Cognitive and linguistic predictors of literacy skills in the Greek language. The manifestation of reading and spelling difficulties in a regular orthography.

by

Dimitris S. Nikolopoulos

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ABSTRACT

The aim of this thesis was three-fold: firstly, to examine the development of reading and spelling abilities in the Greek language; secondly, to identify the cognitive predictors of reading and spelling skills; and finally, to establish how developmental dyslexia is manifested in the regular Greek orthography.

An extensive battery of cognitive, linguistic, and literacy tasks was administered to 132 children: 66 Grade-2 and 66 Grade-4 Greek-speaking children attending four different schools in Athens, Greece. The battery included: tests of reading, spelling, and mathematical attainment; a nonword reading task, various phonological awareness & other phonological processing tests; a non-verbal intelligence test; and various syntactic awareness tasks. Evidence on the manifestation of developmental dyslexia in Greek was based on a chronological-age and a reading-level matched-pairs comparison between poor and average readers.

Despite a large number of difficult polysyllabic word stimuli, reading accuracy was at ceiling for most subjects. Reading speed proved a more effective measure of individual differences. A high degree of accuracy was also observed on many phonological awareness tests. Rapid naming, phonological awareness and speech rate proved the most important predictors of reading ability in the regular Greek language. The predictive value of many variables/tests, however, appeared to differ between English and Greek. Phonological awareness - the most powerful and stable predictor in English - appeared to be a reliable predictor of reading ability only at the initial stages of literacy development (Grade-2). The most significant

predictor at Grade-4 was rapid naming. Speech rate consistently predicted reading skill in all our analyses. Syntactic awareness proved not a reliable predictor. Its contribution was significant only for spelling ability at Grade-4. The matched-pair comparisons supported the above results.

Results are discussed in relation to the existing differences in the orthographic structure of the English and Greek languages. It is suggested that the examination of linguistic differences is important, both, from a theoretical and clinical point of view.

Acknowledgments

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This thesis is dedicated to my grandfather, Professor Nikolaos Kisthinios.

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Chapter 1. THEORIES OF LITERACY ACQUISITION

Chapter 1.1 Introduction

The development of reading and spelling abilities in normal and reading disabled children has been a topic of enduring interest and extensive research over the past few decades. Today, this field of research can claim significant breakthroughs in the mystery of literacy acquisition. The significant theoretical advances that have been made over the last twenty or so years have broadened our understanding of children's or adult's word recognition system, the development of literacy skills at different ages, and those factors that may influence or predict the development of these skills.

The different theoretical accounts offered by dual-route models (e.g. Baron & Strawson, 1976; Coltheart, 1978, 1985; Forster & Chambers, 1973; Marshall & Newcombe, 1973; Morton & Patterson, 1980; Paap & Noel, 1991; Patterson & Morton, 1985); cognitive-developmental models (e.g. Frith, 1985; Marsh, Friedman, Welsh, and Desberg, 1981; Seymour and MacGregor, 1984), and connectionist models of reading and spelling (e.g. Brown & Loosemore, 1994; Plaut, McClelland, & Seidenberg, 1996; Seidenberg & McClelland, 1989) appear to reflect not only the existence of alternative and in some instances rather opposing views on the same psychological phenomenon, but also the gradual refinement of our knowledge of the psychological processes involved in reading and spelling. Each of these three major approaches to reading and spelling processing are examined below.

Chapter 1.2 Dual-Route Models of Word Recognition

One of the major theories of word recognition is dual-route theory (e.g. Baron & Strawson, 1976; Coltheart, 1978, 1985; Foster & Chambers, 1973; Marshall & Newcombe, 1973; Morton & Patterson, 1980; Paap & Noel, 1991; Patterson & Morton, 1985). According to this theoretical framework skilled readers can process written words on the basis of two functionally independent psychological procedures: a direct visual (lookup) procedure and an indirect phonological (sublexical) procedure. The lexical procedure is used for the recognition of familiar or exception words, and the phonological procedure for the decoding of novel words or words with a non-lexical entry (pseudowords). The lexical procedure (route) is thought to exploit the direct association between a whole word orthographic pattern, and a word's pronunciation and/or meaning. This route operates by retrieving the pronunciation of known words stored in the mental orthographic lexicon (see Figure 1-1, pathway A). For this reason, the lexical route is an efficient and fast way of reading familiar words, or exception words, where the application of spelling-to-sound words would lead to an incorrect pronunciation. Application of this route, however, to pronounceable pseudowords fails because, by definition, there are no lexical entries for nonwords in the mental orthographic lexicon.

The phonological procedure, on the other hand, exploits a sublexical routine which relies on a set of grapheme-to-phoneme conversion (GPCs) rules. This procedure leads to the mental lexicon in an indirect way (see Figure 1-1, pathway B). Printed words or letter strings are translated (through the application of GPCs rules) into phonological codes, which are then used to access lexical (Gough, 1972; Rubinstein, Lewis & Rubinstein, 1971) or semantic information (Coltheart, Masterson, Byng, Prior, & Riddoch, 1983). This procedure allows the correct pronunciation of nonwords, unfamiliar words, low frequency words, and difficult words that conform with the spelling rules of the language. Its application, however, to exception words leads to incorrect responses, and more especially to "regularization errors": e.g. the word

'pint' is pronounced as if it rhymed with 'mint'. In the case of regular words, both procedures generate the correct pronunciation, but, on the basis of different means.

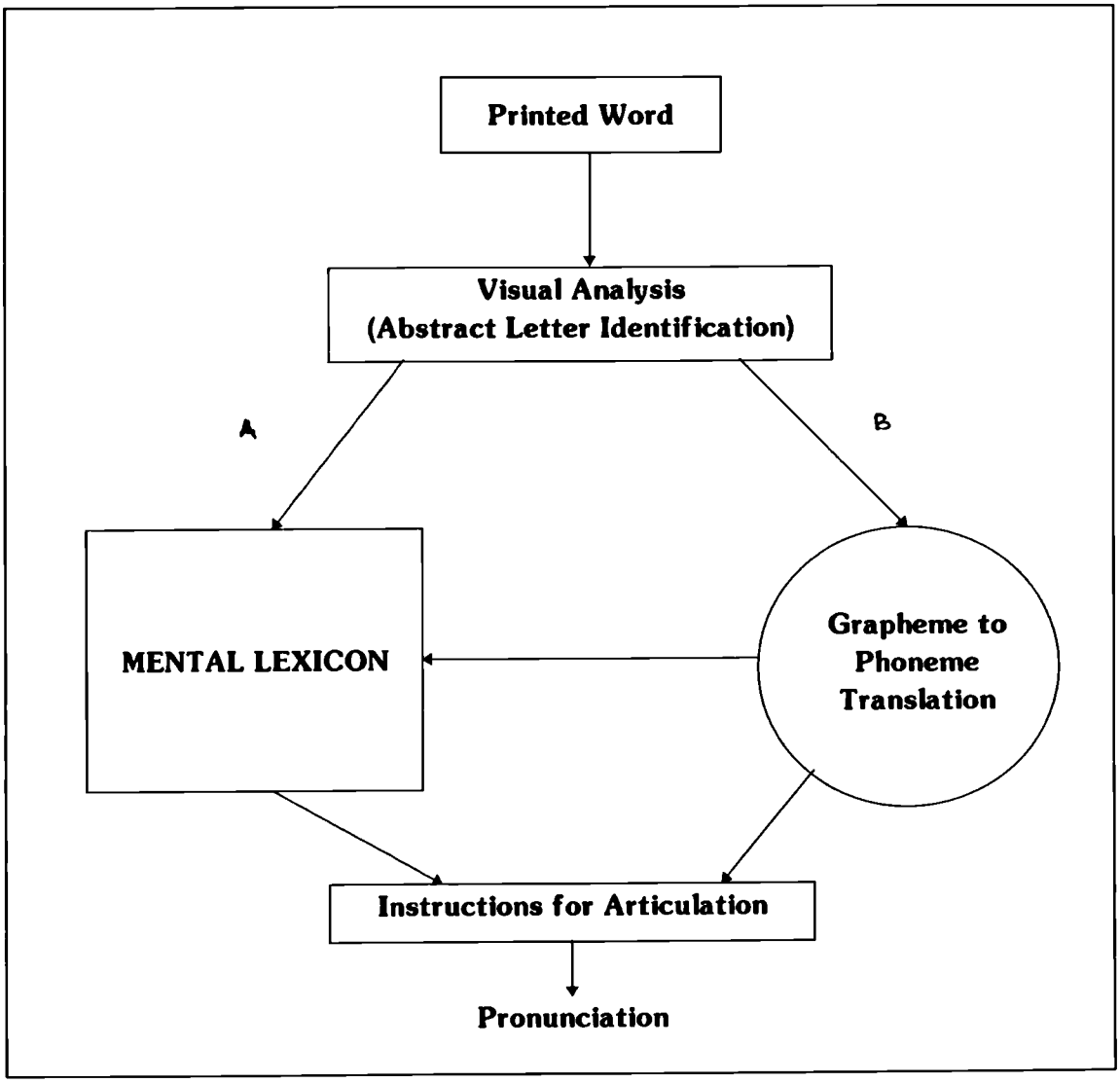

Figure 1-1 Two route model of the reading process (After Coltheart, 1980)

In most of the initial conceptualizations of dual-route models, these two procedures are assumed to run in parallel, leading to a race between them (e.g. Henderson, 1982). For regular words the output of the two routes produces a consistent pronunciation, while for irregular words the two pathways lead to different outputs, yielding interference. This fact explains why regular words are named faster than irregular words (Baron & Strawson, 1976). A number of studies with English lan-

guage stimuli have suggested the dominance of the visual access route, with perhaps, an optional but not preferred phonological route (e.g. Coltheart, Besner, Jonasson, & Davelaar, 1979; Humphreys & Evett, 1985).

Over the years, the dual-route model has established itself as the orthodox theoretical conception of the processes subserving skilled adult reading and spelling (Barry, 1994). Its popularity is due to the fact that these models have succeeded in accounting for a large body of psychological data from adult skilled readers, including cases of surface dyslexia or dysgraphia (where the lexical route is thought to be damaged while the phonological route relatively spared: e.g. Goodman & Caramazza, 1986; Hatfield & Patterson, 1983; Coltheart, 1985), phonological dyslexia or dysgraphia (where the phonological route is thought to be impaired and the lexical route to be relatively intact: e.g. Funnell, 1983; Shallice, 1981), developmental phonological dyslexia (e.g. Temple & Marshall, 1983), and developmental surface dyslexia (e.g. Coltheart, Masterson, Byng, Prior, & Riddoch, 1983; Holmes, 1973).

Despite its popularity, the dual-route theory has not gone unchallenged. Dual-route models, for instance, have been criticized for their strong focus on skilled reading and their rather 'static' description of the mature word recognition system (Seidenberg & McClelland, 1989). Most dual-route theorists have tested the validity of their theoretical formulations either on the basis of data from experiments with adult skilled readers or older cases of acquired dyslexias or dysgraphias. In this way, these models appear to ignore the plausibility of maturational differences in the development of reading or spelling strategies, or the important effect of other social, cultural and educational factors (Frith, 1985).

Questions have also been raised about the independent functioning of the routes suggested by dual-route models. Some theorists claim that the distinction between a visual and phonological route for the processing of regular and irregular words is artificial (e.g. Ehri, 1992; Van Orden, 1987; Plaut et al., 1996; Seidenberg & McClelland, 1989). Ehri (1992) and Van Orden (1987), for instance, have argued that few English word spellings are totally arbitrary (in the sense that they lack letter-

sound relations) and, for this reason, phonological information/processes may also play a role in the recognition of irregular words and the development of a sight vocabulary. Researchers favouring the connectionist approach to literacy development have also pointed out the artificiality of the distinction between visual and phonological processes, arguing, instead, that a single cognitive mechanism may also be capable for the processing of all types of words: avoiding the problematic distinction of regularity and irregularity (Seidenberg & McClelland, 1989)(this approach is more fully analyzed in Chapter 1.3).

The functional independence of the two routes has also been challenged by a number studies showing effects that implicate lexical involvement in the processing of nonwords (Baron & Thurston, 1973; Carr, Davidson, and Hawkins, 1978; Glushko, 1979; Key and Marcel, 1981; Rosson, 1983). Glushko (1979), for instance, found that pseudowords like FEAD (which has as an orthographic neighbour a word with irregular spelling-to-sound correspondences: e.g. DEAD) were pronounced slower than pseudowords whose orthographic neighbours were regular (e.g. FEAL). If FEAD and HEAL had been processed by GPCs alone, as the dual-route theory maintains, then both should have been processed in the same way and there should be no differences in reaction times. Kay and Marcel (1981) have also reported that the pronunciation assigned to an 'ambiguous' letter sequence in a nonword (e.g. the EAD in YEAD) was influenced by the pronunciation of that sequence in a previously presented word: e.g. YEAD being pronounced as /jid/ when the preceding word was BEAD, and, as /jɛd/ when the preceding word was HEAD). This evidence shows that the dual-route account of how we process nonwords cannot be sufficient, since the assignment of phonology to nonwords is open to lexical influence (Humphreys & Evett, 1985). In light of this evidence, insufficient also appears to be the justification offered by most dual-route models (e.g. Coltheart, 1978) for restricting the process of assembled phonology to the use of grapheme-to-phoneme correspondences and ignoring correspondences at other levels.

All these criticisms have gradually led dual theorists to reconsider some of their initial assumptions and propose either new or more refined versions of their models. Patterson and Morton (1985), for instance, have presented a revised version of a dual-route model in which the traditional grapheme-to-phoneme-based sublexical route was supplemented with a "body" system, containing knowledge of correspondences between orthographic and phonological rimes. It has been proposed that these two subsystems work independently, in a 'horse-race' manner, though the exact basis for selecting the output of one system than the other was left unspecified. More in line with a computational implementation of a dual route model, Coltheart, Curtis, Atkins, Haller (1993) have added to the initial dual-route structure an extra GPC learning algorithm, that was reported to perform well on the Seidenberg and McClelland's (1989) training set of words. No strong claims, however, can be made about this model at the moment as the only part of their dual-route cascade (DRC) model that has been implemented is the nonlexical mechanism for inferring the GPCs rules.

Chapter 1.3 Developmental Theories of Reading and Spelling Acquisition.

Developmental theories of literacy acquisition (e.g. Gough & Hillinger, 1980; Ehri, 1990; Frith, 1985; Marsh et al., 1981; Morton, 1989; Seymour and MacGregor, 1984) have taken a different perspective from adult-based dual-route models of word recognition. Within this theoretical framework, reading acquisition, as any other cognitive skill, is viewed as a cognitive developmental process that passes through a number of stages. At each of these stages the developing reader is assumed to approach reading and spelling with qualitatively different cognitive strategies which are characteristic for most children operating at the same stage. In most developmental theories the availability of cognitive strategies in the later stages is assumed to be dependent on the development of earlier strategies. A special emphasis has also been given by these theories on the important effect of environ-

mental factors, and in particular that of explicit reading instruction (e.g. Frith, 1985; Marsh et al., 1981; Seymour & Elder, 1986). Some of the most influential developmental accounts of literacy acquisition are briefly considered below.

Chapter 1.3.1 Marsh, Friedman, Welsh and Desberg (1981)

Marsh, Friedman, Welsh and Desberg (1981) describe the development of reading acquisition in terms of four successive stages. During the first stage of "*linguistic guessing*", children attempt to read words either with a strategy of rote association between the words' unanalyzed visual stimulus and oral response, or by using contextual information to guess their pronunciation and meaning. Children at this stage are unable to respond to novel or unknown words. The second stage is that of "*discrimination net guessing*". Children operating at this stage respond to unfamiliar isolated words with words that have already been learned and which bear some visual similarity with the target word. Initially children are capable of processing only the first letter of the word, and it is only later that they start to take into account other features, such as word length or final letter. Stage three is that of "*sequential decoding*". Left-to-right letter-sound decoding appears to be the predominant strategy of this stage. Children's understanding of the alphabetic principle, however, appears to be rudimentary (i.e. each letter for them represents a single sound) and for this reason children are capable of reading new words only if they are very regular: e.g. CVC words with short vowels like cat. According to Marsh et al. (1981), there appear to be two major factors which lead children to move to the "sequential decoding stage": the first is the gradual increase in the number of sight vocabulary words which places extensive load on their memory, and the second the children's' attainment as defined by Piaget. Stuart and Coltheart (1988) challenged the first proposal on the basis of evidence indicating the absence of a steady rate in the development of children's' vocabulary and evidence demonstrating that the

growth spurt of their word recognition skills was more associated with the mastery of phonics skills rather than the number of words in their sight vocabulary (Davies and Williams, 1974).

The final stage in Marsh et al's (1981) theory is that of "*hierarchical decoding*" where children start to decode words in a more sophisticated way, that is on the basis of high order rules and analogies. Words requiring the application of conditional rules (e.g. knowing that the letter c is pronounced as /k/ when it is followed by a, o, u, and as /s/ when followed by i or e) are no longer difficult for children of this age.

Chapter 1.3.2 Frith (1985)

Another very influential theory of literacy development is that of Frith (1985) who proposes three basic phases: i.e. a logographic phase, an alphabetic phase, and an orthographic phase. The name of each of these three phases is thought to reflect the predominant reading strategies adopted by children at these three landmark points in their literacy development. The order of these three phases was proposed to be strictly sequential and the development of each new strategy to 'capitalize' on the earlier ones. Frith (1985) also acknowledges the similarities between Marsh et al.'s (1981) model and hers, stating that her notion of logographic and alphabetic strategies is analogous to Marsh et al.'s rote learning strategy and sequential decoding strategy, respectively. Marsh et al.'s hierarchical decoding stage was also interpreted either as analogous to her orthographic stage or as an advanced form of her alphabetic strategy.

Word recognition in the "*logographic phase*" is attempted on the basis of salient graphic features (e.g. a word's first letter; word-envelope / length, etc.). Letter order is largely ignored and word recognition is based on partial recognition. Beginning readers are able to recognize only familiar words whose visual stimulus has been previously associated with their corresponding oral response: i.e. development

and use of a 'sight' vocabulary. Gough and Hillinger (1980) describe this stage of literacy development as a stage of paired associative learning. Logographic readers either refuse to pronounce unknown words or guess them on the basis of contextual and pragmatic features. At this phase, spelling is restricted to a few sight words learned by heart. Appreciation of the word's internal phonological structure is thought to take place at the beginning of the "*alphabetic phase*", when children start to use letter knowledge and grapheme-to-phoneme correspondences and conversion rules to decipher novel words or pseudowords. Readers now consider that letter order is crucial because word identification can now also take place using a grapheme by grapheme decoding strategy. Frith considers that mastery of alphabetic skills is crucial, because the development of such phonological skills allows beginning readers to read unfamiliar words independently and expand their sight-vocabulary.

As beginning readers learn more about the alphabetic code, they become able to connect all of the letters seen in spellings to sounds detected in pronunciations, and to detect recurring letter patterns in words (e.g. shared affixes or subsyllabic units such as onsets & rimes); and thus more able to consolidate them into larger orthographic units. Instantaneous analysis of words into multiple-letter orthographic units, without phonological conversion, is considered to be a major characteristic of the final "*orthographic phase*", and a major step to skilled reading and writing. According to Frith (1985) "the orthographic strategy is distinguished from the logographic strategy by being analytic in a systematic way and by being non-visual, and from the alphabetic strategy by operating in bigger units and by being non-phonological" (p.306). No other details, however, are given about this phase.

Within Frith's (1985) framework, developmental progress is explained in terms of an alternating shift in the use and mastery of reading and writing strategies at each developmental stage. The adoption and use of a strategy in one domain is considered to serve as a 'pacemaker' for development of that strategy in the other domain. This explains the causal transition between stages (see Figure 1-2). The beginnings of literacy are thought to lie in the development of logographic reading.

Once beginning readers have developed a sufficient sight-vocabulary in reading, this logographic strategy is then adopted in writing (see Figure 1-2 steps 1a & 1b). Alphabetic writing then becomes the pacemaker for the adoption of alphabetic skills in reading, at stage two (see Figure 1-2 steps 2a & 2b). Frith (1985) suggested that it is through spelling - not reading - that beginners learn the letter-sound mappings and so to appreciate the importance of letter order. These early alphabetic skills are later transferred to reading for the decoding of unfamiliar words. Orthographic reading, at stage 3, becomes the pacemaker for the adoption of an orthographic strategy in writing (see Figure 1-2 steps 3a & 3b).

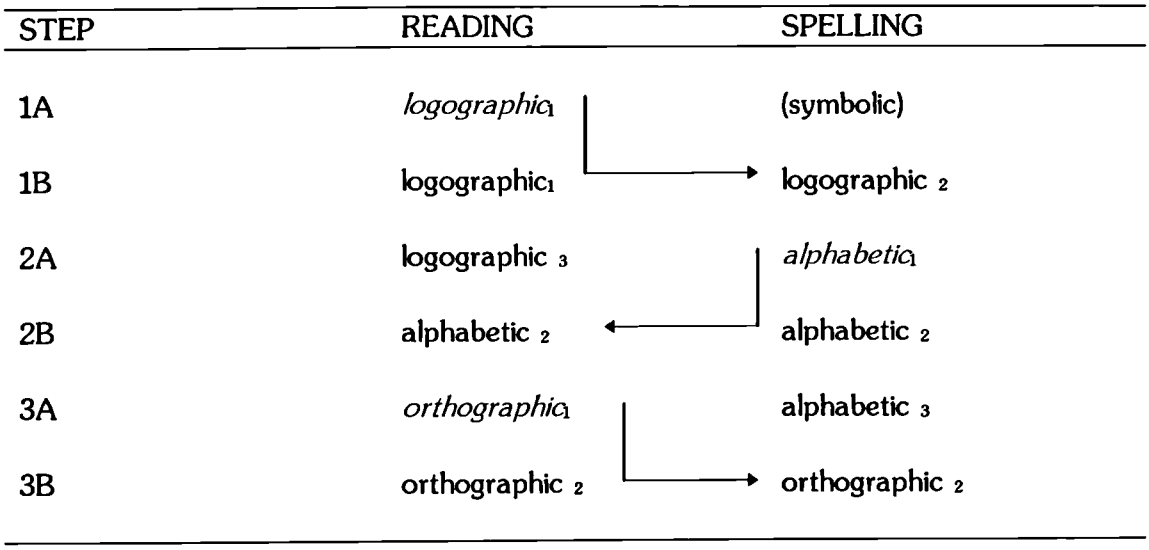

Figure 1-2 The Six-step Model of Skills in Reading and Writing Acquisition (after Frith, 1985).

This developmental framework has also been used by Frith (1985) to explain reading and writing difficulties. 'Classic' developmental dyslexia, for instance, is considered to reflect the arrest of literacy development at the logographic stage (phase 1). Reading, in these cases, remains visually based. Children arrested at this phase fail to make the transition to the alphabetic stage, experiencing severe difficulties with the accurate reading and spelling of nonword stimuli or words that they have not seen before. Frith (1985) acknowledges that, with time and/or remedial help,

development may proceed following arrest, but this is assumed to be atypical. Frith's (1985) theory allows for variability in the manifestation of reading and spelling disorders. The failure in the development of orthographic skills, for instance, is assumed to reflect a developmental arrest at phase two (phase 2b). Children arrested at this intermediate phase of literacy development approximate the reading behaviour of acquired surface dyslexics, exhibiting an over-reliance on alphabetic strategies. This allows these so called 'developmental dysgraphics' a relative degree of accuracy in the reading of regular words but not in the spelling of irregular words which tend to be regularized according to phoneme-grapheme rules (i.e. phonetic errors). A developmental arrest at an even more advanced phase of acquisition, like that of phase 3a (see Figure 1-2) -those being described by Frith (1985) as type-B spellers- results to an atypical cognitive profile of excellent reading performance but very poor spelling competence. This is due to the selective establishment of precise orthographic representations for reading and the premature establishment of imprecise orthographic representations for spelling (Frith, 1985).

Chapter 1.3.3 Seymour & MacGregor (1984)

Seymour & MacGregor, (1984) have also described the development of reading and spelling abilities in terms of three stages. Their model, however, is different from the others in the sense that the three cognitive strategies identified by Frith (1985) are equated with the modular components of an information processing system (Seymour, 1990, p. 165). Following Frith, Seymour & MacGregor (1984) names the first stage of their model "logographic stage", in which words are identified on the basis of their 'wholistic' visual features and their associations with pre-existing semantic and/or phonological representations. A direct connection is drawn between the exercise of a logographic strategy, the establishment of a logographic

lexicon, and that of an analogous word processing system. The second stage in their theory, "*alphabetic stage*", involves the establishment of an alphabetic lexicon based on the acquisition of knowledge between letter-sound correspondences and the development of a "rudimentary grapheme-phoneme and phoneme-grapheme translation device" (Seymour & MacGregor, 1984, p.48). By contrast to Frith's (1985) theory, however, Seymour & MacGregor maintain that the logographic and alphabetic processes are functionally independent and develop concurrently, depending on the teaching regime (Seymour & Elder, 1986). In the third and final stage of Seymour's theory, "*orthographic stage*", children develop a more sophisticated understanding of their orthography after the establishment of an orthographic lexicon which is capable of accounting for the relationship between multi-graphemic units and pronunciation, the conventions of their orthography, and the relations between spelling and meaning (p. 48). The development of this orthographic lexicon is thought to be dependent on the development of alphabetic strategies, that is as an expansion or upgraded version of the alphabetic lexicon. This is only partially in accord with Frith's theory who views the development of orthographic strategy as the outcome of the merging of the two previously developed logographic and alphabetic strategies.

On the whole, the above presentation of some of the most influential developmental theories of literacy acquisition suggests that, despite the existence of differences in the structure of the various theoretical models, most of them favour the same sequence in the development of reading skills. Children learning to read English appear to pass first from a pre-phonological stage of visual cue and paired-associative reading, to an alphabetic stage in which they gain explicit insight into the alphabetic code, and finally to stage when children develop internal multi-letter orthographic representations and a more sophisticated understanding of the workings of their orthographic system.

The theoretical framework suggested by Marsh et al. (1981); Frith (1985); Seymour & MacGregor (1984) and other developmental theorists has proved very useful in explaining, both, normal and abnormal reading and spelling development. The idea of a developmental progression from one phase to the other (after the mastery/consolidation of old and new strategies) has offered developmental models the dual advantage of: a) leaving open the exact timing of such developmental changes/progress according to the individual abilities of each reader, and b) explaining differences in the development of reading and/or spelling competence of beginning readers, attributed by this model to the adoption of new strategies and the asynchronous development of reading and spelling skills. Another advantage of the above mentioned gradual mastery, and dissociation, in the development of reading and spelling abilities is that it leaves 'space' for the development of compensatory strategies (due to a further development of previously mastered strategies) in persons arrested at a certain stage of the model. In this way, developmental theories can account for the existence of different cognitive profiles - and thus for 'heterogeneity' - in the manifestation of developmental reading disorders such as developmental dyslexia.

Developmental theories, like the dual-route models of literacy acquisition, have also been subjected to criticisms with those referring to the sequential nature and the existence of discrete stages in the development of reading skills being the most frequent. Evidence, for instance, has accumulated indicating that not all children pass through the same sequence of stages. Phonologically able English beginning readers (e.g. Stuart & Coltheart, 1988; Seymour, Bunce, and Evans, 1992), or readers learning to read in more transparent orthographies than English (e.g. German: (Wimmer & Hummer, 1990); Brazilian Portuguese: (Pinheiro, 1995); French: (Sprenger-Charolles & Cassalis, 1995) have been found to rely more on a phonological than on a logographic reading strategy: thus skipping the initial logographic stage. The sequential dependence of stages in reading acquisition postulated by

most developmental theories has also been criticized for being unable to account for the selective impairments sometimes observed in developmental dyslexics, who, despite their phonological reading deficits, develop relatively adequate word-recognition skills (Snowling, Hulme, Goulandris, 1994). Furthermore, there is evidence to suggest that beginning readers/spellers may develop a sensitivity to orthographic information earlier than most stage theories seem to suggest. Treiman (1993), for instance, found that, in accord with the spelling constraints of the English orthography, first grade English-speaking children were less likely to use the ck spelling at the beginning of words than at the end. In another experiment with nonwords Treiman (1993) also found that even kindergarten children or first graders declined in more than 50% of the time in selecting nonwords with a ck pattern at the beginning (e.g. ckun) as opposed to nonwords with this spelling pattern at the end of nonwords (e.g. nuck). Cassar & Treiman (in press), have also reported a similar increased level of sensitivity to orthographic information to beginning readers, by showing that even kindergarten children were more likely to chose those stimuli in the experimental list of nonwords which had a consonant cluster at the end (e.g. nuss) than at the beginning (e.g. nnus).

Developmental models have also being criticized for being too descriptive, while leaving many crucial details of the model's workings unspecified (Brown & Loosemore, 1994). Stuart and Coltheart (1988), for instance, have criticized Frith's (1985) model for its inability to provide a detailed account of the reading strategies that are available to the readers in the orthographic stage. Seymour and MacGregor's (1984) model has also been criticized by Stuart and Coltheart (1988) for the unclear definition of their 'wholistic' processing of the logographic stage (as opposed to that of their analytic processing) after the author's statement that 'wholistic' processing may also involve the use of salient letters or group of letters: which according to Stuart & Coltheart creates problems in the conceptualization of the underlying deficits of phonological and morphemic dyslexics (see Stuart and Coltheart, 1988 for a fuller argument).

Chapter 1.4 Connectionist Models of Word Recognition.

