Cognitive processes in first grade reading and spelling of Greek

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ABSTRACT

The aim of this study was to examine the processing strategies used in word reading and spelling by first grade Greek children who were either normal or low achievers in literacy development after six months of reading and spelling instruction. The participants were tested in word and nonword reading and spelling and their performance was assessed on the basis of reading time, accuracy level and error types. Based on the main findings, the following three conclusions were drawn: first, the children, regardless of their literacy achievement level, did not read logographically but instead employed a phonological recoding process in reading any type of Greek word; second, the elements of orthography used in the reading process are likely to be whole syllables, indicating a morphographic level of reading development; and third, the children seemed to spell by deriving the orthographic forms of a word on the basis of sound-spelling correspondence knowledge.

Keywords: Greek language, Literacy acquisition, Reading, Spelling.

Introduction

Writing systems and literacy

The investigation and subsequent understanding of the ways young children acquire and carry out the basic processes of word reading and spelling is not only of interest to the researcher of cognitive processes and development of reading and spelling but it can also have positive repercussions for the formulation of more effective methods of teaching young children to read and spell. And if such an issue has a certain degree of scientific interest for languages which are widely spoken and in which literacy acquisition has been studied extensively (such as English, French, German and others), for languages like Greek, where the scientific study of reading and spelling is recent and scarce, the systematic investigation of every aspect of the issue "how Greek children read and spell" is a scientific and educational necessity.

The need for studying the reading and spelling processes in the Greek language is also justified by the fact that the Greek spelling system is different from spelling systems (like the English) where most of the research has been carried out so far. Consequently, it is necessary the development of methods, materials and procedures for effective teaching of reading and spelling in Greek to be based on research

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involving the Greek language.

The Greek writing system is, like English, a morphophonemic script but is much more transparent than English in the representation of phonology. On the one hand the English spelling system has variable and inconsistent grapheme-phoneme relationships due to many irregular spellings and it is considered as *"deep"* orthography, with higher level morphological constraints (Chomsky & Halle, 1968). On the other hand, the Greek spelling system is much more consistent in grapheme-phoneme correspondences (approaching the 1: 1 mapping from graphemes to phonemes) and can be characterized as a *"shallow"* orthography where, as a rule, pronunciation is predictable from print. The grapheme-phoneme inconsistencies existing in Greek (mainly applying to digraph spelling patterns) are to a large extent rule-learned and apply in almost every case in which the particular spelling pattern occurs.

In spelling, however, Greek is phonologically opaque since there is a 1 : many phonemes - graphemes mapping and, therefore, spelling can not always be predictable from phonology. So in a number of cases (mainly those following the "historic orthography" spelling conditions) a word's phonemic structure can be represented by more than one graphemic alternative. Since most of such spelling patterns are explained by etymological and grammatical knowledge, spelling can be assisted by gradually learned rules based on morphology and lexical information.

In view of the existing differences in the orthographic systems and their classification as deep or shallow orthographies, it could be assumed that the degree to which a writing system represents phonology (by which a system is classified as deep or shallow orthography) is highly likely to be related to the way word recognition process takes place. This is in fact what Katz and Frost (1992) have suggested in their *orthographic depth hypothesis*. According to this hypothesis a reader of a deep orthography is likely to be led (by the nature of the orthography) to process word recognition by using morphological information from the visual-orthographic structure of the written word. However, the reader of a shallow orthography is likely to be encouraged by the high degree of transparency in the representation of phonology to process word recognition by using the phonological information. If this hypothesis is true, then there should be evidence from deep and shallow orthographic systems.

Learning to read in deep and shallow orthographies

The extensive studying of reading acquisition in the English language has resulted in the formulation of various theoretical accounts (for a brief review see Seymour & Duncan's article in this issue). The common characteristic of the early developed cognitive developmental stage models (Marsh, Friedman, Welch, & Desberg, 1981; Frith, 1985) was the idea that the young children's acquisition of reading passes through three different stages. The first is the *logographic* stage in which reading is performed on the basis of a whole word strategy, by associating the whole visual patterns of the words with their pronunciation. At this stage the child is expected to read successfully only a set of frequently encountered words. The unfamiliar words either can not be read or can be approached by guessing on the basis of contextual cues. The logographic strategy is regarded as a natural and necessary first step in the learning to read process until the child reaches 7 years of age when, under the Piagetian framework, the transition of the child's cognitive development from the preoperational stage to the stage of concrete operations occurs. As a result of this and on the basis of the development of phonological awareness of speech structure, the young reader enters the *alphabetic* stage, during which s/he develops a decoding strategy (phonological

recoding) on a sequential basis. At this stage the child recognizes the constituent letters of the word, uses his/her knowledge about the associations between different letters and their sounds, blends together the constituent sounds and forms the pronunciation of the word. Finally, the child reaches the *orthographic* stage, during which s/he can read words by using letter groups.

