% reported speaking three languages, and 41% reported speaking two languages. All participants had a level of English sufficient to be able to understand the study instructions. Although all the children had learnt English as an additional language, ten children (25.6%) reported they were sufficiently proficient to consider English their first language. This group had also spent significantly longer in English education (*mean* = 6.2 years, *SD* = 1.62, *mean* = 2.7 years, *SD* = 2.14, $t(37) = 4.72$, $p < .001$, $d = 1.86$) but were also significantly younger (*mean* = 92.6 months, *SD* = 10.76, *mean* = 144.4 months, *SD* = 23.62, $t(33.77) = -6.66$, $p < .001$, $d = -3.01$). Participants who had language impairments or dyslexia did not take part in the study.

Materials

Children were asked how many years they had attended a school through the medium of English. Furthermore, measures of the child's linguistic ability in English were taken. These linguistic measures were lexical retrieval (RAN), and phonological awareness. In addition, children completed a writing task so that measures of process and production were recorded.

Lexical retrieval (RAN).

Participants were presented with both Form A and Form B of the RAN task from the Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 1999). Each form consisted of an array of letters. Participants read the letters aloud as fast as they could. The time taken, in seconds, for a participant to name aloud the array was recorded in seconds. The sum of the two forms made up the measure of RAN. The Pearson correlation coefficient between Form A and Form B was $r = .83$, $p < .001$.

Phonological awareness.

The phoneme elision measure from the Comprehensive Test of Phonological Processing was used (Wagner et al. 1999). Participants were asked to say the test item's word, once they had repeated the word aloud, they were then asked to repeat the word with a pre-defined phoneme removed. There were 4 practice questions, with feedback, and 20 test questions without feedback. In line with the manual, if a participant made four consecutive errors the researcher ended the task. The internal reliability of the measure was .903 (Cronbach's Alpha).

The writing task.

Children were asked to write, in English, to a prompt from the Wechsler Objective Language Dimensions (Rust, 1996). They were asked to read the prompt and then this was made available throughout the writing task. Children had six minutes to complete the writing task and they wrote on lined paper taped to a digitising tablet for writing (Wacom Intuos PTZ-930), using a pen with an inking nib. The slant of the tablet was adjusted for the individual, depending on their preference. Crossings-out and rewrites were allowed but these were rare. A warm-up task was carried out before the main writing task so that the children would be comfortable with the equipment. In this task, the children were provided with a picture of a town scene and asked to

write down their description of a picture. They were provided with four minutes for this practice task.

Measurements of writing process.

The digitised writing was captured then analysed by Eye and Pen 2 software (Alamargot et al. 2006). Four measures were taken: execution speed, burst length, the number pauses, and the duration of pauses. Execution speed, which was recorded by Eye and Pen 2 when the pen was on the page and in motion, was measured in mean centimetres per second so that the higher the score the faster the children wrote. Bursts were the mean number of words between two second pauses in the writing (Alves & Limpo, 2015; Kaufer et al., 1986). Pauses were any interruption to the flow of handwriting (Olive, 2010) and these instances were where tip of the pen was not in contact with the digitiser tablet for more than 250ms. This duration was informed by Olive et al. (2009) who considered this threshold duration the minimum time likely to be noticed by the writer. The pause duration had a high skew score (1.36); a Log10 transformation was applied and this reduced the amount of skew (0.52).

Measurements of writing quantity.

Four measures were taken of writing quantity. These were the number of words, the lexical richness, the number of sentences, and the proportion of spelling errors. Lexical richness was calculated as Guiraud's measure of richness (Vermeer, 2000), which takes into account the number of words in the text. Both the proportion of spelling errors and the number of sentences had high skew levels (1.36 and 1.71 respectively). Spelling errors were transformed by calculating the square root for each score. However, this was not a sufficient transformation for the number of sentences and a Log10 transformation was applied to this measure. These

transformations resulted in skew scores that were substantively lower (0.08 and 0.82 respectively).

Measurements of writing quality.

Each text was scored using the six dimensions from the Wechsler Objective Language Dimensions (Rust, 1996), Ideas and Development, Organisation Unity and Coherence, Sentence Structure and Variety, Vocabulary, Grammar and Usage, and Capitalisation and Punctuation, by a trained researcher. Each dimension had four criteria, with scores ranging from one to four. Therefore, the lowest possible score was four and the highest was 24. From the texts, 25% were then scored by a second trained rater. The inter-rater reliability (Intra-Class Coefficient) was .81, $p < .001$.