Connectionist or neural network models of reading provide a radical alternative to the standard dual-route and stage models of literacy development. A single mechanism is proposed for the processing of both regular and irregular words (e.g. Brown & Loosemore, 1994; Seidenberg & McClelland, 1989). The basic architecture of many computational models usually consists of a set of phonological units; a set of orthographic units; and an intermediate layer of hidden units connecting the two (see Figure 1-3). Each processing unit has an activation value which ranges from 0 to 1. In many models, words are treated as sets of letter triples (e.g. Brown & Loosemore, 1994; Seidenberg & McClelland, 1989). When the pronunciation of a given word is requested, the network activates all the relevant artificial neurons which stand for the target word: e.g. soap = _so, soa, oap, and ap_ (with the symbol _ denoting the beginning or end of a word). By giving the value 1 to all the neurons which are involved in the computation of a word's pronunciation or spelling, and the 0 value to all those which are not, words are represented in the system as unique patterns of 0s and 1s. In Brown & Loosemore's (1994) computational model, for instance, the word *soap* is represented by the pattern 1011100011 while that of *pill* by the pattern 001011100 (Brown & Loosemore, 1994, p. 322). Learning to read and write depends upon the network 'learning' or setting the right strengths of connections between the units used to represent the pronunciation of words and the units used to represent the spelling of words. The weights on connections between units are initially given small random values. The system is then presented repeatedly with words/letter strings, and, with the help of a learning algorithm (which adjusts the weights between the actual output and the target output) is trained to generate the correct phonology/orthographic representation of words (see Seidenberg & McClelland, 1989 for details).

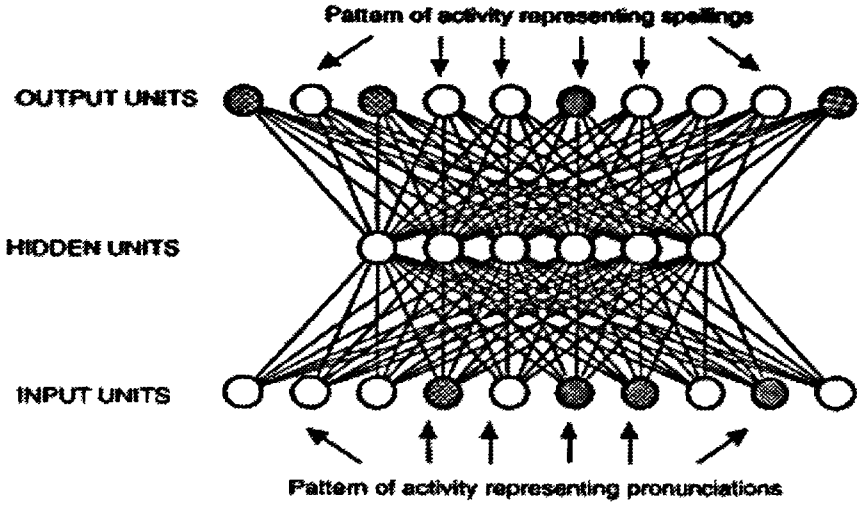

Figure 1-3 The architecture of the connectionist model, only some units and connections are illustrated. (Brown & Loosemore, 1991).

Connectionist models of reading and spelling acquisition have been reported to simulate many aspects of the reading behaviour of normal and dyslexic readers. The models are able to a) 'learn', and, improve its output quality with practice (i.e. the more frequently the network has processed a particular word, the better the output); b) generalize and respond to novel items/nonwords; c) exhibit differences in performance depending on the word's level of processing difficulty (e.g. depressed performance when processing words with many sound-to-spelling 'enemies' or when processing irregular words), and d) exhibit a general decrement in performance for all types of words, after reduction of the number of hidden units (see Brown & Loosemore, 1994; Seidenberg & McClelland, 1989 for more detailed accounts).

The connectionist theory appears to differ from the dual-route and stage-like theories of literacy acquisition in many respects. The existence of the two processing routes - i.e. visual and phonological - and that of a mental lexicon postulated in the dual-route/stage-like theories is denied by connectionist modellers. A single-process mechanism* , instead, appears to be capable of processing regular words,

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*Although see Plaut et al., 1996 for the substantial contribution of a second route/pathway, via semantics.

irregular words, and nonwords (though, see Besner, Twilley, McCann & Seergobin, 1990 for a critique). The development of reading and spelling abilities is viewed as a task of mastering the statistical associations between a set of patterns representing the phonological forms of words, and a set of patterns representing the orthographic forms (Brown & Loosemore, 1994, p. 333). The output of connectionist models appear to improve over time - after sufficient training/exposure to written language - in a similar way to that observed in normally progressing beginning readers. Developmental theories such as Frith (1985) interpret the inability of dyslexic children to develop age-appropriate reading/spelling skills in terms of an 'arrest' at the logographic stage of literacy development, and their failure to develop adequate alphabetic skills to sustain reading and spelling development. In connectionist theories, however, developmental dyslexia is explained more in terms of a limitation on the computational resources available to the network. Training of computational models with fewer hidden units has consistently been found to affect the speed with which the system learns words, as well the quality of their output. The difficulty of dyslexic children to cope with irregular words and nonwords has also been documented in many 'dyslexic' simulations of computational models (e.g. in Seidenberg & McClelland's , 1989 reading model; or in Brown & Loosemore's 1994 spelling model). Impairments in different components of the system (i.e. phonological representations; orthographic representations; hidden units) are also proposed to cause different patterns of reading/spelling disorders: e.g. visual-orthographic deficits, phonological deficits, surface patterns of dyslexia (Seidenberg, 1992).

One of the advantages of the connectionist approach over the other theories of literacy development is that, given its computational structure, it allows more concrete and testable hypotheses about the processes involved in reading or writing than do previous theories which are more descriptive in nature. The use of computer programs (where every single step is defined) to simulate the act of reading and writing has allowed researchers to be more specific/explicit in their formulations,

and, to test in practice whether the assumptions they make and the cognitive processes they postulate are correct and functional in real life.

The fact that exception words are subject to the same set of computational principles as all other types of words also offers connectionist models the additional advantage of simplicity, in the sense that the problematic distinction between regular and irregular words is no longer needed within the connectionist framework (Plaut et al., 1996). A number of researchers over the years have expressed their dissatisfaction over the distinction between regular and irregular words, and the interpretation of regularity effects in word recognition (Glusko, 1979; Parkin, 1982; Plaut et al, 1996; Seidenberg & McClelland, 1989). Plaut et al., (1996) for instance have argued that the marking of exception words not only ignores the fact that most of the letters in these words conform to the regular grapheme-phoneme correspondences, but also that even the parts that are exceptional may conform to some degree of regularity, as in the case of the word pint where the exceptional pronunciation of the /i/ may also occur in other words like mind, or child, nine, etc. This, Plaut et al argue (1996), "prevents these words from benefiting from this partial regularity and from contribution to patterns of consistency it enters into with other items" (p.102). Computation models, they argue, not only avoid such 'unfortunate' distinctions but also they allow these models to exhibit sensitivity to all these partially regular aspects of so-called exception words.

The new theoretical framework proposed by the connectionist approach has been very influential, affecting radically our understanding of the way in which reading and spelling abilities and disabilities may develop. Recent accounts of reading development (Seidenberg and MacClelland, 1989; Plaut at al., 1996) or spelling development (e.g. Brown & Ellis, 1994) can be seen as the gradual move of cognitive psychology towards a more interactive approach where several different sources of knowledge (e.g. phonological, orthographic, semantic) appear to interact in parallel to constrain the operation of the reading/spelling output mechanisms (Brown & Ellis, 1994). The significant impact of connectionist theory to our conceptualization of

normal literacy development is very nicely encapsulated in Frith's words when she states that "stage-like transitions of behaviour may only be a surface phenomenon which may result from their interaction of an unchanging process with changing representations" (Frith, 1994, p. xii). Stated another way, the observed differences in children's' reading and spelling abilities are not interpreted by the connectionist theory as the result of the employment of qualitatively different processing strategies at different stages in their development, but rather in terms of differences in the database (e.g. the size of the vocabulary) over which connectionist models operate (Brown & Ellis, 1994).

The connectionist theory, however, is not without its critics. Several limitations appear to characterize the current connectionist models indicating the need for further research on this area. These are: a) the use of only monosyllable & morphologically simple words in the training corpus (e.g. Pinker, 1991; Pinker & Prince, 1988); the relative difficulty connectionist models have with nonwords (e.g.; Besner et al., 1990; though see Seidenberg & McClelland, 1990 for a reply); the lack of attention paid to the development of orthographic representations (e.g. Plaut et al., 1996) or phonological skills prior to formal reading instruction (Hulme, Snowling, & Quinlan, 1991); and the difficulty connectionist models have in accounting for the contrasting patterns of dysgraphia (i.e. phonological and lexical dysgraphia: Seymour & Evans, 1994).

Chapter 1.5 Summary and conclusions

Descriptions of the cognitive processes/mechanisms underlying literacy development appear to differ, according to the proposed theoretical framework.

Dual-route and developmental theories assume the existence of two processes -i.e. visual route & phonological route- for the pronunciation and spelling of

regular words, irregular words, and nonwords. Most developmental theories view the child as passing through a series of stages, at which different skills are mastered and used: logographic skills, alphabetic skills, orthographic skills (Frith, 1985).

Connectionist models, on the other hand, propose the existence of a single mechanism for the processing of all types of words, and view the development of literacy skills as a process of setting - from the outset - direct mappings between orthography and phonology (Seidenberg & McClelland, 1989).

Although these two views are based on different assumptions, both appear to acknowledge and emphasize the critical importance of phonological strategies/representations to the development of reading and spelling abilities. Within the developmental framework, phonological strategies are considered to be crucial because it is the development of these phonological skills which allows beginning readers to decode unfamiliar words and expand their word vocabulary. It has also been suggested that phonological strategies may also act as a self-teaching mechanism by which beginning readers gradually develop automatic word-recognition skills and become independent readers (Jorm & Share, 1983; Share, 1995). Phonological skills have also been proposed to enable the development of a phonological framework upon which to organize orthographic (Snowling, 1994, p. 126) or morphological information (Seymour & Duncan, 1997).

The quality of phonological -and orthographic- representations is also recognised by the connectionist framework. Damage to the phonological units is assumed to cause deficits in word naming and in tasks requiring access to phonological representations (e.g. Seidenberg, 1992).

The suggestion that the development of adequate phonological skills is crucial to the development, and prediction, of literacy skills is examined in more detail in the next part of the literature review.

Chapter 2. THE COGNITIVE DETERMINANTS OF READING AND SPELLING ABILITIES.

Over the past few decades a considerable amount of research has been devoted to the search for factors that may affect or predict the development of reading and spelling abilities. Instead of looking for factors in the child's environment that may lead to differences in the mastery of literacy skills, cognitive psychologists have directed their investigation to differences in cognitive processes that are intrinsic to the child (Snowling, 1995). This approach has been proved particularly fruitful, and a number of cognitive and linguistic measures has been proposed as possible predictors of literacy skills, including measures of phonological awareness, verbal STM, rapid naming, speech rate, or syntactic awareness. The predictive value of each of these measures will be briefly examined in this section

Chapter 2.1 Phonological Awareness.

One of the most exciting developments of cognitive psychology and extensive research inquiry on literacy development has been the realization and emerging consensus among researchers on the importance of phonological processing skills in early reading and spelling acquisition.

At the heart of these phonological processing skills lies phonological awareness which refers to the ability to reflect explicitly upon the phonological structure of words (Mattingly, 1972; Rozin & Gleitman, 1977). Research evidence indicates that phonological awareness measures are among the best predictors, accounting for large amounts of variance in reading and spelling skills even when the effects of age and IQ are partialled out (e.g. Nation & Hulme, 1997; Wagner & Torgessen, 1987).

The consistency with which most of the phonological awareness measures have been found to correlate and predict later reading development (Bradley & Bryant, 1978; Fox & Routh, 1983; Jorm & Share, 1983; Lieberman, 1973, 1982; Stanovich, Cunningham, & Cramer, 1984) or spelling development (Catalado & Ellis, 1988; Juel, Griffiths, & Gough., 1986; Lundberg, Olofsson, & Wall, 1980; Torneus, 1984) has led researchers to postulate a causal relationship between phonological awareness skills and the development of reading and spelling abilities (Goswami & Bryant, 1990). Further evidence indicating the close, and probably causal, relationship also comes from studies indicating poor levels of phonological awareness in adult illiterates (Morais, Cary, Alegria, And Bertelson, 1979; Morais, Bertelson, Cary & Alegria, 1986); children learning to read non-alphabetic scripts like Chinese or Japanese (e.g. Mann, 1986; Read, Zhang, Nie, & Ding, 1986); dyslexics or other poor readers (e.g. Bruck & Treiman, 1990; Rohl & Tunmer, 1988; Snowling, Stackhouse, & Rack, 1986); and studies indicating the beneficial effect of phonological awareness training on the development of reading & spelling skills (Bradley & Bryant, 1983; Hatcher, Hulme, & Ellis, 1994; Lundberg, Frost, & Peterson, 1988). Phonological awareness difficulties have been so severe and persistent in dyslexics (e.g. Pratt & Brady, 1988; Bruck, 1990) that dyslexia has been characterized as a phonological core deficit (Stanovich, 1988).

The link between phonological awareness and literacy development is now well established. However, there is still some debate over the exact nature of phonological awareness skills and the way the latter relate to and influence literacy development. A large number of cognitive measures has been used over the years to assess phonological awareness, including phoneme and syllable segmentation tasks, matching tasks, phoneme substitution tasks, rhyme & alliteration tasks, sound blend-

ing tasks, phoneme counting tasks, and a number of others (see Adams, 1990; Lewkowicz, 1980; Yopp, 1988 for reviews). Researchers examining the interrelationships between this large number of tests have reported strong correlations amongst them (e.g. Stanovich et al., 1984; Yopp, 1988), but also different ways in which these tests can be grouped together. On the basis of factor analytic procedures, some theorists have argued that phonological awareness is a unitary trait, with most phonological awareness test being measures of the same psychological entity (Stanovich et al., 1984). Others, however, have argued for the existence of rather distinctive, though correlated, factors (Goswami & Bryant, 1990; Lundberg, Frost & Pettersen, 1988; Wagner, Torgesen, Laughon, Simmons, and Rashotte, 1993; Wagner, Torgesen & Rashotte, 1994; Yopp, 1988).

Researchers' interest in distinguishing different types/aspects of phonological awareness skills appears to be closely related to their strong interest in the prediction of literacy skills; and their attempt to establish which aspects of phonological processing have the strongest predictive relationship to reading and spelling at different points in development. Two rather different views exist in the literature. One holds the view that an awareness of phonemes is the most crucial determinant, and predictor, of reading and spelling skills in alphabetic orthographies. The other has put more emphasis on the development of early rhyming skills (Goswami & Bryant, 1990).

Early research on phonological awareness has drawn the distinction between syllable awareness and phonemic awareness (e.g. Liberman, Shankweiler, Fischer, and Carter, 1974). Tasks requiring children to tap the number of phonemes or syllables in words, or to delete a specific phoneme/syllable and pronounce the rest of the word have been the first to be used in the assessment of phonological awareness

skills (e.g. Bruce, 1964). The development of phonological awareness skills has been assumed to proceed from an awareness of syllables to an awareness of phonemes. English speaking children have been found to master syllable awareness skills around the age of four or five, whilst the ability to manipulate phonemes usually does not appear before the age of six or seven when reading instruction comences. (e.g. Bruce, 1964; Gleitman & Rozin, 1973; Liberman et al., 1974). Numerous prediction studies have demonstrated that phonological awareness measures requiring analysis of phonemes were more strongly predictive of reading skill than those requiring analysis of syllables (Lundberg, Olofsson, & Wall, 1980; Mann, 1984; Perin, 1983). Children exhibiting high levels of phonemic sensitivity have consistently been reported to be among the best readers, whilst those lacking this awareness among the worse (e.g. Blachman, 1984; Juel, 1988). Researchers favouring a linear view of syllable structure (see Figure 2-1) have made the claim that learning to read involves segmenting words into units that correspond to the individual phonemes of words and blending the individual sounds together to pronounce the word (Wagner & Torgesen, 1987 p. 195). It is argued that phoneme awareness is vital for the acquisition of literacy skills in alphabetic languages, because phonemes must be mapped to the letters of the alphabet.

A rather different view of the relationship between phonological awareness skills and literacy development has been proposed by Goswami & Bryant (1990), who have placed more emphasis on the development of early rhyming skills. Their argument has been based on an alternative view - i.e. hierarchical view- of the internal structure of English monosyllable words: that of onset (initial consonant or string of consonants) and rime (the vowel and any following consonants)(Treiman, 1985, 1992)(See Figure 2-1).

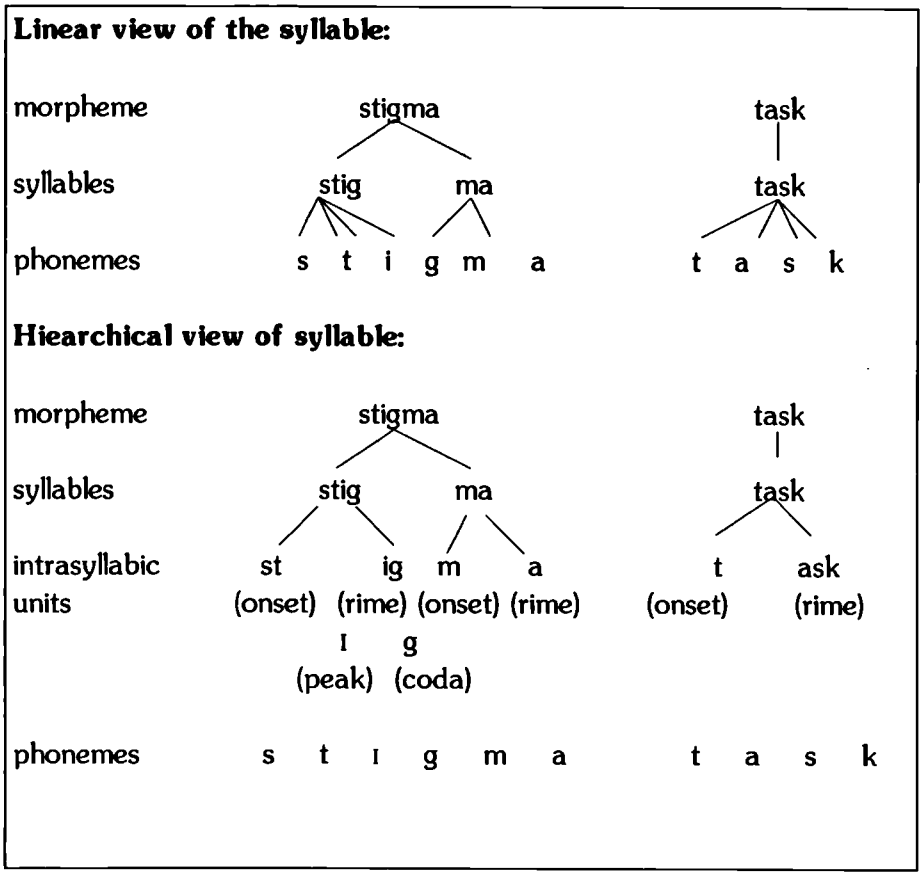

Figure 2-1: Linear and hierarchical views of the syllable. (Treiman, 1992).

It is argued that onset-rime awareness develops naturally prior to the commencement of formal reading instruction, by exposure to rhyming songs and other rhyming activities. The onset-rime distinction has been proved valid in a variety of experimental tasks: i.e. rhyme and alliteration production tasks (Calfee, Chapman, & Venezky, 1972; Maclean, Bryant, & Bradley, 1987); forced-choice rhyme/oddity tasks (e.g. Which word rhymes with bed: sled or ring ?: Lenel & Cantor, 1981); and phoneme deletion tasks carried out at the level of intra-syllabic units (Treiman, 1985). Goswami and Bryant (1990) argued for a direct connection between young children's abilities and interest in rhyming (e.g. Chukovsky, 1963; MacLean, Bryant & Bradley,

1987), their awareness of onset-rime units, and the development of early reading and spelling skills. Rhyming activities were thought to help young children to put words into categories on the basis of sound similarities, and, to understand that words which sound the same are generally read and spelled the same. A specific link between children's analogies in reading and rhyme awareness was also drawn by Goswami and Bryant (1990) to explain the possibility that readers/spellers read and spell on the basis of analogies. Goswami (1986, 1988, 1990) and other researchers (e.g. see Treiman, 1992 for a review) have published a series of studies confirming the use of analogy in reading. Rhyme awareness was also proposed to be an effective way of assessing young children's phonological awareness skills and a reliable and independent predictor of early literacy skills (e.g. Bradley & Bryant, 1983; Bryant, MacLean, & Bradley, 1990; Bryant, MacLean, Bradley, & Crossland, 1990).

Goswami and Bryant's (1990) theory of a naturally occurring progress of phonological sensitivity from syllables, to onset-rime units, to phonemes has been very appealing. Recent evidence, however, reveals that the priority given by these researchers (Goswami & Bryant, 1990) to the onset-rime units may not be completely justified. There is evidence to suggest that young children's awareness of the onset-rime distinction may not develop as naturally as Goswami and Bryant (1990) have suggested. In a number of recent studies, Year-1 and Year-2 children have been found to perform better on phonemic segmentation tasks than on onset-rime segmentation tasks (e.g. Nation & Hulme, 1997; Seymour & Evans, 1994a; Seymour and Duncan, 1997). Seymour and Duncan (1997), for instance, have reported that, in their sample, preschool children with well established rhyming skills at nursery, found segmenting nonwords at the level of onset-peak-coda level (see Figure 2-1) easier than when they were asked to segment nonwords at the onset-rime level at

Year-1 easier. In addition, there is evidence to suggest that phonemic segmentation tasks are also excellent predictors of early literacy skills. A number of studies have reported an even stronger predictive relationship to reading for phoneme segmentation tasks at grade-1, than for onset-rime measures whose contribution has consistently been reported to be significant only at a later stage of development (e.g. Muter, Hulme, Snowling & Taylor, 1997; Nation & Hulme, 1997; Seymour & Duncan, 1997; Wimmer & Landerl, 1994).

All this new evidence appears to contradict many of the claims made by Goswami & Bryant (1990) over the primary role of intra-syllabic units of onset-rime to the development, and prediction, of early literacy skills. What this new body of evidence seems to suggest is that, although preschool children may be aware of the onset-rime distinction, they do not necessarily/automatically use these units to assist reading or spelling (Nation & Hulme, 1997). Furthermore, it suggests that it is the smaller linguistic units of phonemes that are the most important in the early stages of literacy acquisition, and not the larger orthographic units of onset and rime, as suggested by Goswami & Bryant (1990).

Consideration, however, of a more recent description of metalinguistic development (e.g. Gombert, 1992), indicates that the observed inconsistency in the above research findings does not reflect just the existence of two rather opposing views of literacy development, but rather the very complex character of the relationship between the development of phonological awareness and literacy skills (Seymour & Duncan, 1997). Gombert (1992) has recently made the claim that there are two levels of metalinguistic development: an implicit (unconscious) *epilinguistic* level of awareness, and an explicit (conscious) *metalinguistic* level of awareness. Movement from one type of awareness to the other was seen as being dependent on external

factors (e.g. reading instruction) rather than on internal/maturational factors: as it was suggested in Karminoff-Smith's (1986) theory. Using this interesting distinction, Seymour and Duncan (1997) have made the claim that the development of rime awareness in preschool children is implicit (epilinguistic) in nature, and for this reason it does not have an immediate effect on reading at that stage. Introduction of beginning readers to the alphabetic principle (e.g. learning the letters of the alphabet, etc.), on the other hand, they argue, has a direct effect on the development of an explicit (metalinguistic) level of awareness of phonemes. An explicit/metalinguistic level of awareness of rimes, develops only later, when children start to appreciate and use larger orthographic units.

The theoretical framework suggested by Gombert (1992) offers a new perspective in the relationship between the development of phonological awareness skills and the acquisition of literacy skills. Differences in the development, manifestation, and predictive relationship of phonological awareness skills may be attributable not only to the size of the linguistic unit (i.e. syllable, onset-rime, phoneme) but also to the level of metaphonological awareness (i.e. implicit/epilinguistic-explicit/metalinguistic) induced by the linguistic structure of languages and the nature of reading instruction. The explicit emphasis given by these researchers on the important role of external influences to literacy development, is of direct interest to this study, as, both, the orthographic structure of the Greek language and the type of early reading instruction in Greece appear to differ from those in the English language. Both these issues will be further addressed by the present investigation in the Greek language.

Chapter 2.2 Verbal short-term memory

A number of tasks involving phonological processing have been used to investigate the relationship between phonological processing abilities and the development of reading skill, as well as the phonological deficit of dyslexic and other poor readers. Poor performance, for instance, on different types of verbal short term memory tasks (e.g. digit span or word span) is a common finding in most clinical reports of the cognitive profile of disabled readers (Rugel, 1974; Thomson, 1982). Such reports indicate that their use of phonologically based codes and their ability to store phonological codes in immediate phonological memory store is defective (Brady, Shankweiler & Mann, 1983; Brady, Mann & Schmidt, 1987; Jorm, 1983; Torgessen, 1982). Visual short term memory, on the other hand, does not seem to be affected, as most poor readers do not exhibit any difficulty in recalling abstract shapes or nonsense drawings (Hulme, 1981; Katz, Shankweiler & Liberman, 1981; Vellutino, 1979; though see Goulandris & Snowling, 1991 for a contrary view.) but rather when they are asked to recall words (Mark, Shankweiler, Liberman & Fowler, 1977), sentences (Mann, Liberman & Shankweiler, 1980), digits or letters (Katz, Healy, & Shankweiler, 1983).

Strong correlations between phonological awareness measures and reading ability (e.g. see Stanovich, 1992 for a review); or verbal short term memory and reading ability (e.g. Mann, 1984; Rapala & Brady, 1990) are abundant in the relevant literature. Working memory (roughly equivalent verbal short-term memory) makes use of a phonological/speech based code. Baddeley & Hitch (1974), have proposed the existence of a central executive processing system and two peripheral subsystems: the visuo-spatial sketch pad (which holds a limited amount of information in a visuo-spatial code) and the articulatory loop (which holds a small amount of verbal information in a phonological code while being subject to loss of information due to passive decay). Subvocal rehearsal, is of paramount importance for the function of the articulatory loop, as the number of items that can be recalled is thought to depend on the number of items that can be refreshed (by subvocal rehearsal) before

their traces have decayed beyond the point at which they can be recognised at retrieval. Corroborative evidence for the above claims, and especially for the speech based mechanism underlying the articulatory loop comes from studies showing that short words are remembered better than longer words which take more time to be articulated (Baddeley et al., 1975; McDougall, Hulme, Ellis & Monk, 1994), or from studies showing the difficulty that subjects have when they are asked to recall consonants or words that are phonologically similar (Conrad, 1964; Cowan, Cartwright, Winterowd, & Sherk, 1987; Henry, 1991; Hulme, 1984; Hulme & Tordoff, 1989). The parallel increase of memory span with that of the articulation speed is also indicative of the use of a speed based code in this particular cognitive function of working memory. This evidence had initially been interpreted as a measure of how quickly words can be encoded and rehearsed within the decay time of this store and as the main reason for the improvement in memory span with age (Hitch , Halliday, & Littler, 1989; Hulme, Thomson, Muir, & Lawrence, 1984; Hulme & Tordoff, 1989; Hulme & Muir, 1985; Rain, Hulme, Chadderton, & Bailey, 1991).

As verbal short-term memory and reading ability are both mediated by phonology, they are thought to be closely related. One of the first proposals concerning the relationship between verbal short-term memory and reading was that the former provided readers with a storage system during the decoding of unfamiliar words (Baddeley, 1986). When grapheme-phoneme conversion rules are applied to decipher unfamiliar words or low-frequency words, the reader needs to hold the sequence of sounds in the words so that they can be blended together. Efficient phonological coding enables beginning readers to have the maximum amount of cognitive resources available for the difficult task of blending together phonemes to make words (Wagner & Torgesen, 1987). The inability, on the other hand, to maintain the correct sequence of phonemes in short-term memory is considered to be another plausible cause of reading disabilities. This possibility was further investigated by Shankweiler and other researchers (Liberman, Shankweiler, Liberman, Fowler, Fischer, 1977; Shankweiler Liberman, Mark, & Fowler, 1979; Mann, Liber-

man, & Shankweiler,1980) who asked good, average, or poor readers to recall strings of confusable (e.g. b, c, d, p, t) and non-confusable letters (e.g. h, k, q, s, w). Good readers had better overall recall but made more mistakes with the rhyming/confusable letters. No such an effect, however, was found in the average and poor readers groups (Liberman et al., 1977). Their conclusion drawn was that poor readers were less sensitive to the effects of phonological confusability because they suffered from deficits in the phonological processing of the articulatory loop. Similar findings have also been reported by other researchers (Brady, 1986; Brady, Poggie & Rapala, 1989; Olson, Davidson, Kliegl, & Davis, 1984; Rapala & Brady, 1990).

While these studies certainly suggest that poor readers' phonological processing and memory are less accurate than those of normal readers, one should mention the failure of another group of studies, to replicate the confusability effect in poor readers. For instance, when the task difficulty was controlled by Johnston, Rugg, & Scott (1987) with lists being one item shorter than the memory span of each individual both good and poor readers were found to be affected by the confusability effect. Similar results have also been arrived at by some other researchers who have failed to find differences in the degree of the confusability effect between adequate and backward readers, (Alegria, Pignot, and Morais, 1982; Hall, Wilson, Humphreys, Tinzman, & Bowyer, 1983; Holligan & Johnston, 1988).

