The effects of morphological priming on spelling accuracy and the age of acquisition

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ABSTRACT

This study aims to test whether morphological priming aids spelling accuracy; by comparing the scores of four different measures of spelling accuracy from priming and non-priming groups. An opportunity sample of two hundred and seven children aged between five and thirteen years were randomly allocated to either a priming or non-priming group. The priming groups outperformed control groups across all Key Stages in the different measures of spelling accuracy. The benefits of explicitly teaching morphology from the beginning of literacy instruction are discussed.

KEY WORDS:	**SPELLING**	**LITERACY**	**MORPHOLOGY**	**ENGLISH LANGUAGE**	**LANGUAGE AQUISITION**

Introduction

The English national curriculum is to be revised so that children are taught literacy primarily through synthetic phonics. The changes to the Primary National Strategy Framework have transpired following a recent independent review of the teaching of early-years, conducted by former Ofsted inspections director; Jim Rose (Rose, 2006). The fundamental nature of the phonics approach is to teach grapheme (letter)-phoneme (sound) correspondences that highlight the phonological nature of language. Children are taught to isolate a phoneme such as the /h/ in <hat> and associate it to the letter <h>. This process is then repeated for all correspondences in an individual word, which are then blended together to form a recognisable word; /h/a/t/ represents <hat> (Devonshire, Morris & Fluck, 2013).

The English language has been described as “the most irregular language in the world” (Goswami, 2005) due to the deep orthographic nature, where the sound to letter mappings are frequently inconsistent. Orthographies and writing systems vary from culture to culture, providing various alphabetic languages; such as Indo-European languages (e.g. English, Italian), logographic languages such as; Chinese and Japanese Kanji, and phonographic languages such as Japanese Kana (Crystal, 2000).

Within the alphabetic group; Italian, Finnish and Spanish are highly transparent languages allowing a clear, almost one to one correspondence of written and spoken units. Such languages are commonly described as having a clear orthography. Whilst English is an alphabetic language, it varies greatly in complexity in comparison to other languages in its group (Crystal, 2000). English is claimed to have an opaque orthography, as phonological rules can only predict 56% of words. Wyse and Goswami (2008) therefore claim that as transparent languages usually only require children to learn one to one mappings between graphemes and phonemes, literacy acquisition may be easier in those languages.

Researchers have produced a wealth of evidence in support of this view. Substantial differences in reading development were found across 14 European languages (Seymour, Aro and Erskine, 2003). English-speaking children were found to achieve considerably low scores (34% correct word reading), in comparison to the ceiling performance achieved by children who had learnt to read in transparent orthographies such as; Finnish, Spanish, Italian, German, and Greek. Additionally, researchers found that English children take four to five years of formal instruction to be able to read with 90% accuracy, whereas it takes Finnish children approximately ten weeks to match this level of accuracy (Goswami, 2005).

It is important to note the differences in performance of literacy acquisition are not necessarily exclusively influenced by the language itself. Sahlberg (2007) highlighted that whilst Finnish is an extremely transparent language, Finland is also renowned for its exceptional educational system. This poses a possible confound between the nature of the language and the instruction of it.

However, Ellis and Hooper (2001) found strong evidence that suggest fundamental elements of a language do have an impact on the acquisition of literacy skills. A comparison of the literacy acquisition between children in Wales; who either

attended an English speaking school or a Welsh speaking school, revealed that children in the latter school had advanced reading compared to the pupils in the English speaking school. The same method of literacy instruction was used in both schools, with all other confounding variables such as the curriculum, management of the schools, demography and geography carefully controlled. This allowed only the differences in the Welsh (phonologically consistent and a highly transparent orthography) and English language to be compared.

English is a morphophonemic language as it corresponds to morphemes and phonemes. As there are 44 phonemes to 26 letters in the alphabet, the English language if far more regular at the morphemic level as opposed to the phoneme level (Paulesu et al., 2001). English language also preserves etymological information and form rules that often determine how a word is spelled, in addition to the morphological and phonological influences. Etymological influences can be exemplified by the words; conscious, conscience, and science, as they all contain the same etymological root <sci>, requiring a different pronunciation in each word. Conversely, form rules encompass different spelling conventions, such as a <v> is never permitted at the end of a word (Devonshire et al., 2013).

Perhaps given the complex nature of the English language, it is understandable that UK policy makers focus on teaching literacy in sequential stages progressing from the phoneme. However, some researchers fear that this may lead individuals to believe that speech sounds are primarily represented by spelling, which is clearly not the case. Moreover, phonic only instruction makes it difficult for children to generate theories of spelling that exceed phoneme-grapheme mappings. Additionally, individuals treat words that dissent phonic rules as exceptions that must be learnt individually (Pinker, 1994; Venezky, 1970).