The stage model of reading acquisition was supported by subsequent research on the English language (Byrne, 1991; Harris & Coltheart, 1986; Seymour & Elder,1986). The outcome of all this research was the underlining of the hypothesis that the young reader of English is bound to use the logographic strategy as the first step in the learning to read process.

However, other studies on literacy acquisition in a number of languages have cast doubts on the hypothesis of the importance of this logographic process and the consequent underestimation of the role of alphabetic strategy in the acquisition of reading skills. Even in learning to read English, Seymour and Evans (1992) concluded (based on a longitudinal study) that the logographic strategy could be a result of the teaching method employed in the school and not a natural and necessary first step in literacy acquisition. Stuart and Coltheart (1988) suggested that if children have acquired the phonological skills then their reading process is alphabetical from the beginning. Similarly Ehri (1992) pointed out the importance of phonological cues in the first stages of reading and supported the notion of phonological recoding (based on phonemic and alphabetic knowledge) for reading acquisition.

In more regular orthographies, the doubtful role of the logographic stage and, consequently the decisive importance of the alphabetic strategy, has been more evidently shown. In the German language, Wimmer's extensive work with Austrian children has demonstrated that in learning to read and spell German the children mainly apply a phonological recoding and not a logographic strategy (Wimmer & Hummer, 1990; Wimmer, Landerl, Linortner, & Hummer, 1991). Similarly Mannhaupt, Jansen, and Marx (1997), found that ten weeks after beginning school the German first graders did not rely on logographic reading. They concluded that in learning to read German the German speaking children do not seem to use any other reading strategy prior to the alphabetic process. Sprenger-Charolles and Bonnet (1996), in a longitudinal study aimed at evaluating the reading strategies used by French children, found that first graders did not use logographic strategies in learning to read French. In the Greek language Porpodas (in press) evaluated the reading strategies used by first graders after 16 weeks of schooling and literacy instruction and found that good as well as weak readers were relying widely on the alphabetic process. This was interpreted as indicating that the logographic strategy is unlikely to play an important role or to emerge naturally in the process of learning to read Greek.

In view of the shortcomings of the stage models of literacy acquisition Philip Seymour of the University of Dundee (Scotland), based on his many, extensive and detailed studies, developed the *"Dual foundation model"* of reading acquisition (Seymour, 1997, 1999). (A concise description of this model is presented in Seymour and Duncan's article in this issue.) The model is developed in terms of phases which are not necessarily sequential but which can overlap in a cumulative mode. Seymour proposes four main phases:

Phase O: Pre-literacy. This phase refers to the pre-reading period. Due to the nature of their language (and especially the poorly defined structure of the syllable), in this phase English pre-readers normally lack explicit linguistic awareness. In Greek, however, which is characterized by a well articulated and open syllabic structure, pre-readers are expected to approach the task of learning to read with a satisfactory level of explicit phonological awareness at the syllable level (Porpodas, 1989a, 1990).

Phase 1: Foundation literacy. The basic hypothesis is that literacy acquisition requires the knowledge of the visual forms of the letters and their association with the corresponding sounds of speech. Based on that knowledge, two foundation processes are developed: a *logographic foundation* and an *alphabetic foundation*. The logographic foundation is thought to be a process for the representation and recognition of words, on the basis of their partial representation. The alphabetic foundation involves ".. a simple decoding procedure by which individual letters are converted to sounds and the sounds are synthesized to form a pronunciation...and the establishment of meta-awareness of phonemes.." (Seymour, & Duncan, in this issue). The degree of development and use of the logographic or the alphabetic foundation process depends on the nature of the language under process and the teaching methods used. For these reasons the development of a distinct logographic foundation seems unlikely in learning to read Greek (Porpodas, in press) and, therefore, the Greek children are assumed to approach reading by using an alphabetic process.

Phases 2 and 3: Orthographic and morphographic literacy: In Seymour's model "these frameworks are envisaged as abstract structures in which elements of orthography are organised in a manner which reflects their relationship with sound and meaning. At the *orthographic* level the elements consist of the vowel and consonant graphemes organised into a structure which reflects the subdivision of the syllable into a three-part onset-peak-coda format or a two part onset-rime format. At the *morphographic* level, the elements are likely to consist of whole syllables, or, more obviously, free and bound morphemes" (Seymour & Duncan, in this issue). Since Greek is a consistent orthography the focus of the reading process on rime-level spelling sound parts will not give any advantage in processing Greek (Goswami, Porpodas, & Wheelwright, 1997). In addition, since Greek contains polysyllabic words in which most syllables have an open CV or CCV structure, the morphographic phase (where syllabic units can be combined) seems to be more important for the development of reading. Therefore, according to Seymour, "Greek children can progress rapidly through Phases 1 and 2 and approach Phase 3 with an inventory of well defined syllabic units in place".

