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Reading Development in Greek

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Abstract

There is an extensive literature on reading development in English; however, the research carried out in other languages is more limited. The aim of the present study is to examine reading acquisition in Greek. Because of the characteristics of the Greek orthography it was assumed that Greek children would rely on phonological processing in the beginning of reading acquisition and that phonological processing will allow for the development of the orthographic lexicon. In order to test these hypotheses the study explored the word and non-word reading performances of primary school children, assessing effects attributed to phonological processing. In addition, effects that are assumed to be the manifestation of lexical processing were also assessed. The fact that most developmental studies on reading have been performed in English, which has a deep writing system, makes exploring reading in languages with different orthographic features even more interesting.

Key words: reading development, Greek, word reading, non-word reading, lexical processing, phonological processing

Introduction

Learning to read is a task that children find quite difficult; having a set of seemingly bizarre scribbles and trying to extract the linguistic message from them may seem to children just beginning to learn to read as an unusual act. Various abilities that do not develop automatically from experience with the spoken language need to develop in order for a child to become a skilled reader, for example, understanding that letters stand for different sounds, accessing the appropriate lexical representations for a set of letters, integrating the results of orthographic decoding with syntactically-driven parsing operations (Bryne, 1996; Stanovich, 1986). Children need time and instruction to master the skills needed for reading acquisition.

1.1. Reading Development

In the literature there exist various models of reading development assuming that, the strategies children use in order to read emerge in a particular sequence. Stage models hold a common assumption that children first start reading based on the visual rather than the sound structure of words, and then move to sequential phonological strategies and finally phonological strategies along with lexical strategies are used resulting in a fully developed reading ability (Cotheart, 1978; Marsh et al. 1981; Frith, 1985, etc.).

1.2. Reading in different orthographies

The models of reading development assume that stages of reading development are more or less uniform across different alphabetic languages. However, different languages fall in various parts in the continuum in terms of orthographic transparency. Several researchers have suggested that orthographic transparency may have an effect on literacy development. In transparent languages, which have very consistent mappings from spelling to sound, grapheme-to-phoneme correspondences should be easier to detect and used in reading.

In less transparent orthographies, identifying and using grapheme-to-phoneme conversion rules is more complex; in such orthographies it seems more useful to initially learn larger spelling patterns, such as onset-rime, and then use visual strategies (for example, analogy) for reading new words (e.g. Wimmer & Hummer, 1990; Thorstad, 1991; Wimmer & Goswami, 1994; Cossu, Shankweiler, Liberman & Gugliotta, 1995; Hanley et al., 2004). The differences in reading accuracy and reading speed between different orthographies has been suggested to be due to differences in the nature of the orthography in terms to phonological transparency and the difference in reading strategies developed for different orthographies (Ziegler & Goswami, 2005).

1.3. Reading Development in Greek

Researchers have explored reading development in Greek (even though research is more limited) with similar results and conclusions (Porpodas, 1989; Porpodas, 1999; Goswami, Porpodas and Wheelwright, 1997; Chrysochoou & Bablekou, 2011; Chrysochoou, Bablekou, Masoura, & Tsigilis, 2013a) suggesting that the decoding system that has developed for Greek speaking children seemed to be significantly more robust than the decoding system that has developed for English speaking children. The systematic relationships between individual letters and individual phonemes, which is typical in Greek (estimated consistency 95% for reading and 80% for spelling; Protopapas & Vlahou, 2009), enables children to develop a fully specified orthographic lexicon in which representations are underpinned at the phonemic level.

1.4. The present study

The aim of the present study is to examine reading acquisition in Greek. Because of the characteristics of the Greek orthography it was assumed that Greek children would rely heavily on phonological processing in the beginning of reading acquisition and that phonological processing will allow for the development of the orthographic lexicon. In order to test these hypotheses the study explored the word and non-word reading performances of primary school children, assessing effects attributed to phonological processing, i.e., length effects. In addition, effects that are assumed to be the manifestation of lexical (orthographic) processing, a frequency effect for word reading and word-likeness effects for non-word reading, were also assessed.