The close phoneme-grapheme correspondences of transparent languages enable a teaching method like phonics to be highly efficient. Two different approaches to teaching phonics have emerged; synthetic and analytic. Synthetic phonics work by building words through blending phonemes sequentially, whereas analytic phonics identify each phoneme of a whole word to produce the accompanying sound. Whilst in research literature, there is still a substantial debate concerning the respective value of each method (Wyse & Styles, 2007), the consensus between UK policy makers is that the synthetic phonic approach has an “overwhelming” and “much strengthened” efficacy for language acquisition (Rose, 2006 p.20).

Whilst it is clearly logical to teach phonics for literacy skills in transparent languages, it should be stressed that the English language is not transparent. This suggests that phonics may not be the optimal tool for teaching literacy in the UK. However, approaches to teaching English that amalgamate structure and etymology have been overlooked. This disregard may be due to a lack of research that examines the ability of children’s non-phonics-based approaches to obtain literacy skills (Devonshire et al., 2013), and the wealth of research of stage models (Frith, 1985; Marsh, Friedman, Welch & Desberg, 1980; Treiman, 1993).

Many researchers in the UK maintain that spelling acquisition corresponds with a developmental (stage) model; which is reflective in the current teaching practices in the UK (Frith, 1985; Gentry, 2005). Generally, stage models propose that children

pass through a specific sequence of steps in literacy acquisition. Initially children experience a ‘logographic stage’; identifying marks on a page represent letters and words, leading to an ‘alphabetic stage’; the mapping of phonemes and graphemes (phonics). This is followed by the final ‘orthographic stage’; in which children learn to incorporate morphology (Frith, 1985; Larkin & Snowling, 2008).

Nunes and Bryant (2004) noted that many researchers use Piaget’s (1970) theory of intellectual development to support their argument that children learn to read and spell through stages. Piaget (1970) proposed that a child begins to learn with an insufficient schema, to which all ‘ex priori’ knowledge is applied to (e.g. phoneme-grapheme mapping rules). As a child experiences exceptions to these rules, a continual adjustment of their schema leads to eventually supplementing the original way of thinking (e.g. understanding that phoneme-grapheme mappings are not consistent). This consequently leads to a development of a more erudite theory (e.g. incorporating morphology and etymology when spelling words that cannot be deduced by phonology).

Nunes, Bryant and Bindman (1997) demonstrate this principle in their argument that children do not have an awareness of the role of morphemes, and especially fail to notice the connection between suffix morphemes and spelling. Children’s spellings of the final /t/ and /d/ in regular and irregular past tense verbs and non-verbs were tracked between the ages of six, seven and eight, revealing distinctive developmental stages of spelling. During the preliminary stage, children’s spellings were unprincipled; failing to accurately reflect phonemes or morphemes. In the second stage, children were able to symbolize word endings, exclusively in a phonetic manner. In the third stage, children were able to use the <ed> suffix, but in correct (verbs; regular past tense) and incorrect (verbs and non-verbs; irregular past tense) places. In the final stage, children went on to identify the correct places for the <ed> suffix, restricting it solely to regular verbs. Nunes et. al (1997) claimed that this sequence suggests that children take time to fully appreciate the role of morphemes in spelling.

Whilst it is likely that literacy development is strongly influenced by a child’s stage of intellectual development, it cannot be assumed that spelling acquisition must accord to a linear model with separate stages. Piaget’s (1970) theory of intellectual development implies that children have a predetermined progression route. However, some of Piaget’s most influential work demonstrates that interaction with the environment is fundamental in processes of development. Whilst cognitive ability and a prerequisite to comprehend an orthographical system must develop within an individual, literacy rules are explicit, conformist and culturally distinct. Therefore spelling acquisition does not follow an innate developmental path, but requires specific instruction. Moreover, instruction clearly has a substantial effect because the literacy skills children are shown to use correspond directly with the method they have been taught (Harris, 1999).

Read (1986) explored mistakes young children make when spelling multi-morphemic words to assess their appreciation of the role morphemes play. Children were observed to spell the endings of past-tense verbs phonetically (e.g. halp/t/; <helped>, col/d/; <called> and start/i/d; <started>). Moreover, whilst children correctly spelled most [z] plurals for <s>, they also spelled non-plural words ending

in /z/ with <s> (e.g. si/s/e for <size>). Read claimed that children were only able to spell the plural morpheme correctly because <s> is the most common spelling for /z/. Additionally, Treiman (1993) found that children generate similar writing patterns to those found by Read (1986), suggesting that young writers are not aware of the connections between spelling and morphemes.