In summing up, it could be argued that the most decisive step in the process of learning to read seems to be the acquisition of phonological recoding, that is, "the ability to translate printed words independently into their spoken equivalents" (Share,1995, p. 156). Following the above account it could be assumed that Greek children should not face much difficulty in acquiring phonological recoding as a procedure for accurate word recognition. Based on the consistency of orthography, the grapheme-phoneme recoding is expected to be reliable, provided that the lexical item presented conforms to the code (as it is normally the case) or that the basics for the rule-read words have been learned. Success in phonological recoding is enhanced by the fact that Greek children are normally taught using an analytico-synthetic phonics method that directly facilitates phonological recoding as a means of word recognition.

Learning to spell

As in the case of reading, most of the existing research on spelling has been conducted on the English language. On the basis of that research it could be argued that learning to spell involves the employment of visual, phonological, semantic, grammatical and orthographic rules knowledge and skills (Bruck & Treiman, 1990; Gough, Juel, & Griffith,1992; Henderson & Beers, 1980; Marsh, Friedman, Welch, & Desberg, 1981; Waters, Bruck, & Malus-Abramowitz, 1988).

The theoretical accounts on the learning of spelling in English have taken the form of

developmental stage models. Such models have been proposed by Brown (1990), Frith (1980, 1985), Marsh et al. (1981). A close comparison of these models reveals that they share two common characteristics. The first characteristic is that all these models postulate that spelling develops in a series of stages or periods. The second characteristic is that spelling development postulates a period in which spelling is based on a coding strategy of phonological analysis which is called a *phonetic* stage by Brown (1990), an *alphabetic* stage by Frith (1985) and *sequential and hierarchical encoding* by Marsh et al. (1981). The phonological analysis strategy of spelling development is followed by a period in which the spelling strategy is based on lexical analogies, during which visual memory plays a primary role. At this period spelling of a word is produced because it "looks right" (Brown, 1990), it is "independent of sound" (Frith, 1985), or because there is a shift from the phonemic encoding strategy to a strategy based on analogy (Marsh et al., 1981).

The most widely used methodology in order to determine the strategies used by children in their effort to spell, has been the analysis of spelling errors. As Read (1986) has pointed out, children's misspellings "provide a window on their spelling processes, their notions of writing and their judgments of speech sounds" (p. 2). Such an analysis shows to what extent children apply information about grapheme-phoneme conversion. The way to distinguish that, is by classifying spelling errors into two main categories. The first is the *phonetic* or *phonological* or *legal misspelling,* in which the misspelled word is phonetically accurate and "sounds like" the target word. In this case the child is assumed to employ successfully the phonological rules. So s/he has correctly analyzed the spoken word into phonemes and has represented each phoneme with a grapheme. The second category is the *non-phonetic* or *non-phonological* or *illegal misspelling* which is thought to indicate the use of a rote memorization of the word or unsuccessful use of the phonological rules (see Cook, 1981, for a review).

The investigation of spelling in consistent orthographic systems has shown that in German, spelling performance of primary first grade children was strongly based on the knowledge of phonological information (Wimmer & Hummer, 1990). In the Greek language there is also some evidence indicating that the Greek children are highly likely to process spelling by relying mainly on the phonological information (Porpodas, 1989a, b, 1990).

The present study

In the present study we investigated the reading and spelling performance of first grade Greek children. The aim was to examine the Greek children's reading and spelling strategies, in relation to *developmental stage models* and the *dual foundation model* of literacy development described previously, after about six months of schooling and literacy instruction. So, the specific objectives of this study were: (a) to see what processing strategies are employed in reading and spelling by first grade Greek children; (b) to see whether the processes that are used are related to literacy achievement level.

One way to address the first question is to use orthographically regular and exception words and nonwords, derived from those words, and compare the children's reading and spelling performance. If the young children's reading was not performed logographically but relied on phonological recoding then: (1) they should be able to read nonwords with a high degree of accuracy and their few nonword reading errors should not be of a refusal type ("I do not know"); (2) reading of orthographically regular words should be better (mainly in terms of reading times) than reading of orthographically exception words; (3) the reading errors should not be of phonetic type; (4) there should be a length effect

(syllabic) in reading both words and nonwords. If the children's spelling was performed mainly on the basis of phonological information then: (1) there should be far fewer spelling errors in nonword than in word writing; (2) orthographically regular words should be spelled more accurately than exception words; (3) word misspelling should be mainly phonetic.

In order to address the second question, the performances of two groups of children were compared: a group consisting of normally achieving readers/spellers and a group of children who were low-achieving in reading/spelling. Bearing in mind the importance attached to the logographic strategy in the developmental stage models, the inclusion of the group of low-reading/spelling achievers is of particular significance. This comes from Frith's (1985, 1986) implication that, unlike to normal achievers who are expected to enter the alphabetic stage quickly, the low-achievers normally exhibit a developmental arrest at the logographic stage. Consequently, if the differences between the two groups of children represented differences in the strategies used, then the reading and spelling patterns (reflecting the knowledge and use of phonological information) should differ between the two groups of children.

