The use of a rote learning strategy in Greek inflectional spelling

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The use of a rule and a rote learning strategy in Greek inflectional spelling[*]

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ABSTRACT   This study examines the development of morphological spelling strategies in Greek orthography. The objective of the study is to investigate the development of the ability to spell inflectional morphemes, and to assess the relative contribution of rule learning and rote learning to the spelling of such morphemes. In a longitudinal study, 105 first graders' performance on measures of spelling stem morphemes and inflectional morphemes in real words and in pseudo-words is evaluated in three sessions covering a period of 13 months. Results suggest that the acquisition of morphological spelling strategies is not accomplished in a single step but follows various transitions gradually. This developmental course is discussed in relation to recent empirical studies on spelling and also with respect to current theories of spelling development.

Key words: Spelling development, Spelling morphemes, Greek orthography.

1. The use of a rule and a rote learning strategy in Greek inflectional spelling

Learning to spell is a complex process involving at least two fundamental elements: (a) the acquisition of the phoneme-to-grapheme correspondence rules (known as the *alphabetic principle*); and (b) the understanding of the link between morphology and spelling. Competency in spelling in an alphabetic or "morphophonemic" orthography is, therefore, acquired through the use of both phonological and morphological strategies, which are assumed to follow each other in a sequential order.

Phonology refers to the linguistic analysis of the sound structure of words. The *phoneme* is the basic level at which this analysis is performed. This abstract entity is defined as the smallest unit

of sound that makes a difference in meaning, thereby distinguishing one word from another (e.g., the /t/ and /d/ of "bat" and "bad").

Morphology is that aspect of syntax, which relates to the internal structure of word forms, or the analysis of language at the level of the morpheme. The *morpheme* can be a whole word or a word part, and is the smallest meaning-bearing linguistic unit of grammatical analysis, which has semantic, syntactic, and phonological value (e.g., the word "teach-er-s" consists of three morphemes, with the hyphen used to indicate morpheme boundaries).

Current developmental theories of spelling acquisition propose that the two qualitatively different strategies are employed at different stages of spelling development, with phonological strategies emerging first followed by the morphological ones later on in development. In particular, Marsh, Friedman, Desberg, and Saterdahl (1981) and Marsh, Friedman, Welch, and Desberg (1980) have claimed that at the early stages of spelling development children make use of a simple phonetic strategy which enables them to master sound-to-letter correspondences, whereas at later and more advanced stages they grasp the more sophisticated phonetic, and analogy strategies. Frith (1985, 1986) has made an analogous distinction suggesting that children go through an early *alphabetic stage* characterised by the adoption of an entirely phonetic strategy, and a subsequent *orthographic stage* characterised by the grasp of the higher-order, more sophisticated principles of spelling.

A series of recent studies in a variety of alphabetic orthographies including English, French, Portuguese, and Greek has provided empirical support to the theories of spelling development which propose the existence of an initial phonetic stage followed by the adoption of both phonetic and morphological spelling strategies (Beers & Beers, 1992; Bryant, Devine, Ledward, & Nunes, 1997; Bryant, Nunes, & Aidinis, 1999; Chliounaki & Bryant, 2002, 2003, 2007; Da Mota, 1996; Nunes, Bryant, & Bindman,

1997a, 1997b; Totereau, Barrouillet, & Fayol, 1998; Totereau, Thevenin, & Fayol, 1997). These studies have further shown that children's learning about morphologically based spelling patterns requires a long period of time. Treiman's (1993) and Treiman and colleagues' (Treiman & Cassar, 1996; Treiman, Cassar, & Zukowski, 1994) studies, however, suggest that the understanding of at least some morphological relations in spelling may come relatively early in development.

The crucial role of morphological knowledge in learning to spell has been emphasised by Bryant et al. (1999), who have argued that morphology can determine spelling in three broad ways: (a) deciding between two or more phonetically acceptable spellings for the same sound; (b) spelling silent morphemes; and (c) using conventional spellings for morphemes which flout the alphabetic principle.

The first kind of link between morphology and spelling, as proposed by Bryant et al. (1999), is relevant to the Greek orthography. The Greek writing system is more transparent for reading, involving simple and invariant one-to-one grapheme-to-phoneme correspondence rules (Venezky, 1995), than for spelling and particularly vowel spelling. Three of the five vowel sounds of spoken Greek (i.e., /o/, /e/, and /i/) can be represented by two or more alternative spellings, which, when occurring in inflections, can be discriminated purely on the basis of morphology. For example, depending on the word's grammatical status, the vowel phoneme /o/ is represented in inflections either by the letter "o" in singular neuter nouns and adjectives ending in /o/, or by the letter "ω" in first person singular present verbs in the active voice ending in that sound. Similarly, the vowel phoneme /e/ is graphically depicted with the grapheme "ε" in first/second person plural present verbs in the active voice and in the passive voice ending in /e/, and with the digraph "αι" in first/second/third person singular and third person plural present verbs in the passive voice ending in that phoneme.

Thus, the choice among the alternative graphemes for the same sound is not arbitrary when each of the three vowel sounds occurs in inflectional morphemes. The morphosyntactic status of the word being spelled is the key to the correct spelling. By contrast, when the vowel appears in word stems the particular spelling pattern has to be memorised in a rote manner. No morphological rule is available for vowel spelling in stems, except only for the rule dictating that morphologically (either derivationally or inflectionally) related words share their meaning and spelling. Obviously, this rule is of limited use until the late stages of literacy development, when children have presumably acquired a large enough vocabulary to allow them to explore semantic connections among words and make use of them in spelling.