Chapter 2.3 Speech Rate

In view of the above conflicting evidence concerning the relationship between phonological skills and verbal STM, another group of researchers have recently put forward the argument that one of the most critical factors in explaining individual differences in memory span, and reading ability, is the rate and not the quality of phonological processing in the articulatory loop, as suggested by other researchers (Shankweiler et al., 1979). This argument is based on research findings showing a systematic relationship between the rate at which words can be articulated and increases in memory span with age (Hitch et al., 1989; Hulme et al., 1984; Hulme & Tordoff, 1989; Raine et al., 1991). On the basis of this evidence, speech rate is thought to be an index of the speed and efficiency with which words can be encoded and rehearsed in the articulatory loop, as well as one of the main factors responsible for the observed increases in memory span with age. The more quickly words could be articulated, the more words could be encoded and rehearsed in the loop within the critical period of 1.5 to 2 seconds which is the estimated capacity of the loop (Baddeley, Thomson, & Buchanan, 1975; Hulme et al., 1984; Hitch et al, 1989).

Further research findings, however, indicated, that the relationship between speech rate, memory span and reading ability is not as straight forward as was initially thought. More stringently designed studies revealed that speech rate is not the only factor that can explain the parallel increases in memory span. Henri and Millar (1991) showed that even when the articulation speed of words used in memory span tasks is equated, increases in memory span still exist. This, clearly, would not happen if speech rate was the only factor responsible for memory span increases. Findings indicating a lower memory span for nonwords than real words which had similar rehearsal rates - equivalent slope but not intercept values is also very difficult to explain (Hulme, Maughan, and Brown, 1991). This latter finding of lower intercept values for nonwords - which is attributed to the absence of any representation in long-term memory - has then led these researchers to the realization of the impor-

tance of phonological information stored in long-term memory during recall. The availability of permanent phonological representations of words in long-term memory is thought to be important because it allows the decayed traces of those words to be 'refreshed' or 'cleaned-up' from the articulatory loop during retrieval (Roodnerys, Hulme, & Brown, 1993).

The relationship between reading ability, verbal short-term memory, speech rate, and phonological awareness was then examined in more depth in a subsequent study of good, average, and poor readers (McDougall, Hulme, Ellis, Monk, 1994). Examination of the subjects' performance on all the above cognitive measures confirmed the new proposals for a strong association between articulation speed, verbal short-term memory skills, and reading ability. Poor readers, as opposed to good readers, were found to be less efficient on most experimental measures (memory span for words, speed rate, & phonological awareness), but not on the visual memory task (memory span for abstract shapes). These results were interpreted by McDougall et al. (1994) as a clear evidence of the phonological deficits underlying poor readers' inferior performance. Further analyses also indicated that speech rate made an independent contribution to the prediction of reading ability than that made by the measures of phonological awareness (phoneme deletion & rhyme discrimination) or verbal short-term memory. In addition, the contribution of verbal short-term memory was also found not to be significant, once differences in speech rate had been taken into account. On the basis of this evidence McDougall et al. (1994) have questioned the importance of verbal STM in the prediction of reading skill, arguing that verbal STM abilities themselves do not have much effect on the process of learning to read but rather through some closely related process (tapped by speech rate.), and that STM may only be useful as a predictor to the extent that it taps individual differences in speech rate (McDougall et al., 1994, p.129). It was proposed, instead, that speech rate is a more valid and independent predictor of reading skill, offering an index of the speed and efficiency with which the phonological representations in long-term memory of words can be activated.

McDougall et al.'s (1994) proposals suggest a rather different view of the relationship between verbal STM abilities, phonological skills, and the development of reading competence, to that suggested by traditional theories of working memory (Baddeley, 1986). Although both theoretical accounts accept the importance of phonological skills in the development of reading skill, McDougall et al. (1994) argue that it is the speed with which phonological codes are activated from long-term memory that is the most important aspect of phonological processing which connect verbal STM skills to reading performance, and not the constraints placed upon the readers' phonological decoding strategies when reading. Many longitudinal studies did not provide solid evidence that differences in verbal STM contribute, in a direct way, to differences in the development of reading skills (e.g. Pennington, Van Orden, Kirson & Haith, 1991; Pennington, Van Orden, Smith, Green, & Haith, 1990; Wagner et al., 1994). This supports McDougall et al.'s claim about the superiority of speech rate over Verbal STM, but further research is needed to establish its exact relationship to reading subskills (i.e. reading accuracy, speed, comprehension).

Chapter 2.4 Rapid Automatized Naming

The speed with which a person names continuously a series of letters, numbers, colours, or digits has proved to be another strong reading correlate, and a useful diagnostic tool for discriminating poor and adequate readers.

A large number of cross-sectional studies has demonstrated that performance on rapid automatization tasks is strongly correlated with reading ability (Ackerman, Dykman, Gerdner, 1990; Blachman, 1984; Bowers, Steffy, & Swanson, 1986; Denckla & Rudel, 1976; Spring & Capps, 1974; Spring & Davis, 1988). This strong link between naming speed and the development of reading ability has been found to be consistent across a wide age range, including kindergarten and first grade (Blachmann, 1984); grades 4-5 (Eakin & Douglas, 1971), grades 4-10 (Davis & Spring, 1990), or adults (Felton, Naylor, & Wood, 1990). Research evidence also

indicates that naming speed is highly correlated not only with latency of word recognition (e.g. Bowers & Swanson, 1991) or the speed of reading simple text (Biemiller, 1977-78), but also with accuracy for both word and nonword reading (Spring & Davis, 1988).

Longitudinal studies also demonstrate the strong relationship between naming speed and reading ability. Rapid automatization tasks have consistently been found to predict later reading development (Badian, McAnulty, Duffy & Als, 1990; Bowers, 1995, Wolf, Bally, & Morris, 1986), while another group of studies indicates that, in reading, the variance attributed to naming speed is independent from the variance attributed to phonological awareness measures (Blachman, 1984; Bowers, 1995, Bowers & Swanson, 1991; Felton & Brown, 1990; Mann, 1984). Some studies also support naming speed's independence from measures of vocabulary knowledge (Bowers & Swanson, 1991), nonverbal intelligence (e.g. Bowers, Steffy & Tate, 1988), or memory span (Bowers, 1992; Bowers, Steffy & Tate, 1988; Felton & Brown, 1990).

Rapid naming tasks also appear to be very useful diagnostic tools which discriminate very poor from moderate or adequate readers. Davis & Spring (1990), for instance, report that performance on a digit naming speed test significantly discriminated elementary-school disabled readers from age-matched children reading at appropriate levels, correctly classifying 83.3% of the children. Very poor readers have also been found to be both less accurate when naming objects of various word frequencies (Wolf & Goodglass, 1986) and significantly slower when naming digits and letters (Wolf, Bally, & Morris, 1986). This latter result is reported by both studies using either the continuous-trial procedure (Denckla & Rudel, 1976; Spring & Capps, 1974; Wolf et al., 1986) or the discrete-trial procedure (Bowers & Swanson, 1991, for digits & letters; Levy & Hinchley, 1990, for objects). Research evidence also indicates that slow digit and letter naming characterizes adults who were diagnosed as dyslexic in childhood (Felton, Naylor & Wood, 1990; Wolff, Michel & Ovrut, 1990). Moreover, slow naming speed appears to be specific to dyslexia and is not a com-

mon characteristic of either 'garden variety' poor readers (Badian 1993; Wolf, 1991) or children with Attention Deficit Disorders (Ackerman & Dykman, 1993; Felton, Wood, Brown, Campbell & Harter, 1987). On the other hand, dyslexic children (Wolf, 1991) as well as very poor readers (Bowers, 1991, 1992) appear to be significantly slower on rapid automatization tests than other moderately poor readers.

There is however a disagreement among researchers about the specific nature of the relationship between naming speed and reading. Some researchers argue that the close relationship between naming speed and reading ability depends on phonological processing skills, with the naming speed acting as an index of the efficiency with which phonological codes can be retrieved from the long term memory store (Wagner, Torgesen, Laughon, Simmons, & Roshette, 1993; Ellis, 1981; Ellis & Miles, 1981). Proponents of this view have suggested that many of the difficulties that characterize poor readers (e.g. slow articulation, poor short term memory, word finding/naming difficulties) may be due to the incomplete specification of phonological units in long term memory (Torgesen, Wagner, Simmons, & Laughon, 1990).

Other researchers argue that rapid automatization tasks tap something in addition to name retrieval itself, and place more emphasis on the speed of processing and the importance of temporal processing, that is the rate of individual cognitive and linguistic sub-processes involved in naming and reading, and the speed of their integration (Wolf, 1991). Naming speed, in this way, is considered as a " *proxy for slower activation of many lower-level processes involved in reading* " (Bowers, 1995, p.191), while low performance on rapid automatization tasks indicative of impairments or disruptions of the above automatic and non intentional cognitive processes. Consistent with this view are research findings confirming the slow performance of reading disabled children on different rapid performance tasks - e.g. speed of tapping (Wolff, Michel & Ovrut, 1990); speed of handwriting (Ackerman, Dykman, & Peters, 1976, 1977) - or their difficulty in processing rapidly presented

auditory (Tallal, Miller & Fitch, 1993) or visual stimuli (Livingstone, Rosen, Drislane, Galaburda, 1991; Lovegrove, Martin, Slaghuis, 1986).

Researchers working within this approach also emphasize the importance of orthographic processing, postulating a reciprocal relationship between orthographic and phonological codes. While the importance of phonological processing is acknowledged by these theorists (Bowers & Wolf, 1993), orthographic processing is considered to be of primary importance because it serves as a structure/framework for sound representation, facilitating the access of phonological codes from visual input. Research evidence used to support this view comes from studies indicating the reduced ability of poor readers to gain reading (Reitsma, 1983) or orthographic competence from print exposure (Venezky & Massaro, 1979); or from studies indicating the superior effect of phonological awareness training when it is accompanied with explicit sound-letter associations (e.g. use of plastic letters: Bradley & Bryant, 1985), compared to sound training alone. Disruption of the precise timing processes, is assumed to affect the automatic induction of good quality orthographic codes and potentially their rapid connection to phonological representation. In this way, the predictive power of rapid naming measures is open to two different explanations. First, rapid naming may indicate the efficiency with which temporal processing mechanism(s) amalgamate phonological and orthographic codes (Ehri, 1980). Second, rapid naming measures may also be indicative of the quality of orthographic codes established by precise time mechanisms, and possibly the amount of print exposure and practice needed for a code to be unitized and to obtain a good quality representation (Bowers and Wolf, 1993).

While both hypotheses are possible, further research is needed for a better theoretical understanding of the cognitive processes underlying rapid naming measures and their relationship with the development of phonological and orthographic representations and thus with reading and spelling ability.

Chapter 2.5 Nonword Reading

The nonword reading test was included in this description of the cognitive determinants and linguistic predictors of literacy skills because of its extensive use in the literature as a measure of phonological reading skills and one of the major diagnostic tools for the existence of phonological reading deficits in English dyslexics (e.g. Rack, Snowling, and Olson, 1992).

As pseudowords have no stored lexical representations in the mental lexicon, they cannot be read by a direct word recognition strategy. Instead, the pronunciation of a word must be 'assembled' via the phonological strategy/route, rendering, in this way, nonword reading a relatively 'pure' measure of sublexical reading skills (though, see Kay & Marcel, 1981 and Rosson, 1983 for priming effects on nonword reading from orthographic and semantic information, respectively). Given the poor phonological skills of dyslexics (e.g. Snowling, 1995), it is not surprising that many dyslexic children find this task particularly difficult. Many studies have reported significant differences in performance between normal and poor readers on a variety of nonword reading tasks. Dyslexic children have often been found to be significantly slower and less accurate on tasks requiring them: a) to read phonologically complex nonwords (e.g. Olson, Wise, Conners, Rack & Fulker, 1989; Snowling, 1981) but not phonologically simple nonwords (Holligan & Johnston, 1988); b) to match the visual representation of a nonword to its corresponding phonological representation (e.g. Snowling, 1980); and c) to choose among phonologically or orthographically similar nonwords (e.g. Olson, Kliegel, Davidson, and Foltz, 1985). The use of the very powerful reading-level-match design in many studies (i.e. where older dyslexics are matched with younger normal readers on word recognition skills) have allowed researchers to document the existence of a nonword reading deficit in English developmental dyslexics (Rack, Snowling, & Olson, 1992). The evidence for such a claim appears to be strong. Most of the studies which have failed to demonstrate a nonword reading deficit in dyslexics have recently been criticized on the basis of a number of methodological flaws. In a critical consideration of the available research

evidence on nonword reading, Rack et al., (1992) have reported that in many studies which did not find a nonword reading deficit in dyslexic children, (e.g. Beech & Harding, 1984; Johnston et al., 1987; Szeszulski & Manis, 1987) controls had a low reading age of around 7 years. Because, at that level of reading ability most normal readers have not yet developed their phonological reading skills, which are necessary for decoding of nonwords, it would be unlikely for differences to emerge. The inclusion of very low frequency regular words (which pose the same degree of difficulty to beginning readers as nonwords) in the reading tests used for subject selection in some studies (e.g. Treiman & Hirsh-Pasek, 1985), and, the use of some prose reading tests which in many instances underestimate the subjects' real decoding abilities - e.g. the Gilmore Oral Reading test - have also been reported to be the main reasons for the reported absence of any between-group differences between dyslexic and normal readers on nonword reading in some studies (e.g. Szeszulski & Mannis, 1987; Vellutino & Scanlon, 1987). The consistency with which normal reading-age controls have been found to outperform dyslexic children on nonword reading in most of the well controlled studies have led Rack et al., (1992) to present a strong case of a specific nonword deficit in English developmental dyslexics. The same conclusion has also arrived at by van Ijzenboorn & Bus (1994) in a quantitative meta-analysis of the existing research evidence on nonword reading, they reported a half a standard deviation difference on the nonword reading task of 1200 subjects: dyslexic and reading-age matched control children.

Chapter 2.6 Syntactic Awareness

Most of the evidence presented so far reveals the crucial role of phonology in the development of alphabetic literacy skills. The ability to process phonological information appears to be directly connected to the ease with which beginning readers learn to read and write in alphabetic scripts. Whilst the integrity of phonological processing skills appears to be one of the most crucial determinants of literacy de-

velopment, there is also evidence to suggest that syntactic awareness skills may also play a major role in reading acquisition.

Syntactic awareness has been used in the literature to refer to the child's ability to reflect upon and manipulate aspects of the internal grammatical and syntactic structure of sentences (Tunmer, Nesdale, and Wright, 1987). Research evidence indicates that there is a relationship between this type of metalinguistic awareness and children's success in reading. Children experiencing reading difficulties have consistently been found to be deficient on a number of syntactic awareness tests evaluating a) the ability to detect or correct ill-formed sentences (e.g. Tunmer, Nesdale, and Wright, 1987; Vellutino & Scanlon, 1987); b) the ability to use inflectional morphemes (e.g. Carlisle, 1988; Elbro, 1990; Vogel, 1974); and c) the ability to process and use syntactically complex structures (e.g. Vellutino & Scanlon, 1987; Vogel, 1974). Longitudinal studies also show that early semantic and syntactic deficits in spoken language are evident in children who are later diagnosed as dyslexic (e.g. Scarborough, 1990). Strong correlations between children's ability to make explicit semantic and syntactic judgments and their success in reading have also been reported by many researchers (e.g. Bowey and Patel, 1988; Willows & Ryan, 1986). The adoption of a reading-level match design in some of the studies examining the relationship between syntactic awareness skills and reading development have allowed researchers to postulate the possibility of a causal connection between the two (Rego, 1991; Tunmer et al., 1987).

It has been suggested that syntactic awareness can affect the development of reading ability in two possible ways (Tunmer et al., 1987). One way is by enabling readers to monitor their ongoing comprehension strategies more effectively, and the other by helping beginning readers to acquire word recognition skills.

The first view argues that readers who are syntactically aware are in a better position to monitor that their responses to the words in the text they are reading conform to the meaning and syntactic information available in the surrounding context, and hence they are in a better position to detect and correct word recogni-

tion errors that do not conform to the meaning or the context of the sentence they read. Corroborative evidence for this position comes from studies indicating a strong correlation between syntactic awareness and comprehension monitoring (e.g. Bowey, 1986); and from studies indicating that good readers: a) tend to make fewer errors that violate contextual information (Bowey, 1985) and b) are more likely to self-correct word recognition errors that violate prior and subsequent sentence context (e.g. Bowey, 1985; Weber, 1970).

A second way in which syntactic awareness may affect the development of reading proficiency is by facilitating the acquisition of decoding skills and the development of new vocabulary in beginning readers. Tunmer et al., (1987) have suggested that beginning readers who are still in the process of acquiring phonological reading skills - because of their limited word recognition skills during the initial stages of literacy development - often combine incomplete phonological information with contextual information to assist their attempts to decode unfamiliar words. The more words are correctly identified with the help of contextual information, the more feedback beginning readers receive on letter-sound correspondences, and, the more able they become in reading novel words. The use of contextual cues has also been proposed to be very helpful in the learning of 'homographic' words (e.g. c*ough*, r*ough*, and th*ough*; or cl*own*-fl*own*), or exceptional words (e.g. pint & yacht) (Tunmer, Herriman, Nesdale, 1988). In such cases, where the reader can generate alternative pronunciations for the same spelling pattern (e.g. -ough pronounced as /of/, /af/, /eu/), or the use of standard grapheme-phoneme correspondences may only offer partial information (e.g. exceptional words), the use of contextual cues appears to be the most reliable source of information in the selection or prediction of the correct pronunciation. Consistent with this is evidence indicating the beneficial effect of syntactic information in the decoding of very difficult or low frequency words not only in skilled readers (Frederiksen, 1981; Stanovich, 1981), but also in dyslexic (Nation & Snowling, submitted) or other poor readers (Harding, 1984; Hensaw, 1992; Waterman & Lewandowski, 1993).

The claim has been made that context effects may be different for skilled and poor readers. Stanovich (1980, 1984) suggested that skilled readers' word recognition when reading normal text is very rapid and therefore is finished before the expectancies derived from context can exert their influence. In contrast, a greater reliance on semantic and contextual information in word identification occurs in cases where word recognition is slower and less certain, that is, in cases of younger or less skilled readers, or good readers coping with degraded stimuli. The available research evidence appears to support both claims. Research on word recognition has produced a highly consistent pattern of results indicating stronger context effects with beginning readers (e.g. Stanovich, Nathan, West, & Vala-Rossi, 1985; Stanovich West, & Freeman, 1981); children experiencing reading problems (e.g. Briggs, Austin, Underwood, 1984; Perfetti, Goldman, & Hogaboam, 1979; Simpson, Lorsbach, & Whitehouse, 1983; Stanovich & West, 1981); and with increasing word difficulty, unfamiliarity, or degradation (e.g. Perfetti et al., 1979; Simpson et al., 1983; Stanovich et al., 1981). In a more recent study, Nation & Snowling (submitted) have also reported that the availability of contextual information had its greatest effect on dyslexic children (whose phonological reading deficits are severe), and to a lesser degree on poor comprehenders and normal readers matched on reading accuracy. On the whole, this body of evidence supports the view that semantic and syntactic information is often used by reading disabled readers- and normally developing readers - as a back-up strategy to compensate for deficits in phonological reading skills.

The importance of syntactic awareness skills in the development of reading skill is also supported by research on reading comprehension and studies examining the predictive relationship between syntactic awareness and different aspects of reading skill. There is evidence that children with reading comprehension difficulties often have deficient syntactic awareness skills. Nation & Snowling (1997) have used a series of word order correction tasks to assess the syntactic awareness skills of poor readers with specific reading comprehension problems. Their analyses indi-

cated a diminished ability on the part of poor comprehenders in restructuring ill-formed sentences, irrespective of the degree of syntactic complexity and semantic ambiguity of these sentences. The lack of any phonological decoding difficulties and the age-appropriate phonological skills of this group of children with specific reading comprehension problems eliminated the possibility of the observed between-group differences being attributable to differences in decoding skills. Goodman (1976) has also made the claim that poor readers' comprehension difficulties are the result of their insensitivity to the syntactic and semantic information available in the text, and their exclusive reliance on visual cues. A similar conclusion has also arrived at Isakson and Miller (1976) who found that the good readers in their sample made better use of the contextual information by integrating the meanings of the individual words into sentence meaning to correct syntactically and semantically violated sentences. Poor reading comprehenders, on the other hand, were found to ignore the syntactic and semantic cues, treating words as individual entities.

Syntactic awareness measures have also been reported to be predictive of reading ability. Muter & Snowling (1997) have recently assessed the predictive relationship between a number of phonological processing tasks (i.e. phoneme deletion, rhyme awareness, speech rate, verbal STM), syntactic awareness tasks (i.e. listening comprehension & grammatic closure tests) and reading ability. In a series of multiple regression analyses, syntactic awareness was found to account for a small but still significant amount of variance in reading in context [as measured by the Neale Analysis of Reading Ability - Revised (1989)] even when it was entered at the last step of the regression equation, after vocabulary and phonological awareness measures. The contribution of syntactic awareness, on the other hand, was non significant in predicting differences in decoding skill [as measured by the Snowling, Stothard, & McLean (1996) Graded Nonword Reading Test].

In another study, Rego & Bryant (1993) have also examined the predictive relationship between early syntactic awareness skills, phonological awareness skills and the ability to use context information in reading later on. Syntactic and seman-

tic awareness skills were assessed at the beginning of the first year of primary school (before the subjects learn to read) using a cloze task, a sentence anagram task and a sentence completion task. The assessment of phonological awareness skills comprised a rhyme oddity task and a phoneme tapping task. The administration of the outcome measures of contextual facilitation and invented spelling took place five months after the initial testing session. As with the Muter and Snowling (1998) study, syntactic awareness skills predicted children's ability to use contextual information in reading. A specific predictive relationship, however, has been reported for the two types of metalinguistic ability examined in this study. Phonological awareness was found to predict children's ability to master the alphabetic code (i.e. the ability to spell words, or the ability to decode nonwords in Muter & Snowling's study), but not the ability to read words in context. The measures of syntactic awareness and grammatical sensitivity, on the other hand, were found to predict the ability to use context cues in reading unfamiliar words, but not differences in Rego & Bryant's (1993) invented spelling task.

Such consistency in the pattern of results of the above studies indicates that phonological awareness skills and syntactic awareness skills account for separate sources of variance in reading ability. Furthermore, it indicates how important the assessment of both types of metalinguistic abilities is when examining the underlying causes of developmental reading disorders and differences in their manifestation. At least three groups of poor readers can be identified by reference to the integrity of their phonological and syntactic awareness skills: a) poor readers with specific problems in the phonological domain (i.e. dyslexics: Snowling, 1987; 1995); b) poor readers with normal phonological skills, but deficits in the syntactic/semantic awareness domain (i.e. poor comprehenders: Stothard & Hulme, 1995); and c) poor readers experiencing problems in both domains (i.e. garden-variety poor readers: Stanovich, 1988). The evidence presented in this section also indicates that the existence of good syntactic and semantic awareness in dyslexic children may, in some instances, compensate for their phonological deficits and gradually help them to develop age-

appropriate word recognition skills. By contrast, the availability of good phonological awareness skills may also be used as a compensatory strategy by children with poor vocabulary and listening comprehension skills (Stothard & Hulme, 1995).

On the whole, the available evidence on syntactic awareness indicates that, despite the primary role of phonological processing skills in the development and prediction of alphabetic literacy skills, syntactic awareness may also be another contributing factor (Bishop, 1991), and useful source of information to beginning readers and reading disabled children when reading. One point, however, that is still at issue is the origin of syntactic (and morphological) deficits. There is the view that poor readers' difficulties with syntactic awareness tasks reflect a 'pure' deficit in morpho-syntactic development, over and above the phonological deficit (Stein, Cairns, & Zurif, 1984; Byrne, 1981; Vogel, 1974). Alternatively, it has been suggested that syntactic deficits in many poor readers may be further symptoms of a phonological core deficit (Shankweiler, Crain, Katz, Fowler, Liberman, Brady, Thornton, Lundquist, Dreyer, Fletcher, Stuebing, Shaywitz, Shaywitz, 1994-95). In particular, there is evidence to suggest that poor readers' difficulties with inflectional morphology are stronger when the production of morphological forms involves a phonological change within the base morpheme (as in courage/courageous) than in cases where the base morpheme remains intact (as in danger/dangerous) (Fowler & Liberman, 1995). In this way, it appears that it is the phonological component of some morphological tasks that makes them difficult for poor readers, and not so much their insensitivity to the morphological aspect of spoken language.

Syntactic awareness deficits have also been attributed to deficiencies in the phonological domain. Shankweiler and her colleagues have argued that poor readers in many instances find syntactic awareness tasks difficult - particularly those requiring them to process relative clauses, passives, and sentences containing adjectives with exceptional control properties -, not because they lack the relevant grammatical structures, but because of phonological working memory coding deficits. In a series of studies, Shankweiler et al., (e.g. Macaruso, Shankweiler, Byrne, & Crain,

1993; Smith, Macaruso, Shankweiler, & Crain, 1989) have minimized the memory load in many syntactic awareness tasks (e.g. by holding the sentence structure constant; or the number of animate noun phrases the same; or by making the test sentences conform to the presuppositional constraints) and found almost comparable levels of performance between poor and normal control readers. However, an alternative, though not mutually exclusive, explanation has been put forward by Vellutino and Scanlon (1987), who reported significant between-group differences in sentence comprehension skills between sixth-grade poor and normal readers, but not with second-grade readers. The existence of prolonged reading difficulties has been proposed as another possible cause/source of syntactic deficits in poor readers.

Both positions are plausible and further research is needed to establish the exact locus of syntactic awareness deficits. Further longitudinal evidence and evidence from training studies may also be useful in establishing a stronger causal connection between syntactic awareness and reading or spelling ability. One point that needs to be stressed is that most of the studies on syntactic awareness have focused on the relationship between syntactic awareness and different aspects of reading ability (i.e. reading accuracy, reading speed, or reading comprehension). One of the few studies which have included a spelling measure in their regression analyses has been the study by Rego & Bryant (1993) which did not find any strong predictive relationship between the two skills. In the present study/thesis, a closer relationship between syntactic awareness skills and the development of spelling abilities in the highly inflected Greek orthographic system is hypothesized and separate statistical analyses have been planned to examine this specific developmental pathway (see Chapter 8).

Chapter 2.7 Summary & Conclusions.

Research evidence on literacy development reveals that reading and spelling are complex cognitive processes involving a variety of sources of information and

levels of analysis - phonological, syntactic, semantic, orthographic. Of all the reading/spelling correlates, phonological awareness appears to be the most powerful and stable predictor of reading and spelling abilities, not only in comparison to other phonological processing skills (e.g. rapid naming, speech rate, verbal STM) but also to syntactic awareness measures (e.g. Muter & Snowling, 1997, 1998; Rego & Bryant, 1993). The strong and independent contribution of various phonological processing measures (e.g. rapid naming, speech rate, verbal STM), and the existence of severe phonological deficits (both, in input and output phonology) in most poor readers are also revealing of the crucial role of phonology to the acquisition of alphabetic literacy skills. The exact nature, however, of phonological processing skills and the way in which they relate to each other is an issue that needs to be more thoroughly investigated and specified by future research. It is not clear, for instance, whether the variety of phonological awareness and other phonological processing tasks in the literature are indexes of the same underlying cognitive ability or indices of different aspects of the phonological system. Open to question is also the predictive relationship of each phonological sub-skill at different stages of cognitive development.

Research on syntactic awareness also reveals that there is more to reading than phonological decoding. An increased level of sensitivity to the grammatical and syntactic aspects of language appears to enable beginning readers to make intelligent guesses about word pronunciations, through redundancy & semantic predictability *. Contextual information has been found to be very useful in the detection and correction of word identification errors and the development of decoding skills and new vocabulary. There is also evidence that syntactic awareness skills may be used by beginning or poor readers as a back-up strategy to compensate for difficulties in phonological decoding. The predictive value of syntactic awareness measures

* Differences in reading ability have also been explained in terms of reader's ability to construct a coherent and elaborate knowledge structure/frame to represent and use their understanding of the text (e.g. Rahman &Bisanz, 1986; Rossi, 1990; Stanovich, 1982). This body of evidence on reading comprehension is acknowledged, but not dealt/reviewed in this study which has focussed on word recognition.

appears to be small but significant, with most of the studies focusing on the prediction of reading skill. The predictive relationship between syntactic awareness skills and the development of spelling ability has been largely ignored by the majority of researchers, and is a very promising area for future research.

One last point that needs to be stressed is the renewed interest of many theorists in the development of literacy skills in different linguistic environments, that is, in orthographic systems that vary in their degree of transparency and regularity. Until recently, most of the research evidence on literacy acquisition has been based on studies carried out in English language whose orthography is inconsistent and deep. The realization on the part of researchers that differences in the linguistic structure of languages may also lead to differences in the development of reading and spelling skills, has recently been the driving force for the conduction of research in other languages; as a way of validating the available evidence in English and examining new ways of untangling the puzzle of literacy acquisition.

Chapter 3.
ORTHOGRAPHIC VARIATION & ITS SIGNIFICANCE

This chapter presents a brief historical review of the development of alphabetic scripts in order to draw the distinction between deep and shallow orthographies, and to present the main sources of regularities and irregularities of the English orthographic system. Cross-linguistic evidence showing that the observed diversity in the orthographic structure of languages may significantly affect the development of word recognition skills, phonological processing skills and the manifestation of developmental reading disorders is also presented.

Chapter 3.1 Diversity in alphabetic scripts: Shallow & Deep Orthographies.