Method

Participants

Forty-four first grade Greek speaking children, attending ordinary public primary schools in the city of Patras, participated in the study. At the time of the start of the study they had completed about six months of schooling and instruction in literacy. They had been selected so as to form two groups: A group of normally achieving readers/spellers and a group of low achieving readers/spellers. Due to the non existence of standardized reading and spelling tests in Greek, the selection of children and their placement into one or the other group, was based on the teachers' judgment. More specifically, the first-grade teachers of the schools involved were asked to select one or more children from his/her classroom who were slow or weak in reading and spelling development. In order to be sure that those children's difficulties in literacy were not caused by general factors, the teachers were informed that the children they would select should have normal performance in mathematics. In addition, the teachers were asked to select one or more children normally achieving in reading/spelling. The group of normally achieving readers/spellers originally had 24 children. However, during the testing session four children did not complete the final testing and were excluded from the group. So the group of normal achievers finally consisted of 20 children (9 boys and 11 girls), who at the time of selection (early March 2000) had a mean chronological age (C.A.) of 84 months. The group of children who were classified as low achievers in reading/spelling included 24 children (11 boys and 13 girls) who had a mean C.A. of 82 months.

Materials

The language materials used as stimuli in the reading and spelling tests consisted of 24 words and 24 nonwords. The 24 words were chosen in such a way as to be equally divided in terms of orthographic regularity (regular and exception), word frequency (high and low frequency) and word length (2, 3, and 4 syllables). In each of these 12 sub-categories there were two word-items.

Orthographic regularity: One half of the words (12 words), equally divided in terms of frequency and length, were orthographically "regular" since all the constituent letters (and especially the vowels) were spelled in the simplest (phonetic) form, i.e. ε , ο, ι (or - η - in two of the words and - υ - in one of them). So,

there were 6 regular words chosen from each frequency level (with two words from each word length category). Examples of regular words are: "βροχές", "πράσινος", "τραπεζάκι" (from the high frequency group) and "στόλος", "πρόγονος", "πλανόδιος" (from the low frequency group). The other 12 words were regarded as "exception" words since they were spelled in all possible forms developed by the "historic orthography" of the Greek language, i.e., αι, ε, ω, ο, ι, η, υ, ει, οι. In every exception word, two syllables were spelled with vowel digraphs of historic orthography (αι, οι, ει). The exception words were similarly equally divided in terms of frequency and length category. So there were 6 exception words from each frequency level (involving two words from each word length class). Examples of exception words are: "παίζει", "πηγαίνει", "ετοιμάζει" (from the high frequency group) and "κοινοί", "πείθομαι", "ειρηνικοί" (from the low frequency group). At the time of testing the children participating in the study had already been taught all the digraphs of historic orthography included in the word testing materials.

Word frequency: In the absence of standard frequency accounts in Greek, half of the words were sampled from the first part of the language book used in the first year of primary school nationwide. These were words which the participants had already come across at least one or two months before the testing. For the participants of this study these words were regarded as words of high frequency. Examples of these words are: "βροχές", "πράσινος", "τραπεζάκι" (from the group of regular words) and "παίζει", "πηγαίνει", "ετοιμάζει" (from the group of exception words). The other 12 words were selected from the language books used in the sixth year of primary school nationwide and did not occur in the language books of the first grade. For the participants of this study these words were regarded as words of low frequency. Examples of these words are: "στόλος", "πρόγονος", "πλανόδιος" (from the group of regular words) and "κοινοί", "πείθομαι", "ειρηνικοί" (from the group of exception words). In each frequency class the words were equally divided in terms of regularity and word length characteristics. An effort was made to match the corresponding words of each frequency level in terms of consonant complexity.

Word length: There were three, syllable based, word length classes (2-syllable, 3-syllable and 4-syllable) each made up of 8 words, equally divided in terms of regularity and frequency levels. So, in each of the three word length classes there were 4 regular words (two from each frequency level) and 4 exception words (two from each frequency level). Examples of these words are: "βροχές", "στόλος", "παίζει", "κοινοί" (from the 2-syllable word group), "πράσινος", "πρόγονος", "πηγαίνει", "πείθομαι" (from the 3-syllable words) and "τραπεζάκι", "πλανόδιος", "ετοιμάζει", "ειρηνικοί" (from the 4-syllable word group).

From the list of words, a corresponding list of 24 pronounceable nonwords was constructed by changing one or two consonants of the word so that each nonword had the same vowels as, and a similar consonant complexity to the word it had been derived from. Examples of the nonwords thus created are: "κλοχές" (derived from the word βροχές), "στόγονος" (πρόγονος), "βηλαίνει" (πηγαίνει), "ρείλομαι" (πείθομαι), etc.

Procedure

Testing in word and nonword reading was done on an individual basis in one session. The order of presentation of the word or nonword list was counter-balanced among the participants. The stimuli were presented one at a time on a portable computer screen. Each stimulus was preceded by a visual and acoustic marker. The visual marker was a rectangle 1.2 x 5 cm, appearing in the middle of the screen, in which the item would be presented in lower case letters of 0.5 cm size. The appearance of the visual

marker was accompanied by a short acoustic marker lasting 1 sec.