Materials and Methods

2.1. Participants

The sample consisted of 120 Greek-Cypriot primary school students who are native Greek speakers. There were four age groups: thirty students from the second grade of primary school (mean age = 7;6 months), thirty from the third grade (mean age = 8;8 months), thirty from the fourth grade (mean age = 9;5 months) and thirty from the fifth grade (mean age = 10;4 months). The male: female proportion was roughly 1:1. All students that took part in this study were chosen so that their academic performance was rated as ‘normal’, i.e., not exceptionally low, neither exceptionally high, by their school teachers.

2.2. Materials

The participants were given two tasks: single word reading and non-word reading.

2.2.1. Real word reading list

The real word list consisted of 40 words forming a 2x2x2 factorial design in terms of length (short/long) x frequency (high/low) x spelling regularity (morphophonemic/exceptional spelling). Long words were four- and five-syllable words and short words were two- and three-syllable words. In the single word reading list a third factor was included, that of spelling regularity. Thus, half of the words were morphophonemic words (MP)[1] and half were exception words. Table 1 summarizes the word reading list characteristics.

[1] Morphophonemic words can be spelled correctly by employing knowledge of phoneme-grapheme rules and morphological rules in spelling, whereas, the correct spelling of **at least one** sound in the exception words needed to be retried from memory.

Table 1: Characteristics of the items on the word reading list

Length	Short (2-3 syllables/4-7 letters)				Long (4-5 syllables/8-12 letters)			
Frequency	High		Low		High		Low	
SpellingR	MP	Exc.*	MP	Exc.	MP	Except.	MP	Except.
No. of words	5	5	5	5	5	5	5	5
Example	Κάρτα card /karta/	Τυρί cheese /tiri/	Άγγελος angle /agelos/	Δύσπνοια difficulty breathing /dispnia/	Σταματάω stop (I) /stamatao/	Γραμματόσημα stamps /gramatosima/	Μαρμελάδα jam /marmelada/	Ηφαίστειο volcano /ifestio/

*Exception words

2.2.2. Non-word reading list

The non-word reading list included forty items. The non-words formed a 2 x 2 factorial design in terms of length (long / short) and word-likeness (word-like/ not word-like). Short non-words consisted of two and three syllables and long non-words were made from four and five syllables. Word-likeness was measured by means of subjective ratings of Cypriot University students asked to listen and rate 60 non-words using a 5-point scale, from 1: very word-like, i.e., sounds very much like a real word in Greek, to 5: not at all word-like, i.e., does not sound at all like a Greek word. Table 2 summarizes the non-word reading list characteristics.

Table 2: Non-word reading list characteristics

Length	Short		Long	
Word-likeness	Word-like	Not word-like	Word-like	Not word-like
No. of non-words	10	10	10	10
Example	Σότα /sota/	Λάντο /lado/	Φιλάτροπος /filatropos/	Ποτραλάμι /potralami/

2.3. Procedure

The single word and non-word reading tasks were administered individually in a quiet room in the participant's school. Half of the children in each age group were firstly given the word reading test, followed by a short break, and then followed the non-word reading test. The rest of the children were given the two tasks in a reversed order. The testing procedure was completed in one session lasting up to 15 minutes.

The word and non-word reading tasks were administered using a computer software, in order to collect naming latencies. A fixation point appeared on the screen for 500ms followed by the target item. The stimulus stayed on screen until the participant initiated a response. The items were presented in a large font (size 48) and all letters were lower case. A different random order of the words and non-words was generated for each participant. For the non-word reading task it was explained to the children that the task consisted of 'made up' words that they would not recognize, but they should attempt to read them. A correct response was when correct grapheme-phoneme correspondences were used. Prior to receiving each reading task, the children were given five practice items to familiarize them with the items and the task, and with the need to read the items as quickly and accurately as possible. Errors were recorded on line and testing sessions were recorded on audiotape.

3. RESULTS

3.1. Singe word reading

3.1.1. Analysis of errors

Percentage error rates were calculated for the real words. Means were calculated by subjects and by items. A summary of the by-subjects data is given in Table 3 according to length, frequency, regularity and grade.

Table 3: Mean percent correct for single word reading according to length, frequency, spelling regularity and reader grade (standard deviations are in brackets).