However, Harris (1999) recognised the methods in which children are taught can influence the way in which children are perceived to learn. This implies that if children are initially only taught phonics, a researcher will find that those children will learn by the alphabetic principle first. This circular research makes it challenging for alternative teaching methods to be trialled and assessed, explaining why there is currently such significant emphasis placed on the teaching of phonics.

However, evidence has transpired that suggests children do acquire some specific knowledge of morphology in writing. Some morphemic knowledge must be gained by teacher instruction from lists of words that share the same prefixes or suffixes (Nunes & Bryant 2006), and it is possible that other knowledge can also be gained from experiences of reading (Devonshire & Fluck, 2010).

Previous research has evidenced that children can generate theories of written language prior to receiving formal teaching. Byrne (1998) found that children hypothesise the morpheme, rather than the phoneme, is the basic level of representation in the written English language. There is also evidence that US kindergarteners were more likely to judge that double letters were not allowed at the beginning of words, than to judge that they were allowed at the middle or end of words (Treiman and Cassar, 1997). This research calls into question the age of literacy acquisition. Given children's inclination to formulate theories (Piaget, 1970), and their implicit awareness of aspects of their writing system, it may be beneficial to explicitly instruct the multiple levels of representation to early learners (Devonshire, Morris & Fluck, 2013). This evidence conflicts with current UK policy that children's path of literacy acquisition generally begins after five years of age, and should primarily focus on phonics (Rose, 2006).

It is also possible that children are able to work out certain links between morphemes and spellings by themselves. Research has demonstrated that many young readers focus to some extent on the morphology within their spelling and reading far before instruction (Byrne, 1996; Treiman & Cassar; 1996, Treiman, Cassar & Zukowski, 1994). If children are able to infer morphological spelling rules for themselves, this acquisition should be nurtured by fine-tuning of strategy use, and explicit teaching of morphology, as opposed to diluting optimal instruction for the traditional phonics approach.

Previous research has explored the use of priming paradigms; an implicit memory effect in which exposure to a stimulus influences a response to a later stimulus (Kolb & Whishaw, 2005), to examine literacy acquisition. Whilst priming can occur between conceptual, semantic or perceptual stimulus, priming has proven to be most effective when stimuli is presented in the same modality (e.g. verbal priming works best with verbal cues) (Zurif , Swinney, Prather, Solomon & Bushell, 1993; Swinney, Zurif, Prather & Love, 1993). Drews (1996) argued that recognition studies have evidenced that the responses to a target word (e.g. "counted") can be facilitated

when it is preceded by a morphologically related prime word (e.g. “counting”). This morphological priming can occur even when primes and targets are separated by a number of intervening items.

Priming paradigms are particularly useful for examining morphological relationships between words, and the impact that they have on mental processing (Drews, 1996; Longtin, Segui, & Hallé, 2003). Rastle, Davis and New (2004) demonstrated the positive influence morphological priming has on spelling accuracy. Their research showed that when presented with the visual morphological priming stimulus, participants decomposed complex words on the basis of their morpho-orthographic properties. These findings demonstrate that the morphological priming acted as a tool for spelling, consequently aiding spelling accuracy.

The present study uses an audio-visual priming paradigm in order to access whether morphological priming affects spelling accuracy. Additionally, a morphological awareness task emulated from Nunes and Bryant (2006) was employed in order to assess pre-existing morphological awareness. The use of this test would also allow us to examine whether the results of spelling accuracy measures were owing to the morphological priming paradigm or pre-existing knowledge. Due to the morphological link made with the prime (the base word) it was hypothesised that children in the morphological priming groups were likely to spell a larger amount of correct words in comparison to the non-priming groups, regardless of Key Stage. Due to the stage model theory reflected in current teaching practices (the late incorporation of morphology and etymology in spelling instruction), it was also hypothesised that morphological priming would have a positive effect of differing magnitudes on spelling accuracy for each Key Stage. Additionally, it was hypothesised that all measures of spelling accuracy would increase incrementally with age.

Method

Design

A 2 x 3 independent groups factorial design was employed. The factors were a priming condition or non-priming group and Key Stage (levels 1, 2 and 3), explored across four different measures of spelling accuracy used as dependent variables. As a function of the school, year groups were equally split through random allocation into two separate classes, enabling one class to be allocated the priming group and the other, the control. This assisted in ensuring that there was no confounding of ability or allocation to condition.