In the long history of mankind, a large number of languages and writing systems have flourished, evolved, and in many instances died, over the centuries. A final stage in the development of writing systems is marked by the invention of the alphabetic scripts. It is believed that the ancient Egypto-Semetic writing was a precursor to most alphabetic systems (Gelb, 1952). Interestingly enough, this system employed a consonantal script only. In order to resolve ambiguities, vowels had to be invented. This was achieved by the Greeks in the 2nd millennium BC. With the systematic use of vowels came the invention of a full alphabetic system. A distinguishing feature of alphabetic scripts compared to logographic scripts, was that the grapheme set, was very much reduced and completely lost any direct, visual meaningfulness. Instead, alphabetic scripts could be considered as transcribing the sound or phonological properties of the spoken language. In practice, however, all alphabetic scripts do not represent the phonological properties so clearly. The historical development of different languages has led to changes in spelling sound correspondences and importation of spellings from other languages. Alphabetic scripts can be characterized as regular or irregular, shallow or deep, depending on the degree to

which they adhere to a strict alphabetic principle. According to Coltheart (1980) two characteristics distinguish scripts as being regular or irregular:

a) if there is a one-to-one relationship between every grapheme in a word and a corresponding phoneme in its phonological format in a regular script and also

b) if the relationship between graphemes and their corresponding phoneme is invariant.

The Serbo-Croatian orthography exemplies a perfectly regular script which satisfies both of the above conditions. This is because its present alphabet was introduced in the early nineteenth century following the principle, "Spell a word like it sounds and speak it the way it is spelled" (Lukatela & Turvey, 1980). In this way, there appears to be an isomorphic and invariant relationship between its graphemes and phonemes and visa versa. Each letter is represented by only one phoneme, and each phoneme is represented by only one grapheme. On the other side of the 'language continuum', lie languages with a deep and irregular orthography, like Hebrew and English. The basic characteristics and major sources of irregularities pertaining the English orthographic system are briefly reviewed in the next section.

Chapter 3.2 English orthography: sources of irregularities

Irregularities observed in the orthographic structure of languages are usually created as a result of importation, a spelling change when the spoken equivalent is left intact, or a change in the pronunciation of words when the orthography is not altered. In the case of English, this was due to influences of many foreign languages (e.g. Danish, Norwegian, Dutch, German, French, Greek, and Latin); the absence of a standard orthographic reference; and finally the influence of changes in pronunciation (Scholfield, 1994). Some of these influences are preserved in modern English orthography. Brown (1977), for instance, noted that approximately 60% of modern English words are borrowed from other languages. Examples can be used to illustrate the effect of these foreign influences on the pronunciation and/or spelling of

various modern English words. The word *give,* for instance, is exceptionally pronounced with a short vowel, by reference to the Norwegian word jiven and not to other English words like *hive, strive.* The initial sound of word *psychology* is spelled with [ps] by reference to the Greek word ψυχολογία whose initial sound is /ps/. English phonotactic constraints, however, do not allow the sequence 'ps' and for this reason this or other Greek loan words (e.g. pneumatic) are pronounced without the 'p'. Similarly, the French initial ‹h› survives in the spelling of many modern English words such as honour, horrible; as does the French sound /ou/ in words such as through, would, could. These are some of the many examples found in the English language. The impact of these influences over the centuries has been profound and has resulted in what distinguishes English as being an irregular and deep alphabetic system. Inconsistencies appear to exist in both grapheme to phoneme and phoneme-to-grapheme correspondences, that is, in both reading and spelling.

Venezky (1970), has noted 17 possible phonemic assignments for the spelling unit ‹ o ›; 10 for the spelling unit ‹ a ›; and 9 for the spelling unit ‹e›. Altogether the five vowels of the English alphabet have been found to elicit a total of 44 phonemic representations. Such variation in the phonetic realization of vowel graphemes, appears to be a major source of uncertainty in the pronunciation of many English words. Recent studies examining the statistical properties of the English orthographic system report that the pronunciation of vowels is predictable only in 51% of the monosyllabic words, while that of onset-vowel in 52% of monosyllabic words (Treiman, Mullenix, Bileljac-Babic, & Richmont-Welty, 1995). A higher degree of predictability, however, is observed when vowel graphemes are considered with neighbourhoods corresponding to the intra-syllabic unit of rime: 77% (Stanback, 1992; Treiman et al., 1995;). These results indicate that some degree of consistency in the pronunciation (and spelling) of English words is achieved through morphological consistency. This, however, is not always the case, as there are instances where free morphemes or other multi-letter spelling units are either phonologically condi-

tioned (e.g. heal - health) or lexically conditioned (e.g. ‹ eat › pronounced as /i:/ in *leaf, cheap, peach*; as /ei/ in *great*; or as /e/ in *sweat*).

The representation of many common semantic aspects of words in violation of simple grapheme-phoneme regularity (e.g. divide-division;) needs special mention, because it is an extra feature which gives rise to the concept of 'deep orthography'. Both 'depth' and irregularity contribute to non-transparency in English orthography.

Spelling in English appears to be even less straightforward than reading. This is also due to the stark lack of consistency in the orthographic representation of phonemes. Linguistic analyses indicate that the English orthographic system today has around 44 phonemes, but over 100 graphemes (Wijk, 1966). Most of these analyses also indicate that the inconsistency and irregularity in the sound-to-spelling correspondences lies largely in the vowels (Treiman et al., 1995, Venezky, 1970). The variety with which the basic vowel sounds a, e, i, o, u, (and y) are combined in diphthongs (i.e. ae, ai, ea, ee, ei, ia, ie, io, oe, oo, ou, ue, and ui) or in other forms (e.g. aw, ew, ow, oy, ey, ay, er, ur, ir, ar, are, air, ear, igh: Barry, 1994), is worth mentioning. The existence of many alternative orthographic representations for many phonemes appears to be in direct proportion to the predictability and ease with which the appropriate, each time, spelling pattern is selected. Barry & Seymour (1988), for instance, report a low degree of predictability for many long vowels and diphthongs in many monosyllabic and some disyllabic words. In the case of the /ɔʊ/, which is spelled in 13 different ways in English words (i.e. dole, droll, bowl, coat, toe, folk, soul, owe, sew, dough, mauve, brooch & yeoman: Barry, 1994, p.28), it was found that the most common spelling pattern "Œ' for this vowel sound occurred only in 32% of wo'rds. The second most common pattern "o" occurred in 26% of words, while the "ou" and "oa" spelling patterns in 16% and 15% of words respectively (Barry & Seymour, 1988). Such a high degree of inconsistency in the sound-to-spelling correspondences of many vowels appears to be circumscribed - as in reading - by some degree of morphological invariance among words. The vowel sound /eɪ/, for instance, which is spelled in 12 ways when in isolation, is spelled with

only four alternatives (as in cane, gain, deign, rein) when it is part of the rime /ein/ (Barry, 1994).

On the whole, the above description of the basic linguistic characteristics of the English orthography indicates the high degree of irregularity characterizing the English orthographic system. The stark lack of consistency and isomorphic relationship between graphemes and phonemes for reading and spelling explains why the English language has been characterized as a 'deep' orthographic system. Furthermore it indicates how useful lexical consultations and morphosyntactic information may be in deriving the correct pronunciation and spelling of many irregular words.

Chapter 3.3 The Development of Literacy skills in the Greek and Other Languages

For many decades, research on word recognition and other areas of cognitive functioning has been based mainly on studies carried out in English orthography. The gradual realization on the part of researchers of the importance of languages' linguistic characteristics and the impact these may have on the development of some cognitive skills such as reading and spelling has led to what has been called the Orthographic Depth Hypothesis (Katz & Feldman, 1981; Katz & Frost, 1992). This term has recently been used in the literature to state that differences in orthographic depth can lead to processing differences in naming and lexical decision tasks (Katz & Frost, 1992). Deep orthographies are thought to discourage the use of phonological recoding because of the inconsistency in the grapheme-to-phoneme correspondences. Shallow orthographies are believed to support word recognition that involves the language's phonology because of the high consistency of letter-sound correspondences. Proponents of the strong version of this (ODH) hypothesis

deny the existence of a mental lexicon and argue that, in very transparent orthographies, the only route from print to semantics is via the 'assembled' routine (Bridgeman, 1987; Turvey et al., 1984). A direct mapping from orthographic input lexicon to phonological output lexicon is assumed to exist in scripts with inconsistent spelling-sound correspondences. Evidence in favour of this view is reported by studies indicating the absence of any priming effects or frequency effects in 'shallow' orthographies (Frost &Katz, 1989; Frost, Katz, & Bentin, 1987; Katz & Feldman, 1983). This strong version, however, has been strongly criticized on both theoretical and methodological grounds (see Besner & Smith, 1992; Seidenberg, 1992 for reviews). Nowadays, a weaker version of the Orthographic Depth Hypothesis seems to enjoy general acceptance among many researchers (Besner & Smith, 1992; Katz & Frost, 1992; Seidenberg, 1992). According to this weak version, the degree to which a prelexical process is active is believed to be a function of an orthography's depth, and that this prelexical analysis will be more functional (less costly) in shallow orthographies (Besner & Smith, 1992; Katz & Frost, 1992; Seidenberg, 1992).

In recent years, there has been a growing body of evidence supporting this hypothesis, and revealing significant cross-language differences not only in word recognition skills or the development of reading and spelling abilities in general, but also in the development of phonological awareness skills and the manifestation of developmental reading disorders.

Wimmer & Hummer (1990), for instance, have strongly questioned the importance of the logographic stage in the regular German orthography, on the basis of evidence indicating a higher degree of dependence on alphabetic reading and spelling strategies by normally developing or delayed Austrian first graders. Both groups in the above study exhibited a high degree of accuracy when reading or spelling real

words and visually similar/dissimilar nonwords. Further error analysis revealed a low percentage of refusals or real word substitution errors, and the predominance of phonologically correct errors in most reading and spelling responses. This pattern of errors and the high correlation between the number of correctly read nonwords and real words ($r = .85$, $p<.001$) or between the grapheme-phoneme knowledge and the number of phonologically correctly spelled words ($r = .81$, $p<.001$) have led Wimmer & Hummer (1990) to conclude that the use of a logographic strategy may not be so important and necessary in the German orthography, where the relationship between its graphemes and phonemes is consistent and early reading instruction is strongly influenced by a 'phonics' approach.

Similar results have also been reported by Porpodas, Pantelis and Hantziou (1990) in a study carried out in the regular Greek orthographic system. Forty first-grade primary school normally developing children were examined in a series of word and nonword reading tasks, in which many of the psycholinguistic properties of the word stimuli had been manipulated (i.e. imagery level; semantic content, grammatical class, regularity, or frequency). No significant word superiority or word frequency effect was observed. Furthermore, most subjects read content and function words, and high and low imageability words equally well indicating the strong use of a phonological reading strategy by the Greek first graders. The employment of a direct visual word recognition strategy was also apparent, but to a smaller extent. This was evident by the absence of any consistent word frequency effect and the existence of a small proportion of visual errors in both word and nonword reading tasks. An almost identical pattern of results has recently been reported by a series of studies carried out in other regular orthographic systems such as French (Sprenger-Charolles & Casalis, 1995); Brazilian Portuguese (Pinheiro, 1995); or Turkish (Oney & Durgunoglou, 1997), all indicating the preferential use of a phonological reading strategy by the users of regular orthographies.

More direct and stringent comparisons of the influence of the orthographic consistency of some languages on reading acquisition have also yielded identical

results. Wimmer & Goswami (1994), for example, have examined the word recognition strategies of 7-, 8-, & 9-year-old English and German primary school children, using analogous word and nonword reading tasks in both languages. The participants of each country were chosen to be at about the same point in their school career. Their assumption was that, if German readers relied more on a sublexical word recognition strategy and English on a more direct/visual strategy, then the former would find the nonword reading task much easier than the latter. The results confirmed their hypothesis. All three groups of German readers outperformed their English counterparts (both in terms of accuracy and speed) in the nonword reading task, but not in the numeral word reading and the number word tasks. In fact, the youngest 7-year-old German readers were significantly more accurate than the oldest and more experienced 9-year-old English readers. Significant differences were also observed in the type of errors made, indicating the differential use of strategies by the two groups. The German readers not only attempted to read all words/nonwords, but also the majority of their errors were other nonsense words. In contrast, 37 refusals were made by the English readers, whose errors were visual in nature: i.e. real word substitutions (e.g. reading the nonword *sen* as /seen/). All this evidence was interpreted by the authors as indicative of the adoption of different reading strategies by the English and German readers, due to the differences in the orthographic structure of the two languages and the type of reading instruction (whole-word approach vs. phonics) adopted in the two languages/educational systems.

The development of a high degree of mastery of alphabetic reading skills by the learners of regular orthographies has then led researchers to the realization that the manifestation of developmental reading disorders may not be identical in all orthographic systems. Wimmer (1993) has been one of the first to note that the manifestation of developmental dyslexia in the regular German orthographic system may be primarily manifested in terms of reading speed and not so much in terms of reading accuracy, as in the 'deep' English orthography. Examination of the reading

behaviour and cognitive profile of 74 German dyslexic children revealed a pervasive speed deficit for all reading measures used in the study, including text, high frequency words, nonwords, or a digit naming task. German dyslexics' reading speed deficit, however, was not accompanied by a deficit in reading accuracy. Most of the German dyslexics managed to read correctly 90% of the words and 70% of the stimuli in the nonword reading task. The lack of any refusals and the predominance of phonological reading errors (in most cases only one phoneme was wrong, omitted, or in the wrong place) is worth mentioning given the dyslexic status of these children. The high degree of accuracy of German dyslexic children on three phonological tasks that are usually discriminative in the English language (i.e. rhyme oddity detection, vowel substitution, and nonword spelling) was also striking.

On the whole, the evidence from this set of studies in the German and other regular languages clearly indicates how the transparency of these orthographic systems facilitates the development and mastery of phonological reading skills - at least in terms of reading accuracy - not only in normally developing children but also in developmental dyslexics.

Consistent with this view of an increased level of mastery of phonological skills by the users of regular orthographies is also the evidence from another group of studies exploring the effect of orthographic consistency on the development of phonological awareness skills and the way in which phonological representations are structured in regular orthographic systems.

There is evidence to suggest that the mastery of phonological awareness skills is much easier for those learning to read in an alphabetic language than it is to readers of non-alphabetic systems (e.g. Chinese, Japanese). In a series of experiments in the Japanese syllabary system, Mann (1986) has reported significant differences in performance on tasks requiring an awareness at the level of syllables ('mora' counting task) or phonemes (phoneme counting task). All first grade Japanese children found the 'mora'-syllable counting task very easy (100% success rate), whilst only 10% of them were successful on the phoneme counting task. By contrast, the

percentage of American first graders who had passed comparable tasks in the Liberman et al. (1974) study was 90% for the syllable counting task and 70% percent for the phoneme counting task. Such differences in the rate of success between English & Japanese children learning to read in different orthographic systems, indicate the important effect of the orthographic structure of these two languages on the development of differing levels of phonological awareness skills in children of the same age/grade. Similar differences in the ability to manipulate speech sounds have also been observed in Chinese adults who were literate either in the traditional logographic Chinese characters, or in an alphabetic version of the Chinese orthographic system called *Hanyu pinyin* (Read, Yun-Fei, Hong-Yin, & Bao-Qing, 1986). Chinese adults who have learned to use only the traditional logographic Chinese characters experienced considerable difficulty on tasks asking them to add or delete individual consonants in spoken Chinese words or nonwords (36% & 19% mean accuracy scores, respectively). The 'alphabetic' group, on the other hand, found the same tasks much easier, approaching a 90% mean accuracy score for words and 72% for nonwords. Both these two studies in the Japanese and Chinese non-alphabetic scripts clearly show how differences in the written language input may affect the degree of awareness of different phonological levels.

Further evidence to this effect is provided by studies examining the development of phonological awareness skills in very regular (Indo-European) orthographic systems. In a replication of the Liberman et al., (1974) study, Cossu, Shankweiler, Liberman, Katz, and Tola, (1988) asked 4-,5-,7-, and 8-year-old Italian children to tap the number of syllables and phonemes in Italian words. Their performance was then indirectly contrasted to that of the Liberman et al.'s (1974) English speaking children, using the same pass/fail criterion of six consecutive correct responses. Most children in both studies found the syllable segmentation task much easier than the phoneme counting task, indicating a similar pattern in the development of phonological skills in both languages. The degree of mastery of phonological awareness skills, however, was not identical in the two languages. The Italian

children outperformed the English children on all tasks, at all grade levels. In particular, Italian children as young as 4-years-old found the syllable counting task much easier than the English children of the same age. Significant differences were also observed on the phoneme counting task at all grades, with that at grade one being the most significant (with 27% more Italian children reaching the pass criterion and achieving a 93% mean accuracy score). The simplicity of the Italian vowel system and that of its syllable structure were proposed as the main reasons for the higher levels of awareness skills in Italian preschool and first grade children.

A higher degree in the mastery of phonemic awareness skills has also been reported by Caravolas & Bruck, (1993) in the Czech language. One hundred Czech and one hundred and one English-speaking Canadian pre-kindergarten, kindergarten and grade-1 children were tested in this study on three phonological awareness tasks aiming to see whether the higher variety and frequency of complex consonant clusters in the Czech language will have any effect on the development of phonological awareness skills in Czech subjects. Overall, the results supported the authors' hypothesis. Czech pre-kindergarten and kindergarten children significantly outperformed their English-speaking counterparts on a task asking them to isolate the first phoneme in CCV nonwords. A higher level of awareness of complex syllable onsets in Czech children was also apparent in Grade-1, on a similar task asking them to delete the first sound from CCV and CVC nonwords. Again, Czech children performed significantly better on CCV nonwords, than on CVC nonwords where the performance of both groups was equally high (92% & 90%). Significant between-language differences were also found in grade-1 on a nonword spelling task aiming to assess the subject's accuracy of complex onsets. Once again, Czech children produced significantly more acceptable spellings of complex onsets and significantly fewer errors on final consonant clusters than the English-speaking first graders. No difference however was found on the spelling of singleton onsets or final singleton consonants, revealing the specific difficulty of Canadian beginning readers with the manipulation of consonant clusters. In view of this evidence, Caravolas and Bruck

(1993) attributed the higher levels of phonemic awareness in Czech children to the combined effect of the oral and written language input provided by the linguistic characteristics of the Czech orthography, and in particular to its high degree of transparency and the high degree of frequency and variety of its complex syllable onsets.

Further evidence indicating how differences in the phonological and orthographic input may drastically affect the saliency of specific phonological units in languages differing in orthographic depth comes also from a series of recent cross-linguistic studies carried out by Usha Goswami and her collaborators in the French, Spanish, and Greek languages (Goswami, Gombert, Fraca de Barrera, in press; Goswami, Porpodas, Wheelwright, in press). In an attempt to examine possible differences in the level of sub-word phonology in different languages, Goswami et al., contrasted the reading competence of 7-, 8- and 9-year old English, French, & Spanish children (Goswami, Gombert, Fraca de Barrera, in press) or English and Greek children (Goswami, Porpodas, Wheelwright, in press) on a nonword reading task in which pseudowords either: a) shared rime spelling patterns with real words in each orthography (e.g. t***axi*** [h***axi***], in English): designated as O+P+ ; b) only shared rime phonology with real words (e.g. h***acksi*** [h***axi***]: designated as O-P+ ; and c) shared neither orthography nor phonology (e.g. zoip) designated as O-P-. The first group of words (O+P+) aimed to assess a preference for the formation of phonological-orthographic representations at the onset-rime level. The other two groups aimed to assess the formation of phonological-orthographic representations at the phoneme level. Overall, the results of these cross-linguistic comparisons revealed the special role of rime familiarity for the English children, but not for the French, Spanish, or Greek children who were found to rely on smaller orthographic representations, formed at the level of phonemes. In particular, English children, found the rhyming O+P+ nonwords much easier to decode than the O-P+ and O-P- nonwords, at every grade level and every syllable length. When reading the orthographically

unfamiliar but phonologically familiar nonwords (O-P+), or, the orthographically & phonologically unfamiliar nonwords (O-P-), English children experienced considerable difficulties both in terms of accuracy and speed. This however was not the case with the Spanish readers who found the O-P- nonwords only slightly more difficult than the O+P+ nonwords. Similar results have been reported in the regular Greek orthographic system, with Greek readers of all grades reading the O-P- nonwords very accurately but not as fast as the other two nonword groups. The very small and in most cases insignificant differences in the reading performance of Spanish and Greek readers when reading these three groups of nonwords reveal the special phonological status of rhyming units in the highly inconsistent English orthography. These units , however, did not have any strong facilitative effect on the reading performance of those learning to read regular orthographies, where the high consistency in the grapheme-phoneme correspondences appears to favour the development of orthographic representations at the phoneme level.

Studies examining the predictive value of phonological awareness skills in regular orthographies have also indicated significant variations in the degree of sensitivity to different phonological units across languages. Wimmer & Landerl (1994) have reported significant differences in the predictive relationship between rhyme awareness and learning to read in the regular German orthographic system. Bradley & Bryants' rhyme and onset oddity task was translated in German and administered to 45 first graders, prior to the commencement of formal reading instruction. Reading and spelling measures were then administered at the end of the first grade, and two and three years later: at the end of grade-3 and grade-4. Contrary to the evidence from the studies carried by Bryant and colleagues in the English language (e.g. Bradley & Bryant, 1985), rhyme awareness was only minimally predictive of reading and spelling abilities at grade-1. Its predictive power, however, significantly improved by grade-3 and grade-4. No such predictive improvement was observed for word-onset awareness which posed a greater degree of difficulty than the rime task to Austrian readers.

The authors interpreted this differentiation in the predictive power of rhyme awareness in the early stages of literacy development in terms of the different degree of transparency of the two orthographic systems. The greater reliance of Austrian beginning readers on the reliable grapheme-to-phoneme conversion rules, in the German orthographic system, was considered to be the main reason for the minimal use of rime analogies, which have been proved to be so useful in the inconsistent English orthography. The important role of rhyme skills to later reading and spelling development, however, has been acknowledged by Wimmer & Landerl (1994) and explained on similar grounds as in the English literature, that is, on the basis of the development of connections between recurring spelling patterns in written words and their corresponding phonological units.

There is also another study in the Brazilian-Portuguese language which indicates similar differences in the degree of sensitivity, and predictive power, of different phonological units in languages varying in orthographic depth. Cardoso-Martins (1995) assessed the phonological sensitivity of 105 6 year-old Brazilian children just before they started learning to read Portuguese, and then examined their progress in reading and spelling at the middle and end of the school year. Four phonological awareness tasks were used in this study (rhyme detection; syllable or phoneme detection; and phoneme segmentation skills) with an explicit aim to examine the relationship between phonological awareness and learning to read and spell in the regular Brazilian-Portuguese language. A series of multiple regression analyses indicated a strong predictive relationship between syllable awareness skills or phonemic segmentation skills and variation in the ability to learn to read or spell four or nine months later. In accord with the evidence from the English literature, the rhyme detection task proved one of the easiest tasks, as opposed to the phoneme detection task which was one of the most difficult. Its contribution, however, to predicting reading or spelling skill was only minimal at the middle of the school year and non significant by the end of the year, indicating the low saliency of rime unit to the very regular and syllabic-based Portuguese language.

Comparisons of the phonological awareness skills of reading disabled children learning to read in the deep English orthography or in other more regular languages, offer additional evidence to the important effects of the existing variations in the orthographic depth or other specific linguistic characteristics of languages on the development of differing levels and to some extent language-specific phonological skills. Research evidence in the English language reveals the existence of severe phonological deficits in developmental dyslexics, manifested in terms of a lower performance on intra-syllabic awareness tasks or other tasks requiring phonemic manipulation, whether or not the traditional chronological age match design (e.g. Backman, Mamen & Ferguson, 1984) or the more powerful reading-level match design is used (Bradely & Bryant, 1978; Bruck, 1992; Bowey, Cain, Ryan, 1992; though see Beech & Harding, 1984 for opposite results).

These phonological deficits, however, are not manifested in an identical way in other languages with a more transparent orthography. Studies examining the underlying cognitive deficits of Spanish or Dutch reading disabled children report the absence of any rhyme awareness deficit in these languages, at least when a reading-level design is adopted. Gonzalez (1997) reports the results of a study in the Spanish regular orthography based on the comparison of 45 8.5 year-old reading disabled children; 44 normal readers of the same age; and a group of 44 younger (6.5 year-old) children of the same reading age in three phonological awareness tests. Significant differences in performance were found among the three experimental groups in a phoneme segmentation task and a phoneme reversal task, but not in a rhyme-oddity detection task. A similar design was also adopted by DeGelder & Vrooman (1991) in the Dutch language. A phoneme and syllable deletion task and an onset-rime task were used to assess the phonological awareness skills of a group of 11-year-old Dutch dyslexic children and contrast them to those of a group of normally progressing readers of the same age, and, to those of a younger group of 8-year-old children. The reading-level match comparison showed a significant deficit

in the phoneme deletion task, but not in the syllable or onset-rime tasks; although in all these tasks the dyslexics' performance was significantly worse than that of chronological-age controls. In line with this evidence are also the results reported by Wimmer (1993), in his study of 74 grade-2, -3, and -4 German developmental dyslexics. A high degree of accuracy was reported for all dyslexic, chronological-age, and reading-level control children on a rhyme detection task. Although dyslexic children were significantly worse than their chronological age controls, no significant differences were found when the performance of grade-4 dyslexic children was contrasted to that of younger grade-2 children. In this way, one can see that the manifestation of phonological deficits in reading disabled children using a transparent orthography is not identical to the manifestation of developmental dyslexia in the English deep orthography, where such underlying deficits are manifested in most phonological processing measures.

Chapter 3.4 Summary and conclusions

Languages vary in the degree of their orthographic transparency or 'depth'. English orthography is a highly irregular and capricious orthography, where the relationship between graphemes and phonemes is, in many instances, obscure. Such a high degree of variation from the alphabetic principle, however, does not characterize all European orthographies which tend to be much more regular and transparent. Research examining the acquisition of literacy skills in different linguistic environments suggests the significant impact of orthographic variation on the development of these skills. Studies carried out in different orthographic systems reveal the existence of significant cross-language differences in the development of many literacy skills.

The available cross-linguistic evidence on word recognition suggests that beginning readers learning to read in different orthographies adapt their reading processing strategies to the demands of the orthographic system they are learning to read or spell. Studies in the German, Greek, Portuguese or other regular languages reveal a higher degree of reliance on phonological reading and spelling strategies to that exhibited by the users of the English deep orthography. The main reason for this being the high degree of consistency in the grapheme-phoneme correspondences of these orthographies. Because of the low degree of predictability of many spelling patterns, English-speaking beginning readers tend to rely more on a direct/visual word recognition strategy. A long time is usually needed before English beginning readers became competent users of phonological reading strategies, and, in this way, they tend to be error-prone in the initial stages of literacy development. By contrast, the users of more regular orthographies appear to depend more on the highly successful phoneme-to-grapheme conversion rules, and master the alphabetic reading principles more easily and earlier than do their English counterparts.

Research in other areas of cognitive functioning also reveals significant between-language differences. The development of phonological awareness skills has been found to be significantly affected by the orthographic structure of languages. Although children in most orthographies tend to follow the same developmental sequence - i.e. finding the syllable or rhyming tasks significantly easier than the phonemic awareness tasks -, the exact pattern of development of these skills appears to be significantly affected by the specific linguistic characteristics of languages. Transparent orthographies with a high preponderance of open CV syllables (e.g. Italian, Portuguese, Japanese syllabary) heighten the development of phonological awareness skills at the syllable level (e.g. Cossu et al., 1988; Cardoso-Martins, 1995;

Mann, 1986, respectively). Similarly, orthographies with richer inventories of complex consonant clusters, that is Czech language, induce a better and faster conscious awareness of consonants comprising clusters to that induced by other languages with a simpler phonological structure (Caravolas & Bruck, 1993). The highly inconsistent and deep English orthography, on the other hand, favours the development of intra-syllabic awareness skills, at the onset-rime level (e.g. Goswami et al., in press). Evidence from the carefully-controlled studies by Goswami at al., (in press), and from the few predictive studies in the Portuguese and German orthographic systems (Cardoso-Martinns, 1995; Wimmer & Landerl, 1994) reveal that the saliency and contribution of onset-rime awareness to the development of reading competence is very limited - at least in the initial stages of literacy development- in languages with a more transparent orthography.

The existence of significant between-language differences prior to the commencement of formal reading instruction is worth mentioning, because it indicates how variation in the oral language input may affect the development of particular types of phonological awareness skills (Caravolas & Bruck, 1993; Cardoso-Martins, 1995). The important effect, on the other hand, of the orthographic/written language input, and in particular, the beneficial effect of one's exposure and active engagement with a transparent orthography is also evident in the most significant between-language group differences found after the beginning of formal reading instruction: grade-1 subjects.

The manifestation of reading disorders also appears to be affected by the orthographic structure of languages. The few studies carried out in languages other than English indicate the existence of a speed-deficit in reading, rather than of an accuracy-deficit which usually characterizes the reading behaviour of most English

developmental dyslexics (Wimmer, 1993). The absence of any rhyming deficit or syllable awareness deficit (DeGelder & Vrooman, 1991) in reading disordered children learning to read a transparent orthography, in conjunction with their errorless performance in reading clearly reflects the beneficial effect of transparency of these languages; indicating, at the same time, how an increased level of accuracy-awareness in these reading disabled children may exert a masking effect, rendering the identification of these difficulties in transparent orthographies more difficult than it is in the deep English orthography.

In conclusion, the growing cross-linguistic evidence on the acquisition of literacy skills clearly offers a very useful reference point, against which many of the claims made in the deep and highly inconsistent English orthography can be contrasted and universally validated. However, further research is needed as at the moment the number of cross-linguistic studies is small and the information they offer piecemeal. For instance, most of the studies mentioned above have offered evidence only on a small selection of phonological awareness tasks, and, a relatively narrow age-span: i.e. most assessing (pre)kindergarten and grade-1 children. Furthermore, very few of them have offered evidence on how phonological awareness skills develop in normally progressing children at different times in their development. Very few have also addressed the issue of how transparency may affect the predictive power of phonological awareness tests, or, other phonological processing tasks, and, how developmental dyslexia may be best predicted or diagnosed in regular orthographies. Some of these issues are addressed by the present research in the Greek language, whose basic linguistic characteristics are described in the next chapter.