	Short				Long			
	High		Low		High		Low	
Grade	MP	Expect.	MP	Expect.	MP	Expect.	MP	Expect.
2nd	97	9	93	92	93	93	84	83
	(4)	(3)	(5)	(9)	(4)	(8)	(3)	(6)
3rd	100	100	95	95	100	99	87	86
	(0)	(0)	(4)	(3)	(0)	(2)	(4)	(7)
4th	100	100	99	100	100	100	100	99
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)
5th	100	100	100	100	100	100	100	99
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)

The word reading performance of the fourth and fifth grade children is almost perfect so an analysis for accuracy was only carried out for the second and third grades.

ANOVAs were conducted on the subject and item means. The variables were grade (2nd and 3rd), length (short / long), frequency (high / low) and spelling regularity (morphophonemic / exception words). There was a significant effect of length: F1 (1,58) = 66.09, p<.0001, F2 (1,38) = 63.97, p<.0001, with fewer errors made for short words than long words. Fewer errors were made for high frequency words than low frequency words: F1 (1,58) = 156.50, p<.0001, F2 (1,38) = 97.60, p<.0001. The effect of spelling regularity was significant by subjects but not by items: F1 (1,58) = 92.35, p<.0001, F2 (1,38) =3.39, p=.052. The interaction of length and grade was significant: F1 (1, 58) = 5.10, p<.0001, F2 (1,38) = 23.49, p<.0001. Simple main effects revealed that the effect of length was significant for both grades [second grade: F1 (1,58) = 104.94, p<.0001, F2 (1,38) = 108.82, p<.0001 and third grade: F1 (1,58) = 33.52, p<.0001, F2 (1,38) = 36.87, p<0001]. Inspection of the means reveals that there is a larger length effect for second grade than for third grade; but this could be due to a ceiling effect, as accuracy levels of third grade children were very high for short words.

A length x frequency interaction was also significant: F1 (1,58) = 51.45, p<.0001, F2 (1,64) = 37.66, p<.0001 (see Figure 2.2). Simple main effects revealed that the length effect was significant for both high and low frequency words [low frequency words: F1 (1,106) = 119.87, p<.0001, F2 (1,32) = 117.05, p<.0001, high frequency words: F1 (1,106) = 5.79, p=.016, F2 (1,32) = 4.58, p=.040]. Inspection of the means reveals that for long words the difference between high frequency and low frequency words is larger than that for short words. Again there is the possibility of a ceiling effect as high accuracy levels exist for short word reading. All other two and three way interactions and the four way grade x length x frequency x spelling regularity interactions were either not significant or were not robust.

To sum up the above results, the word reading accuracy improves from second to fifth grade, with fourth and fifth grade children reaching perfect performance. Significant effects of length and frequency were present: with short words being read more accurately than long words and high frequency words being read more accurately than low frequency words. Also, the length x grade and length x frequency interactions were found to be significant; however, these interactions may be due to ceiling effects as the accuracy for short word reading is at high levels.

3.1.2. Analysis of latencies:

Response latencies corresponding to mispronunciation errors, null responses, and spoiled trials, typically as a result of the microphone not registering the child's response, were removed from the latency analyses (2.5% of responses were removed). A summary of the by-subjects data is given in Table 4 according to length, frequency, spelling regularity and grade. Figure 2.3 shows the overall mean latencies for the four grades (in ms).

Table 4: Mean naming latencies (in msecs) for the single word items according to length, frequency, regularity and reader grade (standard deviations are in brackets).

	Short				Long			
	High		Low		High		Low	
	MP	Expect.	MP	Expect.	MP	Expect.	MP	Expect.
2nd Grade	840 (68)	851 (11)	1210 (226)	1197 (29)	1094 (100)	997 (25)	1106 (147)	1127 (98)
3rd Grade	828 (164)	838 (95)	943 (222)	988 (291)	932 (166)	939 (198)	898 (92)	905 (245)
4th Grade	741 (69)	751 (59)	861 (230)	848 (270)	818 (101)	799 (256)	809 (150)	871 (101)
5th Grade	710 (156)	720 (83)	828 (202)	835 (282)	815 (152)	818 (191)	876 (63)	900 (239)