The children had been instructed to press the space bar for an item to appear on the screen and they had to read it aloud as quickly as possible in front of a microphone connected to a tape recorder. When the reading of the presented item was over, the experimenter pressed a prespecified key on the keyboard to have the item disappear from the screen. The order of presentation of the items of each list (of word and nonwords) was random but the same for all children. Prior to the presentation of each list, five similar items were used as practice items in order to familiarize the children with each task.

The whole duration of the testing procedure for each child was tape-recorded for the detailed measurement of the reading time for each item and the reading accuracy evaluation.

Testing of word and nonword spelling was group administered in the classroom on different dates.

Scoring

Scoring of each child's performance in word and nonword reading was based on the measurement of reading time and accuracy of each item. The reading time results were calculated from the items read correctly. In order to obtain the reading time (from onset of stimulus presentation to the completion of its pronunciation) the sound data of the tape recorder were transferred into an IBM compatible computer by using a sound blaster. So for each item we could have on the screen a spectographic presentation of the sound data of each item read, from the moment of the acoustic marker until the end of the child's pronunciation. In this way not only we were able to specify the total reading time for each item, but we could also divide the total reading time into the so-called "recognition time" (from onset of stimulus presentation until the moment prior to initiation of pronunciation) and "pronunciation time" (from onset of pronunciation until its completion). Although this process was painstaking and laborious, it was worth doing since it enabled us to have an idea of how the processing time was spent.

Scoring of reading accuracy involved two aspects: the number of accurately read items and the type of reading errors. The reading errors were classified into phonological, visual and derivational errors.

Spelling errors were classified as phonological or phonetic when the word produced sounded like the target word. In Greek these are errors which are expected to occur mainly in words spelled in "historic orthography". Alternatively, an error was classified as non-phonological or visual if the word produced had lost its phonological identity. Nonword spelling was assessed in terms of phonological accuracy.

Results

Reading

Reading time: Table 1 presents the means and standard deviations of reading times in msecs, taken by the children of each group to read a word and nonword. The reading time scores that are shown are: the reading time taken for the completion of the reading process (*total reading time*), which is then divided into two subscores, one for *recognition* and the other for *pronunciation.* An ANOVA of the total reading scores showed that there was a significant group effect, $F(2, 129) = 30.74$, $p < .001$, according to which the low achieving children required almost twice as much time for word and nonword reading as the normal achieving children. *Post hoc* Scheffe multiple comparisons showed that words were read significantly faster than nonwords by the normally achieving children, which, however, was not the case for the low achieving ones. (In fact, the low achieving

children exhibited higher scores for word than nonword reading which nevertheless were not significantly different.) The most interesting point of these results (which is clearly shown in Figure 1) seems to be the finding that the reading time differences between the two groups of children or between item classes (words and nonwords) were largely due to time spent for recognition and not for pronunciation of each item. The impression one gets looking at Figure 1 is that the children, irrespective of their literacy development level, spent more or less the same time in pronouncing an item regardless of whether it was a word or nonword (the only exception was the difference between normally and low achieving children in word reading where the difference was significant at $p < .05$ level). This is likely to mean that the pronunciation time represents entirely the time for overt articulation of the written stimulus, which follows the completion of the process for its cognitive recognition. It is the differentiation, therefore, at this stage of the reading process (i.e., the recognition stage) which is likely to reflect the children's differences in reading. Therefore, the low achieving children, in comparison to the normally achieving ones, are slow in reading because they need more time to complete the cognitive processes for the recognition of a word or a nonword.

A further analysis of the recognition reading times on the basis of word regularity is shown in Table 2. What is interesting (and, to a certain extent, unexpected) about these results is that the time needed for recognizing an orthographically regular word did not differ significantly from the time required for the recognition of an orthographically exception word. This tendency applied to both groups of readers and it could be interpreted as being due to the fact that the children were likely to have reached a stage of development where they could not be affected by the spelling differentiation of the different types of words. In addition, such results could be taken as an indication that the rule-learned grapheme-phoneme inconsistencies of the "exception" words are learned quickly by the children and, since they apply almost to every such spelling pattern, after a certain stage the children treat them as usual cases. This supports the notion that reading of Greek seems to be influenced by the regular character of the Greek spelling system.

The impact of the clearly defined and open syllabic structure characterizing the Greek language is also evident in the results of Table 3,

Table 1
Means and standard deviations (in parentheses) of reading times (recognition, pronunciation, total) in msecs for each word and nonword by the children of the two groups

Groups of children	Word reading time			Nonword reading time		
	Recognition	Pronunciation	Total	Recognition	Pronunciation	Total
Normal achievers in reading / spelling ($N = 20$)	1900.4 (786.6)	1061.0 (176.2)	2961.5 (767.6)	2508.3 (864.2)	1113.3 (141.8)	3621.7 (879.5)
Low achievers in reading / spelling ($N = 24$)	4567.8 (1203.2)	1275.7 (273.0)	5843.6 (1224.5)	4194.0 (1483.2)	1189.6 (296.9)	5383.6 (1518.5)