Therefore, to acquire competency in spelling, at least as far as the spelling of inflectional morphemes is concerned, Greek-speaking children need to become aware of the direct connection between morphology and spelling as well as of the specific morphological rules determining the correct spelling of the vowel sounds in such morphemes. However, it is in principle possible too that children may learn how to spell inflections simply by rote memorizing word-specific spellings, as they do for the spelling of stems.

The present longitudinal study aims at addressing the issue of the extent to which children base their spellings of vowels in inflections on a rule and/or on a rote learning strategy. In other words, the research question addressed is whether children spell inflections by applying morphological spelling rules or by simply rote memorizing the particular spellings. Given that real word inflections can be spelled by using either a rule or a rote learning strategy, the aim of the study is to determine the extent to which each strategy contributes to the spelling of inflections in the 13-month period under investigation.

The answer to this question would come from two sets of analyses: (a) a comparison of the children's progress with time in spelling stem and inflectional morphemes in real words (*use of a rule learning strategy*); and (b) a comparison of the children's spelling success with inflectional morphemes in real words and in pseudo-words (*use of a rote learning strategy*).

The rationale is that, if children learn to apply morphological rules when they spell inflections in the time period under investigation, the improvement over this period in their spelling of the sounds studied should be greater in inflectional than in stem morphemes in real words, where the learning has to be by rote. If children use a rote learning strategy when they spell inflections, they should spell the vowels with greater success in real word inflections than in pseudo-word inflections, where rote memorisation is of no use. The spelling of inflections in such "invented" words, which are by definition completely unfamiliar to the children, can only be based on morphological rule learning.

On the basis of this reasoning, therefore, the present study examines specifically beginning spellers' performance on graphically representing two Greek vowel phonemes, /o/ and /e/, which have two phonetically plausible graphemic renditions each ("o"/"ω" for /o/, and "ε"/"αι" for /e/), under two experimental conditions in each analysis: (a) in stems and in inflections in real words; and (b) in inflections in real words and in pseudo-words.

2. Method

Participants

One hundred and five Greek-speaking children (51 male and 54 female), sampled from the first grade at the time of the first session, were asked to spell to dictation real words and pseudo-words, and were followed up over a period of 13 months. The initial testing (Session A) took place in the first grade, four months after school entry, in January and February of the school year (mean

age of participants: 6;05, *SD* 3.4m). The rationale was that the children would need at least two to three months of literacy instruction in order to learn the letters of the alphabet and to start writing. Session B took place at the end of the first grade (mean age: 6;10, *SD* 3.3m). Finally, the last testing (Session C) was conducted in the middle of the second grade, a year after Session A (mean age: 7;06, *SD* 3.2m).

Four test scores were missing from the sample over the 13-month period (two in Session B, and another two in Session C) owing to short absences from school during the testing periods. These data were treated as missing data and were eliminated from the analyses considering all three sessions. Thus, the total number of participants whose data were further analysed was reduced to 101 (49 male and 52 female). However, whenever the analyses were restricted to Session A, the data from all 105 children initially taking part in the study were considered.

The sample was drawn from five state-supported primary schools serving a middle-class area in the city of Heraklion in Crete, South Greece. In the absence of any standardised measure of spelling in Greek for the first-grade age level, the selection criterion for participation in the study was based on teachers' evaluations. Children should be performing normally on reading and spelling in order to qualify for inclusion in the sample. All the children tested had attended preschool, and were monolingual speakers of Greek and also free of any neurological, sensory, or language impairment.

Materials and Procedure

Two experimental spelling tasks, one involving real words and one involving pseudo-words, were administered in small groups of five to ten children at a time. The tasks were designed to assess children's ability to represent two vowel sounds (/o/ and /e/) in stem and in inflectional morphemes in real words, as well as in inflections in pseudo-words, in the early stages of writing. In the absence of word frequency norms in Greek for the first-grade age level, the decision about the words that should be included in each spelling condition was based on the experimenter's judgement about the relative frequency of appearance of each word in first-graders' schoolbooks. The lists of the words involved in both spelling tasks are presented in Appendices 1 (Session A) and 2 (Sessions B and C).

In Session A, children spelled to dictation four real words with the vowel sound /o/ and another four with the vowel sound /e/, under two conditions: the sound was part of the stem or the inflection of the word. Two instances of each of the two different spellings for the /o/ sound, "o" and "ω", and for the /e/ sound, "ε" and "αι", were included in this short version of the spelling task. In Sessions B and C, an extended version of the real word spelling task and also the pseudo-word spelling task were presented to small groups of children. Overall, children spelled sixteen real words, the same as those in Session A plus another eight, thus involving four instances of each of the two different spellings for each sound. Eight pseudo-words with the vowel sound /o/ and another eight with the vowel sound /e/ in their inflection, matched with the real words for orthographic length, grammatical class, syllabic structure (consonant complexity), and placement of stress, were also dictated in Sessions B and C. All words in the experimental lists were composed of two morphemes, a stem and an inflection.

The decision to dictate fewer words and no pseudo-words in Session A was based on the reasoning that an extended version of the spelling task or a pseudo-word spelling task (like the ones employed in Sessions B and C) might be too difficult for children at this early stage of reading and spelling acquisition. The possibility of floor effects, as shown in earlier pilot work, prevented the administration of the real word spelling task in its complete form in the first session.