Procedure

Data collection was carried out on a one-to-one basis by a trained researcher. Testing occurred in a separate room to the classroom that was distraction-free but was open and easily accessible to participants. The measures were counterbalanced for each child.

Results

There were five measures of the writing product: the number of words, the lexical-diversity, the number of sentences, the quality of writing, and the proportion of spelling errors. There were two measures of language: the child's lexical retrieval and phonological awareness scores. Moreover, the time a child had studied at an English school, along with their chronological age were recorded. Furthermore, four measures of writing process were collected: the mean execution speed, mean burst length, number pauses, and the mean duration of these pauses. SPSS 24 was used to calculate the descriptive and inferential statistics and the descriptive statistics are summarised in Table 1.

[Insert Table 1 about here]

Pearson correlation analysis (see Table 2) between measures indicated that execution speed, burst length, number of pauses, and pause duration were significantly related to the number of words (execution speed: $r = .381$, $p = .017$, burst length: $r = .422$, $p < .01$, number of pauses: $r = .795$, $p < .001$, pause duration: $r = -.438$, $p = .005$), lexical richness (execution speed: $r = .400$, $p = .012$, burst length: $r = .420$, $p < .01$, number of pauses: $r = .739$, $p < .001$, pause duration: $r = -.421$, $p = .008$), and writing quality (execution speed: $r = .392$, $p = .014$, burst length, $r = .494$, $p < .01$, number of pauses: $r = .605$, $p < .001$, pause duration: $r = -.533$, $p < .001$). The pattern was different for the proportion of spelling errors, where there were no significant associations between this product measure and the process measures (execution speed: $r = 0.098$, $p = .553$, burst length, $r = -.185$, $p = .260$, number of pauses: $r = -.263$, $p = .106$, pause duration: $r = .004$, $p = .981$). For the number of sentences there the associations between execution speed, $r = .247$, $p = .013$, and burst length, $r = .259$, $p = .111$ were non-significant, but there were significant associations for the number of pauses, $r = .675$, $p < .001$, and pause duration, $r = -.332$, $p = .039$. Lexical retrieval was significantly associated with the number of words, $r = -.429$, $p = .006$, lexical richness, $r = -.461$, $p = .003$, number of sentences, $r = -.445$, $p = .004$, and writing quality, $r = -.405$, $p = .011$. For phonological awareness, there was a significant association with the proportion of spelling errors, $r = -.341$, $p = .033$.

[Insert Table 2 about here]

To explore the associations between the product, process, and language measures, forced entry regression models with three steps were carried out with each writing product (number of words, lexical richness, number of sentences, writing quality, and the proportion of spelling errors) as an outcome measure. Since the sample size was small the results should be interpreted

with caution. In the first step, time at an English school and chronological age were added. This recognised the duration of English education reported by children in the Participant section. The second step included the measures of lexical retrieval and phonological awareness. In step three, execution speed, burst length, the number of pauses, and pause duration were added.

Number of words as an outcome measure

The model is summarised in Table 3. The model with step 1 added accounted for a significant amount of the variance, however neither age nor years at an English school were significantly associated with number of words. The model at step 2 was also significant. Lexical retrieval was significantly associated at this step, $\beta = -0.416$, $p < .01$. At step 3, the model continued to be significant. However, at this step, lexical retrieval no longer accounted for significant variance, $\beta = -0.104$, $p = .641$. Instead execution speed, $\beta = 0.239$, $p = .017$, burst length, $\beta = 0.320$, $p = .012$, and the number of pauses, $\beta = 0.239$, $p < .001$, were significant.

[Insert Table 3 about here]

Lexical richness as an outcome measure

No measure was significantly associated with lexical richness in step 1 (see Table 4). However, once lexical retrieval and phonological awareness were added (step 2), lexical retrieval, $\beta = -.447$, $p = .002$, was significantly associated with lexical richness. Adding writing process measures, in step 3, reduced lexical retrieval's contribution so that it was non-significant, $\beta = -.104$, $p = .325$, and then execution speed, $\beta = .247$, $p = .034$, burst length, $\beta = .304$, $p = .037$, and the number of pauses, $\beta = .600$, $p < .01$, were significantly associated with lexical richness.