Participants

An opportunity sample of 207 (111 males, and 96 female) children who attended a private preparatory school in the South East of England participated in this study. The school was selected by expediency, as they were able to accommodate the research criteria. The school contained mixed ability children, with English as their first language. The National Curriculum is organised into four partitions of Years called 'Key Stages' (KS), and so we have applied these established divisions into the study. This enabled justification for a variance of difficulty across the different spelling tests. Participant characteristics can be seen in Table 1.

Table 1
Participant Characteristics (PRI = priming condition; NPRI = non priming condition)

Key Stage	Year	N	PRI	NPRI	Age (years) *M : SD*	Gender (M : F)
KS1	1	22	12	9	5.77 : 0.43	13 : 9
	2	18	9	9	6.83 : 0.38	8 : 10
KS2	3	28	14	14	7.82 : 0.39	13 : 15
	4	25	13	12	8.84 : 0.37	15 : 10
	5	25	12	13	9.80 : 0.41	12 : 13
	6	34	17	17	10.9 : 0.44	22 : 12
KS3	7	27	14	13	11.9 : 0.32	13 : 14
	8	28	14	14	12.8 : 0.39	15 : 13

Materials

Two different types of spelling tests were constructed; a pseudo spelling test and real-word spelling test. The real-word spelling test was provided with either a priming

response sheet, or a non-priming response sheet; dependent on the condition of the receiver.

1. **The pseudo word spelling test (morphological awareness task):**

This spelling test either contained 10 (KS1), 15 (KS2) or 20 (KS3) pseudo words. Each item consisted of a sentence contextualising an individual word; either a pseudo-noun or pseudo-verb. As all the pseudo words were nonsense, and thus unfamiliar to the children, word-specific knowledge would not have aided the spelling of any of these words. Therefore, the task was a direct test of an individual's knowledge of connections between morphemes and spelling. These tests were based on the 'morphological awareness task' used in Nunes and Bryant (2006). (See Appendix 1, 7 and 13).

Response Sheet: A basic 10 (KS1), 15 (KS2) or 20 (KS3) item response form was used for the participants to right down their answers. (See Appendix 2, 8 and 14).

Coding*:* Each answer in the pseudo spelling test, was given a morphological awareness score (TCFLS) provided the spelling of the inflected/derived suffix was correct. This enabled children who may have spelt the base incorrectly to still be awarded for the correct spelling of the suffix. (See Appendix 19).

2. **The real-word spelling test:**

This spelling test either contained 10 (KS1), 20 (KS2) or 20 (KS3) real words. For the priming condition; a sentence contextualising the base of the word was read aloud, followed by a sentence contextualising the individual word, thus providing a verbal prime. (See Appendix 3, 9 and 15). However, the non-priming condition, each item consisted of a sentence contextualising an individual word. (See Appendix 5, 11 and 17). These tests were based on National Literacy Strategy resources (TES, 2010).

Response Sheet: A basic 10 (KS1), 20 (KS2) or 20 (KS3) item response form was used for the participants to right down their answers. For the priming condition; the sentence contextualising the base of the word was written, followed by the sentence contextualising the individual word with a space to write their answer, thus providing a visual prime (See Appendix 4, 10 and 16). However, for the non-priming condition, the sentence contextualising the individual word was written, with space to write their answer. (See Appendix 6, 12 and 18).

Coding: Each answer in the real-word spelling test was given a separate morpheme (TMS), base (TBS), suffix (TSS) and complete word (TCWS) score. This enabled the different components of the word to be measured separately.

Procedure

The study took place within the school, in the summer term of the academic year. The participants were seated in their usual classrooms, and provided a brief explanation of the spelling tests by their teacher, whilst the experimenter observed. The children were given a pseudo spelling test, shortly followed by a real-word spelling test instructed by their class teacher. On completion, the children were thoroughly debriefed, provided with more information about the aims of the study, informed of how they could obtain information of final results, and reminded of their right to withdraw.

Results

The main aim of this study was to see whether morphological priming had an effect on the accuracy of children's spelling, in addition to assessing the age and extent of their morphological awareness. Spelling accuracy was assessed using four different measures; Total Morpheme Score (TMS), Total Base Score (TBS), Total Suffix Score (TSS) and Total Correct Word Score (TCWS). The results begin with an exploration of the relationship between morphological priming and the spelling accuracy. The results are then organised according to the Key Stages of the children.