The real word and pseudo-word spelling measures in Sessions B and C were presented orally in two separate testing sub-sessions, in a

counterbalanced order. The words of the real word spelling task and the pseudo-words of the pseudo-word spelling task were presented in a randomised, but constant, order to all the participants. The real words and pseudo-words were always embedded in a context that made their grammatical status clear, and were presented orally in short sentences, following Nunes et al.'s (1997a) paradigm (e.g., *"Apple. Apple is my favourite fruit. Write apple"*).

3. Results

(i) Analyses of Correct Spellings in Real Word Stem and Inflectional Morphemes

As discussed in the introduction, the rationale underlying the current set of analyses is that, if children learn the morphological rules for spelling inflections in the time period under examination, their spelling of inflections (where spelling by rules and spelling by rote are both important) should show a greater improvement with time than that of stem morphemes (where only rote learning is of use). This is because the children should take advantage of the additional source of information (the morphological rules) that is available for the spelling of inflections. Thus, the hypothesis tested is the one about *rule learning* specifically.

On the basis of this reasoning, the present analysis focuses on the question of whether rule learning, that is, an increase in rule knowledge, took place over the 13-month period under investigation. It is predicted that the course of children's learning about the rule for spelling the /o/ sound (for which the grammatical distinction involved is a simple one and also the alternative spellings are both single letters) in stems and in inflections in real words will diverge over time, with a marked developmental improvement in inflectional spelling. However, a slower rate of development is predicted for the /e/ inflectional spellings on the basis of Chliounaki and Bryant's (2002, 2003) evidence that morphological rule learning is more difficult for beginning spellers of

Greek when the morphological spelling rule involves complex grammatical distinctions and also when there are digraphs among the spelling alternatives for a sound.

Table 1 presents the mean number of correct spellings for "o"/"ω" (sound /o/) and for "ε"/"αι" (sound /e/) in real words (stems and inflections) in all three sessions.

Sound /o/

As shown in Table 1, there was a large asymmetry in the initial correct use of the two spellings for the sound /o/. In the first and the second session, the children performed much better on spelling words which took the "o" spelling than words with the "ω" spelling. Children also seemed at first to learn when to use "ω" with inflections faster than they did with stems. In the first session, the overall difficulty of spelling the sound /o/ in stems and inflections was roughly the same, although "ω" was spelled slightly better in inflections. However, by Session B children had made more progress with the "ω" spelling in inflections than in stems. By the third session there was no longer any difference between stems and inflections.

Furthermore, a great improvement in this period in spelling /o/ was apparent. The improvement was almost entirely in the use of "ω" and in words where the vowel sound was spelled as "ω". This improvement was initially greater for the inflections than for the stems in Session B, but by Session C the children's scores approached ceiling for spelling both kinds of morpheme.

These initial observations were confirmed in subsequent analyses.

The Session A spelling scores for the vowel sound /o/ as a whole were first of all analysed with a one-way repeated measures ANOVA with "morpheme" (stem/inflection) as the independent variable. This analysis produced a significant main effect of morpheme, $F_{(1, 104)} = 8.725$, $p < 0.01$ ($h^2 = 0.077$), indicating that the children performed better on spelling the sound /o/ in inflections than in the stems.

Table 1

Mean Correct Spelling Scores and Standard Deviations for each Spelling for the /o/ and the /e/ Sound in Sessions A, B, and C

Sound	Spelling	SESSION A (N = 105) Real Words Stems (out of 2)	Inflections (out of 2)	SESSION B (N = 101) Real Words Stems (out of 4)	Inflections (out of 4)	Pseudo-words Inflections (out of 4)	SESSION C (N = 101) Real Words Stems (out of 4)	Inflections (out of 4)	Pseudo-words Inflections (out of 4)
/o/	"o"	1.89 (0.32)	1.80 (0.43)	3.83 (0.38)	3.65 (0.59)	3.17 (0.93)	3.69 (0.52)	3.85 (0.38)	3.14 (0.98)
	"ω"	0.71 (0.70)	1.10 (0.82)	1.69 (1.17)	2.74 (1.38)	2.01 (1.45)	3.27 (1.15)	3.37 (1.04)	3.45 (1.03)
/e/	"ε"	1.92 (0.30)	1.91 (0.34)	3.94 (0.24)	3.67 (0.86)	3.69 (0.72)	3.99 (0.10)	3.57 (0.94)	3.16 (1.18)
	"αι"	1.10 (0.86)	0.13 (0.46)	2.53 (1.05)	1.17 (1.53)	0.91 (1.34)	3.13 (0.97)	2.04 (1.61)	1.70 (1.62)

Note: Standard Deviations are in parentheses.

Subsequently, children's spelling success with "o" and "ω" in Session A was analysed by means of repeated measures *t*-tests (analysis of variance was not possible due to the relatively small number of test items in each condition). The *t*-tests revealed that performance on spelling "o" words was significantly better than performance on spelling "ω" words ($t = 14.965$, $df = 104$, $p < 0.001$ for stems; $t = 8.320$, $df = 104$, $p < 0.001$ for inflections), and also that "ω" was spelled significantly better in inflections than in the stems ($t = 4.534$, $df = 104$, $p < 0.001$).