[Insert Table 4 about here]

Proportion of spelling errors as an outcome measure

The model for the proportion of spelling errors (see Table 5) had only one significant association through steps 1 and 2. This was chronological age (step 1, $\beta = .536$, $p < .01$; step 2, $\beta = .455$, $p = .03$). With the addition of both writing activity and pause measures in step 3, age remained significant, $\beta = .623$, $p = .005$, while phonological awareness, $\beta = -.331$, $p = .023$, burst length, $\beta = -.739$, $p < .001$, and pause duration, $\beta = -.404$, $p = .041$, were also significantly associated with the proportion of spelling errors.

[Insert Table 5 about here]

Number of sentences as an outcome measure

In step 1 neither measure was significantly associated with the number of sentences; in step 2 lexical retrieval was the only significant measure, $\beta = -.456$, $p = .005$. Adding the writing process measures, in step 3 (see Table 6), resulted in the association for lexical retrieval becoming a non-significant association, $\beta = -.194$, $p = .192$, and only the number pauses, $\beta = .600$, $p < .001$, was then significantly associated with the number of sentences.

[Insert Table 6 about here]

Writing quality as an outcome measure

With age and time at an English school in step 1, neither measure was significantly associated with higher quality texts (see Table 7). However, when lexical retrieval and phonological awareness were added, lexical retrieval, $\beta = -.394$, $p = .011$, became significantly associated with writing quality. In step 3, with the process measures added, lexical retrieval was no longer significantly associated, $\beta = -.012$, $p = .921$, with writing quality but both execution speed, $\beta = .298$, $p = .032$, and the number pauses, $\beta = .443$, $p = .01$, were significantly associated with an outcome measure.

[Insert Table 7 about here]

Discussion

This study explored the associations between writing product and process of children writing in EAL. Children writing in an additional language operate under cognitive resource constraints that can be framed in two different ways. The first is in terms of a writing trade-off (Skehan, 1998; Skehan & Foster, 1999) where fluency, accuracy, and complexity each place demands on the writer. The second is that writing in a different, and likely less proficient language, can draw on skills from a child's L1 (Cummins, 2000). There are a number of ways the resource demands of writing can be related to the product. A writer's product might be affected by having fewer words, a less diverse range of words, fewer sentences, lower writing quality, and/or more spelling errors. Moreover, the writing process is also affected. Writing by hand takes place either as pauses – long pen lifts from the page (Olive et al., 2008) – or as periods of writing activity, which can be measured as bursts of words (Kaufer et al., 1986) or the overall writing execution speed (Sumner et al., 2012). Furthermore, less is known about linguistic skills that relate to these process and product measures. Two measures that are known to relate to reading and spelling, and are likely related to writing, are phonological awareness (Caravolas, 2004) and lexical retrieval (Savage et al., 2008), the latter typically measured through RAN (Powell, et al., 2007).

The study found that lexical retrieval, when entered into step 2, was significantly associated with four of the five writing products: number of words, lexical richness, the number of sentences, and writing quality in handwritten text. This was after age and the years a child had attended an English school had been taken into account. For these four product measures, the association with lexical retrieval was no longer significant when the writing process measures

were added to the hierarchical regression in step three. From the Pearson correlations, lexical retrieval was significantly associated with both execution speed and burst length – but neither pause measure – and so an interpretation from the analysis is that lexical retrieval is subsumed under writing activity instead of the pauses a writer makes.

The pattern for phonological awareness was different to that of lexical retrieval. When entered into step 3, phonological awareness of English words contributed significant unique variance to the proportion of spelling errors. This was also found in the Pearson correlation analysis. EAL children with high phonological awareness scores had a significantly lower proportion of spelling errors. Moreover, this is consistent with studies of children writing in their L1 that have found that children draw on phonological representations to provide accurate handwritten words (Babayiğit & Stainthorp, 2011; Hooper et al., 2010; Williams & Larkin, 2013).

For the writing process measures, the four measures had different patterns of association with the measures of writing product. Pause duration, although associated with the number of words, lexical richness, number of sentences, and writing quality when analysed as a bivariate correlation, was not significantly associated with these writing product measures once step one and step two of the hierarchical regression were entered into the model. The number of pauses, however, was associated with these four writing products. The pattern of association was different for the two pause measures when the proportion of spelling errors was used as an outcome measure. For this outcome measure, the number of pauses was not significantly associated but the association was significant for the duration of pauses.

The two measures of writing activity produced different patterns of association with the writing product measures. Execution speed, once age, years at an English school, and language

measures had been taken into account was significantly associated with the number of words, lexical richness, and writing quality. Burst length, however, was significantly associated with the number of words, lexical richness, and the proportion of spelling errors. In the context of EAL children, in comparison to L1 writing (Alves & Limpo, 2015), the findings here suggest that burst length is more associated with writing quantity instead of the quality of the written text.