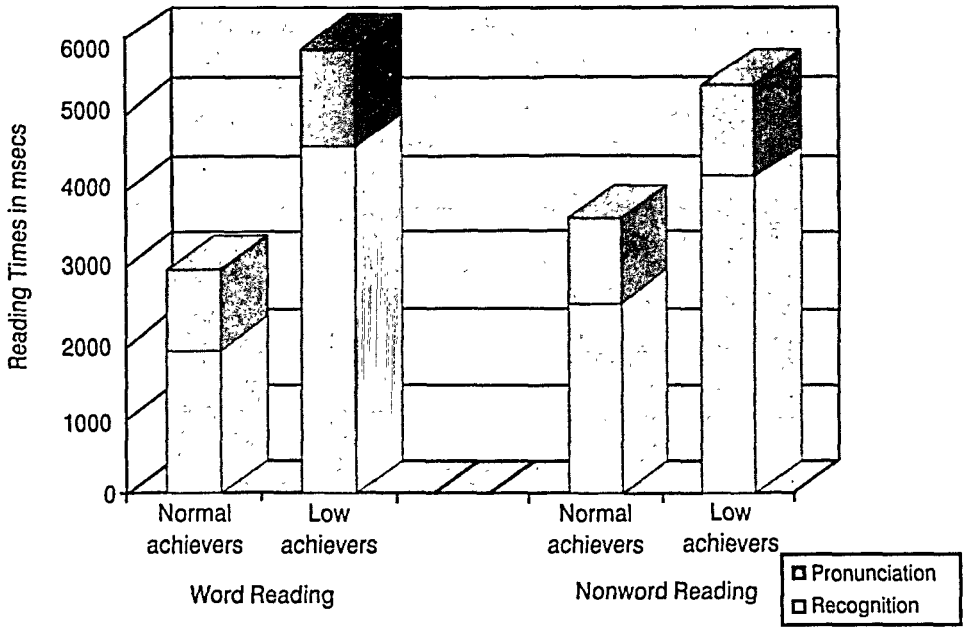

Figure 1
Mean reading times for recognition and pronunciation in msecs for each word and non-word by the children of the two groups.

where word and nonword reading times are presented in terms of word/nonword syllable number. The strong syllabic effect which is evident in the reading performance of both groups of children, $F(2, 129) = 21.34, p < .001$, is an indication that the present young readers were likely to employ a reading process based on phonological recoding of the well defined syllabic units and their subsequent combination.

Reading accuracy: Table 4 presents the mean percentages of accuracy achieved by the children of the two groups in reading words and nonwords. The results show that the primary-one grade Greek children were reading words and nonwords with high accuracy. Although, as was excpected, the reading accuracy difference was significant between the two groups of children, both for words ($p < .001$) and nonwords ($p < .05$), there was not any significant accuracy difference between reading of words and nonwords in either group of children. The first point emerging from these results is that all children (irrespective of their achievement level) could phonologically recode almost any type of written item with a high degree of success. The second point (which comes out if we compare the reading times and the accuracy rates of the children's reading performance) is that for the young Greek readers, the main index reflecting the level of reading development is likely to be the recognition reading time and not the accuracy rate. Therefore, it might well be that the consistency of the Greek writing system facilitates the young readers' phonological recoding of almost any type of lexical item but it eliminates neither the children's differences nor the different

Table 2
Means and standard deviations (in parentheses) for recognition times in msecs for regular and exception words by the children of the two groups

Group of children	Word category	
	Regular words	Exception words
Normal achievers in reading / spelling (N = 20)	1852.1 (845.1)	1948.8 (1589.2)
Low achievers in reading / spelling (N = 24)	4801.2 (780.6)	4334.5 (1055.4)

Table 3
Means of reading times in msecs for each word and nonword (on the basis of syllable number) by the children of the two groups

Group of children	Words			Nonwords		
	2-syllable	3-syllable	4-syllable	2-syllable	3-syllable	4-syllable
Normal achievers in reading / spelling (N = 20)	2428	3043	3412	2990	3834	4040
Low achievers in reading / spelling (N = 24)	5022	5459	7046	4835	5324	5990

processing requirements of various written stimuli. All these differences seem to be clearly reflected in the reading times performance.

Reading errors: The types of reading errors made by the children of the two groups in reading words and nonwords are shown in Table 5. Since the normal and low achievers had not made any error of the refusal type ("I do not know") either in word or nonword reading, the errors were classified into phonological and visual type. From the results it is clear that there were no errors which could be attributed to incorrect grapheme-phoneme recoding. The errors that were made were exclusively classified as visual errors where one or two letters (usually the last letter) were mainly omitted or changed.