General Spelling Measures

An independent groups MANOVA was conducted on the four measures of spelling accuracy (TMS, TBS, TSS, TCWS) comparing the data from the primed condition and the non-primed condition. A significant difference was observed between the two groups, Wilks' $\lambda = .770$, $F(4,202) = 15.3$, $p = .001$, $\eta_p^2 = .023$. As the MANOVA was significant, separate univariate ANOVAs were justified on the individual dependent variables. However, because the scores for each Key Stage had a different possible total score; it made sense to conduct the analyses on each individual Key Stage separately. A further variable (year) was added to the univariate ANOVAs. This was included as there are different age groups within each Key Stage and we wished to examine the efficacy of the treatment across the age group within each Key Stage.

Key Stage 1

A 2 x 2 (year x condition) factorial ANOVA for independent groups was used to test for differences in four spelling accuracy measures (TMS, TBS, TSS, TCWS). A significant main effect of year was found, with all spelling accuracy measures being higher in the older year. This indicates that the increase in age of participants was associated with increase in spelling accuracy. (See Table 2).

Table 2
Main effect of Year on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 1

Test	Y1 *M* [*SD*]	Y2 *M* [*SD*]	F	p	η_p^2
TMS	6.92 [4.97]	13.50 [4.74]	21.87	**=.001**	.378
TBS	3.84 [3.24]	6.06 [2.29]	9.12	**=.005**	.202
TSS	3.08 [2.17]	7.44 [2.87]	31.26	**=.001**	.465
TCWS	1.71 [2.24]	5.22 [2.71]	23.37	**=.001**	.394

A significant main effect was also observed for condition, with three of the spelling accuracy measures (TMS, TBS and TCWS) obtaining higher scores in the priming condition in comparison to the non-priming condition. This indicates that overall, morphological priming increased the spelling accuracy of base words, morphemes, and complete words. (See Table 3).

Table 3
Main effect of Condition on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 1

Test	PRI *M*# [*SD*]	NPRI *M* [*SD*]	F	p	η_p^2
TMS	12.08 [5.45]	8.33 [5.63]	7.10	**=.011**	.165
TBS	6.43 [2.71]	3.47 [2.50]	16.34	**=.001**	.312
TSS	5.65 [3.23]	4.87 [3.31]	1.01	=.321	.027
TCWS	4.46 [3.13]	2.47 [2.52]	7.46	**=.010**	.172

In all tables PRI = priming condition and NPRI = non priming condition.

A significant interaction effect was only found for TBS (not the other measures) between year and condition. As the means indicate (see Table 4.) that in the morphological priming condition there was almost no difference in performance between the two years but in the non-priming condition performance in the younger year was much worse. Simple main effects analysis confirmed this interpretation as there was no significant difference between the years in the priming condition (p = .498) but there was a significant difference in the non- priming condition (p = .001).

Table 4
Interaction effects of Year and Condition on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 1

Test	PRI *M* (Y1[*SD*], Y2 [*SD*])	NPRI M (Y1[*SD*], Y2 [*SD*])	F	p	η_p^2
TMS	9.83[5.10], 14.33 [5.05]	4.00[2.31], 12.67 [4.56]	2.19	=.148	.057
TBS	6.08[3.0], 6.78 [2.39]	1.60[1.17], 5.33 [2.06]	4.30	**=.045**	.107
TSS	3.75[2.56], 7.56 [2.79]	2.40 [1.35], 7.33 [2.87]	.521	=.475	.014
TCWS	2.92[2.54], 6.00 [3.08]	.500, [.53] 4.44 [2.19]	.351	=.557	.010

Key Stage 2

A 4 x 2 (year x condition) factorial ANOVA for independent groups was used to test for differences in four spelling accuracy measures (TMS, TBS, TSS, TCWS). A significant main effect of year was found, with all spelling accuracy measures increasing incrementally with year. This indicates that the increase in age of participants was associated with increase in spelling accuracy (See Table 5).

Table 5
Main effect of Year on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 2

Test	Y3 *M* [*SD*]	Y4 *M* [*SD*]	Y5 *M* [*SD*]	Y6*M* [*SD*]	F	p	η_p^2
TMS	21.46a [8.28]	27.21 [8.83]	30.92b [7.37]	32.82b [7.75]	11.99	**=.001**	.257
TBS	9.36a [5.66]	13.36c [5.27]	14.76b [4.93]	15.94bd [4.76]	9.98	**=.001**	.224
TSS	12.14a [3.24]	13.80c [4.33]	16.16b [2.81]	16.88bd [3.18]	12.18	**=.001**	.260
TCWS	6.64a [4.68]	10.36c [6.22]	12.80b [5.01]	14.68bd [5.63]	13.25	**=.001**	.277

Means with letters next to them that are different indicate there is a significant difference ($p < .05$) between those means

A significant main effect was also observed for condition for only one spelling accuracy measure (TBS) obtaining higher scores in the priming condition, in

comparison to the non- priming condition. This indicates that overall, morphological priming increased the spelling accuracy of base words. (See Table 6).