ANOVAs were conducted on the subject and item means. The variables were grade (second, third, fourth and fifth), length (short / long), frequency (high / low) and spelling regularity (morphophonemic / exception words). There was a significant effect of grade: $F1 (3,116) = 16.61$, $p < .00001$, $F2 (3,96) = 11.46$, $p<.0001$. Post-hoc comparisons using Newman-Keuls tests revealed that in both the by-subjects and by-items analyses the fourth and fifth grade children had shorter latencies than the third and second grade children (all $p<.01$). Additionally, second grade children had longer latencies than the third grade children ($p<.01$). The comparison between the fourth and fifth grade was not significant. There was a significant effect of length: $F1 (1,116) = 440.65$, $p < .0001$, $F2 (1,96) = 95.63$, $p<.0001$, with latencies for short words being shorter than those for long words. The latencies were significantly shorter for high frequency words than low frequency words: $F1 (1,116) = 608.96$, $p < .00001$, $F2 (1,96) = 128.70$, $p<.0001$. The effect of spelling was not significant: $F1 (1,116) = 7.53$, $p > .05$, $F2 (1,96) = 8.21$, $p>.05$.

The length x frequency interaction was found to be significant: $F1 (3,116) = 58.69$, $p < .0001$, $F2 (1,96) = 23.52$, $p<.0001$. Simple main effects revealed that the length effect was significant for both low frequency words: $F1 (1,232) = 317.08$, $p < .00001$, $F2 (1,32) = 35.24$, $p<.0001$ and high frequency words: $F1 (1,232) = 26.32$, $p = .0003$, $F2 (1,32) = 10.56$, $p=.0031$. Inspection of the means reveals that the difference between short and long words is larger for low frequency words than for high frequency words.

The three way, grade x length x frequency interaction was significant: $F1 (3,116) = 6.17$, $p=.0006$, $F2 (3,96) = 13.94$, $p=.0015$ (see Figure 2.5). Separate ANOVA revealed that in the second grade the length x frequency interaction was significant by subjects $F1 (1,29) = 4.30$, $p = .047$, but not by items $F2 (1,32) = 2.23$, $p = .075$, for the third grade the length x frequency interaction was not significant: $F1 (1,29) = 3.88$, $p =.058$, $F2 (1,32) = 1.13$, $p = 0.12$, for the fourth grade the length x frequency interaction was significant: $F1 (1,29) = 9.38$, $p =.0048$, $F2 (1,32) = 8.77$, $p = .0075$, and similarly for the fifth grade: $F1 (1,29) = 5.27$, $p =.029$, $F2 (1,32) = 11.08$, $p = .002$. Inspection of the means reveals that there is no interaction between frequency and length for the second and third grade; however, there is a length x frequency interaction for the fourth and fifth grades. The remaining interactions were either not significant or were not robust.

To summarize, latencies decreased across the grades. Children have shorter latencies for short words than long words and for high frequency words than low frequency words. For the fourth and fifth grades there was a length x frequency interaction, with short words being read faster than long words only when the word was of low frequency. For second and third grade children's performance such an interaction did not exist, there was an effect of length for both high and low frequency words.

3.2. Non-word reading

3.2.1. Analysis of error:

Percentage error rates were calculated for the non-words. Means were calculated by subjects and by items. A summary of the by-subjects data is given in Table 5 according to length, word-likeness and grade. Figure 1 shows the mean non-word reading accuracy according to grade.

Table 5: Mean percentage correct for non-word reading according to length, word-likeness and reader grade (standard deviations are in brackets).

	Short		Long	
	Word-like	Not word-like	Word-like	Not word-like
2nd Grade	95 (1.6)	87 (1.0)	86 (6.4)	80 (1.6)
3rd Grade	96 (1.0)	90 (3.0)	91 (2.5)	86 (6.4)
4th Grade	100 (0.00)	99.7 (1.0)	97 (0.9)	94 (1.4)
5th Grade	100 (0.00)	99.4 (0.1)	95 (1.0)	95 (1.8)