Chapter 4. THE GREEK LANGUAGE

Chapter 4.1 Brief Outline.*

Modern Greek, unlike English, is a very regular language with a highly transparent orthography. One of its basic characteristics is the almost perfect one-to-one correspondence between its graphemes and phonemes for reading. There are virtually no irregular Greek words with arbitrary pronunciations (as in the English words *enough, yacht, eight*), or words containing schwa /ə/ (as in potato). Furthermore, there are no silent vowels or syllables: e.g. as in radic*a*lly or Glou*ce*ster, respectively. The Greek reader always pronounces each syllable and phoneme indicated in the written word: e.g. ποτάμι= /pɒ'tamɪ/ = river); ποδήλατο = /pɒ'ðɪlatɒ/ = bicycle. The pronunciation of most Greek words is highly predictable and the application of basic grapheme-to-phoneme conversion rules highly successful. Consequently, the need for Greek readers to memorise the pronunciation of a given word as whole (as in heal-health in English), or, remember the appropriate context dependent rule of pronunciation as it usually happens in English (e.g. hit - hive: final e) is much less. All the above characteristics, in conjunction with the prevalence of open-CV syllables in most Greek words render the Greek orthography very consistent and highly transparent.

Such a high degree of regularity and consistency, however, is not preserved in spelling, because some of the vowel phonemes in Greek are represented by more than one grapheme (see Table 4.1).

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* This brief outline is included for those wishing to have only a brief summary of the basic characteristics of the Greek orthography. The rest of this chapter describes in more detail the particular characteristic of the Greek phonology, morphology, and syntax.

Table 4.1: The Greek vowel phoneme-grapheme correspondence

Vowel Phonemes	Corresponding Graphemes
/a/	α
/ɒ/	ο, ω
/ε/	ε, αι
/ɪ/	ι,υ,η, οι, ει, υι
/u:/	ου

One of the reasons for this is the preservation in modern Greek of some vowel graphemes, which in Ancient Greek (4th century BC) were used to indicate differences in pitch and duration. The letter ο, for instance, was used for the short sound /o/ as in the English word *octopus*, while the letter ω for the long sound /ɔε/, as in *opener*. Another major reason for this variability in the phoneme-grapheme correspondences is the highly inflectional nature of the Greek orthography. Whilst in English a final -s is used to denote the third person singular in verb declension (e.g. s/he play-s), and plurality in noun declension (e.g. cat-cats), in Greek orthography different ending suffixes are used for first, second, and third person singular and plural to mark the grammatical identity of nouns and verbs (e.g. I play = παίζω /'pεzɒ/; you play = παίζεις; /'pεzɪs/, s/he plays = παίζει /'pεzɪ/; we play = παίζουμε /'pεzumε/; you play = παίζετε /'pεzετε/; they play = παίζουν /'pεzun/) Most of these endings, end either in a vowel or a vowel and a final-s or -ν. Different sets of vowel graphemes are used for nouns and verbs. For instance, the grapheme ο is used for nouns ending in /o/ (e.g. το ποδήλατο = /po'ðɪlatɒ/ = bicycle), while the grapheme ω is required in verbs ending in /o/: active first person present tense (e.g. παω = /'paɒ/ = go). Because of this close relationship between the grammatical identity of Greek words and the selection of the appropriate vowel-endings in verbs and nouns, the use of grammatical and morpho-syntactic information in the Greek

orthography is of primary importance to the Greek spellers. Whilst this greater variety in the selection of vowel graphemes renders spelling in Greek much more demanding than reading, the spelling system is nevertheless more predictable than that of English. The 44 phonemes of the English orthography elicit more than 100 graphemes (Wijk, 1966), whereas the 25 phonemes of the Greek orthography only around 30 graphemes.

Chapter 4.2 Historical evolution of the Greek language.

Greek is one of the family of Indo-European languages and it has the distinction of having the oldest orthography (Triandafilidis, 1917) and the longest history of all European languages (Moleas, 1989). Since the establishment of the Ionian alphabet in approximately the 4th century BC, and despite subsequent changes in the pronunciation, vocabulary, grammar and syntax, the Greeks are still writing their language in a similar fashion to their ancestors approximately 2500 years ago. The use of such 'historic orthography' is of direct interest to this study, because it is the main reason for the irregularities observed in the spelling of many modern Greek words.

One of the basic characteristics of the ancient Greek language was its melodiousness/prosody and the use of music tone, based mainly on the use of different phonemes in terms of duration (e.g. long / short phonemes), and pitch (e.g. acute or grave phonemes) (Argyriadis, 1984). Sentences, as a whole, had a musical quality, like that found in the poems of Homer. To ascribe such a prosody in their pronunciation, ancient Greeks used different letters / vowels for different phonemes. For instance, for the vowel phoneme /o/ the letter "ω" indicated a long sound /ɔɛ/, while

the letter o indicated a short sound /o/. Similarly, the letter "ε" indicated a short sound [ε] as in elephant, while the letter ι a long sound [i:] as in equal. Of the 24 letters in the Greek alphabet (see Appendix A) seven were vowels (α, ο, ω, ε, η, υ, ι) to represent seven phonemes while today they represent only four - /a/, /o/, /ε/, /ɪ/ - of the 24 phonemes of the Greek language (see Appendix 1). The important point about these phonemes is that all vowels of the Ancient Greek alphabet had a 'phonetic role', that is, each one representing a phoneme of different pitch and duration. With the Hellenization of many ancient populations in Asia, Egypt and other places by Alexander the Great (356-323 BC) the Greek language went through a process of simplification as a result of the many nationalities who were then using it. Some of the most important changes in the pronunciation which remain to this day, are: a) the introduction of different breathing and stress symbols; b) the use of lower case letters instead of capitals; and, c) the gradual decline of the melodiousness/prosody in spoken Greek and the subsequent replacement of the music tone by a 'dynamic' tone (the emphasis was now on the accentuation of syllables and not on the musicality of each letter) (Moleas, 1989). This last change was very important because the vowels gradually lost their phonetic function (Argyriadis, 1984). Thus, there was no real need for the use of different letters for the same phoneme because in everyday life these phonetic differences were no longer represented after the loss of the distinction between long and short vowels (with all simple vowels being short). Despite the general demand* for a simpler way of writing, the changes in the pronunciation of words were not followed by a change of the vowels in spelling (Triandafilidis, 1917). For a number of different reasons (cultural, political, economic) the variety in the writing of vowels remains today. In spite of the latest reformation

* During the 19th century there was a great debate in Greece on this issue -

of the Greek writing system in 1982, which established the use of only one stress symbol and abolished the different breathing symbols, this 'historic orthography' of vowels was still preserved. This preservation is one of the main reasons of the current use of more than one grapheme/letter for the same phoneme, and one of the main reasons for the intricacies that characterise Greek spelling nowadays. The basic characteristics of Modern Greek and the main differences with the English language are described in more detail in the next section.

Chapter 4.3 Greek phonology, morphology, and syntax.

Modern Greek is a language that differs from English in many respects. Significant differences exist between the two languages in their phonology, morphology, syntax, and intonation. A brief analysis of the main differences, and some background information will be given in this section to explain how the Greek orthographic system functions.

The sound system of Modern Greek is rather economical, consisting of twenty four distinctive phonemes: five vowels and nineteen consonants (see Appendix A). In contrast to the complex vowel system of English language (inventories range from 12 to 19 vowels, and 5 to 8 diphthongs: Ladefoged, 1993), the Greek vowel system is much simpler, mainly because its vowel sounds are remarkably pure in quality. Vowel length in Greek phonology is not a distinctive feature because it is fairly constant. Each of the five Greek vowels has only one phonetic realisation, being pronounced somewhere between English short and long vowels in length (Mackridge, 1985)(see Table 4.2).

Table 4.2: The i-a vowel continuum: English and Greek divisions.

English					
i	ɪ	eɪ	ɛ	a	ɑ
sheep	ship	shape	bed	hat	bad
	i		ɛ		a
Greek					

In addition to its high degree of consistency, Greek is also characterised by a high degree of articulatory (structure) simplicity, as the prevalent syllable structure in most words is that of open consonant-vowel. In a linguistic analysis of 28 texts/passages of different kinds of prose, for instance, Zachos (1991) reports that in a total of 5147 words (23822 phonemes) the predominant phonemic/syllable structure was that of the CV type. In particular, from a total of 11026 syllables that can take the form of CV, CCV (or CCCV) and VCC (or VCCC) it was found that :

87% were of the CV type

6.86% were of the CCV type

5.48% were of the VCC type.

The prevalence of open CV syllables in many Greek words renders the Greek orthographic system highly transparent and less phonologically complex than other languages whose orthographic structure abounds in complex consonant clusters: e.g. Polish, Czech, English.

Modern Greek rhythm also tends to be syllable-timed rather than stress-timed, and this often gives Greek speech a staccato effect, that is, the tendency for changes in pitch to occur with sudden jumps rather than with a gradual ascent or descent(Waring, 1976: 280-1 cited in Mackridge, 1985). One of the reasons for this

staccato effect and the highly syllabic nature of the Greek language is the high occurrence of multi-syllabic words. In contrast to English, there are very few monosyllable content words in Greek. The majority of them tends to be multisyllabic, exceeding, in some instances, eight or nine syllables in length: e.g. α/να/πο/δο/γυ/ρι/σμέ/νο/ /anapɒðɒɣɪɾɪ'smɛnɒ/, σκου/λι/κο/μυρ/μη/γκό/τρυ/πα /sku:lɪkɒmɪrmɪ'gɒtrɪpa/. This means that the onset-rime distinction is not applicable in the Greek orthography as it is in English where monosyllable rhyming words like *m<u>ight</u>, f<u>ight</u>, n<u>ight</u> l<u>ight</u>* abound. For all the above reasons, beginning reading instruction in Greek explicitly emphasises word segmentation skills at the syllable and phoneme level. Greek beginning readers are usually asked to break words in a 'rhythmic' way first into syllables: e.g. πατάτα → <u>πα</u> <u>τά</u> <u>τα</u> = /pa 'ta ta/; and then into their subsequent phonemes (π -α-τ-ά-τ-α)(see Appendix A).

All the above linguistic characteristics of the Greek language (i.e. the isomorphic relationship between graphemes-phonemes; the high degree of consistency in the phonetic realisation of vowel and consonant graphemes; its articulatory simplicity and syllabic structure/rhythm) renders it highly regular for reading, and less inconsistent and difficult than English.

Chapter 4.3.1 Noun Morphology.

Greek morphology capitalises on the distinction between verbs and nouns. A variety of different endings are used in each group. In the case of nouns, the stem of a word always remains invariant and different endings are added, depending on the gender (see Table 4.3 below) the case, and the number of the noun (see Table 4.4 below). In Greek, there are three grammatical genders (Feminine, masculine, and

neuter); four cases (nominative, genitive, vocative, and accusative) and two numbers (singular and plural). From the point of view of declension, Greek nouns are divided into three chief classes: each one corresponding to one of the three genders. Each class has a variety of endings. Masculine nouns, for instance, can end in -ος, -ης, -ας, -ες, and -ους, feminine nouns may end in -α, -η, or -ου, while neuter nouns can end in -ο, -ι, -ως, -μα, -σιμο (See Table 4.3).

Table 4.3 : Some Possible Endings of Greek Nouns

	Masculine	
- ος	as in	ο δάσκαλ**ος** (teacher)
- ης	as in	ο νικητ**ής** (winner)
- ας	as in	ο αγκών**ας** (elbow)
- ες	as in	ο καφ**ές** (coffee)
-ους	as in	ο παππ**ούς** (grand-father).
	Feminine	
- α	as in	η καρδιά (heart)
- η	as in	η ψυχή (soul)
- ου	as in	η αλεπού (fox)
- ος	as in	η διάμετρος (diameter)
	Neuter	
- ο	as in	το βουν**ό** (mountain)
- ι	as in	το σκοιν**ί** (rope)
- ως	as in	το καθεστ**ώς** (regime)
- μα	as in	το σώ**μα** (body)
- ιμο	as in	το τρέξ**ιμο** (joking
- ος	as in	το βέλ**ος** (arrow)
- ας	as in	το κρέ**ας** (meat)

Different suffix endings are also used for each of these nouns in all four grammatical cases, in singular and plural. This means that each noun in each of the above three main noun classes has eight different endings. For example, the masculine noun δάσκαλος = teacher has eight different endings as seen in Table 4.4.

Table 4.4 : An Example of Noun Declension of a Masculine Noun Ending in -os

	Singular	
Nominative:	δάσκαλ**ος**	e.g. Ο δάσκαλ**ος** έφυγε - The teacher has gone
Genitive:	δασκάλ**ου**	Αυτό το βιβλίο είναι του δασκάλ**ου** - This is the teacher's book.
Accusative:	δάσκαλ**ο**	Είδατε το δάσκαλ**ο** - Did you see the *teacher* ?
Vocative:	δάσκαλ**ε**	Δάσκαλ**ε** είσαι εδώ ? - *Teacher* are you here ?
	Plural	
Nominative:	δάσκαλ**οι**	Οι δάσκαλ**οι** έφυγαν -The *teachers* have gone
Genitive:	δασκάλ**ων**	Αυτά τα βιβλία είναι των δασκάλ**ων** - These are the teacher's books.
Accusative:	δάσκαλ**ους**	Είδατε τους δασκάλ**ους**? - Did you see the *teachers* ?
Vocative:	δάσκαλ**οι**	Δάσκαλ**οι** είστε εδώ ? - *Teachers* are you here ?

Table 4.4 reveals the existing differences in declension between English and Greek. The suffix of the Greek word δάσκαλος (teacher) changes in every case, while in English it remains unchanged most of the time.

The highly inflectional nature of Greek is further demonstrated in the agreement between nouns, adjectives, pronouns, and articles.

In English syntax, agreement is relatively limited. It occurs between the subject of a clause and a present tense verb* (i.e. 3rd person singular), or, between demonstratives and nouns (i.e. use of the demonstratives *this* or *that* in singular, and *these* or *those* in plural). In Greek, agreement usually involves a higher number of factors such as number (singular-plural), gender (feminine, masculine, neuter), case (nominative, accusative, dative, and so on) and person (1st, 2nd, 3rd). The high agreement between a noun and all its determinants (articles, pronouns, adjectives) in

* In English the verb be has a richer involvement with agreement than other verbs: *am* is required with the 1st person singular subject I; *are* with the 2nd; and *is* with the 3rd person singular. It is also the only verb where singular/plural agreement applies in the past tense (was, were). This type of declension approximates to some extent the declension of Greek verbs, where different suffix endings are used for the 1st, 2nd, and 3rd person singular or plural, both in present or past tenses.

the Greek orthography is indicated by the use of the same suffix endings. Three sentences -one with a masculine subject, one with a feminine and one with a neuter subject- are given below to indicate the highly inflectional nature of Greek orthography:

i) Αυτ**ός** **ο** δάσκαλ**ος** (masc. subject)είναι πολύ καλ**ός** άνθρωπ**ος**
(this teacher is a very nice man)

ii) Αυτ**ή** **η** παράστασ**η** (fem. subject) ήταν πάρα πολλ**ή** καλ**ή**
(this performance was very good)

iii) Αυτ**ό** τ**ο** αυτοκίνητ**ο** (neuter subject) είναι πολύ γρήγορ**ο**
(this car is very fast).

The use of the same vowel suffix ending in all words indicating gender (i.e. -ος for masculine words; -η for feminine words; and -ο for neuter words) in each of the above three sentences respectively to indicate differences in the gender, number, or case reveals the prominent role of grammatical and morphosyntactic information in Greek. In order for a noun, adjective, article, and pronoun to be spelled correctly, the speller needs to be aware of the gender, number, and case, of the word s/he wants to write, as all these three sources of information affect the ending of the word in question.

Chapter 4.3.2 Verb Morphology.

The written form of verb morphology also presents some difficulty for Greek spellers, as the inflectional behaviour of verbs is not always predictable. In contrast to noun morphology, irregularities appear in the formation of the stems. Ideally, a reader/speller needs to know six pieces of data about each verb: the imperfective

stem; the perfective active stem; the imperfective non-past (present tense) active configuration type; the imperfective passive stem; the imperfective non-past passive configuration type; and the past passive participle. Irregularities in the stem include:

a) change of radical vowel (e.g. προφτα͟ίνω - πρόφτα͟σα) (/prɒ'ftɛnɒ/ - /'prɒftasa/)

b) change of stem-final consonant (e.g. βγάζ͟ω ---› βγάλ͟ω) (/'vɣazɒ/ -/'vɣalɒ/)

c) deletion or addition of a sound or sounds (e.g. μπαίνω - μπω (/'bɛnɒ/ - /'bɒ/) / καίω -κάηκα (/'kɛɒ/ - /'kaɪka/)

d) metathesis of sounds (e.g. καλ͟ώ - κλ͟ήθηκα) (/ka'lɒ/ - /'klɪθɪka/)

e) suppletion of one root by another (e.g. λέω -είπα) (/'lɛɒ/ - /'ɪpa/)

f) lack of dental in the perfective passive stem (e.g. κόβ͟ω - κόπ͟ηκα) (/'kɒvɒ/ - /'kɒpɪka/)

Up to three of these irregularities may coexist within the paradigm of a single verb.

Verb endings, on the other hand, are more predictable as the appropriate ending for the 1st, 2nd, or 3rd person singular and plural recurs reliably. There are two chief types of imperfective stems: a) one having penultimate stress in the first person singular (e.g. τρ͟έχω = run), and the other final stress (e.g. αγαπώ = love). Stress assignment also plays an important role as it affects the inflection of these two groups. In the first group (stress on the penultimate syllable) verbs in the second and third person singular always end in - εις and -ει, while in plural suffixes for 1st, 2nd, 3rd persons are -ουμε, -ετε, -ουν. When the stress falls on the last syllable, final endings are -ας and -α in singular and in -άμε, -άτε, ούν for the plural. These are the two main groups of active endings (see Table 4.5), while there is one group of endings for the passive voice (see Table 4.5: right column)

Table 4.5 : Main Active and Passive Verb Endings

Singular/Active voice.		Singular/Passive voice.	
1st person	τρέχ**ω**	αγαπ**ώ**	κοιμά**μαι**
2nd person	τρέχ**εις**	αγαπ**άς**	κοιμά**σαι**
3rd person	τρέχ**ει**	αγαπ**ά**	κοιμά**ται**
Plural/Active voice		**Plural/Passive voice.**	
1st person	τρέχ**ουμε**	αγαπ**άμε**	κοιμό**μαστε**
2nd person	τρέχ**ετε**	αγαπ**άτε**	κοιμ**άστε**
3rd person	τρέχ**ουν**	αγαπ**ούν**	κοιμ**ούνται**

Knowing these three sets of endings, the user of the Greek language can correctly spell most of the active and passive voice verbs.

A major difficulty, however, in the spelling of both verbs and nouns appears to be the selection of the appropriate vowel-grapheme in the stem of words. Vowel sounds in Greek are represented by more than one grapheme.. The phoneme /i:/ is represented by six different graphemes (η, ι, υ, οι, ει, υι), the phoneme /ε/ by two (ε and αι) and the phoneme /o/ by two (ο and ω). The only way to select the appropriate grapheme in the stem of words (e.g. επ**ι**χ**ει**ρ**η**ση, αυτοκ**ί**ν**η**το) is by reference to the etymology of each word, and the use of detailed visual orthographic information. Word endings, on the other hand, appear to pose less difficulty to Greek spellers. The systematic way with which these endings are formed, used, and taught in the Greek primary & secondary school, and the high degree of their frequency in written language render the apprehension of these endings somewhat easier, at least for normal readers. The above description of the highly inflectional nature of the Greek morphology also reveals how syntactic/grammatical information facilitates the selection of the appropriate (each time) word ending in nouns and verbs.

From all the above, one can conclude that the regularity of the Greek language is one sided, with reading being easier, and spelling posing significantly more difficulties.

Chapter 4.3.3 Stress Assignment.

Stress assignment is another linguistic feature that distinguishes the Greek language from other European languages such as English, German, Italian. All Greek words of more than one syllable carry an accent over the stressed vowel to indicate which syllable must be accentuated (e.g. πατάτα= potato = /pa ´ta ta/). Apart from this prosodic function, the stress symbol in Greek also has an important semantic/lexical role. In some cases, changes in the position of stress affect, the meaning of words. There are instances, where the position of the stress is the only distinguishable feature in the pronunciation of two different words: e.g. γέρος /'γερɒs/ (old)-γερός /γε'rɒs/ (robust); παίρνω /'pernɒ/ (take) - περνώ /per'nɒ/ (pass); κουραστικές /kurastι'kes/ (tiring) - κουράστηκες /ku:'rastɪkes/ (you got tired). In these cases, differences in the position of stress appear to affect not only the meaning, but also the grammatical identity (e.g. from noun to adjective: γέρος-γερός) and spelling of many words: e.g. παίρνω-περνώ. Stress position is also closely related to the inflection of verbs. In the active voice, if the stress is on the last syllable of verbs ending in the vowel -ω (e.g. αγαπώ), then all verbs of this group take the endings -ας, - α, -άμε, -άτε, -ουν (see Table 1.3 above). If the stress is on the penultimate syllable, then they take the endings -εις, -ει, -ουμε, -ετε, -ουν (e.g. τρέχω = I run; τρέχεις = you run, τρέχει=s/he runs, etc).

This linguistic characteristic of the Greek language was thought to be very useful in the examination of the underlying causes of poor reader's insensitivity to

punctuation marks in writing, and it was further investigated with the stress assignment test.

Chapter 5. DEVELOPING A STUDY IN THE GREEK LANGUAGE (METHODOLOGY)

Chapter 5.1 Statement of the problem.

The review of the research presented in Chapter 2 revealed that the development of literacy skills depends heavily on the development of two major types of metalinguistic awareness skills, that is, phonological skills and syntactic awareness skills. Extensive research on literacy acquisition has shown a strong predictive association between a variety of phonological measures (e.g. phonological awareness tasks; verbal STM tasks; speed of articulation and rapid naming tasks); syntactic awareness measures, and the development of reading and spelling skills.

Until recently, most of the research evidence on literacy acquisition has been based on findings from studies carried out in the 'deep' and highly irregular English orthographic system. With its particular sound system and orthography, however, the English language is not a typical example of an alphabetic system, as most of the other Indo-European languages have a much more regular and transparent orthography. The differences in the orthographic structure of the English and other European languages creates the problem of the universal applicability of some of the claims made in the English literature. The cross-linguistic evidence summarized in Chapter 3 suggests that the particular linguistic characteristics of a language may affect the development of many literacy and metalinguistic skills. However, strong claims about the impact of orthographic variation on literacy acquisition cannot be made, because the number of cross-linguistic comparisons is still small and the information they offer piecemeal. Many of the initial studies have restricted the focus of

their examination on the effects of orthographic transparency on word recognition skills, overlooking at the same time the possibility that the existing differences in the orthographic structure of languages could also affect many aspects of the cognitive profile of both normal and reading disabled readers. Despite the growing number of cross-linguistic studies over the last few years and the gradual expansion of the scope of the research inquiry to include the examination of phonological awareness skills or differences in the manifestation of developmental dyslexia in regular orthographies (e.g. Caravolas & Bruck, 1993; Wimmer, 1993, respectively), the picture of how the transparency of many European languages can affect the development of literacy skills is far from complete and clear. Studies examining the importance of phonological skills in regular orthographies have limited their examination to the use of a small number of phonological awareness tasks: i.e. phoneme and syllable counting or deletion tasks or rhyme oddity tasks. The importance of some other aspects of the phonological system (such as the ability to retain phonological information in STM, or, the ability to retrieve phonological codes from LTM); or some other metalinguistic skills (such as syntactic awareness) have largely been ignored by most cross-linguistic investigations. Studies examining the development of phonological awareness abilities in regular languages have also restricted their examination to a rather limited age-span examining mostly kindergarten and grade-1 children. Consequently, very little is known about the development of these abilities at other ages. Furthermore, few studies have simultaneously explored the predictive relationship of multiple cognitive and linguistic measures to provide a more comprehensive picture of the interaction and contribution of each of these measures to the development of literacy skills in regular orthographies.

Chapter 5.2 Rationale of the study

The present study in the Greek language has been designed to address some of the issues outlined above. Its main aims were to examine the development of literacy skills in the regular Greek orthography; identify the cognitive predictors of reading and spelling abilities; and establish the manifestation of reading and spelling disorders in this regular orthographic system. To this end, an extensive test-battery of cognitive and literacy tasks was constructed to examine the cognitive profile of 132 Greek primary school readers from grades 2 and 4. It comprised three tasks of educational attainment (reading, spelling, and basic number skills); a test of phonological reading skills (nonword reading); seven phonological awareness tasks, three phonological processing tasks; six syntactic awareness tasks; and a test of nonverbal intelligence (see Table 5.1).

This test battery was administered to two groups of children, seven and nine-year-olds - to provide cross-sectional data on the development of metalinguistic and literacy skills after participants had received one year, or three years of formal reading instruction, and to identify the concurrent predictors of reading and spelling skills in the Greek language.

Table 5.1: Experimental Test Battery

OUTCOME VARIABLES	**READING** **SPELLING** ***NONWORD READING*** MATHEMATICS: (As a control condition)
PREDICTOR VARIABLES	***SPEECH RATE*** ***VERBAL STM*** ***RAPID NAMING*** 1. Objects 2. Colours 3. Letters 4. Digits ***PHONOLOGICAL AWARENESS*** 1. Syllable Counting 2. Syllable Deletion 3. Phoneme Counting 4. Phoneme Deletion 5. Phoneme Substitution 6. Spoonerisms 7. Consonant Segmentation ***SYNTACTIC AWARENESS*** 1. Recalling Sentences 2. Sentence Assembly 3. Word Structure 4. Subject-Verb Accordance 5. Distinction: Feminine, Masculine, Neuter 6. Stress Assignment
CONTROL VARIABLES	***NONVERBAL INTELLIGENCE*** (Ravens Progressive Matrices)

One of the first issues addressed by the present thesis was the development of reading abilities in the regular Greek language. Because of the high degree of regularity and articulatory simplicity (i.e. predominance of open CV syllables) of the Greek orthographic system; and the existing cross-linguistic evidence on this issue (e.g. Wimmer, 1993) it was predicted that the development of reading abilities in the Greek language would not be manifested in the same way as in the English irregular

language. Greek readers were expected to develop their phonological reading skills very early, and, thus to be very accurate in reading from the early stages of literacy acquisition. For this reason, two criteria were used when assessing the development of reading skills in the Greek language: i.e. the total number of reading errors; and, the time taken to read all words of the reading test. The aim was to see which of the two criteria - i.e. reading accuracy or reading speed - would be the most sensitive to detect the development of reading abilities in the regular and highly transparent Greek orthography. This would then permit the use any of these two criteria, or a combination of both, in the classification of the participants as poor, average, or good readers.

The second major objective of this study was to determine the cognitive predictors of reading and spelling skills in the regular Greek orthography. To do this, all three sets of phonological awareness tasks, phonological processing tasks and syntactic awareness tasks were treated as predictor variables, and single-word reading and spelling were designated as the two main outcome variables. The Ravens Progressive Matrices Intelligence Test (Ravens, 1976) was used to assess nonverbal reasoning, while the measure of basic number skills was used as a control variable to establish the specificity of the predictive relationship between the predictor variables and the outcome variables: i.e. reading and spelling, but not mathematical skills.

The third aim of the study was to establish the importance of phonological awareness skills in predicting reading and spelling attainment in Greek. A wide selection of phonological awareness tasks of varying degrees of cognitive difficulty was employed to allow a more comprehensive assessment of the phonological awareness abilities of Greek readers; and, establish the predictive utility of each test

in the regular Greek orthography. The consistency and isomorphic relationship between graphemes and phonemes led to the hypothesis that Greek readers would rapidly develop an awareness of the phonological structure of words.

A fourth aim was to examine the predictive relationship between phonological processing skills, that is speech rate, verbal STM, rapid naming, and phonological awareness skills and reading and spelling in Greek.

A fifth aim was to establish the role of syntactic awareness skills in the Greek language. As very little cross-linguistic evidence is available on the predictive relationship between syntactic awareness and the development of literacy skills in regular orthographies, one first aim of this set of analyses was to determine the contribution of syntactic information to the development of reading and spelling abilities in the highly inflected Greek orthography. The highly inflected nature of the Greek morphology and the need for the Greek spellers to use grammatical and syntactic information in the selection of the appropriate suffix ending in the spelling of Greek nouns and verbs (see 4.3.1: Morphology. page 85) prompted the hypothesis that there would be an important predictive relationship between syntactic awareness skills and the development of spelling abilities in Greek.

The sixth aim of this study was to establish how reading and spelling disorders are manifested and identified in the regular Greek orthography. One of the major reasons for pursuing this second objective was the lack of any standardized reading or spelling test in the Greek language and the limited research on the issue of identification of developmental reading and spelling disorders in Greek, and other regular languages.

Chapter 5.3 Participants

One hundred and thirty-two children participated in the study. Sixty six (36 boys, 30 girls) were Grade-2 primary school children with a mean age of 7 years 1 month (range: 6 years 6 months to 7 years 6 months). Sixty six (31 boys, 35 girls) participants were Grade-4 primary school children with a mean age of 9 years 2 months (range: 8 years 6 months to 9 years 6 months). All children were native speakers of the Greek language and a attended school regularly in Athens, Greece. Bilingual children or children with any hearing, sight, or any other serious health problem were excluded. Test administration was discontinued in cases of discomfort experienced by the subjects being tested. One grade-4 child and three grade-2 children were excluded for such reasons. Parental consent was gained prior to testing. All parents were sent a letter describing the aim of the study, the activities to be used in testing, details about the academic qualifications of the experimenter; his address/telephone number for correspondence; and a written consent form which had to be returned to the classroom teacher prior to the commencement of the study.