Table 6
Main effect of Condition on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 2

Test	PRI *M* [*SD*]	NPRI *M* [*SD*]	F	p	η_p^2
TMS	29.59 [9.20]	27.00 [8.92]	2.13	=.148	.020
TBS	14.89 [5.49]	12.03 [5.56]	8.02	**=.006**	.072
TSS	14.71 [4.25]	15.76 [3.65]	.507	=.478	.005
TCWS	12.16 [6.51]	10.41 [5.77]	2.01	=.159	0.19

A significant interaction effect was found between year and condition on two of the spelling accuracy measures (TSS and TCWS). As can be seen in Table 6 the interaction for the TSS variable is the result of the fact that in the primed condition there is a linear increase in performance as a function of time, but in the non-primed condition performance declines between year 5 and 6. Simple main effects analysis only leant partial support to this analysis as the differences between years 5 and 6 in both conditions were not significant ($p > .05$). The shape of the interaction was similar for TCWS, but again simple main effects analysis revealed that the increase in performance from year 5 to year 6 was non-significant. The decrease in performance from 5 to 6 in the non-priming condition was also non-significant.

Table 7
Interaction effects of Year and Condition on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 2

Test	PRI *M* (Y3[*SD*], Y4[*SD*], Y5[*SD*], Y6 [*SD*])	NPRI *M* (Y3[*SD*], Y4[*SD*], Y5[*SD*], Y6[*SD*])	F	p	η_p^2
TMS	23.14 [9.68], 25.92 [8.62], 31.00 [8.14], 36.71 [3.31]	19.79[6.54], 28.50 [9.23], 30.85 [6.93], 28.94 [8.99]	2.37	=.075	.064
TBS	11.14 [6.57], 13.62 [4.91], 15.33 [5.31], 18.65 [1.50]	7.57 [4.07], 13.62 [4.91], 14.23 [5.31], 13.24 [1.50]	1.54	=.208	.043
TSS	12.14 [3.72], 12.31 [4.63], 15.67 [3.28], 18.00 [2.21]	12.14 [2.83], 15.42 [3.48], 16.62 [2.72], 15.77 [3.65]	3.16	**=.028**	.084
TCWS	7.64 [5.65], 9.31 [6.14], 12.67 [5.30], 17.71 [13.82]	5.64 [3.39], 11.50 [6.37], 12.92 [4.94], 11.65 [5.60]	3.47	**=.019**	.091

Key Stage 3

A 2 x 2 (year x condition) factorial ANOVA for independent groups was used to test for differences in four spelling accuracy measures (TMS, TBS, TSS, TCWS). No significant main effect of year was found, with spelling accuracy measures revealing similar results between years. This indicates that the increase in age of participants did not have a significant effect on spelling accuracy. (See Table 8).

Table 8
Main effect of Year on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 3

Test	Y7 *M* [*SD*]	Y8 *M* [*SD*]	F	p	η_p^2
TMS	31.91 [7.79]	34.29 [5.31]	2.36	=.131	.044
TBS	15.21 [5.09]	16.36 [3.21]	1.60	=.211	.030
TSS	16.70 [3.29]	17.93 [2.90]	2.26	=.139	.042
TCWS	13.44 [5.13]	14.93 [4.23]	1.92	=.172	.036

A significant main effect was observed for condition, with all spelling accuracy measures obtaining higher results by children in the priming condition, in comparison to children in condition two. This indicates that overall, morphological priming increased the spelling accuracy across all measures. (See Table 9).

Table 9
Main effect of Condition on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 3

Test	PRI *M* [*SD*]	NRI *M* [*SD*]	F	p	η_p^2
TMS	36.39 [3.86]	29.80 [7.40]	18.14	**=.001**	.262
TBS	18.32 [1.68]	13.26 [4.58]	31.45	**=.001**	.381
TSS	18.07 [2.82]	16.55 [3.30]	3.43	**=.070**	.063
TCWS	16.68 [3.24]	11.69 [4.70]	21.59	**=.001**	.297

No significant interaction effect was found between year and condition on the spelling accuracy measures. (See Table 10).