Spelling

Spelling accuracy: The mean percentages of correctly spelled words (separately for orthographically regular and exception words) and nonwords are presented in Table 6. An ANOVA of the total spelling accuracy scores showed that there was a significant group effect, $F(2, 129) = 34.57$, $p < .001$. *Post hoc* Scheffe multiple comparisons showed that the low

Table 4
Mean percentages and standard deviations (in parentheses) of accuracy for word and nonword reading by the children of the two groups

Group of children	Item category	
	Total words	Total nonwords
Normal achievers in reading / spelling (N = 20)	96.0 (7.2)	94.7 (6.7)
Low achievers in reading / spelling (N = 24)	83.6 (15.7)	86.4 (12.3)

Table 5
Mean percentages of reading error types (phonological or visual) for words and non-words by the children of the two groups

Group of children	Word errors		Nonword errors	
	Phonological errors	Visual errors	Phonological errors	Visual errors
Normal achievers in reading / spelling (N = 20)	0	3.9	0	5.2
Low achievers in reading / spelling (N = 24)	0	16.3	0	13.5

achieving children were significantly less accurate both in word spelling ($p < .001$) and in nonword spelling ($p < .05$). However, it is worth noting the high accuracy rate in nonword spelling achieved by both groups of participants. The level of nonword spelling accuracy was by far significantly higher (at $p < .001$ level) than the corresponding level of word spelling accuracy for every group of children. This is a clear indication of the employment of an alphabetic process in nonword spelling.

But the most interesting (although expected) finding was the great difference (at $p < .001$ level) in spelling performance between regular and exception words in both groups of children (although it was more greatly evident in the case of the low achieving children). This means that words were spelled using an alphabetic strategy. If the words deviated from regular orthography (as happens with the so called "exception words" which follow the "historic orthography" spelling) then the possibility of spelling them correctly was related to their frequency level. This means that only highly frequent exception words could be spelled correctly.

Spelling errors: Table 7 presents the mean percentages of spelling errors categories made by the children of the two groups in word and nonword spelling. The most interesting findings from those results were the following: firstly, the absence of phonetic errors in nonword spelling in both groups of children, which is likely to mean

Table 6
Mean percentages of correctly spelled words and nonwords by the children of the two groups

Group of children	Words			Nonwords		
	Regular	Exception	Total	"Regular" derived	"Exception" derived	Total
Normal achievers in reading / spelling (N = 20)	36.2*	21.0*	57.2	42.4*	46.6*	89.1
Low achievers in reading / spelling (N = 24)	31.4*	7.8*	39.2	34.0*	40.6*	74.6

Note: * Maximum score = 50

Table 7
Mean percentages of spelling error types (phonetic or visual) for words and nonwords by the children of the two groups

Groups of children	Word class				Nonwords			
	Regular words		Exception words		Total words		Total nonwords	
	Phonetic errors	Visual errors	Phonetic errors	Visual errors	Phonetic errors	Visual errors	Phonetic errors	Visual errors
Normal achievers in reading / spelling (N = 20)	12.0	1.6	28.5	.8	40.6	2.4	0	10.8
Low achievers in reading / spelling (N = 24)	10.2	8.3	37.1	5.2	47.3	13.5	0	25.3

that the children's erroneous spelling production was due either to phonological memory factors (of the unfamiliar stimulus heard) or to producing the corresponding word. The second point worth mentioning is the occurrence, by far excessive, of phonetic errors in word spelling. This was mainly due (as was expected) to exception words. In the case of regular words, the occurrence of phonetic errors was not caused by inability to applying the phonological strategy but was due to some words which were spelled with the vowel - η - and not the - ι - . It can be seen therefore that the analysis of reading errors adds weight to the hypothesis that the children are highly likely to apply the phonological strategy in their spelling.

Discussion

The aim of the present study was to examine the reading and spelling strategies employed by first grade Greek children (after they had recei-

ved about six months of literacy instruction), in relation to *developmental stage models* and the *dual foundation model* of literacy put forward in the English language. In addition we wanted to see whether the strategies that are used are related to the children's level of literacy achievement.

The main conclusions from the findings of the present study could be summarized as follows: first, there was a clear difference in the performance of the two groups of children, since the normally achieving children read, both words and nonwords, better (in terms of reading time and accuracy) and spelled them more accurately than the low achieving children. Secondly, there was a considerable resemblance in the patterns of reading and spelling performance (that reflect the underlying processes of reading and spelling) exhibited by the children of the two groups. This is based on the performance of the two groups according to which:

- Reading of nonwords was highly accurate.
- There were no "refusal type" reading errors in nonword reading.
- The reading errors were not phonetic.
- Regular and exception words were read in a more or less similar manner.
- Reading performance was affected by the word/nonword length in terms of syllable number.
- Nonword spelling was highly accurate and much better than word spelling.
- Regular words were spelled much more accurately than exception words.
- The spelling errors were mainly phonetic in the case of words, but not phonetic in the case of nonwords.

On the basis of these results it could be argued that the low achievers have reached a stage of literacy development which, in terms of the pattern of strategies used, is likely to resemble that of normal achievers. This assumption is not in line with Frith's (1985, 1986) suggestion that the low-achievers in the English language normally exhibit a developmental arrest at the logographic stage. However, since there was no evidence for the existence of such a developmental arrest it could be assumed that, by exhibiting such performance, the participants of this study seem to have acquired sufficient knowledge of phonological information which could be used efficiently (although not at the same pace by both groups) in processing word reading and spelling.