A more detailed analysis of children's correct use of the individual spellings "o" and "ω" for /o/ in Sessions B and C was also performed (Session A could not be included in this analysis due to the small number of test items in each condition).

A 2 × 2 × 2 (Letter x Word Type x Session) repeated measures ANOVA was carried out on the Session B and C scores for the correct spelling of "o" and "ω" in stems and in inflections. The main terms were "letter" ("o"/"ω"), "morpheme" (stem/inflection), and "session" (B/C).

This analysis produced a significant letter effect, $F (1, 100) = 129.020$, $p < 0.001$ ($h^2 = 0.563$), attributed to "o" being easier than "ω". There was also a significant morpheme effect, $F (1, 100) = 30.981$, $p < 0.001$ ($h^2 = 0.237$), which was due to the scores being higher in inflections than in the stems. The session effect was significant too, $F (1, 100) = 115.582$, $p < 0.001$ ($h^2 = 0.536$), and established that the children performed better in Session C than in B.

The analysis also produced three significant two-way interactions: i) a Letter x Morpheme interaction, $F (1, 100) = 25.810$, $p < 0.001$ ($h^2 = 0.205$); ii) a Letter x Session interaction, $F (1, 100) = 92.748$, $p < 0.001$ ($h^2 = 0.481$); and iii) a Morpheme x Session interaction, $F (1, 100) = 11.130$, $p < 0.01$ ($h^2 = 0.100$).

A significant three-way Letter x Morpheme x Session interaction, $F (1, 100) = 37.629$, $p < 0.001$ ($h^2 = 0.273$), was also observed. The latter complex interaction was further explored applying the *Bonferroni method* for correction of the significance level (Howell, 1992). For the purposes of this analysis twelve paired samples *t*-tests were performed, and thus the significance level was adjusted to a stringent p of 0.004 (i.e., $a = 0.05/12 = 0.004$). Therefore, in this analysis the probability required for significance is reduced from 0.05 to 0.004.

The reasons for this complex interaction were as follows.

(a) In Session B the scores for words which took the difficult "ω" spelling were significantly higher in inflections than in stems ($t = 7.099$, $df = 100$, $p < 0.001$). In Session C, however, there was no difference between inflections and stems in children's success in spelling words which took the "ω" spelling ($t = 0.883$, $df = 100$, $p = 0.379$), and the scores were high with both kinds of morpheme. No difference between "o" stems and inflections was found in either session, when the stringent p value was applied ($t = 2.564$, $df = 100$, $p = 0.012$, for Session B; $t = 2.601$, $df = 100$, $p = 0.011$, for Session C).

(b) There was a significant improvement from Session B to C in spelling words with the difficult "ω" spelling in stems ($t = 12.328$, $df = 100$, $p < 0.001$) and in inflections ($t = 4.650$, $df = 100$, $p < 0.001$). The scores for spelling words with the easy "o" spelling were high throughout these two sessions, but improvement from Session B to C reached significance only for spelling words with "o" in inflections ($t = 3.069$, $df = 100$, $p < 0.004$). No such improvement in spelling words with "o" in stems ($t = 2.099$, $df = 100$, $p = 0.038$) was found, when the stringent p was applied.

Therefore, no evidence was found for an increase with time in the magnitude of the difference between "ω" inflections and "ω" stems. On the contrary, the use of "ω" in both stems and inflections improved significantly with time so that performance was close to ceiling levels in Session C.

The ceiling levels of performance with "o" both stems and inflections throughout the two

sessions indicate that the spelling "o" may be used indiscriminately to represent the sound /o/. This suggestion is in line with Bryant et al.'s (1999) and Chliounaki and Bryant's (2002) argument about a *default option hypothesis*, according to which beginning spellers of Greek initially adopt a limited phonological spelling rule (i.e., /o/ is spelled as "o").

Sound /e/

Table 1 also shows that the children learned faster when to use "e" and "ai" in stems than in inflections, and this pattern was consistent between sessions. Moreover, a great improvement in spelling /e/ over the period that Sessions B and C covered was apparent. This improvement, however, was entirely in the use of "ai". These observations were confirmed in subsequent analyses, which followed the same pattern as the one employed for the /o/ sound spelling data.

More specifically, the analysis for the /e/ sound spellings in Session A (a one-way ANOVA with "morpheme" as the independent variable) produced a significant main effect of morpheme, $F_{(1, 104)} = 104.180, p < 0.001 (h^2 = 0.500)$, indicating that the children performed better on spelling the sound /e/ in stems than in the inflections. The t-tests performed showed that performance on spelling "ε" words was significantly better than performance on spelling "αι" words ($t = 8.887$, $df = 104$, $p < 0.001$ for stems; $t = 26.330$, $df = 104$, $p < 0.001$ for inflections), and also that "αι" was spelled significantly better in stems than in the inflections ($t = 9.864$, $df = 104$, $p < 0.001$).

A $2 \times 2 \times 2$ ANOVA was also run on the Session B and C correct spelling scores for "e" and "ai", with repeated measures on three factors: "letter" ("e"/"ai"), "morpheme" (stem/inflection), and "session" (B/C). This analysis produced a significant main effect of letter, $F_{(1, 100)} = 200.927$, $p < 0.001 (h^2 = 0.668)$, because of "e" being easier than "ai". A significant main effect of morpheme, $F_{(1, 100)} = 192.051, p < 0.001 (h^2 = 0.658)$, was also found, and was due to the scores being higher in

stems than in the inflections. The main effect of session was significant too, $F_{(1, 100)} = 51.843$, $p < 0.001 (h^2 = 0.341)$, and was attributed to children's progress in spelling /e/ in Session C.