Table 10
Interaction effects of Year and Condition on Total Morpheme Score, Total Base Score, Total Suffix Score and Total Correct Word Score for Key Stage 3

Test	PRI *M* (Y7[*SD*], Y8 [*SD*])	NPRI *M* (Y7 [*SD*], Y8 [*SD*])	F	p	η_p^2
TMS	36.36 [3.08], 36.43 [4.64]	27.46 [8.78], 32.14 [5.22]	2.219	=.143	.042
TBS	18.50 [1.56], 18.14 [1.83]	11.92 [5.42], 14.57 [3.34]	2.758	=.103	.051
TSS	17.86 [2.41], 18.29 [3.27]	15.54 [3.76], 17.57 [2.56]	.961	=.332	.018
TCWS	16.57 [2.82], 16.79 [3.72]	10.31 [5.14], 13.07 [3.99]	1.410	=.241	.027

Adding morphological awareness test scores as a covariate did not change any of the results; demonstrating that any improvements in performance were achieved through morphological priming, not pre-existing knowledge. Furthermore, to ensure that the reason for the superior scores in the priming condition were not due to difference in pre-existing morphological awareness scores a t-test was conducted on the pre-existing morphological awareness scores in priming and non-priming groups. There was no difference between the groups on this score (p = .77 n.s.).

Discussion

The main objective of this study was to investigate the impact of morphological priming on different measures of spelling accuracy (TMS, TBS, TSS and TCWS). The main findings of this study revealed that overall morphological priming made a significant difference on the accuracy of children's spellings, consequently supporting our first hypothesis that; morphological priming will have a positive effect on spelling accuracy regardless of Key Stage. Subsequent findings were categorised by Key Stages to examine the efficacy of morphological priming across the different years within each Key Stage.

With regard to our second hypothesis, morphological priming also had a positive effect of different magnitudes within each individual Key Stage for at least one measure of spelling accuracy. In Key Stage 1, 2 and 3 a significant main effect was observed for condition in TBS, with children obtaining higher spelling accuracy of base words in the priming condition, in comparison to the non-priming condition. Key Stage 1and 3 also found a significant main effect for condition in TMS and TCWS, with children obtaining higher spelling accuracy of morphemes and complete words in the priming condition, in comparison to the non-priming condition. Additionally in Key Stage 3 a significant main effect for condition in TSS was also found, with children obtaining higher spelling accuracy of suffixes in the priming condition, in comparison to the non-priming condition. Interestingly, adding morphological awareness test scores as a covariate did not change any of the results; demonstrating that any improvements in performance were achieved through morphological priming, not pre-existing knowledge.

Findings from this study partially supported our third hypothesis that all measures of spelling accuracy would incrementally increase with age. In Key Stage 1and 2 a significant main effect of year was found across all spelling accuracy measures, indicating that the increase in age of participants was directly associated with the increase in spelling accuracy. However, no significant main effect of year was found for Key Stage 3, with spelling accuracy measures revealing similar results between both years.

With reference to the first hypothesis, the findings show clear evidence that children's spellings were significantly more accurate when exposed to a morphological priming paradigm. This finding is consistent with the results of previous research (Deacon & Bryant, 2006); that claim children are able to understand to a certain extent the role suffixes play in determining spelling. However, it is important to note that these findings uphold the minority perspective of the positive influences of morphological instruction at the beginning of literacy instruction.

Many researchers in the UK assume that the failure of children to spontaneously use morphological strategies is evidence that they are unable to utilise or even comprehend morphological tools (Nunes & Bryant, 2009; Larkin & Snowling, 2008). This research is also reflective of UK policy maker's ideas of children's morphological capability. Nunes and Bryant (2009) state, 'there is no point in trying to teach children all the complexities of a very sophisticated system at the same time' (p.13).

However, this ideology is deduced from circular reasoning; current education policy instructs that children are to be taught literacy primarily through phonics, which in turn means these children are only using phonics for literacy acquisition. Researchers often assume this chosen literacy method is due to the effectiveness or preferential choice of the individual child, without responding to the fact that the child has never been exposed to an alternative. Moreover, this circular research fails to address the morphological ability of children. As the main finding of this study demonstrates the positive influence of morphological priming across all ages, teaching should aim to nurture and fine-tune children's ability to use morphological tools, instead of focussing on one strategy; phonics, which does not address a morphophonemic writing system such as English.