Overall, the analyses demonstrated a role for lexical retrieval in EAL writing and that this linguistic measure has a role in execution speed and burst length. This finding is consistent with the view that some of the processes that take place during the act of handwriting are related to translating ideas into linguistic information (Chenoweth & Hayes, 2003). This is then consistent with a cascading components model of writing (Lambert et al., 2011), in that execution speed is made up of some translation processes instead of solely transcription and motor processes.

The finding that lexical retrieval is related to writing products is consistent, to some extent, with both Babayiğit and Stainthorp (2010) and Williams and Larkin (2013) whose participants were writing in their L1. In Babayiğit and Stainthorp (2010) lexical retrieval was associated with writing product speed, but not writing quality. The children, however, in their sample were younger than in this study and writing in a transparent orthography. A group closer to the age of the participants in this study were those of Williams and Larkin (2013). In their study, RAN was associated with the number of verbs written as well as the proportion of spelling errors, but not other measures such as number of words and overall writing quality. There is a limit to the comparability between the two studies, but it suggests that, given RAN was not often significantly associated with the majority of writing outcomes in studies of L1 writing, writing in EAL places greater demands on the language translating process of writing (McCutchen, 2000). Overall, the correlation patterns then offer partial support for Skehan's (1998) view of the trade-

off between accuracy, fluency, and complexity in an EAL context. However, in completing their writing output the study also offers evidence to support that children drew on a common underlying proficiency. Although the group were older than Babayiğit and Stainthorp (2010), they were of a comparable age to the typical subgroup in Williams and Larkin (2013). The group in this study wrote a comparable number of words, and to a similar writing quality, to the group in Williams and Larkin (2013).

Finally, time spent at an English school was significantly associated with the number of words, lexical richness, and writing quality, when analysed as a Pearson correlation, and this would be consistent with an expectation that learning experiences in school support writing development. However, the findings from the study also indicated that the association between time spent at an English school and these three outcome measures became non-significant once age had been taken into account. Over and above direct writing instruction, experience of education in English is likely to have an indirect relationship to writing product. Within models of writing, there are several areas where the experience of a school environment is consistent with an indirect relationship. Bereiter and Scardamalia's (1987) model predicts that experience in school helps foster suitable memories that can then be retrieved for writing. These experiences also support the development of discourse and content knowledge that a more experienced writer can draw upon in order to produce more developed texts.

Measuring the process of writing – through pauses, execution speed, and bursts – demonstrated the contribution these make to writing product and one key theme was that fluency of lexical retrieval facilitated the writing process. Writing is often carried out under timed conditions and previous studies have shown phonological fluency plays a role in writing (e.g. Williams & Larkin, 2013), whereas phonological accuracy is more related to spelling accuracy

(Babayiğit & Stainthorp, 2010). Moreover, phonological fluency is related to reading, which is considered part of the reviewing system in writing (Chenoweth & Hayes, 2003). Although reading skills themselves are outside the scope of this paper they also have a fluency element. Exploring reading and phonological fluency, in the context of writing, would be an area of future research.

The children in this study had a wide range of L1 languages. Some of which shared similarities in written form with English, such as Italian and Portuguese, but others, such as Punjabi and Hindi, have writing systems that are different. Moreover, it has been proposed that the greater the similarity in the linguistic systems of the two languages, the greater the degree of positive transfer across languages (Odlin, 1989). Once sufficient learning in one language has taken place it facilitates principles in other languages (Cummins, 2000; Honig et al., 2000). To some extent, there is evidence of this in other literate skills. For example, that similar processes are shared across reading in Chinese and English (McBride-Chang & Ho, 2005; Yan et al., 2012). However, this does place challenges in supporting children where schools have groups of children with mixtures of languages. For example, the means of identifying the L1 languages for individual children and then understanding how to best harness the links between these languages and the primary language of the school. It is not unusual in schools in the United Kingdom, and in other countries, for many languages to be spoken. The findings here underline the importance of supporting educators to personalise the classroom curriculum to help every child meet their potential.

In summary, lexical retrieval was shown to have a significant and indirect relationship to the number of words, lexical richness, number of sentences, and writing quality in writing

product for EAL children. This was associated through the processes of writing. In writers who are learning EAL this demonstrates the role of fluid lexical retrieval in translating ideas into text.