The analysis also produced two significant 1st order interactions: i) a Letter x Morpheme interaction, $F_{(1, 100)} = 36.390, p < 0.001 (h^2 = 0.267)$; and ii) a Letter x Session interaction, $F_{(1, 100)} = 27.950, p < 0.001 (h^2 = 0.218)$. However, there was no significant Morpheme x Session interaction, $F_{(1, 100)} = 0.451$, $p = 0.504 (h^2 = 0.004)$, and no significant three-way Letter x Morpheme x Session interaction, $F_{(1, 100)} = 2.547, p = 0.114 (h^2 = 0.025)$.

The two significant two-way interactions found were explored further with t-tests applying the Bonferroni adjustment of the significance level: for the purposes of these analyses, four t-tests were conducted for each of the interactions found, and thus the significance level was set to correspond to $p < 0.013$. The post-hoc analysis revealed the following results.

The t-tests exploring the Letter x Morpheme interaction revealed that performance on spelling /e/ was significantly better in stems than in the inflections for both spellings ($t = 5.685$, $df = 100$, $p < 0.001$, for "e"; $t = 10.531$, $df = 100$, $p < 0.001$, for "ai"). The single letter "e" was also spelled better than the digraph "ai" in both stems and inflections ($t = 12.742$, $df = 100$, $p < 0.001$, for stems; $t = 12.153$, $df = 100$, $p < 0.001$, for inflections). There is nothing in this pattern of results to account for the significant two-way interaction, although it is clear from an inspection of Table 1 that the interaction was probably due to the fact that the difference between stem and inflectional correct spellings (irrespective of session) was greater for "ai" than for "e". Further analysis was not conducted, however, as the Letter x Morpheme interaction is not of central importance for the purposes of this study.

The t-tests exploring the Letter x Session interaction confirmed that there was improvement from Session B to Session C only with the "ai" words, irrespective of morpheme type ($t = 0.366$, $df = 100$, $p = 0.715$, for "e"; $t = 7.142$, $df = 100$,

$p<0.001$, for "ai"). The letter "e" was always spelled better than "ai" ($t=15.070$, $df=100$, $p<0.001$, for Session B; $t=8.887$, $df=100$, $p<0.001$, for Session C), and this difference between the "e" and "ai" correct spellings was greater in Session B, although not significantly so.

These results provide no evidence of rule learning over the period that the two sessions covered. Furthermore, the finding that spelling improvement was only evident for "ai" words (irrespective of morpheme) and not for "e" words, for which performance was at ceiling throughout the two sessions, supports the default option hypothesis (Bryant et al., 1999; Chliounaki & Bryant, 2002).

(ii) Analyses of Correct Spellings in Real Word and Pseudo-word Inflectional Morphemes

The rationale underlying the current set of analyses is that, if children base their spellings of inflections in real words on a rote learning strategy (the rote memorisation of specific word spellings) to any extent, they should spell the two vowels with greater success in real word inflections than in pseudo-word inflections because rote learning is of use for real word spelling only. On the basis of this reasoning, the main question addressed is whether each of the spelling alternatives for each of the vowel sounds under examination is used correctly more often in real word inflections than in pseudo-word inflections.

The hypothesis tested is that children do make use of the additional information (a rote learning strategy) that is available for the spelling of real word inflections. Given that in Greek orthography young spellers must use a rote learning strategy with stem morphemes, it is reasonable to expect that they will use this strategy to some extent with inflections too. It is predicted that success with real word inflectional spellings will be greater than success with pseudo-word inflectional spellings.

Since a pseudo-word spelling measure was not administered in the first session, the present analyses are restricted to Sessions B and C.

The mean correct spelling scores for each of the four different spellings for the two vowel sounds in real word and pseudo-word inflections in Sessions B and C are presented in Table 1.

Sound /o/

In Table 1 it can be shown that in Session B the scores for spelling /o/ correctly in pseudo-words were consistently lower than in the real words. However, by Session C the "ω" pseudo-word score only had improved, so that there was no longer any difference between this score and the "ω" real word score.

A $2 \times 2 \times 2$ (Letter x Word Type x Session) repeated measures ANOVA was performed on the "o" and "ω" correct spelling scores, with three within-subjects factors, each with two levels: "letter" ("o"/"ω"), "word type" (real/pseudo), and "session" (B/C).

This analysis produced significant letter, F (1, 100)=29.683, $p<0.001$ ($h^2=0.229$), word type, F (1, 100)=72.316, $p<0.001$ ($h^2=0.420$), and session, F (1, 100)=62.988, $p<0.001$ ($h^2=0.386$), differences. The letter main effect indicated that performance was better on spelling "o" than "ω". The word type effect was due to the greater difficulty of spelling the /o/ sound in pseudo-words than in the real words. The session effect reflected progress in spelling /o/ in Session C.

The analysis also revealed three significant two-way interactions: i) a Letter x Word Type interaction, F (1, 100)=6.002, $p<0.05$ ($h^2=0.057$); ii) a Letter x Session interaction, F (1, 100)=41.815, $p<0.001$ ($h^2=0.295$); and iii) a Word Type x Session interaction, F (1, 100)=7.932, $p<0.01$ ($h^2=0.073$).