With reference to the second hypothesis, morphological priming had a positive effect of different magnitudes within each individual Key Stage for at least one measure of spelling accuracy. These results do not provide support to research of stage models of language acquisition. Pacton and Deacon (2008) claim that most stage models of spelling development comply with the theory that morphological awareness develops later, that being after phonological awareness. The 'late' stage model assumes that is takes several years for children to understand the role morphology has in spelling (Gentry, 2005; Frith, 1985), implying morphology is too difficult a strategy for beginner writers to appreciate. However in this study, even children in their first Year of Key Stage 1 in the morphological priming group gained higher scores on the spelling accuracy measures than those in the non-priming group. This finding clearly demonstrates that children as young as five years can use and understand morphological concepts. This finding again contends with existing research (e.g. Nunes & Bryant, 2009) and ideas of UK policy makers (e.g. Rose, 2006) that argue that it is preferential to start with phonic teaching before introducing the other elements of the writing system.

In this study, a morphological awareness test emulated from Nunes and Bryant (2006) was employed as a co-variant to assess pre-existing morphological awareness. The results of this test did not have any impact on the data, corresponding with previous research (Nunes & Bryant, 2009; Larkin & Snowling, 2008) to suggest that children did not have any explicit prior awareness of morphological tools. However, this finding may due to the fact that they have only received phonics instruction for spelling, and thus, this strategy has become their default when attempting to spell. Moreover, the failure of this co-variant to affect the results of the spelling accuracy measures demonstrates the effectiveness of morphological priming; as children's scores were not influenced by pre-existing knowledge, improvements of spelling accuracy were solely attributable to morphological priming.

The principle aim of this study was to find evidence that would stimulate an educational response to children's morphological ability. The current national curriculum has been revised to focus literacy teaching primarily on phonics (Rose, 2006); thus ignoring children's morphological ability and subsequently complicating the process of literacy acquisition. This study has demonstrated the positive effects of morphological priming on spelling accuracy, in turn demonstrating the positive influence of morphology.

Additionally, previous research has evidenced that children who demonstrate a higher level of morphological awareness than their peers, score higher results on all measures of literacy skills (Bowers, Deacon & Kirby, 2010; Carlisle, 2010; Nunes and Bryant, 2009). Nunes and Bryant (2009) also propose that leaving the task of discovering morphology entirely to children themselves, is a questionable educational practice. The findings revealed in this study demonstrate that children as young as five years are able to benefit from morphological spelling tools, thus inferring that explicit teaching from the beginning of education, would have a wider benefit on literacy skills.

The participants of this study were privately schooled children. This may pose as an issue to the replication of this study. According to The Good Schools Guide website, as independent schools are not administered by local, county or national governments, their academic standards are generally higher than those found in state schools. Pupils receive a wider education with levels beyond the national curriculum, and there is often a particular theory of education. This may mean that the participants of this study have been exposed to different literacy strategies in comparison to mainstream schools, and thus it may prove problematic to assume the findings of this study can generalise to the wider population.

The spelling tests were conducted by each class's usual teacher in their classroom as it was important to mimic the environment in which children would receive generic tests. Whilst the ecological validity of this study was important to its execution, classroom dynamics such as teacher-pupil interaction and behaviour varied from classroom to classroom. There is a chance this may have influenced results, and could also prove problematic for exact replications.

Additionally in the morphological awareness task obtained from Nunes and Bryant (2006), some children may have not applied pre-existing knowledge of morphology to the pseudo words, as they did not comprehend that the individual pseudo word replaced a real word. Instead of applying appropriate knowledge to determine the spelling of these pseudo words, children may have interpreted these words as nonsense and independent from their context, and so spelled them as such. This may have meant that morphological awareness impacted the results of spelling accuracy measures in addition to the morphological priming. Future research should investigate the spelling strategies children report to be using in order to further examine the ability of children in a range of different strategies. Very few studies have made use of this method (e.g. Devonshire & Fluck, 2010; Rittle-Johnson & Seigler, 1998), clearly suggesting more research is necessary.

The study showed that morphological priming made a significant difference on the accuracy of children's spellings across all Key Stages. These findings have important implications for educational practice, and developmental theories of literacy. Whilst some researchers do argue the advantages of teaching morphology to children at the Key Stage 2 (Deacon & Bryant, 2006; Devonshire, Morris & Fluck, 2013; Nunes and Bryant, 2009), the mainstream ideology shows a wealth of support for the principle instruction of phonics. However based on our findings, as children's spellings are positively influenced by morphological priming; morphology instruction should be taught from the beginning of their formal literacy instruction.

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