Participants were selected after screening for nonverbal intelligence (Ravens Standard Progressive Matrices, 1983). This test of nonverbal reasoning was administered as a group test at the beginning of the 1995-96 academic year to all grade-2 (109 children) and all grade-4 children (132 children) of the four primary schools in which the study was conducted. Because of the length of the experimental test-battery it was not possible to test all 241 children within the 1995-96 academic year in which the testing had been planned for. For this reason, it was decided to test a sample of 66 children from grade-2 and a sample of 66 children from grade-4. To ensure a normal distribution of nonverbal ability in each group, 11 children in

each of the two grade levels were of above ability (according to Ravens Matrices), 44 children of average ability, and 11 children of below average ability: a total of 66 children in each grade level.

The investigation was carried out in four different schools in Athens, Greece. All schools were situated in middle-class areas in Athens. One school was in the centre of Athens, while the other three in Palio Faliro, a suburb of Athens. The three schools in Palio Faliro were accepting children only from their area, while the school in the centre of Athens children from different areas of the district of Athens. In this last case, a bus service was provided by the school for the collection and distribution of children. Most of the participants came from middle-class families; many of the mothers were housewives, and almost half of them being currently not in employment.

The differences between the centralized educational system of Greece and the de-centralized system of England deserve mention. The Greek educational system is highly centralized and all schools (state schools and private schools) comply with the decisions of the Ministry of Education and Pedagogical Institute. All teachers, in all districts, follow the same curriculum and use the same books that are provided and distributed by the relevant educational organization at the beginning of each academic year. Head teachers supervise progress to make sure that at the end of each academic year all teachers have taught all the necessary curriculum areas. The Ministry of Education also provides teachers with books for each subject (e.g. language, mathematics, physics, etc.) offering general guidelines on how to use pupils books and how to teach each lesson. As a result, there is a high degree of uniformity on what is taught in all areas of Greece.

Chapter 5.4 Materials

Each participant was administered the following test battery. Since it was necessary to devise tests for use with Greek readers, the tasks are described in detail in this section.

Chapter 5.4.1 Single Word Reading Test.

Reading ability was assessed using a single word reading test of graded difficulty, adapted from Goulandris & Psonis (unpublished). This test is modeled on the British Ability Scale test of single word reading (Elliot, Murray, Pearson, 1983) with words arranged in order of difficulty. The test begins with easy high frequency content words (like *μαμά*= mother, *καλοκαίρι* = summer) or function words (like εγώ = I/me; εδώ = here) (all printed in large letters: font size: 18); and gradually becomes harder with the inclusion of polysyllabic low frequency words containing difficult consonant clusters like εγχείρηση = operation, αμφιθέατρο = amphitheatre (printed in normal size: font size 12). Because of the high degree of transparency and regularity of the Greek language, many children produced errorless performance. Thus, many words of the initial test were replaced by low frequency words with difficult consonant clusters (e.g. *εκχέρσωση*= land reclamation; υπερδιέγερση = overexcitation) to increase the level of decoding difficulty. The final version of this reading test comprised one hundred and thirty-one words printed on two A4 pages (see Appendix C). All participants were asked to read aloud all 131 words as quickly as

possible. The time taken for each subject to read the whole test was measured using a stopwatch. All unsuccessful attempts to read a word and the number of errors were recorded.

Chapter 5.4.2 Nonword Reading.

Participants were asked to read 48 nonwords (See Appendix D) varying in syllable length from 2 to 4, printed on three A4 pages, in order to test their ability to decode words. The degree of decoding difficulty was varied by altering a) the *syllable length* (2-4 syllable nonwords: e.g. νάλα, σαράβι, βηλέφωνο); b) the *visual similarity* with real words (1 or 2 letter alterations: e.g. γάλα (milk) /'ɣala/--› **ν**άλα /'nala/; μήλο(apple) /'milɒ/ —› **ɣ**ή**κ**ο /'ɣikɒ/); and, c) the *phonological complexity* of stimuli (nonwords containing 1 or 2 clusters: e.g. πέτρα (stone) /'pɛtra/ —› **λ**έτρα /'lɛtra/; φράχτης (fence) /'fraxtis/ -› **β**ράχτης, /'vraxtis/ respectively).

Four words were used for each type of alteration: a total 16 words in each syllable length word group. Reading time was recorded with the use of a stopwatch. A record of the number of errors and the children's responses was also kept.

Chapter 5.4.3 Single Word Spelling Test.

A single word spelling test of graded difficulty was constructed to assess spelling ability. It contained 6 sets of 12 words, one for each grade of the Greek

elementary school. An attempt was made to standardize the above test. A pilot study was carried out in two schools in Athens, Greece. Children in each grade were asked to spell a selection of 60 age-appropriate words. From this pool of 360 words, 12 words were selected for each grade for the final version of the test. This final selection (see Appendix E) was undertaken to ensure that the majority of children of a given grade were able to spell most of the words correctly as well as those of the previous grades; but not the words which were selected for children in the higher grades. Within each age group, the words were also arranged in terms of increasing level of spelling difficulty.

The participants of the main study were asked to spell all the words up to those appropriate for children 2 grades in advance of their year. In this way, grade 2 children were asked to spell 48 words (groups 1, 2, 3 and 4), while grade 4 children were asked to spell 72 words (groups 1 to 6). Each word was dictated as a single word, followed by a short sentence containing the word. For instance, the Greek word *σχολείο* (school) was repeated twice, and then was followed by the sentence: *Κάθε πρωί πάω στο σχολείο (Every morning I go to school).* The word to be spelled was repeated again in isolation and children had to write it down. One point was allocated for each word spelled correctly.

Chapter 5.4.4 Phonological Awareness Test Battery.

Seven tests were administered to test phonological awareness: i.e. Phoneme counting, Phoneme deletion, Syllable counting, Syllable deletion, Phoneme substitution, Spoonerisms, and a consonant segmentation task (See Appendix F). To increase the level of difficulty of these tests, half of the phoneme manipulations had to be accomplished by segmenting consonant clusters (e.g. τρένο=train → [κ]ρένο). The other half of the test required the segmentation of open CV words (e.g. γάλα

→ [ν]άλα). Training (6 trial words) and corrective feedback was given for all but the consonant segmentation task before administering the experimental words. In each of these tasks, the experimenter pronounced each item twice, and then awaited the subject's response.

Chapter 5.4.4.1 Phoneme and syllable counting tasks

In the Phoneme counting and Syllable counting tests children were asked to count the number of phonemes and syllables of different words. Subjects were instructed to repeat aloud each single phoneme or syllable of a word, while putting down a counter (small coloured plastic brick) for each phoneme/syllable they were counting (e.g. φως = /fɒs/ = light = /φ/ + /ω/ + /ς/ = 3 phonemes = 3 plastic bricks. These counters were used to help the examiner to check the counted phoneme/syllables, and make the task more stimulating and interesting for the subjects being tested. Twenty words (10 with & 10 without consonant clusters) containing two to five phonemes were used in the phoneme counting task and sixteen words (2-5 syllables; 8 with & 8 without consonant clusters) in the syllable counting task. One point was allocated for each correct answer, in this and all the other phonological awareness tests.

Chapter 5.4.4.2 Phoneme and syllable deletion tasks

In the phoneme and syllable deletion tasks participants had to delete a specific phoneme or syllable from a given word and provide the examiner with the new pronunciation of the word after deletion (e.g. say *φως = /fɒs/* without the final -s = /fo/). Twenty three words of different syllable length (3-5 syllables) were used in the first test, 22 words of 3 to 6 syllables in the second. In half the cases the deletion had to be made from an open CV syllable while, half from a consonant cluster.

Chapter 5.4.4.3 Phoneme substitution task

The phoneme substitution task required children to exchange the first phoneme of a given word with another phoneme provided by the examiner (e.g. νερό = water - / γ / → *γερό*), as well as to change a pre-specified phoneme in words

which had this phoneme twice in different positions (e.g. πα_τά_τα = potato - change the phoneme /τ/ with the phoneme /χ/ –› *πα_χά_χα*). Fifteen words were used in this test: a total of 15 points maximum.

Chapter 5.4.4.4 Spoonerisms

In the spoonerism task subjects had to exchange the first phoneme in each of 10 word pairs (e.g. **μ**αχαίρι - **π**ηρούνι, /**m**a'xerɪ/ - /**p**ɪ'ru:nɪ/= knife - fork → **π**αχαίρι - **μ**ηρούνι, /**p**a'xerɪ/ - /**m**ɪ'ru:nɪ/). In five word pairs the phoneme exchange had to be made from open CV words (e.g. as in *μαχαίρι-πηρούνι*), while in the other five from words containing a consonant cluster in the initial position (e.g. **χ**ρόνια-**π**ολλά, /'**x**r**p**nɪa/ - /**p**p'la/ → **π**ρόνια-**χ**ολλά). Two points were given for each correct word pair: 1 point for each phoneme correctly exchanged.

Chapter 5.4.4.5 Consonant segmentation task

The consonant segmentation task required children to segment words orally into syllables. Two sets of Greek words were used for this task. One set comprised fifteen words containing an open-CV first syllable (e.g. τίγρης = tiger → τί / γρης); while the second set fifteen words with a closed first syllable (e.g. χαρτί = paper→ χαρ / τί). By asking subjects to syllabify orally these words, they were in essence asked to decide: a) either to keep the sequence of consonants together (whenever the sequence of clusters was a syllable onset: e.g. sp as in the English word ho/spi tal), or, b) to split them (whenever the sequence of consonants was not a syllable onset: e.g. nj as in en / joy). This test aimed to assess the subjects' ability to segment sequences of consonants into phonetically acceptable manner and in this way their ability to decode words. One point was allocated to each correct response: a total of 30 points maximum.

Chapter 5.4.5 Verbal Short Term Memory

In this test, subjects were asked to recall the exact sequence of words presented by the examiner. Three lists of words, one for each syllable length (2-, 3-, and 4- syllable words), were employed in this test. All words were taken from primary school language books of the first grades to ensure word familiarity. Each list started with two words and gradually increased to three, four, up to eight words (see Appendix G), by adding an additional word in random order every other trial (two trials at each syllable length). In this way, subjects had to start with two pairs of words of two words, then two pairs of words of three words and so on:

e.g.:	ποτήρι-καρότο	(glass-carrot)
	καράβι-τραπέζι	(boat-table)
	ντουλάπα-κόκορας-ποτήρι	(cupboard-glass-carrot)
	καμπάνα-μπαστούνι-καρότο	(bell-stick-carrot), etc.

A discontinuation rule was applied after two consecutive unsuccessful attempts in each syllable length word list. This test was scored by assigning one point for each successful attempt.

Chapter 5.4.6 Speech rate

This task required subjects to repeat continuously and as fast as possible a given pair of words until told to stop. The same set of words was used as for the memory span test. Four pairs of words were selected for each of the three syllable length-groups (see Appendix H). To increase the level of difficulty of the task, special attention was given so that each word-pair contained at least one letter articulated at different places in the vocal tract: i.e. labials, velars, and alveolars. Words were ordered in such a way so that in each pair of words the changes in the place of articulation occurred at the beginning of each word. For example, the word pair μπάλα-κότα (ball-chicken) begins with a labial (μπ = /b/), and the second word κότα with a velar (κ = /k/), having also an alveolar in it (τ = /t). The demand for a quick alternation in the place of articulation was assumed to be more difficult and chal-

lenging - and hence more revealing of individual differences - than the repetition of words with phonemes articulated in the same place of the vocal tract.

The word pairs were presented orally by the examiner to the children one at a time. The children were asked to repeat each word pair once to ensure that it had been perceived correctly. If a child mispronounced a word pair, corrective feedback was given, and the child was asked to say the word pair again. This procedure was followed until the child correctly repeated the word pair. The children were then told to repeat the word pair as quickly as possible without making errors until told to stop. The examiner started the stopwatch at the beginning of the first repetition and stopped the watch after the 10th repetition. To ensure a continuous production of speech and to minimize the potential effect of subjects anticipating the number of repetitions being counted, the children were told to stop at some point between the 11th and 13th repetitions. This point varied randomly with each word pair; that is, either the 11th, 12th, or 13th repetition was chosen as the stopping point. This task was scored for both accuracy and speed. The accuracy score was the total number of errors for the 10 word pairs. The speed score was the average length of time it took to repeat all word pairs.

Chapter 5.4.7 Rapid Naming Tests

These tests consisted of 4 charts, each depicting 5 items repeated ten times in random order (see Appendix I). Each chart tested naming speed for one type of stimuli: Digits (9, 2, 7, 4, 5), Colours (blue, black, red, brown, yellow), Letters (ε, σ, o, λ, 6), or line drawings of common objects (ball, key, umbrella, scissors, and tab).

Stimuli were matched in terms of frequency, syllable length, and familiarity to avoid differences in performance. In the case of object naming, for instance, all items were objects used in everyday life, to ensure the 'concrete environmental fa-

miliarity' and 'operativity' of stimuli (Denckla & Rudel, 1976). An attempt was also made to keep the number of syllables identical across all four categories. Of the five items used in each category three were two-syllable words while the other two were three-syllable words. Only in one case - i.e. colours - this was not possible. Of the three available two-syllable colour names, two (i.e. black = μαύρο & white = άσπρο) were semantically associated (opposites). This violated the third criterion of item selection which was used to ensure that there would be no semantic association among items (i.e. not seen or used together in the environment). For this reason one of the two (white) had to be discarded and another one-syllable word (blue = μπλέ) had to be used instead.

A continuous-trial procedure was selected because this procedure is believed to reflect the cognitive processes that are involved in reading continuous text (Katz & Shankweiler, 1983; Wolf, 1991) and be more sensitive to the difficulties among poor and reading disabled readers (Blachman, 1984). Naming was from left to right in all four tests, and from top to bottom in the case of objects and colours. Objects or colours patches were put on 2 x 2 cm squares arrayed on a A4 chart in 5 rows and 5 columns. Letters or Digits were typed in font size 18 in a single row, divided into 10 groups of five items. Subjects were asked to name all 50 items as quickly as possible without making errors. The measure of interest was the amount of time taken to name all 50 items, keeping a record of the time taken for each category as well as of the number of uncorrected errors.

Chapter 5.4.8 Syntactic Awareness

Six tasks were used to assess children's syntactic awareness. Three were adapted from the Clinical Evaluation of Language Fundamentals- Revised test battery (Semel, Wiig & Secord, 1987) and translated into Greek: i.e. *Recalling Sentences; Word Structure; and Sentence Assembly* subtests. Three additional tasks were also devised to assess children's sensitivity to syntactic/linguistic features that are characteristic of the Greek language: stress assignment; the distinction between the three genders of the Greek language (masculine-feminine-and neuter); and the accordance between subject and verb (all can be seen in Appendix J).

Chapter 5.4.8.1 Recalling sentences

This task requires subjects to recall sentences with different degrees of syntactic difficulty: e.g. recall of simple active sentences; interrogative affirmative, negative or passive sentences; or recall of more difficult active & passive sentences with noun modification, or coordination, or subordinate clause, or conjunction deletion. While the significance of elicited imitation is not yet understood, the cognitive process involved in this task is considered to be a complex one, involving receptive language, syntactic ability and memory factors, and not just imitation or memory span alone (Vogel, 1974). The twenty-six sentences of the English test were translated into Greek with some modifications. The following criteria were used:

a)An attempt was made to keep the number of syllables of the Greek sentences as close as possible to the number of syllables of the English sentences to avoid differences in performance due to extreme memory load. This is because Greek words tend to be longer than English words. As a result, some of the sentences used in the Greek version were rewritten using different nouns/verbs, while keeping the syntactic category the same in both versions. For instance, the exact translation of the English sentence "Was the car followed by the police ?" (9 syllables) in Greek

"Ακολουθήθηκε το αυτοκίνητο απο την αστυνομία; " would have resulted into a sentence 20 syllables in length. The sentence which has been finally selected for this syntactic category (Interrogative passive): "Ακούστηκε τίποτα απο το μεγάφωνο ; " i.e. "Was anything heard from the speaker?"has 14 syllables. This correspondence in the number of syllables, however, was not always possible in the more complex syntactic categories (i.e. active sentences with conjunction deletion or with relative clause: No 25 & 26 respectively). In such cases, the differences were quite large - 12 to 14 syllables - but it was thought that, since long words abound in the Greek language, such differences may be worth keeping to resemble the memory load of sentences used in common every day speech.

b) to use sentences that would be 'natural' in every day Greek. Taking, for instance, the above sentence "Was the car followed by the police?" = "Ακολουθήθηκε το αυτοκίνητο απο την αστυνομία" it could be argued that, while this sentence is syntactically correct, the use of the passive voice for this verb is not so frequent and thus not so 'natural' in Greek, as the use of the active voice: "Ακολούθησε η αστυνομία το αυτοκίνητο ; ". For this reason, more frequent passive voice verbs like *ακούστηκε= heard in the sentence* "Ακούστηκε τίποτα απο το μεγάφωνο; " have been selected as more appropriate.

The same scoring procedures used in the English sub-test were also used in the Greek version. Three points were given if the subject's response was identical to the one given by the examiner; 2 points if there was one error; 1 if there were two to three errors and 0 if four or more errors.

Chapter 5.4.8.2 Word Structure (Grammatical Closure Sub-test)

A number of different grammatical phenomena are assessed by this test: e.g. knowledge of regular and irregular plurals; noun possessives; personal & possessive pronouns; regular and irregular past tense and future tense; derivation of nouns

from verbs; adjective derivation; formation of comparative and superlative; and finally knowledge of demonstratives. The examiner with the help of a stimulus manual starts a sentence and the child is required to finish it. The stimuli are presented as line drawings displaying simple tasks for each grammatical phenomenon examined. An example of such a stimulus and the required answer is seen in Figure 5.1

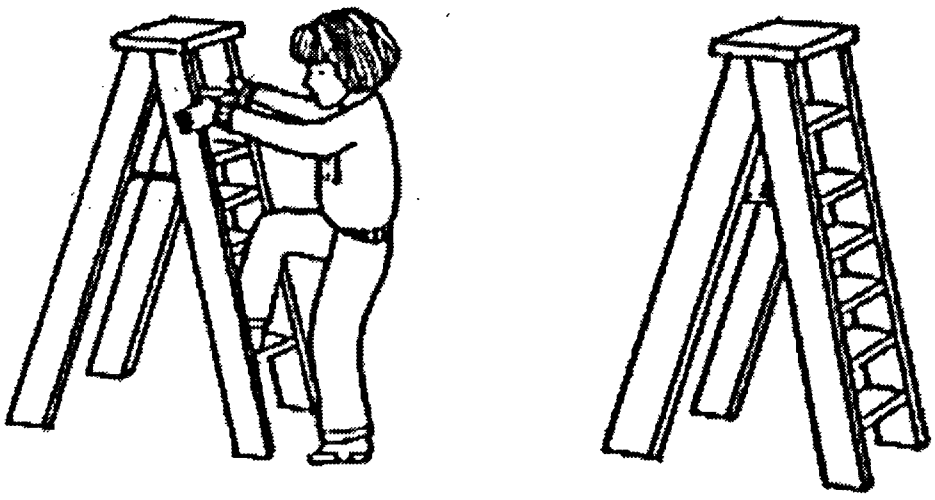

Figure 5.1 Here the girl is climbing a ladder. Here is the ladder the girl has (*climbed*)

When translating the English version of this into Greek it was decided to include: a) nouns that have more syllables in plural than in singular (e.g. γράμμα = letter –› γράμμα**τα**) or irregular nouns in which plural are completely different from the rest of the nouns of the same category (e.g. στάση = bus-stop –› στάσ**εις** κουρέας = hair dresser –›κουρείς); b) irregular verbs that either change their radical vowel and loose their stem-final consonant in the past tense (e.g. ανεβ**αίν**ω = climb –› ανέβ**η**κα = climbed), or their perfect stem is completely different from their imperfect stem (τρώγω = eat –› έφαγα = ate; βλέπω = see –› είδα = saw); c) irregular noun derivatives (βάφω = paint –› μπογιατζής = house painter).

Chapter 5.4.8.3 Sentence Assembly (Word Order Correction) Test

The Sentence Assembly test was used to assess the ability to assemble syntactic structures into grammatically acceptable and semantically meaningful sentences. Participants are presented visually with randomly sequenced words that can be made into a sentence (e.g. kicked, the girl, the boy), and asked to construct two sentences using all words: e.g. The boy kicked the girl, or, The girl kicked the boy. The parts of each sentence are typed in landscape orientation on an A4 page printed in bold letters (Fonts: Magenta New Times; Letter size: 24).

The test starts with easy sentences (e.g. Simple declarative/active sentences: the boy is tall) and gradually becomes more difficult with the inclusion of sentences requiring more complex syntactic structure: e.g. declarative/active with subordinate clause: I want it, even if it is expensive). Some sentences are structured in such a way that the assembly of two correct sentences is possible only if the subject uses interrogation as the second alternative: e.g. tall, the boy, is: The boy is tall, or, Is the boy tall ?

One demonstration and two trial items help subjects to understand the nature of the task. After that, no corrective feedback is given. The child is allowed one repetition of the parts of a sentence in case of difficulty. No discontinuation rule was applied in the Greek version, because more flexibility in sentence formation is allowed in the Greek language/syntax. Greek allows more freedom in expression, so many constraints of English syntax are not applicable in Greek. Taking, for instance, the test item No. 13 (and, is running, is falling, the girl, the boy) four possible declarative alternatives are possible, as in English the subject comes always before the verb:

a) The girl is running and the boy is falling.

b) The boy is running and the girl is falling.

c) The girl is falling and the boy is running.

d) The boy is falling and the girl is running.

In Greek, however, this constraint does not always apply, and apart from the exact translation of the four sentences mentioned above (a, b, c, d) another four sentences (e, f, g, h) are also permissible.

a) Το κορίτσι τρέχει και το αγόρι πέφτει = The girl is running and the boy is falling.

b) Το αγόρι τρέχει και το κορίτσι πέφτει = The boy is running and the girl is falling.

c) Το αγόρι πέφτει και το κορίτσι τρέχει = The girl is falling and the boy is running.

d) Το αγόρι πέφτει και το κορίτσι τρέχει = The boy is falling and the girl is running.

e) Πέφτει το κορίτσι και τρέχει το αγόρι = (The verb is first and the subject follows: if this translation was permissible in English it would be something like *Is falling the girl and is running the boy*?).

f) Πέφτει το αγόρι και τρέχει το κορίτσι = Similarly, 'Is falling the boy and is running the girl

g) Τρέχει το κορίτσι και πέφτει το αγόρι = Is running the girl and is falling the boy.

h) Τρέχει το αγόρι και πέφτει το κορίτσι. = Is running the boy and is falling the girl.

Because of the existence of so many alternatives, the same scoring procedures could not be used in the Greek version of this test. One point was assigned, instead, to every syntactically correct response and zero to any unsuccessful attempt. A record of all errors was also kept for each subject.

Chapter 5.4.8.4 Stress Assignment Test

The use of a stress mark on every polysyllabic Greek word is very important because its presence affects in some cases both the prosody (e.g. by indicating which syllable is accentuated) and the meaning (i.e. changes in the position of the stress mark, affect the meaning: e.g. νόμος (law) - νομός (prefecture). The stress assignment test aimed to assess the consistency with which grade-2 and grade-4 average

or poor children use the stress mark in writing and contrast it with their awareness of the semantic/lexical role of the stress mark. Ten pairs of sound-alike words were used to assess this type of linguistic awareness. After presenting subjects with cards with line drawings and giving them pair of words (in which the only difference in pronunciation is the place of the stress) the experimenter asked them to choose which of the two was depicted on the card. All participants were asked to justify their answers. It was hypothesized that if poor readers' insensitivity to punctuation marks (and more especially to the stress symbol in Greek words) is primarily the result of a deficit in this specific linguistic aspect of language, then these children would also have great difficulty distinguishing the subtle differences in pronunciation of the sound-alike pairs used in this test. If, on the other hand, the reasons for their difficulty with punctuation marks lie elsewhere (e.g. phonological/orthographic deficits), then it was expected that Greek poor readers would continue to omit the stress symbol in spelling but have no difficulty in choosing the correct word of the two sound-alike alternatives. Ten such cards and pairs of words were used for this purpose. One point was given for each correct answer.

Chapter 5.4.8.5 Distinction between feminine, masculine, & neuter

This test aimed to assess children's sensitivity to the three genders of the Greek language. Stimuli were constructed by replacing the correct adjectival suffix ending by an ending appropriate to an alternative gender. Subjects were asked to identify any errors in an auditory presented sentence and to repair errors identified: e.g. αυτός ο δάσκαλος (masculine) είναι καλός (masculine adj.), μα αυστηρή (feminine adj.) = this teacher is good but strict. Ability to detect such syntactic violations was thought to be indicative of the subjects' awareness of the basic rules governing Greek morphology and syntax. Six sentences were presented orally and

repeated a second time. The first three experimental sentences had two adjectives, one of which was wrongly pronounced: see example above. The inclusion of the first adjective had a facilitating role, as, by being pronounced correctly it was offering a clue of the correct pronunciation of the second adjective. The remaining three sentences had only one adjective, so no clue was provided. Participants had to decide if there was anything wrong in the sentences they heard. If the answer was affirmative, they had to name the incorrect word and provide the examiner with the correct response. One point was assigned to each correct answer and 0 to each incorrect one.

Chapter 5.4.8.6 The subject-verb accordance violation test.

Similar reasoning was followed in the subject-verb accordance violation test. This time, the focus was on the agreement between the subject of a sentence and the verb. Six sentences were used. Each had its verb distorted either by putting the subject in singular and the verb in plural (e.g. Η Μαρία τραγουδ**ούν** ωραία = Maria sing nice, instead of Η Μαρία τραγουδ**άει** ωραία = Maria sings nice), or by putting the subject in a different person of the same number (e.g. Ο Νίκος διαβάζ**εις** πολύ καλά = Niko *you* read very well, instead of Ο Νίκος διαβάζ**ει** πολύ καλά = Niko reads very well). The same scoring procedure was used as in the previous test: 1 point for each correct answer.

Chapter 5.4.9 Number Skills

Basic number skills were assessed using a version of the British Abilities Scales (BAS) Arithmetic sub-test (Elliott , Murray, & Pearson, 1983), adapted for Greek children.

This test starts with very easy one-digit mathematical operations (additions: 2+7; subtractions: 6-3; multiplications: 2x7; and divisions: 6:2) and continues with more difficult two-digit operations: e.g. with or without carrying; operations where the divisor is bigger than the dividend; or operations involving fractions or decimals (See appendix K). The order of operations is mixed and arranged in increasing level of difficulty.

As this test-battery has not been standardized in Greek, a pilot study with a sample of 360 children (grades 1 to 6) was carried out into two schools in Athens, Greece to see if this test could be used with children being educated in the Greek educational system. Before administration, the necessary changes were made to the content and presentation of this test to reflect the current arithmetic curriculum in Greek and differences in the mathematical symbols in use in Greece: e.g. the decimal indicator in English is a period while in Greek is a comma. The results of the pilot study indicated that the English version was equally valid when used with a Greek population. All subjects in the main study were asked to try and find the answer to all mathematical operations, even if some of them were unknown to them. No time limit was applied and all subjects worked at their own pace. One point was allocated for each correct operation.

Chapter 5.4.10 General Intelligence.

The Ravens Standard Progressive Matrices (Ravens, 1976) was used to determine which children would be selected for the study, and, as an indicator of the participant's nonverbal ability. It was administered as a group test to all pupils of the classes that had been selected to take part in this study. It was selected be-

cause it is not a culturally biased test, not very time-consuming and easily administered as a group test. The use of the British norms, however, proved unreliable for our Greek sample. Comparison of the Group scores indicated that individual scores in both grades were not normally distributed (see Table 5.2).

Table 5.2: Characterisation of the participants according to the British and Greek norms: Ravens test.

British Norms		**Greek Sample Z Scores**	
Grade-2	***Grade -4***	***Grade-2***	***Grade-4***
29 Superior	30 Superior	2 Superior	0 Superior
22 Above	30 Above	17 Above	22 Above
41 Average	49 Average	71 Average	88 Average
14 Below	15 Below	19 Below	14 Below
3 Impaired	8 Impaired	0 Impaired	8 Impaired.

For this reason, it was decided to administer this test to the whole Grade-2 & Grade-4 population of the four schools and use these scores as normative data.

Chapter 5.5 Procedure

The tasks were administered to the children by the author in a quiet room near the classroom area. Each child was seen individually for two sessions each lasting two and a half hours. Each session included breaks, as appropriate, to allow children to rest. Two tests from the whole test-battery were administered by the author as group tests: the General Intelligence (Ravens, 1976) and the Basic Number Skills tests (Elliott , Murray, & Pearson, 1983).

The test battery was divided into two parts: one starting with the phonological awareness and processing measures and the other starting with the syntactic awareness measures. Presentation of tests was randomized and counterbalanced within and between phonological awareness and syntactic awareness measures to

avoid any order effects. Both parts required an equal amount of time to be completed.