Figures

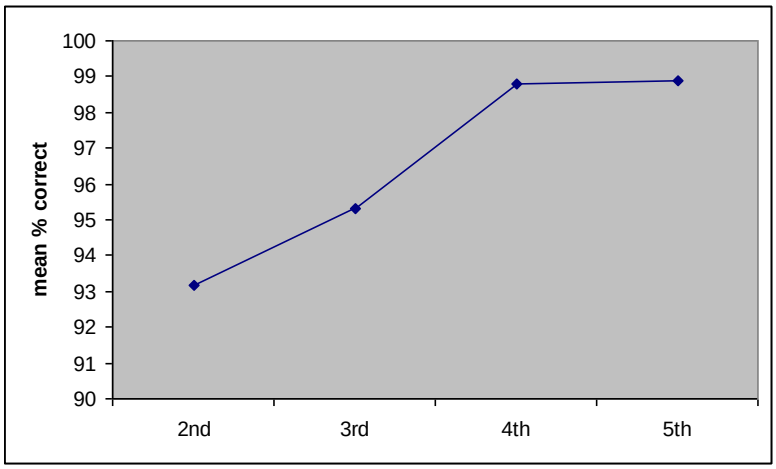

Figure1. Mean non-word reading accuracy for the four grades

The word reading performance of the fourth and fifth grade children is almost perfect so an analysis for accuracy was only carried out for the second and third grades. ANOVA were conducted on the subject and item means. The variables were grade (second and third grade), length (short / long) and word-likeness (word-like / not word-like). There was a significant effect of grade: F1 (1,58) = 63.81, p<.0001, F2 (1,38) = 68.54, p<.0001. Post-hoc comparisons using Newman-Keuls tests revealed that, in both the by-subjects and by-items analyses, the errors made by the third grade children were significantly less than those made by the second grade children (p<.01). There was a significant effect of length: F1 (1,58) = 100.29, p<.0001, F2 (1,38) = 53.09, p<.0001, with fewer errors made for short non-words than long non-words. The effect of word-likeness was also significant: F1 (1,58) = 44.04, p<.0001, F2 (1,38) = 68.54, p<.0001, with more errors made for not word-like non-words than for word-like non-words.

The interaction of length and grade was significant: F1 (1,58) = 3.35, p=.021, F2 (2,38) = 2.89, p=.039. Simple main effects revealed that the effect of length was significant for both grades: second grade F1 (1,58) = 60.04, p<.0001, F2 (1,38) = 41.94, p<.0001, and third grade F1 (1,58) = 16.76, p=.0001, F2 (1,38) = 8.60, p=.0039. Inspection of the means reveals that the difference between short and long non-words for second grade children is larger than the difference for third grade children. All other interactions were not significant.

In summary, non-word reading accuracy improved from second to third grade and plateaus at the fourth and fifth grade (see Figure 2.6). There are strong length and word-likeness effects for the second and third grade.

3.2.2. Analysis of latencies:

Mean naming latencies were calculated by subjects and by items for each of the four grades, latencies of incorrect responses were excluded from the analysis. A summary of the by-subjects reading latencies is given in Table 6 according to length, word-likeness and grade. Figure 2 summarizes latencies according to grade.

Table 6: Mean naming latencies for non-word reading according to length, word-likeness and reader grade (standard deviations are in brackets).

	Short		Long	
	Word like	Not word like	Word like	Not word like
2nd Grade	1257 (336)	1425 (279)	1468 (121)	1672 (127)
3rd Grade	1033 (194)	1239 (140)	1301 (203)	1539 (102)
4th Grade	892 (139)	1031 (620)	1105 (546)	1279 (196)
5th Grade	862 (197)	965 (245)	1077 (335)	1125 (206)