A significant three-way <u>Letter x Word Type x Session interaction</u>, F (1, 100)=27.300, $p<0.001$ ($h^2=0.214$), was produced as well. This complex interaction was analysed further applying the Bonferroni method for multiple comparisons, and thus adjusting the significance level to $p<0.004$ (12 comparisons).

.The reasons for this complex interaction were as follows.

(a) There was a significant real over pseudo-word superiority in the spelling of the "o" words in Session B ($t=4.465$, $df=100$, $p<0.001$) and in Session C ($t=7.140$, $df=100$, $p<0.001$). However, this real over pseudo-word superiority was found for the "ω" words in Session B ($t=6.057$, $df=100$, $p<0.001$) and not in Session C ($t=0.862$, $df=100$, $p=0.391$).

(b) There was a significant improvement from Session B to C in spelling real word and pseudo-word inflections with the "ω" spelling ($t=4.650$, $df=100$, $p<0.001$, for "ω" real words; $t=9.622$, $df=100$, $p<0.001$, for "ω" pseudo-words). The scores for spelling words with the "o" spelling were high in both sessions, but improvement from Session B to C reached significance only for spelling real word inflections with "o" ($t=3.069$, $df=100$, $p<0.004$). No such improvement in spelling pseudo-words with "o" was found ($t=0.226$, $df=100$, $p=0.822$).

The finding that the children spelled "o" real words better than "o" pseudo-words in Sessions B and C is an indication of their use of a rote learning strategy to some extent at that time. The finding that they spelled "ω" real words with greater success than "ω" pseudo-words in Session B suggests that they were also spelling "ω" inflections to some extent by rote at that time. The use of "ω" in both real word and pseudo-word inflections improved significantly with time so that performance was close to ceiling levels in Session C. The fact that the real over pseudo-word superiority was no longer evident for "ω" in Session C suggests that the children were no longer relying on a rote learning strategy when spelling "ω" inflections. However, an alternative interpretation of this finding is that there was reliance on a rote learning strategy at least to a certain extent in Session C, but this was masked by the children's great advancement in correct pseudo-word spellings. According to this account,

the use of a rote learning strategy was not revealed in Session C because performance on spelling "ω" real words and pseudo-words was close to ceiling.

Moreover, the finding that the correct spelling scores for "o" in both real word and pseudo-word inflections approached ceiling levels in both sessions indicates that "o" may be used as a default spelling for the sound /o/ (Bryant et al., 1999; Chliounaki & Bryant, 2002).

Sound /e/

An inspection of Table 1 shows that in both Sessions B and C the scores for spelling /e/ with the digraph "ai" were consistently lower in pseudo-words compared to the real words, whereas such a difference between real word and pseudo-word spelling scores was apparent for "e" only in Session C.

A $2 \times 2 \times 2$ (Letter x Word Type x Session) ANOVA was carried out on the "e" and "ai" correct spelling scores, with repeated measures on three independent variables: "letter" ("e"/"ai"), "word type" (real/pseudo), and "session" (B/C).

This analysis revealed significant letter, F (1, 100)=168.191, $p<0.001$ ($h^2=0.627$), word type, F (1, 100)=32.252, $p<0.001$ ($h^2=0.244$), and session, F (1, 100)=16.974, $p<0.001$ ($h^2=0.145$), main effects. The main effect of letter was due to "e" being easier than "ai", the main effect of word type was because the /e/ sound was spelled better in real words than in pseudo-words, and the main effect of session confirmed spelling progress with /e/ in Session C.

The analysis also produced two significant 1st order interactions: i) a Word Type x Session interaction, F (1, 100)=8.182, $p<0.01$ ($h^2=0.076$); and ii) a Letter x Session interaction, F (1, 100)=21.341, $p<0.001$ ($h^2=0.176$). There was no significant Letter x Word Type interaction, F (1, 100)=0.828, $p=0.365$ ($h^2=0.008$), and no significant three-way Letter x Word Type x Session interaction, F (1, 100)=3.136, $p=0.080$ ($h^2=0.030$).

The significant two-way interactions were analysed further with multiple *t*-tests applying the Bonferroni method. Four *t*-tests explored each of

those interactions, and thus the significance level was adjusted to $p < 0.013$.

The analysis of the Word Type x Session interaction revealed that the real over pseudo-word superiority in the spelling of /e/ – irrespective of grapheme – was apparent in Session C only, when the stringent p value was applied ($t = 2.076$, $df = 100$, $p = 0.040$, for Session B; $t = 5.563$, $df = 100$, $p < 0.001$, for Session C).

The post-hoc analysis exploring the Letter x Session interaction showed that there was improvement from Session B to C only with "ai", irrespective of word type ($t = 5.405$, $df = 100$, $p < 0.001$), whereas performance worsened in Session C with the "e" words ($t = 2.584$, $df = 100$, $p < 0.013$).

The finding that /e/ real words were indeed spelled better than /e/ pseudo-words (irrespective of grapheme) in Session C suggests that the children were to some extent spelling /e/ inflectional endings in a rote manner at that time.

The finding that there was improvement between sessions with "αι" words only (irrespective of word type) and that performance on spelling "ε" words (irrespective of word type) was at ceiling in Session B and in fact worsened but still remained close to ceiling in Session C supports the default option hypothesis for Greek spelling (Bryant et al., 1999; Chliounaki & Bryant, 2002). It seems likely that the children initially used "ε" as a default spelling for /e/, and that they then learned by rote that certain words are spelled with the digraph "αι" too.