Chapter 5.6 Descriptive statistics - Preliminary analyses

Means and standard deviations for each variable used in this study at each grade level are presented in Table 5.3 and Table 5.4. To allow comparisons between tasks, the measures of nonword reading, speech rate, and verbal STM were averaged across the three syllable lengths (2-, 3-, & 4- syllables). To facilitate the comparison of the individual tasks used to assess rapid naming, phonological awareness and syntactic awareness skills, a composite score was used for these three variables (see Table 5.3). The mean time taken to complete all four rapid naming tasks (i.e. objects, colours, digits, letters) was used as the main variable of rapid naming. Inspection of the means and standard deviations of the seven individual phonological awareness tasks and six syntactic awareness tasks (see Table 5.4) revealed significant group differences between grade-2 and grade-4 children on all but the phoneme and syllable counting tasks or in the three syntactic awareness tasks of stress assignment; subject-verb accordance and the distinction between feminine, masculine and neuter. For this reason, these tests were not included in the main composite scores of phonological awareness and syntactic awareness respectively, which comprised the mean number of correct responses on the remaining five phonological awareness tasks and three syntactic awareness tasks, respectively (see Table 5.3). These two main composite scores were then used in the subsequent statistical analyses for phonological and syntactic awareness, reported in chapter 7 and chapter 8.

Inspection of means and standard deviations of all nine major variables indicated the gradual development of these abilities with age. Fourth graders significantly outperformed second graders on all measures.

Table 5.3: Means and standard deviations of language and literacy tasks (main variables/composite scores).

	GRADE 2		*GRADE 4*	
MEASURES	Mean	(SD)	Mean	(SD)
Reading speed (time:sec/whole test)	420.0	(134.0)	235.0	(111.0)
Reading errors (total: 131 words)	7.3	(6.0)	4.9	(6.1)
Spelling (max. no of words = 72)	20.6	(9.0)	44.4	(17.0)
Nonword reading (time:sec/whole test)	138.0	(45.2)	92.5	(37.6)
Nonword reading errors (48 words)	4.2	(3.6)	2.2	(3.3)
Speech Rate Mean (word/sec)	1.6	(0.19)	2.02	(0.27)
Verbal Short Term Memory.	16.6	(2.6)	18.2	(3.3)
Rapid Naming Mean (sec)	53.7	(9.93)	40.40	(8.02)
Phon/cal Awareness Total. (max. = 106)	83.7	(12..2)	91.9	(11.1)
Syntactic Awareness (max. = 152)	114.7	(9.8)	127.4	(11.9)
BAS - Number Skills (max. = 34)	11.6	(2.2)	21.1	(3.5)

All group differences were significant at the $p < .001$ level with the exception of reading errors ($p < .05$). Importantly, there was a high degree of accuracy in both groups of children on the single-word reading and nonword reading tasks. Children of both grades made very few errors on these two tests. Reading speed, on the other hand, appears to be more sensitive to variability in reading skill between the two groups. Grade-2 children took almost twice as long as grade-4 chil-

dren to read the same group of words: that is 420 sec. vs. 235 sec., respectively. Similar results are also observed in the nonword reading task. Grade-4 children were faster and more accurate than grade-2 children.

Table 5.4: Individual Tests: Means and Standard Deviations.

	GRADE 2	*GRADE 4*
MEASURES	Mean (SD)	Mean (SD)
Rapid Naming Tasks		
Objects mean time in seconds	62.8 (14.9)	50.3 (12.1) *
Colours	53.3 (10.9)	44.3 (9.1) *
Letters	62.4 (16.8)	40.3 (10.6) *
Digits	36.4 (7.5)	26.7 (7.11) *
Phonological Awareness tasks		
Phoneme Counting/ 20	17.6 (2.6)	18 (2.6)
Phoneme Deletion/ 23	21.7 (2.0)	22.4 (1.4) *
Phoneme Substitution/ 15	11.5 (2.5)	12.8 (2.3) *
Syllable Counting/ 16	15.5 (1.0)	15.7 (1.1)
Syllable Deletion/ 18	16.6 (1.9)	17.4 (1.6) *
Consonant Segment./ 30	19.8 (4.1)	22.5 (3.8) *
Spoonerism/ 20	14 (5.0)	16.6 (4.8) *
Syntactic Awareness tasks		
Recalling sentences/ 78	58.6 (5.6)	63.6 (7.0) *
Sentence Assembly/ 42	27.4 (4.9)	33.2 (4.8) *
Grammatical closure/ 32	28.7 (2.3)	30.6 (1.9) *
Stress assignment test/ 9	8.5 (0.75)	8.9 (0.32)
Subject-verb accordance/ 6	5.9 (0.17)	5.9 (0.39)
Dist: Fem.-masc-neut/ 6	5.9 (0.27)	6 (0.00)

* $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Thus the present data set was used to address the roles of phonological awareness, phonological processing and syntactic awareness in learning to read in the Greek language.

Chapter 6. THE ROLE OF PHONOLOGICAL AWARENESS IN GREEK

Chapter 6.1 Introduction.

As discussed in Chapter 2, there is now a massive body of evidence indicating that phonological awareness is one of the most powerful predictors of reading or spelling, accounting for significant amounts of variance in reading skill, even after the effects of age and intelligence have been controlled (see Goswami & Bryant, 1990; Wagner & Torgessen, 1987 for reviews). However, the development of phonological awareness skills is, at least partially, a product of literacy skills (Morais, Alegria, & Content, 1987; Perfetti, Beck, Bell, & Hughes, 1987). The available cross-linguistic evidence summarized in chapter 4 reveals that the saliency of certain types of phonological awareness skills (i.e. onset-rimes, syllables, phonemes) is not identical in all alphabetic scripts, but rather depends highly on the phonological properties of a language and the specific demands imposed by different types of reading instruction (e.g. phonics vs. whole-language approaches)(e.g. Wimmer, 1993). This raises the question of the importance of phonological awareness skills in regular orthographies. The claim has been made in the English literature that children who do well on phonological awareness tasks are quick to pick up how phonemes relate to graphemes in the orthography (Snowling, 1996) and use this knowledge of letter-sound correspondences as a self-teaching device to improve their word recognition skills (Jorme & Share, 1983). English, however, is a very irregular and inconsistent orthography. So, it is possible, that the strong predictive power of phonological awareness meas-

ures in English may be closely related to this stark lack of consistency in the grapheme-phoneme correspondences and the relative difficulty many English beginning readers have in understanding that, despite the many irregularities, there is a systematic relationship between the speech sounds and the letters found in words. By contrast, the available cross-linguistic evidence indicates the beneficial effect of regularity on the development of phonological awareness skills. Nonetheless, a close predictive relationship between these metalinguistic skills and early literacy acquisition also exists in regular languages (Lundberg et al., 1988). Moreover, very little is known about how phonological awareness skills relate to literacy skills later on, after several years of reading instruction and exposure to a regular alphabetic script. The present study attempts to address this issue in the regular Greek language, by examining the development and predictive validity of different levels of phonological awareness skills at two points in development, age 7 & age 9.

Seven phonological awareness tasks of differing degrees of cognitive difficulty were used for this purpose (see Chapter 5 for more detail). Six of these, i.e. syllable and phoneme counting and deletion tasks, phoneme substitution, and spoonerisms, are commonly used in English as reliable predictors and useful diagnostic tools in both experimental and clinical practice. The seventh task, was a newly developed test which aimed to assess children's consonant segmentation skills and serve as an extra diagnostic tool and predictor of reading ability in the Greek language.

Consideration of the linguistic characteristics of the Greek language (e.g. 1-1 grapheme-to-phoneme correspondences; simplicity in its phonological structure: predominance of open CV syllables) prompted the hypothesis that the development of phonological awareness skills in Greek would be relatively easy and fast. If true,

then the diagnostic sensitivity and predictive power of many phonological awareness tasks would also be affected, negatively, by the regularity of the Greek language and the high degree of competence in the manipulation of the phonological structure of words in Greek readers (i.e. ceiling effects).

All seven phonological awareness tasks were administered to all 132 participants of the present study: i.e. 66 grade-2 and 66 grade-4 children (see Chapter 5).

Chapter 6.2 Results.

Chapter 6.2.1 The development of phonological awareness skills in the regular Greek language.

The performance of the children on the seven phonological awareness tasks is shown in Table 6.1.

A high degree of accuracy was exhibited by most Greek readers of both grades on most phonological awareness tasks. The performance of both groups of children was at ceiling on three of the seven tasks used in the present study. In fact, it was only on the more difficult tasks of phoneme substitution, spoonerisms and consonant segmentation that Greek readers did not exhibit such a high degree of competence (see Table 6.1).

Table 6.1: Means and standard deviations of individual phonological awareness tests

	GRADE 2			GRADE 4		
MEASURES	Mean	SD	% Cor	Mean	SD	% Cor
Phoneme Counting max. = 20	17.6	2.6	88%	18	2.6	90%
Phoneme Deletion max. = 23	21.7	2	94%	22.4	1.4	97%
Syllable Counting max. = 16	15.5	1	97%	15.7	1.1	98%
Syllable Deletion max. = 18	16.6	1.9	92%	17.4	1.6	97%
Phoneme Substitution max. = 15	11.5	2.5	77%	12.8	2.3	85%
Spoonerism max. = 20	14.0	5	70%	16.6	4.8	83%
Consonant Segmentation max. = 30	19.8	4.1	66%	22.5	3.8	75%

Chapter 6.2.2 The relationship between phonological awareness skills and literacy skills in Greek.

Prior to statistical analysis, routine screening procedures were employed to ensure that the raw score distributions conformed to the assumptions which underlie the use of inferential parametric statistics. Moderate to substantial departures from normality were observed on most individual phonological awareness measures. The necessary logarithmic, inversion, and square root transformations were applied as appropriate to reduce skewness, much of which was due to ceiling effects, to reduce the number of outliers, and improve the normality, linearity, and homoscedasticity of residuals (Tabachnick & Fidell, 1996). Logarithmic transformations were used on the

phoneme counting and phoneme substitution tasks, while inversion transformations on the phoneme deletion, syllable counting and deletion tasks. Only one measure, consonant segmentation, was not sufficiently skewed to require transformation. After the above transformations, the transformed scores were checked once again for skewness and then transformed into standardized scores for each grade separately. The standardized scores were then used in the subsequent partial correlation, principal component, and regression analyses.

Partial correlations (controlling for age and IQ) between the seven phonological awareness tasks, reading and spelling were conducted to examine the interrelationships between these seven phonological awareness measures, and their predictive relationship to literacy development in the Greek language (see Table 6.2). Highly significant correlations were obtained between reading and phoneme deletion ($r = .44$, $p<.000$) spoonerisms ($r = .42$, $p=.000$), and phoneme substitution, ($r = .34$, $p<000$). The same variables showed the highest correlations with spelling ability ($r = 39$; .50, & .37, respectively, $p<.000$ in all). The consonant segmentation and syllable deletion tasks, on the other hand, yield relatively low, though significant correlations with both reading ($r = .27$ & .25, $p<.01$) and spelling ($r = .29$, $p<.01$). Neither syllable counting nor phoneme counting correlated with reading or spelling ability or the other phonological awareness tests, possibly because of ceiling effects.

Table 6.2: Partial correlations between phonological awareness tests (controlling for IQ & age), and reading and spelling.

BOTH GRADES

	Reading	Phon Cnt	Phon Del	Phon Sub	Spooner	Syll Cnt	Syll Del	Cons Seg
Phon Cnt	.13							
Phon Del	.44***	.21*						
Phon Sub	.34***	.30**	.46***					
Spoon	.42***	.24**	.44***	.63***				
Syll Cnt	.17	.14	.09	.11	.07			
Syll Del	.25**	.08	.48***	.28**	.16	.26**		
Cons. Seg	.27**	.04	.25**	.35***	.24**	.07	.21*	
Spelling	.65***	.14	.39***	.37***	.50***	.26**	.29**	.29**

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

Interesting changes in the pattern of relationships between reading or spelling skill and the different phonological awareness tests are evident when one looks at the two grades separately. In grade 2 (see Table 6.3), the tests with the highest and most significant correlations to reading are the consonant segmentation test (r= .38, p<.01) and the phoneme deletion test (r=.38, p<.01). All the other phonological awareness tests in this grade, including that of the spoonerism test, had very low and/or non significant correlations to both reading and spelling.

In grade 4, (see Table 6.3, lower part) on the other hand, the pattern of relationship changes as the spoonerisms test has the highest and most significant correlation with both reading (r=..64, p<.001) and spelling (r=.68, p<.001). The phoneme deletion and substitution tests in this grade appear to be highly related to both reading and spelling skills, having even higher correlations than in grade 2. In contrast, the consonant segmentation test in this grade, is not related at all to reading as it was in grade 2.

Table 6.3: Summary of partial correlations between phonological awareness tests, reading and spelling for Grade 2 and Grade 4 (controlling for IQ and Age).

GRADE-2

	Reading	Phon Cnt	Phon Del	Phon Sub	Spoon	Syll Cnt	Syll Del	Cons. Seg
Phon Cnt	.12							
Phon Del.	**.38 ****	.20						
Phon Sub.	**.31 ***	.22	.42**					
Spooner.	.19	.16	.30*	.65***				
Syll Cnt.	.17	.13	.04	.04	-.06			
Syll Del.	.21	.07	.45***	.33**	.05	.20		
Cons. Seg.	**.38 ****	-.06	.33	.39**	.27*	-.13	.09	
Spelling	.53***	.07	.30	.29	.31*	.17	.11	.21

*** = p<0.001, ** = p<0.01 ; * = P<0.05

GRADE-4

	Read	Phon Cnt	Phon Del	Phon Sub	Spoon	Syll Cnt	Syll Del	Cons. Seg
Phon Cnt	.17							
Phon Del.	**.49 *****	.23						
Phon Sub.	**.39 ****	.38**	.50***					
Spooner.	**.64 *****	.35**	.58***	.61***				
Syll Cnt.	.27	.14	.17	.19	.23			
Syll Del.	**.32 ***	.10	.53***	.23	.30*	.31*		
Cons. Seg.	.22	.14	.21	.33**	.22	.25	.32*	
Spelling	.81***	.22	.51***	.47***	.68***	.35**	.43***	.33**

*** = p<0.001, ** = p<0.01 ; * = P<0.05

A principal component analysis with oblique (oblimin) Rotation was used to explore the structure of phonological abilities tapped by the seven phonological awareness measures. A two-factor solution gave a clear and easily interpreted structure (see Table 6.4). The first factor (eigen value = 3.01) had strong loadings from the tests of phoneme counting, phoneme deletion, phoneme substitution,

spoonerisms, and consonant segmentation, accounting for 43% of the observed variance. The tasks of syllable counting and syllable deletion, on the other hand, loaded highly on Factor 2 (eigen value = 1.03), accounting for 14% of the variance. Factor 1 was interpreted as a phoneme factor while Factor 2 as a syllable factor.

Table 6.4: Rotated factor loadings for the seven phonological awareness tasks.

	FACTOR 1	FACTOR 2
1. Phoneme Counting	.51	.06
2. Phoneme Deletion	.69	.17
3. Phoneme Substitution	.88	-.05
4. Spoonerisms	.87	-.16
5. Consonant Segm.	.58	.02
6. Syllable counting	-.11	.89
7. Syllable deletion	.30	.62

Chapter 6.2.3 Concurrent predictors of reading and spelling ability in Greek: phonological awareness measures.

A series of fixed-order hierarchical regression analyses were conducted to examine the predictive relationship of the seven phonological awareness tasks with reading and spelling ability. Since the pattern of correlations was different for the two grades, regression analyses were conducted for each grade separately and not across the whole sample. Hierarchical regression analyses were also conducted with mathematical skills as a dependent variable to assess the specificity in the relationship between phonological awareness skills and literacy attainment.

Chapter 6.2.3.1 Predicting reading ability.

Table 6.5 summarises the results of two sets of regression analyses contrasting the predictive validity of syllable awareness skills and phonemic awareness skills. The first two steps in these and all the subsequent analyses were identical. Age and IQ were controlled by a forced entry in the first step of the regression equation. Since most of the phonological awareness tasks in this study involved a memory component (i.e. remembering the sequence of phonological segments in words), the measure of verbal short term memory was entered in the second step to control for differences in verbal STM skills. The predictive validity of phoneme and syllable awareness tasks was contrasted using two factor scores as predictors: i.e. a syllable and a phoneme factor score. Based on the results of the principal component analysis (seeTable 6.4), the syllable factor score comprised the total number of correct responses on the syllable counting and syllable deletion tasks, while the phoneme factor score the total number of correct responses on the five phonemic awareness tasks used in the test battery. The order of entry of these two factor scores was altered in the first two sets of regressions. In SET A (see Table 6.5, 3rd step), the syllable factor was put ahead of the phoneme factor score. In SET B the order of entry was reversed to see if the phoneme factor will make an independent contribution over and above that made by the syllable awareness tasks (see Table 6.5, 4th step).

Table 6.5: Summary of fixed order regression analyses contrasting the predictive validity of syllabic and phonemic awareness skills - READING ABILITY.

		GRADE -2			GRADE -4	
		R^2Ch	Sig.		R^2Ch	Sig
1	Age & IQ	14%	.009	Age & IQ	16%	.004
2	Verbal STM	5%	-	Verbal STM	20%	.000
			SET A			
3	Syllable Factor	3%	-	Syllable Factor	6%	.01
4	Phoneme Factor	11%	.003	Phoneme Factor	8%	.002
			SET B			
3	Phoneme Factor	13%	.001	Phoneme Factor	13%	.000
4	Syllable Factor	1%	-	Syllable Factor	1%	-

On the whole, the results of these two sets of regression analyses reveal the low predictive validity of syllabic awareness skills in predicting reading skill in Greek. In most cases, the syllable factor score did not make any significant contribution to predicting reading attainment, even when it was put in the first steps of the regression equation. The only case where syllable awareness predicted reading skill was in grade-4, accounting for 6% ($p<.01$) (see Table 6.5, SET A, right column). Its contribution, however, was not significant when the syllable factor score entered the regression equation after the phonemic awareness skills (see Table 6.5, SET B, 4th step).

Because of the low predictive validity of the syllable awareness skills, the syllable factor was excluded from the subsequent hierarchical regression analyses which aimed to establish the predictive value of the five phonemic awareness tasks used in the study. Five sets of regression equations were used for this purpose, placing each time the variable of interest in the last step of the regression to see if it would make an independent prediction from the previous measures (see Table 6.6 SETS C, D, E, F, G). The order of entry of all predictor variables was also alter-

nated at the same time to check: a) whether each of the five measures would yield any predictive relationship with the dependent variable; and b) to examine in more depth the interrelationship between highly intercorrelated variables (e.g. phoneme deletion, phoneme substitution, spoonerisms).

Table 6.6: Summary of fixed order regression analyses for all individual phonemic awareness tests - READING ABILITY.

		GRADE -2			GRADE - 4	
		R^2Ch	Sig.		R^2Ch	Sig
				SET C		
1	Age & IQ	14%	.009	Age & IQ	16%	.004
2	Verbal STM	5%	-	Verbal STM	20%	.000
3	Phon. Sub.	6%	.03	Phon. Sub.	6%	.02
4	Spoonerism	-	-	Spoonerism	14%	.006
5	Phon. Del.	6%	.03	Phon. Del.	1%	-
6	Cons. Seg	4%	.05	Cons. Seg	-	-
7)	Phon. Cnt	-	-	Phon. Cnt	-	
				SET D		
3	Phon. Cnt	10%	.004	Phon. Cnt	3%	-
4	Phon. Del.			Phon. Del.	8%	.005
5	Phon. Sub.	2%	-	Phon. Sub.	1%	-
6	Spoonerism	-	-	Spoonerism	9%	.001
7)	Cons. Seg	5%	.05	Cons. Seg	-	-
				SET E		
3	Spoonerism	2%	-	Spoonerism	19%	.000
4	Phon. Sub.	4%	-	Phon. Sub.	-	-
5	Cons. Seg	6%	.02	Cons. Seg	-	-
6	Phon. Del.	4%	-	Phon. Del.	1%	-
				SET F		
3	Cons. Seg	10%	.004	Cons. Seg	1%	-
4	Phon. Del.	5%	.03	Phon. Del.	9%	.003
5	Spoonerism	-	-	Spoonerism	10%	.000
6	Phon. Sub.	1%	-	Phon. Sub.	-	-
				SET G		
3)	Phon. Del.	10%	.004	Phon. Del.	10%	.002
4(	Phon. Sub.	2%	-	Phon. Sub.	1%	-
5)	Cons. Seg	4%	.05	Cons. Seg	-	-
6)	Spoonerism	-	-	Spoonerism	10%	.000

Significant differences in the pattern of prediction were observed for grades 2 and 4. In grade-2 (see left column of Table 6.6), the most reliable predictor of reading ability proved to be the consonant segmentation task, accounting for a unique proportion of variance in reading (R^2Ch = 5%, $p<.05$), even after differences in all the other phonemic awareness tests have been controlled for (see SET D). The phoneme deletion task was also predictive of reading skill in most analyses, but it failed to make an independent contribution once it was entered after all the other three phoneme awareness tasks (see SET E). The tasks of spoonerism and phoneme substitution were not reliable predictors of reading ability in grade-2. Phoneme substitution appeared to share some common variance with phoneme deletion, spoonerism and consonant segmentation, indicated by the significant and the high intercorrelations between them and the failure of any of these tasks to predict reading ability independently of the other (see Sets D, E, F, G).

Regression analyses carried out for grade-4 children (see Table V, middle column), on the other hand, revealed that the most reliable predictor of reading skill at age 9 was the spoonerism test. While phoneme substitution (see SET C) and phoneme deletion (see SET G) were predictive of reading attainment when they were entered in the first steps of the regression equation, their contribution was not significant once they were entered after the spoonerism test (see SET E); which accounted for a unique and highly significant proportion of variance (R^2Ch = 10%, $p<.001$) even when the effects of all the other phoneme awareness measures have been accounted for (see SET G). Phoneme substitution and consonant segmentation did not prove to be reliable predictors of reading ability. The contribution of consonant segmentation was not significant in any of the analyses; while that of pho-

neme substitution was significant only when it was entered as the 3rd step of the regression equation ahead of all the other predictors (SET C).

Chapter 6.2.3.2 Predicting spelling ability.

A series of multiple fixed-order regression analyses were also conducted for spelling ability to examine the predictive relationship of all seven phonological awareness tasks with the second main dependent variable of the study. Once again, differences in age, non-verbal ability and verbal STM skills were controlled in the first two steps of the regression equations. The first two sets of regression equations aimed to contrast the predictive validity of syllabic awareness and phonemic awareness skills (see Table 6.7). As with the statistical analyses for reading ability, a syllable factor score and a phoneme factor score were used as predictors in these two sets of regression equations (SET A & SET B in Table 6.7). In these analyses too, the phonemic awareness factor proved a much more powerful predictor of concurrent spelling attainment, in both grades. In most cases the syllable awareness factor did not make any significant contribution to predicting spelling ability, even when it was put in the first steps of the regression equation. The only case in which the syllable factor made a significant contribution was in grade-4, accounting for 16% ($p < .001$) when it was entered ahead of the phoneme factor. Its contribution, however, was significantly reduced once the syllable factor was entered after the phoneme factor, accounting for 5% of the variance ($p < .01$).

Table 6.7 Summary of fixed order regression analyses contrasting the predictive validity of syllable and phoneme awareness skills - SPELLING.

	GRADE 2			GRADE 4	
	R^2Ch	**Sign.**		**R^2Ch**	**Sign.**
Age & IQ	29%	.000		4	-
Verbal STM	-	-		18	.000
		SET A			
Phoneme Factor	10%	.003	Phoneme Factor	24%	.000
Syllable Factor	1%	-	Syllable Factor	5%	.01
		SET B			
Syllable Factor	3%	-	Syllable Factor	16%	.000
Phoneme Factor	8%	.005	Phoneme Factor	13%	.000

The predictive validity of phoneme awareness tasks was examined in a series of regression analyses (summarized in Table 6.8), after the exclusion of the syllable factor. The order of entry of all predictor variables was altered to examine the effects of each phoneme awareness test on spelling attainment (see Table 6.8). The first set of this group of regression analyses (Set C) aimed to assess the contribution of consonant segmentation skills, putting phoneme counting ahead of phoneme deletion (3rd & 4th step). The second set of regression equations (Set D) assessed the predictive validity of the spoonerism test, while putting at the same time phoneme deletion (3rd step) ahead of phoneme counting (4th step Set D). The third set of regressions (Set E) examined the predictive validity of phoneme deletion, putting phoneme substitution ahead of spoonerism. The fourth set (Set F) aimed to assess the predictive validity of phoneme substitution, while putting phoneme deletion

ahead of spoonerism. The final set of regression analyses aimed to see which phonological awareness tasks would continue to make an independent contribution to predicting spelling, once the effects of the spoonerism test have been accounted for.

Table 6.8: Summary of fixed order regression analyses for all phoneme awareness tests - SPELLING ABILITY.

		GRADE -2			GRADE -4	
		%R^2Ch	Sign.		%R^2Ch	Sign
					SET C	
1	Age & IQ	29%	.000	Age & IQ	4%	-
2	Verbal STM	-	-	Verbal STM	18%	.000
3	Phon. Cnt			Phon. Cnt	5%	.05
4	Phon. Del.	6%	.02	Phon. Del.	11%	.002
5	Phon. Sub.	2%	-	Phon. Sub.	3%	-
6	Spoonerism	2%		Spoonerism	12%	.000
7	Cons. Seg	1%	-	Cons. Seg	2%	-
					SET D	
3	Phon. Delt	7%	-	Phon. Del	14%	.001
4	Phon. Cnt.	-	.02	Phon. Cnt.	2%	-
5	Phon. Sub.	2%	-	Phon. Sub	3%	-
6	Cons. Segm	-	-	Cons. Segm	2%	-
7	Spoonerism	2%	-	Spoonerism	12%	.000
					SET E	
3	Phon. Sub	6%	.02	Phon. Sub	12%	.001
4	Spoonerism	2%	-	Spoonerism	17%	.000
5	Phon. Cnt	-	-	Phon. Cnt	-	-
6	Cons. Seg	1%	.-	Cons. Seg	2%	-
7	Phon. Del.	3%	-	Phon. Del.	1%	-
					SET F	
3	Phon. Del.	7%	.01	Phon. Del.	14%	.01
4	Spoonerism	4%	.05	Spoonerism	16%	.000
5	Cons. Seg	-	-	Cons. Seg	2%	-
6	Phon. Cnt.	-	-	Phon. Cnt.	-	.-
7	Phon. Sub.	-	-	Phon. Sub.		-
					SET G	
3	Spoonerism	7%	.01	Spoonerism	28%	.000
4	Phon. Del.	4%	-	Phon. Del.	1%	-
5	Cons. Seg	-	-	Cons. Seg	2%	-
6	Phon. Sub.	-	-	Phon. Sub.	-	-
7	Phon. Cnt.	-	-	Phon. Cnt.	-	-

On the whole, the above regression analyses show that the most powerful predictors of spelling ability in Greek were the phoneme deletion and spoonerism tests. In grade 2, the tests of phoneme deletion (R^2Ch = 6%, $p<.05$, SET B), phoneme substi-

tution (R^2Ch = 5%, $p<.05$, Set C) and spoonerism (R^2Ch = %, $p<.001$) were all predictive of spelling skill, but none of them made an independent contribution, once the effects of all the other tests have been taken into account (see SET C, E, D, left column, last step). These three measures appeared to share some common variance with each other, as in most cases their predictive power varied according to the previous order of entry. The same results were also observed in grade-4, with the notable exception of the spoonerism test (see Set, B, C, D, E), which was the only measure which accounted for a unique amount of variance over and above the one accounted by all the other phonological awareness tasks (R^2Ch= 12%, $p<.001$) (see Table 6.8, SET D, right column). It is also worth noting that once the spoonerism test was entered ahead of all the other correlated tests, none of them significantly predicted spelling skill either in grade-2 or in grade-4 (see Table 6.8, SET G, left and right columns).

Chapter 6.2.3.3 Predicting mathematical skills (control condition)

To assess the specificity of the relationship between phonemic skills and literacy phonological awareness tasks and mathematical skills a series of regression analyses were performed with the BAS subtest of basic number skills as the dependent variable. Table 6.9 summarizes the main regression analyses for grade-2 and grade-4.

Table 6.9: Summary of hierarchical order regression analyses for mathematical skills

	GRADE-2			GRADE-4	
Variable	**R^2Ch**	**Sign**	**Variable**	**R^2Ch**	**Sign**
Age & IQ	17%	.003	Age & IQ	14%	.01
Verbal STM	-	-	Verbal STM	1%	-
Syllable Counting.	-	-	Syllable Counting	-	-
Syllable Deletion	-	-	Syllable Deletion	5%	.05
Phoneme Counting	-	-	Phoneme Counting	-	-
Phoneme Deletion	-	-	Phoneme Deletion	-	-
Phoneme Substitution	-	-	Phoneme Substitution	8%	.01
Spoonerisms	-	-	Spoonerisms	-	-
Consonant Segment.	-	-	Consonant Segment.	-	-
Phoneme Counting	-	-	Phoneme Counting	2%	-
Phoneme Deletion	-	-	Phoneme Deletion	4%	-
Phoneme Substitution			Phoneme Substitution	7%	.02
Spoonerisms	-	-	Spoonerisms	-4%	--
Consonant Segment.	-	-	Consonant Segment.	-	-
Syllable Counting.	-	-	Syllable Counting	-	-
Syllable Deletion	-	-	Syllable Deletion	5%	.05

The results from the first group of analyses (grade-2, left column) indicate that none of the seven phonological awareness tasks predicts mathematical skills. However, in grade-4, the tasks of syllable deletion (R^2Ch = 5%, $p<.05$) and phoneme substitution (R^2Ch = 8%, $p<.05$) predicted mathematical skills.

Chapter 6.3 Summary of results

The regression analyses revealed that the strongest predictors of reading in Grade-2 were the consonant segmentation and phoneme deletion tasks, and of spelling the phoneme deletion, phoneme substitution and spoonerism tasks. By contrast none of the phonological awareness measures predicted the development of mathematical skills. In grade-4, the strongest predictor of concurrent reading or spelling attainment proved the spoonerism measure.