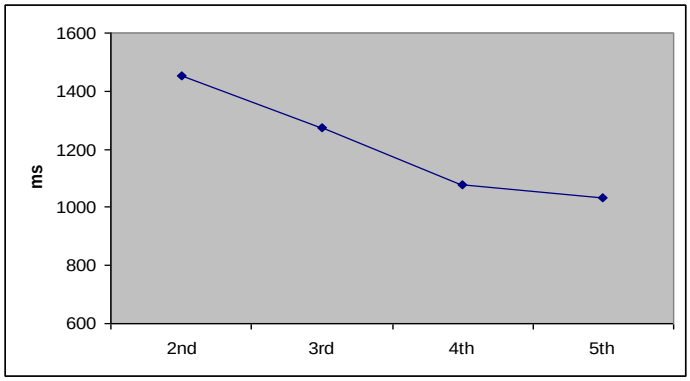

Figure 2. Mean naming latencies for non-word reading

ANOVAs were conducted on the subject and item means. As for the errors analysis, the variables were grade (second, third, fourth and fifth), length (short/ long) and word-likeness (word-like/not word-like). There was a significant effect of grade: F1 (3,116) = 24.21, p <.00001, F2 (3,108) = 14.56, p<.0001. Post-hoc comparisons using Newman-Keuls tests revealed that in both the by-subjects and by-items analyses the fourth and fifth grade children had significantly shorter latencies than the third and second grade children (all p<.01) and third grade children had significantly shorter latencies than second grade children (p<.01). The comparison between the fourth and fifth grade was not significant. There was a significant effect of length: F1 (1,116) = 81.63, p < .00001, F2 (1,108) = 43.72, p<.0001, the reading latencies were significantly longer for long non-words than for short non-words. The effect of word-likeness was also significant: F1 (1,116) = 100.08, p < .00001, F2 (1,108) = 73.25, p<.0001, the latencies were significantly shorter for word-like non-words than nonword-like non-words.

The interaction of word-likeness and grade was significant: F1 (3,116) = 20.91, p < .0001, F2 (3,108) = 17.89, p<.0001. Simple main effects revealed that the word-likeness effect was significant for all grades, second : F1 (1,116) = 96.70, p<.0001, F2 (1,144) = 73.25, p < .00001, third: F1(1,116) = 66.79, p < .00001, F2 (1,144) = 60.01, p<.0001, fourth: F1(1,116) = 31.03, p < .00001, F2 (1,144) = 24.13, p<.0001, fifth: F1(1,116) = 29.32, p < .00001, F2 (1,144) = 18.25, p<.0001. Inspection of the means reveals that the difference between word-like and not word-like non-words is larger for the second and third grade than the fourth and fifth grade. All other interactions were either not significant or were not robust.

Summarizing, non-word reading latencies decreased from second to third grade and plateaus at the fourth and fifth grade (see Figure 2.8). There is a strong length effect for all grades and a strong word-likeness effect for the second and third grade and not so strong for the fourth and fifth grades.

4. DISCUSSION

The aim of the present study was to assess Greek-Cypriot children's reading performance (accuracy and latency) using word reading and non-word reading tasks. The purpose was to explore the factors that affect children's word reading performance and investigate the type of reading strategies employed. Considering the transparent phonological structure of the Greek orthography it was expected that even the youngest children taking part in the study would achieve high levels of reading ability. Additionally, it was expected that all children would employ both lexical and phonological strategies when reading, depending on the type of word being read – e.g., high frequency words are supposed to be read using the lexical route whereas low frequency words through the sub-lexical route.

Findings showed that high word reading accuracies exist for children in all grades. The word reading accuracy of the fourth and fifth grade children is close to perfect. Word reading accuracy improved from second (89%) to third grade (95%). For non-word reading, overall children had high accuracy rates ranging from 87% for the second grade children to 97% for the older children. Non-word reading accuracy improved from second (87%) to third grade (94%) and from third to fourth (98%) and fifth (98%) grade where accuracy was almost perfect. A point that needs to be noted is that there were no reading refusals during reading words or non-words. A conclusion based on these findings can be that, reading Greek accurately seems like a straight forward and easy process and poses a limited number of problems even to young children.

The findings of this study are in line with cross-linguistic studies that have shown that progress in reading is a lot faster in transparent orthographies compared to opaque orthographies. Results for reading accuracy are also consistent with those obtained from earlier studies of Greek were children show high accuracies in single word reading. In English, it has been generally found that reading accurately seems to be more challenging. It seems likely, therefore that the nature of the Greek writing system, is the reason for the children's highly accurate performances in reading Greek. In Greek, there are systematic relationships between individual letters and individual sounds which facilitate children to develop a fully specified orthographic lexicon in which representations are underpinned at the phonemic level.

Since children exhibit high accuracy rates for word and non-word reading it seems that the crucial indicator of children's ability in processing the Greek writing system is the time children required to read words and non-words (latency). In the reaction time measures younger children exhibited a significant delay in the word reading and non-word reading tasks in comparison with older children. This finding suggests that it is preferable to explore reaction times rather than accuracy scores when evaluating the reading performance of children and more importantly evaluating the difficulties children face during reading.