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Table 1. Descriptive statistics for each measure (N = 39)

Measure	Mean	SD	Min	Max
Age	131.10	31.03	79	184
Time at an English school	3.59	2.53	0.10	7
Phonological awareness	12.28	5.31	4	19
Lexical retrieval	33.36	9.53	18	61
Execution speed	2.86	0.88	1.40	5.03
Burst length	6.70	4.01	1.23	15.25
Pause duration	1369.89	594.56	670.64	3274.42
Number of pauses	76.23	34.08	20	148
Number of words	49.26	23.71	9	117
Proportion of spelling errors	0.08	0.08	0	0.36
Lexical richness	8.16	2.52	3.32	14.49
Number of sentences	3.38	2.70	1	13
Writing quality	13.49	3.07	8	19

Note: Measurements are as follows: Age = months; Time at an English school = years; RAN = seconds; Phonological awareness = total correct score; Execution speed = the mean speed of writing in centimetres per second; Burst length = mean number of words per burst; Pause duration = mean duration of pauses; Writing quality = sum of the six WOLD elements (range 4 – 24).

Table 2. Pearson, two tailed, correlations ($N = 39$) for the measures in the study. Correlations with age as a covariate are reported below the diagonal.

	Measure	1	2	3	4	5	6	7	8	9	10	11	12	Age
1.	Time English school	-	0.135	-0.079	0.033	0.295	0.213	-.347*	.393*	.399*	-0.24	0.146	.345*	-.641**
2.	Phon. awareness	-0.068	-	0.031	-.325*	-0.163	-0.087	0.12	-0.067	-0.094	-.341*	0.001	0.006	-0.288
3.	Lexical retrieval	-0.133	0.021	-	-.432**	-.365*	-0.272	0.311	-.429**	-.461**	-0.072	-.445**	-.405*	-0.036
4.	Execution speed	0.302	-0.262	-.441**	-	.389*	0.116	-0.3	.381*	.400*	0.098	0.247	.392*	0.294
5.	Burst Length	.497**	-0.132	-.364*	.370*	-	0.069	-.721**	.422**	.420**	-0.185	0.259	.494**	0.13
6.	Number of pauses	-0.022	-0.213	-0.306	0.248	0.124	-	-0.238	.795**	.739**	-0.263	.675**	.605**	-.357*
7.	Pause duration	-.434**	0.132	0.312	-.321*	-.731**	-0.246	-	-.438**	-.421**	0.004	-.332*	-.533**	0.023
8.	Number of words	0.246	-0.181	-.469**	.533**	.498**	.768**	-.457**	-	.969**	-.360*	.645**	.778**	-.336*
9.	Lexical richness	0.258	-0.21	-.501**	.551**	.495**	.705**	-.438**	.966**	-	-.388*	.582**	.781**	-.331*
10.	Spelling errors	0.091	-0.244	-0.063	-0.047	-0.281	-0.116	-0.008	-0.243	-0.279	-	-.326*	-.360*	.470**
11.	Number of sentences	0.032	-0.057	-.461**	.322*	0.292	.662**	-.334*	.629**	.560**	-0.273	-	.693**	-0.19
12.	Writing quality	0.218	-0.085	-.434**	.521**	.561**	.561**	-.550**	.755**	.759**	-0.266	.679**	-	-0.289

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

Table 3. Multiple regression model with number of words as an outcome measure

Measure and steps	B	SE B	β	
Step 1				
$R^2 = 0.17$, $F(2, 36) = 3.59$*				
Age	-0.108	0.152	-0.142	
Time at an English school	2.831	1.858	0.302	
Step 2				
$\Delta R^2 = 0.19$*, $F(4, 34) = 4.79$**				
Age	-0.196	0.142	-0.257	
Time at an English school	2.028	1.693	0.217	
Phonological awareness	-0.703	0.641	-0.157	
Lexical retrieval	-1.036	0.345	-0.416	**
Step 3				
$\Delta R^2 = 0.47$***, $F(8, 30) = 18.9$***				
Age	-0.114	0.095	-0.149	
Time at an English school	0.519	1.082	0.055	
Phonological awareness	0.299	0.369	0.067	
Lexical retrieval	-0.104	0.222	-0.042	
Execution speed	6.446	2.558	0.239	*
Burst length	1.893	0.704	0.320	*
Number of pauses	0.479	0.062	0.688	***
Pause duration	7.741	15.733	0.056	