4. Discussion

The main aim of this research was to examine the extent to which Greek-speaking children apply morphological spelling rules to their spelling when these are available, and also to pinpoint the timing of this transition to appreciating the role of morphology in spelling. More specifically, the longitudinal study on Greek spelling presented addressed the question of whether children learn about the morphological spelling rules for the two sounds studied (/o/ and /e/) at the beginning stages of literacy acquisition.

The study provided evidence that young children do make use of both rule and rote learning strategies when they spell inflectional morphemes. The use of a rote learning strategy in inflectional spelling was documented by the general finding that the children's accuracy in spelling the two vocalic sounds was greater in real word inflections than in pseudo-word inflections at the end of grade 1 and in the middle of grade 2. During this period the children also learned to use morphological rules to a certain extent when they spelled inflections in real words.

However, a different pattern of spelling development was documented for each of the sounds studied. In relation to the phoneme /o/, a relatively fast rate of spelling progress was documented, on the basis of two findings: (a) by the middle of the second grade the children achieved a satisfactory level of performance with /o/ inflections in pseudo-words; and (b) at that time performance on spelling /o/ stems and inflections in real words reached ceiling. The superiority of inflectional over stem spellings that was present at the end of grade 1 was no longer present in the middle of grade 2. This result does not necessarily mean that rule learning was absent over this period, as the finding that success in spelling "ω" specifically was no different in inflections and in stems in the last session might be simply due to the ceiling levels of performance with both kinds of morpheme. Furthermore, performance on spelling "o" reached ceiling too in both stems and inflections and in both sessions. With regards to the phoneme /e/, however, no evidence for rule learning was found in the comparisons between stems and inflections.

The finding about the relatively early emergence of the morphological rule for spelling /o/, as compared to /e/, in Greek inflections is congruent with the evidence provided by Treiman

et al.'s (1994) and Treiman and Cassar's (1996) studies suggesting that a morphological spelling strategy of using information about the morphemic structure of words in spelling is available to young 7-year-old first-graders, although not in a fully developed form. However, Treiman and Cassar also reported evidence favouring the late acquisition of morphology hypothesis. This evidence was based on the finding that familiarity with the conventional spelling of the past tense -ed inflection in English was evident in the spellings of 9-year-old children, and this rather late acquisition was corroborated by the findings of Nunes et al. (1997a, 1997b) about the same morpheme.

The finding that rule learning was not documented for /e/ (at least over the period up to the middle of the second grade) adds to the growing body of literature suggesting that children learning to spell in a variety of alphabetic scripts of morphophonemic nature take a long period of time to develop a complete appreciation of the impact of morphology on their orthography (Beers & Beers, 1992; Bryant et al., 1997; Bryant et al., 1999; Chliounaki & Bryant, 2002, 2003, 2007; Da Mota, 1996; Nunes et al., 1997a, 1997b; Totereau et al., 1998; Totereau et al., 1997).

The pattern of spelling development in Greek that has been documented by the present data is in complete concordance with the common suggestion of the developmental theories of spelling acquisition (Ehri, 1986, 1992; Frith, 1985, 1986; Henderson, 1985; Henderson & Templeton, 1986; Marsh et al., 1980; Marsh et al., 1981) that at different phases of development children are able to use different types of linguistic information in spelling (phonological first – morphological later). The view that in the course of spelling development phonological strategies precede the supposedly more sophisticated morphological ones is given ample empirical support by the present findings on Greek spelling.

Regarding the timing of the emergence of the more advanced morphological spelling strategies, some evidence was produced to support the predictions of Ehri's (1986, 1992) model for an early representation of inflectional morphology in spelling. In the case of the spelling of the Greek vowel sound /o/ that was studied, the understanding and use of the specific morphological rule determining the correct choice between the two alternative spellings for /o/ in word inflections was acquired relatively early in development, midway through the second grade. This finding is completely consistent with Ehri's placement of the morphemic stage of spelling at the age of 7, although in Ehri's scheme the morphemic stage (which is the last to develop) involves a variety of orthographic conventions. This early acquisition of the morphologically based /o/ spellings is probably related to the relative ease of the grammatical distinction that the rule involves, that is, the one between a noun and a verb.

However, spelling development appeared in this study to be slower for the other Greek vowel sound studied, /e/. Children of 7 years of age were still far from reaching a complete understanding of the morphological rule for spelling /e/. This was probably due to the fact that this rule is quite complex involving the rather difficult grammatical distinction between the active and the passive voice in verbs. This finding is congruent with Bryant et al.'s (1999) and Chliounaki and Bryant's (2002, 2003) conclusion that children's understanding and use of the morphological spelling rules for the /e/ and the /i/ sounds in Greek develops at a slow rate and may require a long period of time. This finding is also certainly in line with the predictions of Henderson's model (Henderson, 1985; Henderson & Templeton, 1986) and of Marsh and colleagues' model (Marsh et al., 1980; Marsh et al., 1981) for children's late adherence to the morphemic principle of spelling. Inflectional morphology is represented in spelling roughly at the age of 8-9 in Henderson's scheme, while derivational morphology in Marsh et al.'s scheme is still hard to represent at the age of 10. Nevertheless, this finding is not in contrast with

Ehri's scheme (1986, 1992), as she predicted that the morphemic stage of spelling would continue to develop over many years.