In respect to word reading and non-word reading latencies, it was found that for word reading second grade (1050 ms/word) children read words significantly slower than third grade children (935 ms/w), third grade children had significantly longer latencies than fourth grade children (844 ms/w). Fourth grade children had slightly longer latencies than fifth grade children (813 ms/w) but the difference was not significant. Children's non-word reading latencies decrease dramatically from second (1456 ms/non-word) to third grade (1278 ms/nw) and from third to fourth (1077 ms/nw) grade and show a very small decrease from fourth to fifth (1007ms/nw) grade.

The word reading list and the non-word reading list included items that differentiated words in respect to their length. The lists were developed to address the issue of whether there are differential effects of number of syllables on word and non-word naming latencies. A length effect was present both for word and non-word reading for children of all grades. Children had shorter latencies for short words than long words, as well as having shorter latencies for short non-words than long non-words. These findings are an indication of the phonological processing in reading Greek. For word reading the length effects illustrates that the word was processed using phonological processing, at least to some considerable extend. These results are in line with studies indicating that length affects the visual recognition of words (e.g., Morrison & Ellis, 2000, Burani et al., 2001; Raman et al., 2004).

From the present findings it can be suggested that the word length factor has its greatest effect at the earlier stages of reading acquisition, since for word reading it was found that the interaction of length and grade was significant with a larger length effect for second grade than for third grade children.

So it seems that younger children rely more on the sub-lexical process during reading and as time goes by children are able to read more words through the lexical-route, hence, limiting the contribution of phonological processing. However, even if the length effect is more robust in the smaller grades it does not become redundant for older children; all children were found to use phonological processing strategies during reading.

The frequency effect was also significant for all children for single word reading, with children exhibiting shorter latencies for high frequency words than low frequency words. The contribution of frequency suggests that word reading in Greek does involve lexical access. The interaction of length and frequency found to be significant only for older children (fourth and fifth grade), where the length effect was found to be significant for low frequency words and not for high frequency words, suggests that the lexical route processes high frequency words quickly so the non-lexical route makes little or no contribution to the naming of these words. On the other hand, low frequency words allow a substantial contribution from the non-lexical route, which processes words serially, hence short words are read faster than long words. The finding that the length x frequency interaction is not present for the second and third grade children may suggest that younger children rely heavily on phonological processing and there is a more substantial contribution of the sub-lexical route in word reading, even for high frequency words that are supposed to be processed through the lexical route. The presence of a length x frequency interaction in the word decoding process of children in the fourth and fifth grade suggests that high frequency words are decoded mainly by the lexical route. It can be argued that even though both phonological and lexical processing takes place in reading Greek words, younger children show more reliance in the phonological processing whereas older children show more reliance in the lexical processing of words.

During non-word reading children showed a word-likeness effect, with word-like non-words being read faster than not word-like non-words. Cascade processing of the dual-route cascade model (Coltheart et al., 1993) allows non-words to activate orthographically similar words in the orthographic lexicon and this activation then feeds down to the phonological lexicon and the phoneme system. Phonemic activation generated from the lexical route paired with the correct non-lexical processing facilitates reading of word-like non-words, thus the translation for word-like non-words is faster that that not word-like non-words.

The significant frequency effect for word reading and the significant word-likeness effect for non-word reading being present for all grades, even for younger grade two children suggest that children reading Greek do not solely rely on phonological mediation during reading, but also have developed an orthographic lexicon that allows the use of the lexical route (Route L) when reading words and non-words. However, the lexical procedure did not entirely replace phonological mediation, as suggested by the fact that length effect was present for all children.

In conclusion, the present study shows that Greek word recognition is affected by the length, and frequency of the word, and children especially older ones read using both phonological and lexical reading strategies. It could be supposed that, since Greek has regular grapheme-phoneme correspondences, the non-lexical route would have a larger contribution to naming Greek words and that the non-lexical route would be faster in Greek than what is in less transparent orthographies, e.g., English; so lexicality effects, like word frequency, would not have a large effect in Greek word recognition. However, the present study suggests that the lexical processing does play an important role in reading Greek since a significant frequency and word-likeness effects were found and also the interaction between length and frequency was significant for older children.

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