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

Table 4. Multiple regression model with lexical richness as an outcome measure

Measure and steps	B	SE B	β	
Step 1				
$R^2 = 0.17$, $F(2, 36) = 3.65$*				
Age	-0.010	0.016	-0.128	
Years at an English school	0.315	0.197	0.317	
Step 2				
$\Delta R^2 = 0.23$**, $F(4, 34) = 5.61$**				
Age	-0.021	0.015	-0.257	
Time at an English school	0.222	0.175	0.223	
Phonological awareness	-0.087	0.066	-0.184	
Lexical retrieval	-0.118	0.036	-0.447	**
Step 3				
$\Delta R^2 = 0.38$***, $F(8, 30) = 12.82$***				
Age	-0.015	0.012	-0.183	
Time at an English school	0.070	0.134	0.070	
Phonological awareness	0.010	0.046	0.020	
Lexical retrieval	-0.028	0.028	-0.104	
Execution speed	0.708	0.318	0.247	*
Burst length	0.191	0.087	0.304	*
Number of pauses	0.044	0.008	0.600	***
Pause duration	1.094	1.954	0.074	

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

Table 5. Multiple regression model with proportion of spelling errors as an outcome measure

Measure and steps	B	SE B	β	
Step 1				
$R^2 = 0.23$, $F(2, 36) = 5.28$**				
Age	0.003	0.001	0.536	**
Years at an English school	0.007	0.013	0.104	
Step 2				
$\Delta R^2 = 0.05$, $F(4, 34) = 3.19$*				
Age	0.002	0.001	0.455	*
Time at an English school	0.005	0.013	0.078	
Phonological awareness	-0.007	0.005	-0.220	
Lexical retrieval	-0.001	0.003	-0.043	
Step 3				
$\Delta R^2 = 0.26$**, $F(8, 30) = 4.35$**				
Age	0.003	0.001	0.623	**
Time at an English school	0.021	0.013	0.316	
Phonological awareness	-0.011	0.004	-0.331	*
Lexical retrieval	-0.005	0.003	-0.281	
Execution speed	-0.025	0.031	-0.130	
Burst length	-0.031	0.008	-0.739	***
Number of pauses	-0.001	0.001	-0.243	
Pause duration	-0.404	0.189	-0.404	*

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

Table 6. Multiple regression model with number of sentences as an outcome measure

Measure and steps	B	SE B	β	
Step 1				
$R^2 = 0.04$, $F(2, 36) = 0.69$				
Age	-0.004	0.005	-0.163	
Years at an English school	0.011	0.056	0.041	
Step 2				
$\Delta R^2 = 0.21$*, $F(4, 34) = 2.74$*				
Age	-0.005	0.004	-0.248	
Time at an English school	-0.011	0.052	-0.043	
Phonological awareness	-0.006	0.020	-0.051	
Lexical retrieval	-0.032	0.011	-0.456	**
Step 3	-0.005	0.004	-0.248	
$\Delta R^2 = 0.32$**, $F(8, 30) = 4.81$**				
Age	-0.001	0.004	-0.065	
Time at an English school	-0.031	0.050	-0.118	
Phonological awareness	0.014	0.017	0.112	
Lexical retrieval	-0.014	0.010	-0.194	
Execution speed	0.063	0.117	0.083	
Burst length	0.022	0.032	0.131	
Number of pauses	0.012	0.003	0.600	***
Pause duration	-0.245	0.721	-0.062	

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

Table 7. Multiple regression model with writing quality as an outcome measure

Measure and steps	B	SE B	β	
Step 1				
$R^2 = 0.13$, $F(2, 36) = 2.62$				
Age	-0.011	0.020	-0.115	
Years at an English school	0.329	0.246	0.271	
Step 2				
$\Delta R^2 = 0.16$*, $F(4, 34) = 3.37$*				
Age	-0.019	0.020	-0.195	
Time at an English school	0.239	0.232	0.197	
Phonological awareness	-0.037	0.088	-0.065	
Lexical retrieval	-0.127	0.047	-0.394	*
Step 3				
$\Delta R^2 = 0.39$***, $F(8, 30) = 7.87$***				
Age	-0.029	0.017	-0.291	
Time at an English school	-0.139	0.195	-0.115	
Phonological awareness	0.084	0.067	0.145	
Lexical retrieval	-0.004	0.040	-0.012	
Execution speed	1.040	0.462	0.298	*
Burst length	0.257	0.127	0.336	
Number of pauses	0.040	0.011	0.443	**
Pause duration	-2.581	2.841	-0.143	

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