Overall, in discussing the conclusions drawn it is important to note some methodological limitations of the longitudinal study reported. First, in the absence of frequency norms in Greek for the age level studied the sets of real words that were included in the stem and the inflection condition could not be balanced for word frequency. The fact that there was no control for the possibility of frequency effects did not allow for inferences to be drawn from the stems-inflections comparison in relation to rule knowledge. Second, the fact that the experimental design of the study did not include a pseudo-word spelling measure in the first session and also employed a short version of the real word spelling (stems/inflections) tasks in this session posed a certain limitation to the analyses conducted thereafter, as there were instances in which a direct comparison of children's progress with real word and pseudo-word spelling across the three sessions was not possible.

In conclusion, the developmental analysis in this study suggests that in the early stages of spelling acquisition in Greek rote and rule learning both have a role in spelling success with inflectional morphemes. What is further established by the present data is that in an almost transparent orthography like Greek at least some understanding of the influence of morphology on the orthography is acquired relatively early in spelling development following the mastery of the alphabetic principle. As a general principle though, the complete mastery of a conditional morphological rule presents a certain challenge for the inexperienced speller, and hence it requires a long period of time and presumably a lot of experience with the orthography in order to be achieved. Factors such as the level of complexity of the morphological distinction involved, the type of grapheme (single-letter versus digraph), and possibly the number of alternative spellings for a sound may contribute to a different rate of acquisition of the spelling rule for each vowel sound for which there is more than one equally plausible alternative representation. This hypothesis awaits further investigation.

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APPENDIX 1

The spelling word list in Session A

Sound	Spelling	REAL WORDS	
		Stems	*Inflections*
/o/	**"o"** πόλη (town)	τόπι (ball) μήλο (apple)	μωρό (baby)
	"ω"	ζώνη (waistband) μωρό (baby)	δίνω (I give) γελώ (I laugh)
/e/	**"e"**	γελώ (I laugh) δένει (s/he ties)	παίζουμε (we play) μιλάμε (we talk)
	"ai"	παιδί (child) παίζουμε (we play)	κοιμάμαι (I sleep) κλείνομαι (I am shut up in)

APPENDIX 2

The spelling word list in Sessions B and C

Sound	Spelling	REAL WORDS		PSEUDO-WORDS
		Stems	*Inflections*	*Inflections*
/o/	**"o"**	τόπι (ball) πόλη (town) βόδι (ox) φοβάμαι (I am afraid of)	μωρό (baby) μήλο (apple) δώρο (present) νερό (water)	γονό ζίρο ψόκο βεσό
	"ω"	ζώνη (waistband) μωρό (baby) δώρο (present) φωνή (voice)	δίνω (I give) γελώ (I laugh) βγαίνω (I go out) φιλώ (I kiss)	σίχω τενώ χρέγω λιβώ
/e/	**"ε"**	γελώ (I laugh) δένει (s/he ties) θέση (place/seat) νερό (water)	παίζουμε (we play) μιλάμε (we talk) δείχνουμε (we show) ανοίγουμε (we open)	ζέθουμε θιράμε μίσκουμε ερίχουμε
	"αι"	παιδί (child) παίζουμε (we play) βγαίνω (I go out) καιροί (days/times)	κοιμάμαι (I sleep) κλείνομαι (I am shut up in) φοβάμαι (I am afraid of) ρίχνομαι (I fly into)	διβάμαι δρίφομαι κοπάμαι βίπτομαι

Η χρήση των στρατηγικών εκμάθησης κανόνων και οπτικής απομνημόνευσης στην ορθογραφημένη γραφή καταληκτικών μορφημάτων στο ελληνικό ορθογραφικό σύστημα

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ΠΕΡΙΛΗΨΗ

Η παρούσα έρευνα εξετάζει την εξέλιξη των στρατηγικών ορθογραφίας στην ελληνική γλώσσα. Αντικείμενο της έρευνας είναι η παρακολούθηση της εξέλιξης της γραφής καταληκτικών μορφημάτων, καθώς και η εκτίμηση της συνεισφοράς της εκμάθησης κανόνων και της οπτικής απομνημόνευσης στην ορθογραφημένη γραφή αυτών των μορφημάτων. Στη διαχρονική αυτή έρευνα παρακολουθείται σε τρία διαστήματα χρονικής διάρκειας 13 μηνών η επίδοση 105 μαθητών της πρώτης τάξης του δημοτικού σχολείου στη θεματική ορθογραφία, καθώς και στην καταληκτική ορθογραφία σε πραγματικές λέξεις και σε ψευδολέξεις. Τα αποτελέσματα δείχνουν ότι η κατάκτηση των στρατηγικών ορθογραφίας δεν επιτυγχάνεται σε ένα στάδιο, αλλά ακολουθεί μια εξελικτική πορεία. Ακολουθεί συζήτηση για τα αποτελέσματα σε σχέση με πρόσφατες ερευνητικές μελέτες με αντικείμενο την ορθογραφημένη γραφή, καθώς και τις τρέχουσες θεωρίες για την εξέλιξη της ορθογραφικής ικανότητας.

Λέξεις-κλειδιά: Εξέλιξη ορθογραφικής ικανότητας, Ορθογραφημένη γραφή μορφημάτων, Ελληνικό ορθογραφικό σύστημα.

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