In the case of reading it seems highly likely that the children of both groups read words by employing a process in which they use the knowledge of phonological factors and, in addition, the specific knowledge for the rule-governed pronunciation of the digraphs existing in the exception words. So, there is no possibility that the children of either group read using a logographic process. This conclusion is supported by the findings that both normal and low achievers could read nonwords very accurately (by using grapheme-phoneme conversion rules) as well as exception words (by applying the knowledge of the rules directing the pronunciation of the constituent digraphs). Further support was also provided by the findings of the types of reading errors and the existence of a word length effect. From all of the above it could be concluded that in reading Greek, children from ordinary schools, after six months of schooling, did not read logographically but performed the reading process by phonologically recoding any type of written item of the Greek language. This conclusion is not in line with Marsh et al. (1981) and Frith's (1985) assertion that the logographic stage is a natural and necessary first step in the process of learning to read till the age of 7, when, the transition of the child's cognitive development from the preoperational stage to the stage of concrete operations, permits the acquisition of the alphabetic strategy. Contrary to this theory, the children of the present study, at the age of 7, were already reading using a phonologically based strategy. A plausible explanation for this may be the phonemic transparency of the Greek spelling system and the tea-

ching method of reading used in the first grade. Both these factors make possible the use of grapheme-phoneme correspondences for the recognition of words or nonwords and the sounding out of the grapheme sequences. This is in line with similar findings in consistent orthography like German (Mannhaupt, Jansen, & Marx, 1997; Wimmer & Hummer, 1990; Wimmer, Landerl, Linortner, & Hummer, 1991) as well as with earlier findings from the Greek language (Porpodas, in press).

In addition, the present study found that the reading time difference between normal and low achievers is due exclusively to the cognitive processing that is needed for the recognition of words and not for their pronunciation. From the tape recording of the children's reading it is evident that, as a rule, almost all children applied the following procedure when they were reading: (1) They processed each item (sometimes with evident subvocalizing) on a syllabic basis and they did not start pronouncing it until they had completed its recognition. (2) When they started pronouncing the item, they pronounced it continuously, more or less as adults do, and not syllable-by-syllable. This is probably why pronunciation time is almost similar across the children's reading efficiency level or the lexical identity of the stimuli (words or nonwords). This reading behavior might well be a result of the teaching method used in primary schools which encourages the proper pronunciation of the word and, consequently, "forces" the children to apply a subvocalizing processing of the word (on syllable-by-syllable basis) until its recognition.

Another interesting question is whether the children's reading could be regarded as being in the *alphabetic, orthographic* or *morphographic* phase (in terms of Seymour's model). Bearing in mind that Greek children (taking advantage of the consistency of the Greek orthographic system) are likely to start reading by using the alphabetic process and, additionally, that the children in this study were tested when they had completed almost six months of reading and spelling instruction, it is highly likely that, at the time of testing, they had passed the alphabetic phase. Consequently, it could be argued that the children (at least the good readers) employ a reading strategy of the morphographic phase. This suggestion seems to be supported by the following findings. First, by the pattern of results which emerges when we compare word and nonword reading. More specifically, in the case of the normal achievers there was a word effect (mainly in RT and less so in accuracy). This seems to indicate that the normal readers, in translating print to sound, do not proceed simply by assigning sound to graphemes and blending them together in a bottom-up way. If that were the case there would not be any differences between word and nonword reading. The most likely reason is that the children had reached a stage where they can use a syllabic code. Such online assembling of syllables is also enhanced by the high consistency of vowels in Greek. However, since the syllabic units in words occur in a more familiar lexical environment, then a word superiority effect would not be unexpected.

The second finding that seems to support the children's morphographic processing, is the word and nonword length effect (in terms of syllables) which is clearly evident in word and nonword reading.

In the case of spelling, as has already been mentioned, one of the main findings was that children who were low achievers exhibited a poorer understanding and use of phonological information in their spelling than normally achieving children did. This was not surprising and it is in line with findings in the English language (Bruck & Waters, 1988; Cromer, 1980; Lennox & Siegel, 1993). However, looking at the patterns of spelling performance of the two groups of children it could be assumed that first grade spellers in the present study, regardless of their performance level in lireracy development, are likely to spell a word not by "reading out" the word's orthographic form from memory but by deriving its orthographic form on the basis of

their knowledge about sound-spelling correspondences. This assumption is based on the following three sources of evidence. First, that spelling of nonwords was highly accurate and even better than the spelling of words. Secondly, that regular words were spelled much more accurately than exception words and, thirdly, that word spelling errors were phonetically accurate. This interpretation is also supported by similar findings of an earlier study with beginner spellers of Greek (Porpodas, 1999).

In conclusion, from the findings of the present study it seems highly likely that young readers and spellers of Greek rely mainly on phonological information knowledge for processing reading and spelling of words. This seems to be true for normal and low achieving children and it could be mainly attributed to the consistency of the Greek spelling system.

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