The present results indicate that young readers of Greek have high levels of phonological awareness skills at an early stage in their development. A high degree of competence was exhibited in the manipulation of the phonological structure of words even by grade-2 (7 year-old) children in most of the phonological awareness tasks, with performance being at ceiling on the syllable counting and syllable deletion tasks as well as approaching ceiling in the phoneme counting and phoneme deletion. Fourth graders exhibited even higher degrees of competence. The only tests which appeared to challenge the phonological skills of Greek readers were the more difficult tasks of phoneme substitution, spoonerism, and consonant segmentation. The mean accuracy score in these tasks ranged from 66% to 77% at grade-2, while from 75% to 85% at grade-4.

Although the present study was not designed to directly assess cross-language differences in the development of phonological awareness skills, the high degree of accuracy on the part of Greek readers on most phonological awareness tasks needs to be emphasised, given the evidence that English-speaking children of the same age find the same tasks significantly harder. Nation and Hulme (1997), for instance, report a mean accuracy score of 24% on a phoneme counting task at grade 1, a mean of 50% at grade-3, and a mean of 75% at grade-4. In the present study, Greek children obtained a mean accuracy score of 88% at grade-2, and 90% at grade-4. In a number of studies, grade-2 English-speaking children have also consistently been reported to achieve a mean accuracy score of 70% on phoneme deletion tasks (Wagner et al., 1993, 1994; Muter & Snowling, 1998) which stands in stark contrast to the 94% of the second graders of the present study.

In accordance with evidence from other studies (Lundberg, Frost & Peterson, 1988; Hoien, Lundberg, Stanovich, & Bjaalid, 1995), two phonological awareness fac-

tors accounted for performance on the phonological awareness tasks: a phonemic factor and a syllable factor. Of the two, the phonemic factor proved the most reliable predictor, as the syllable counting and syllable deletion tasks failed to predict literacy skills in most instances since performance was at ceiling. In general, the spoonerism and phoneme deletion tasks proved the most reliable predictors of reading skill. Some interesting changes in the pattern of prediction, however, were observed with age. The phoneme deletion and consonant segmentation tasks were the most significant predictors of concurrent reading attainment at age 7, while the spoonerism task the most significant predictor at age 9.

This pattern of predictive relationships presents some interest from a cross-linguistic point of view. Phoneme counting and deletion tasks are used in the English language as reliable diagnostic tools and as reliable predictors of literacy skills from about the age of six years onwards. Muter & Snowling (1998), for instance, have found the phoneme deletion task to be one of the most powerful concurrent and longitudinal predictors of reading skill at age 9. Similar results have also been reported by Nation & Hulme (1997) in a phoneme counting task with 6-, 8-, and 9-year-old English-speaking children. In the present study, phoneme counting did not predict reading or spelling ability at all. Phoneme deletion, on the other hand, proved a reliable predictor of concurrent reading attainment at age 7 (grade 2) but not at age 9 (grade -4), once differences in other phonological tasks have been controlled for. Overall, the spoonerism task was the most powerful predictor of reading and spelling skill at age nine even when STM was controlled.

One plausible explanation for the stronger relationship between phonological skills and reading in older children is the reciprocal effects of literacy on phonological awareness. In addition, the greater emphasis placed by the Greek methods of

reading instruction on the development of segmentation skills at the level of syllables or individual phonemes might play a role (cf. Wimmer, 1993).

Recently, Snowling and Hulme (1994) have made the claim that the importance of conscious awareness of phonological structure for learning to read may have been over-stated, based on evidence that, in some cases (e.g. children with Down's syndrome), children may develop age appropriate reading skills in spite of their difficulty with phonological awareness tasks (Cossu, Rossini, Marshall, 1993). Thus, Snowling and Hulme (1994) concluded that phonological awareness are at best indirect measures of the phonological processes that are acquired for learning to read (p.25). The results of the present study offer some support for this claim, since it suggests that the linguistic environment affects the development of metaphonological awareness skills. The role of phonological processing skills which do not require conscious awareness plays in the assessment of children's' underlying phonological abilities in Greek is examined in the next chapter.

The assessment of phonological awareness skills in the present study included a newly developed test which assessed children's consonant segmentation skills, by means of a spoken syllabification task (see Chapter 5). This test was used as an additional indicator of children's phonological skills and another possible predictor of reading skill in Greek. Children were asked to syllabify words orally and in this way to try and segment the consonantal sequences that were present in one of the words' syllable boundaries into phonologically acceptable ways (e.g. as in e-lec-tri-city). The prediction was made that children who are sensitive to the phonological constraints of their language will be able to detect faster which letter sequences in a

word are 'permissible' or not, and in this way will be more competent and faster in decoding consonant clusters or words than children who lack this type of sensitivity. The results of the present study indicated that the ability to segment consonantal sequences was predictive of concurrent reading attainment at age 7 (grade-2) but not at age 9 (grade-4). At grade-2 the consonant segmentation task was the only test which made an independent contribution to the prediction even when differences in all the other phonological awareness skills have been controlled for. The lack of any predictive relationship in grade 4 was however not surprising because during the third and fourth year of reading instruction Greek children receive explicit instruction on how to segment words into syllables and how to identify - with the help of some standard grammatical rules - which consonantal sequences are permissible or not.

The present set of analyses examining the role of phonological awareness skills to the development and prediction of reading and spelling abilities in the Greek language also included a control condition in which mathematical skills acted as a dependent variable. The results of regression analyses for mathematical skills indicated that few of the phonological awareness measures predicted arithmetic skills. The only exception was in grade-4 where the syllable deletion and phoneme substitution tasks accounted for some variance in arithmetic skill. At first sight, these findings are difficult to explain. However, the absence of any verbal ability test in the testing protocol of this study precludes testing the hypothesis that these skills tap verbal abilities that are crucial for the development of mathematical as well as of reading skills.

On the whole, the evidence presented in this chapter indicates that phonological awareness skills are important to the development of reading and spelling abilities, even in languages with very regular orthographies. However phonological awareness abilities appear to develop more easily in readers of such languages. The next chapter reports an assessment of the importance of a number of phonological processing skills to reading and spelling development and contrasts them to phonological awareness measures.

Chapter 7. THE ROLE OF PHONOLOGICAL PROCESSING SKILLS

Chapter 7.1 Introduction

"Learning to read requires integrating a system for processing written words with one that already exists for processing spoken words" (Snowling, 1996, p.4). Research evidence indicates that one of the most crucial elements in the development of both these systems is the development of intact input and output phonological processes and the development and storage of appropriate phonological representations (Stackhouse & Wells, 1997). For many years, phonological awareness tasks have been used as major tools of assessing children's phonological skills (e.g. Bruce, 1964; Lieberman et al., 1974). However, recently research inquiry has gradually moved to finer distinctions not only between different levels of phonological awareness skills (i.e. at the level of syllables, onset-rimes, or phonemes), but also between different kinds of phonological processing skills (i.e. distinction between phonological awareness, phonological coding in working memory, phonological recoding in lexical access (Wagner & Torgesen., 1987).

Within this theoretical framework, the present set of analyses set out to investigate the importance of various phonological processing skills in the development of literacy skills in the regular Greek orthography at age 7 and age 9. Given the recent concerns about the over-stated importance of phonological awareness tasks in the assessment of the quality of underlying phonological representations (Snowling & Hulme, 1994) and the evidence indicating the impact of the regularity of the Greek language on the diagnostic sensitivity of many phonological awareness tasks (see Chapter 6), a major objective was to establish whether the predictive power of

other phonological processing measures, not requiring conscious awareness, would also vary in a regular orthography.

To this purpose, seven phonological processing tasks, namely, a speech rate task, a verbal STM task, four rapid naming tasks & a nonword reading task were administered to all 132 participants of this study. These analyses contrast their predictive relationship to literacy skills at age 7 and age 9 with that of phonological awareness.

Chapter 7.2 Results.

Chapter 7.2.1 The relationship between nonword reading, speech rate, rapid naming, verbal STM, phonological awareness and literacy skills in Greek

Descriptive statistics of all major phonological processing measures are given in Table 5.3 and Table 5.4. To allow comparison between tasks, composite scores were used for the phonological awareness measures[1], and the four rapid naming measures. Mean reading time per word was used for the nonword reading; the average words per second for the speech rate; and the average words remembered in the 3 syllable lengths in the verbal STM task (see chapter 5).

Pre-analyses screening procedures were used, identical to those reported in Chapter 6 for the individual phonological awareness tasks. After the necessary logarithmic (nonword reading; phonological awareness; rapid naming) and square root (verbal STM) transformations, all scores were transformed to standardised scores for each grade separately and then used in the subsequent analyses.

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[1] The total score across five phonological awareness tasks remaining after the exclusion of phoneme and syllable counting tasks (see chapter 5).

Partial correlations (controlling for age & IQ) between all the main experimental measures were conducted to examine the interrelationships among all variables in question and their relationship to reading and spelling.

Some interesting changes in the pattern of relationships were observed when carrying out correlations for each grade separately (see Table 7.1).

Table 7.1: Correlation matrix for grade-2 (below diagonal line) and grade 4 (above diagonal line) children

							GRADE-4		
	Read	Spell	BAS	Nonw Read.	Phon. Awar.	Rapid	Sp. Rate	STM1	Synt. Awar.
Reading		.81***	.51***	.92***	.55***	.66***	.62***	.48***	.43***
Spelling	.53***		.59***	.77***	.64***	52***	.57***	.44***	.53***
BAS	.10	.32**		.49***	.43***	.47***	.26*	.12	.28*
Nonword R.	.90***	.40**	-.04		.45***	.67***	.58***	.46***	.36**
Phon. Awar	.48***	.39**	.19	.38**		.56***	.53***	.39**	.42**
Rapid Nam.	.30*	.01	.09	.34**	.14		.65***	.37**	.35**
Speech Rate	.41**	.31*	.18	.35**	.29*	.39**		.32*	.54***
STM1	.24	.01	.03	.26*	.25*	.11	.39**		.48***
Synt. Awar.	.27*	.13	.27*	.15*	.48***	.16	.43***	.54***	
GRADE 2		***p<0.001, ** p<0.01 ; * P<0.05							

First, the correlation between spelling ability and reading ability significantly increased with age (r=.53, p<.001 at grade-2 and r=.81, p<.001 at grade-4). The correlation between nonword reading and reading ability, on the other hand, remained identical irrespective of differences in age (r= .90 & .92 respectively, all being significant at the p<.001 level). Of the four phonological processing tasks, the measure with the highest correlation to reading or spelling ability at grade-2 was phonological awareness (r=.48, p<.001; & r=.39, p<.01, respectively); with that of speech rate (r=.41, p<.01) and rapid naming (r=.30, p<.05) yielding a significant correlation with

reading but not with spelling ability. At age 9 (grade-4), however, rapid naming and speech rate were the measures with the highest correlation with reading ability (r=.66, p<.001 & r= .62, p<.001, respectively). Phonological awareness on the other hand yielded a somewhat lower though significant correlation (r= .55, p<.001,). Significant differences with age were also observed for the measure of verbal STM. A low and nonsignificant correlation of STM with reading and spelling ability was obtained at grade-2 (r=.24 & r=.01, ns, respectively), but it was significant at grade-4 (r=.48, p<.001 for reading & r=.44, p<.001 for spelling).

Chapter 7.2.2 Phonological processing skills as predictors of reading attainment in a regular orthography.

Chapter 7.2.2.1 Predicting reading attainment

Hierarchical multiple regression analyses were used to examine the predictive relationship of the different phonological processing skills.

All five regressions, summarised in Table 7.2, shared the same first step to take out the effects of age and IQ. Then the order of entry of each variable was altered to determine the exact amount of variance contributed by each variable, by placing it at the last step of each of the regression equations (see Sets A, B, C, D: 5th step). In Set A, verbal STM (2nd step) was put ahead of phonological awareness (3rd step) to control for differences in STM skills which form a strong component of the tests used in the phonological awareness composite score. Phonological awareness was also put ahead of speech rate (4th step) and rapid naming (5th step) to control for differences in phonological awareness skills. Then the order of these last two (Set A & B), and all the other measures (see Set C & D) was altered to see if

they would still make an independent contribution after differences in all the other measures had been accounted for. The first four steps of Set C, D, & E were identical to those reported in the McDougall et al, (1994) study[1] to make the examination of the role of speech rate in English and Greek languages comparable. Set F aimed to examine whether the non significant contribution of phonological awareness in Grade 4 (see Set D, middle column) was primarily due to the very significant contribution of the two 'speeded' measures of rapid naming and speech rate, rather than of the combined effect of these two measures and that of verbal STM (see Set D).

Nonword reading was excluded from all these analyses because of its very high correlation with reading ability. Such a high and consistent correlation across the two ages (r= .90 & r= .92), in conjunction with the very high degree of accuracy of most Greek readers on this test suggested that the nonword reading measure was a task identical to reading and therefore not a very informative measure as a predictor of reading in the regular Greek orthography.

Regression analyses carried out for each grade separately revealed interesting changes in the pattern of prediction with age. Phonological awareness proved to be the most significant predictor of reading ability at age 7 (grade 2), accounting for the most significant amount of variance even when it was entered at the last step of the regression equation (R^2Ch= 10%, $p<.01$, Set D, left column of Table 7.2). Speech rate also proved a significant and independent predictor of reading ability at age 7, (R^2Ch= 4%, p= .05). Rapid naming did not make an independent contribution to predicting reading ability, once other phonological skills have been statistically

[1] The only difference being the use of five phonological awareness tasks in the present study, instead of the two (i.e. rhyme discrimination, phoneme deletion) used in the McDougall et al, (1994) study.

controlled (R^2Ch= 2%, ns, Set A) and verbal STM did not predict reading ability at all (R^2Ch= 0%, ns, Set C).

Table 7.2: Summary of fixed order regression analyses for READING.

		GRADE -2			GRADE -4	
		R^2Ch	Sign.		R^2Ch	Sign
				SET A		
1	Age & IQ	14%	.009	Age & IQ	16%	.000
2	VerbalSTM	5%	-	Verbal STM	20%	.000
3	Phon Awar.	13%	.001	Phon Awar.	11%	.001
4	Speech R	8%	.008	Speech R	12%	.000
5	Rapid Nam	2%	-	Rapid Nam	5%	.006
				SET B		
2	Phon Awar.	15%	.001	Phon Awar.	23%	.000
3	STM	2%	-	STM	7%	.006
4	Rapid Nam	6%	.02	Rapid Nam	14%	.000
5	Speech R	4%	.05	Speech R	3%	.02
				SET C		
2	Phon Awar.	15%	.001	Phon Awar.	23%	.000
3	Speech R	10%	.003	Speech R	15%	.000
4	Rapid Nam	2%	-	Rapid Nam	6%	.004
5	STM	-	-	STM	3%	.03
				SET D		
2	Speech R	16%	.001	Speech R	32%	.000
3	STM	1%	-	STM	8%	.002
4	Rapid Nam	2%	-	Rapid Nam	7%	.002
5	Phon Awar.	10%	.002	Phon Awar.	1%	-
				SET E		
2	STM	5%	-	STM	20%	.000
3	Speech R	10%	.004	Speech R	20%	.000
4	Phon Awar	10%	.003	Phon Awar	3%	-
5	Rapid N	2%	-	Rapid N	5%	.007
				SET F		
2	Rapid Nam	11%	.02	Rapid Nam	37%	.000
3	Speech R	9%	.007	Speech R	5%	.007
4	Phon Awar	11%	.002	Phon Awar	2%	-
5	STM	-	-	STM	3%	.02

At age 9, however, it was the measure of rapid naming which accounted for the most statistically significant amount of variance (R^2Ch= 5%, $p<.01$, Set A right column). By contrast, the measure of phonological awareness failed to predict any independent variance in reading once differences in rapid naming and speech rate were taken into account (see Set F). In contrast to age 7, verbal STM at age 9

predicted a unique amount of variance (R^2Ch= 3%, $p<.05$, Set C). Speech rate proved an independent and consistent predictor of reading ability (R^2Ch= 3%, $p<.05$, Set C), regardless of the order of entry.

Chapter 7.2.2.2 Predicting spelling attainment.

Identical regression analyses to those reported above were also performed for spelling to determine the cognitive determinants of spelling ability in the regular Greek language. The most significant regression analyses are summarised in Table 7.3.

Table 7.3: Summary of fixed order regression analyses for SPELLING.

		GRADE -2			GRADE -4	
		R^2Ch	Sig.		R^2Ch	Sig
				SET A		
1	Age & IQ	29%	.000	Age & IQ	6%	.000
2	Verbal STM	-	-	Verbal STM	18%	.000
3	Phon Awar.	8%	.005	Phon Awar.	21%	.000
4	Speech R	6%	.02	Speech R	8%	.000
5	Rapid Nam	-	-	Rapid Nam	-	-
				SET B		
2	Phon Awar.	8%	.006	Phon Awar.	35%	.000
3	STMd	-	-	STM	4%	.05
4	Rapid Nam	-	-	Rapid Nam	4%	.04
5	Speech R	7%	.009	Speech R	5%	.02
				SET C		
2	Phon Awar.	8%	.006	Phon Awar.	35%	.000
3	Speech R	4%	.04	Speech R	9%	.001
4	Rapid Nam	-	-	Rapid Nam	-	-
5	STM	1%	-	STM	2%	-
				SET D		
2	Speech R	7%	.01	Speech R	30%	.000
3	STM	-	-	STM	7%	.009
4	Rapid Nam	1%	-	Rapid Nam	2%	-
5	Phon Awar.	7%	.01	Phon Awar.	8%	.002
				SET E		
2	Rapid Nam	-	-	Rapid Nam	26	.000
3	Speech R	8%	.007	Speech R	8%	.005
4	STM	1%	-	STM	5%	.02
5	Phon Awar	7%	.01	Phon Awar	8%	.002

On the whole, phonological awareness and speech rate proved to be the most powerful and consistent predictors of spelling ability. Both these two measures accounted for an independent amount of variance in spelling ability in both grades. Speech rate accounted for a unique 7% of the variance in grade-2 (see SET B in Table 7.3, left column) and for a unique 5% of the variance in grade 4 (see SET B in Table 7.3, right column). Phonological awareness accounted for a unique 7% of the variance in grade-2 and for a unique 8% of the variance in grade-4 (see SET E in Table 7.3, left & right columns). Rapid naming and verbal STM, on the other hand, were not reliable predictors as their contribution was not significant once differences in phonological awareness and speech rate have been controlled for (see SET A & C).

Chapter 7.2.2.3 Predicting mathematical skills (Control condition).

Regression analyses carried out for mathematical skills are summarised in Table 7.4.

Table 7.4: Summary of hierarchical regression analyses for mathematical skills

	GRADE-2			**GRADE-4**	
Variable	**R^2Ch**	**Sign**	**Variable**	**R^2Ch**	**Sign**
			SET A		
Age & IQ	17%	.000	Age & IQ	14%-	.002-
Verbal STM	-	-	Verbal STM	1%	-
Phonological Awar.	3%	-	Phonological Awar.	15%	.001
Speech Rate	2%	-	Speech Rate	-	-
Rapid Naming	-	-	Rapid Naming	9%	.005
			SET B		
Verbal STM	-	-	Verbal STM	1%	-
Speech Rate	3%	-	Speech Rate	5%	-
Rapid Naming	-	-	Rapid Naming	14%	.001
Phonological Awar.	-	-	Phonological Awar.	5%	.03

None of the four phonological processing tasks predicted mathematical skills at grade-2. At grade-4, however, rapid naming (R^2Ch= 9%, $p<.005$, Set A) and phonological awareness (R^2Ch= 5%, $p<.05$, Set B) did account for a statistically significant amount of variance in basic number skills.

Chapter 7.3 Summary of regression results.

The present set of analyses evaluated the relationship between phonological processing skills, reading and spelling in the regular Greek orthography.

The finding of a significant contribution of phonological processing skills to the development of literacy skills in Greek accords well with findings from studies indicating a strong and rather independent predictive relationship between phonological awareness, phonological processing and the development of reading and spelling abilities in English (e.g. Bowers, 1995; Bowers & Wolf, 1993). The present data add to the available cross-linguistic evidence by showing that the strong predictive relationship between phonological skills and literacy skills is not confined to phonological awareness skills (Cardoso-Martins, 1995; Lundberg et al, 1980; Wimmer & Landerl, 1994) but rather extends to most phonological processing skills.

The pattern of predictions changed with age. The most significant predictor of reading ability in the regular Greek orthography at age 7 (grade 2) was the measure of phonological awareness. Rapid naming, on the other hand, proved the most significant predictor of reading ability at age 9 (grade 4). None of these two measures significantly predicted reading skill at age 9 or age 7 respectively, once differences in other phonological processing measures have been controlled for.

The above results suggest that a basic understanding of the systematic relationship between graphemes and phonemes is crucial at an early stage in literacy

development, even in languages with a very transparent orthography. By contrast to the evidence from the English orthography where phonological awareness is the most potent and stable predictor of literacy skills across all ages (Wagner et al., 1993, 1994, 1997), the present findings also indicate that, at least in 'shallow' orthographies, the primary importance of such an awareness is developmentally limited as the contribution of other phonological processing skills become more important as children advance in their ability to decode words.

The claim has been made that even though phonological awareness and rapid naming are measures with a strong phonological component, the latter should be conceptualized primarily according to its primary emphasis on speed of processing (Wolf & Bowers, 1994). In particular, Bowers (1995) has proposed that rapid naming measures are proxies of the speed and efficiency with which the many cognitive, visual, and linguistic sub-processes underlying reading are integrated. If this hypothesis is correct, and if phonological awareness tasks are good indices of how good children develop alphabetic reading skills (Bradley & Bryant, 1983; Snowling, 1994), then phonological awareness measures should indeed yield a very strong predictive relationship at age 7, when Greek children are still striving to master the consistencies of their language. The present investigation revealed that Greek-speaking children of this age rely heavily on a sublexical reading strategy. Due to the highly isomorphic relationship between Greek phonemes and graphemes this route is clearly underpinned at the phonemic level. This explains why tasks assessing children's awareness of the segmental structure of words (i.e. phonological awareness tasks) in the present study are strongly related to the development of concurrent reading attainment at age 7 (grade-2).

The stronger contribution of rapid naming, at age 9, over the measure of phonological awareness may also be explained by the fact that, after almost four years of instruction and exposure to a very regular orthography, the fourth graders in the present study should have mastered the basic alphabetic skills and moved to higher levels of reading competence. At this later stage of development, the capability of automatic processing and, in particular, the speed with which single letter identities are retrieved and integrated (or unitized, according to LaBerge & Samuels, 1974) into larger orthographic codes is considered to be essential for skilled reading (Adams, 1990; Bowers & Wolf, 1993; Bowers, 1995). Given that the acquisition of grapheme-phoneme correspondences in regular orthographies like Greek is a rather trivial task and the development of reading skills primarily manifested in terms of reading speed, one should expect that, at these later stages of literacy acquisition when the development of alphabetic skills is well established and differences in reading latencies are much more pronounced, measures of character processing automaticity (Davis & Spring, 1988) should indeed yield a very strong and independent relationship to the fluent encoding and blending of the constituent sounds of words. The present results appear to confirm this hypothesis.

On the whole, the argument can be made that the observed differences in the predictive relationship of rapid naming and phonological awareness tasks in the Greek language may be the result not only of the inherent differences in the cognitive requirements of these two tasks, but also of the developmental and cross-orthographic differences in the manifestation and assessment criteria used to attest the development of reading abilities. In the present study, reading ability was assessed in terms of differences in reading speed. In the Wagner et al., (1997) study,

and in most of the other studies in English, the measure of reading accuracy has been used to assess reading skills.

The present set of analyses also sought to establish the predictive validity of two further phonological processing measures in the regular Greek language: that of speech rate and verbal STM. Both these measures have been used in the English language to gouge the integrity of underlying phonological representations in both normally and abnormally developing children (McDougall et al, 1994; Snowling & Hulme, 1994).

Speech rate was found to be an important cognitive determinant of literacy skills in the regular Greek orthography. In all analyses, this measure made a significant and independent contribution to predicting variance in reading and spelling ability in Greek, irrespective of differences in age. These findings support and, at the same time, extend McDougall et al.'s (1994) claim for the importance of the speech rate as an independent predictor of reading ability (accuracy) in English. In the McDougall at al., (1994) study, speech rate accounted for a unique amount of variance in reading over and above that explained by two phonological awareness tasks (i.e. phoneme deletion and rhyme discrimination) or a verbal STM task. In the present study, speech rate proved a very reliable predictor not only of reading ability, but also of spelling ability. Furthermore, it accounted for a statistically significant amount of variance over and above that explained by phonological awareness, rapid naming, and verbal STM. In most of the analyses[1], speech rate also proved a much more reliable predictor than verbal STM. The only case in which the results of the present study did not conform to those reported by McDougall at al., (1994) was in

[1] Whether identical to those carried out by McDougall et al., (1994) or not.

grade-4, where the contribution of verbal STM remained significant even when it was entered at the last step of the regression equation.

The independent contribution of speech rate to that made by phonological awareness supports Snowling and Hulme's (1994) claim that phonological processing tasks not requiring conscious awareness (e.g. nonword repetition, speech rate) may be more sensitive measures of the integrity of phonological representations (Muter & Snowling, submitted). The consistency with which speech rate predicted reading or spelling ability in the present study, in conjunction with the developmental variation in the other phonological processing tests, suggests the universal validity of speech rate. The later seems to be unaffected by the linguistic characteristics of the language in which it is used.

An unexpected finding in the present study was the strong predictive association between measures of phonological awareness and rapid naming and concurrent attainment in basic number skills, at age 9. One possible explanation for this pattern of results may be the use of the Ravens Standard Progressive Matrices Intelligence Test for the assessment of the participants' intellectual skills. The apparent shortcoming in using this type of intelligence test in the present analyses is the lack of any control over differences in verbal abilities, which are considered to be essential for the development of appropriate symbolic representations of both letters and numbers (Bialystock, 1992). Arguably, the measure of phonological awareness may be acting in the present analyses as a measure of verbal abilities. The significant contribution of rapid automatized naming to mathematical attainment in Greek may also be 'explained' in terms of differences in processing speed. Researchers exploring the relationship between speeded naming and literacy skills have emphasized the strong link between these measures and general processing speed (Kail &

Hall, 1994). A strong predictive relationship has also been reported between processing speed and the ability to perform mathematical operations (Bull & Johnston, 1997). Examination of the underlying causes of arithmetic difficulties appear to suggest the existence of profound difficulties in automating basic arithmetic facts, which in turn have been interpreted as stemming from a speed-of-processing deficit (Bull & Johnston, 1997).

Both of the above interpretations are speculative and further research is needed to establish the exact relationship between verbal skills, speed of processing and the development of mathematical skills. The independent contribution of phonological awareness and rapid naming to predicting mathematical skills in the present study and the available evidence indicating that arithmetic difficulties may be related to phonological memory deficits (e.g. Hitch & McAuley, 1991) suggests the merit of exploring the role of these and other phonological processing skills to the development of numeracy skills in more depth.

Chapter 8. THE ROLE OF SYNTACTIC AWARENESS.

Chapter 8.1 Introduction.

Having examined the role of phonological awareness and other phonological processing skills in the regular Greek orthography, the next objective of this study was to establish the role played by syntactic awareness in literacy development. This examination was of particular interest because of the highly inflectional nature of the Greek orthography.

Until recently, great emphasis has been placed on the role of phonological skills, while the importance of other language abilities (e.g. syntactic, semantic, pragmatic) has been mainly neglected (Bishop, 1991). As a result, our knowledge about the developmental trends and predictive relationship between syntactic awareness skills and literacy skills is not as detailed as is our knowledge of the relationship between phonology and literacy. Two ways in which syntactic awareness may influence reading development have been proposed. One is by enabling readers to monitor their ongoing comprehension processes more effectively (Bowey, 1986), and the other by helping children acquire word recognition skills (Tunmer et al., 1988) (see Chapter 2).

Evidence from longitudinal studies (e.g. Tunmer et al., 1988); cross-sectional studies (Gottardo, Stanovich, & Siegel, 1996; Muter & Snowling, 1998; Willows & Ryan, 1986) and studies with clinical samples (e.g. Gillon & Dodd, 1994; Tunmer et al., 1987) supports the existence of a strong association between syntactic awareness skills and reading ability. However, the exact nature of the relationship and the origin of syntactic deficits is still debated. Some theorists view syntactic awareness as a separate component of a general metalinguistic ability, and the measures used to

operationalise this component as independent predictors of literacy skills (e.g. Tunmer & Hoover, 1992; Tunmer et al, 1988). Within this view, syntactic awareness difficulties are interpreted as reflecting a more pervasive linguistic immaturity and a direct deficit in syntactic control (Byrne, 1981, Stein, Cairns, & Zurif, 1984; Vogel, 1974). Others, however, put more emphasis on the primary importance of phonological processing skills and argue that syntactic awareness measures are not independent predictors of reading ability (Gottardo et al., 1996) and that difficulties in this domain are rather epiphenomena of a deficit at the phonological level (Mann, Shankweiler, & Smith, 1984; Shankweiler et al, 1994-95).

One limitation of the existing studies on syntactic awareness is that the focus of their inquiry is usually restricted to reading ability. One of the few studies that included the examination of both reading and spelling abilities was a study by Rego & Bryant (1993) in English. In this study, early syntactic awareness skills have been reported to be predictive of later reading skill, but not of spelling attainment on an 'invented spelling' task five months later (see Chapter 2). Two more recent studies, however, have suggested a rather different predictive relationship between syntactic/grammatical awareness and the development of spelling skills. In a longitudinal study with 6- to 11 year-old primary school children, Nunes, Bryant, & Bindman (1997) found that performance on a grammatical awareness task predicted children's later success in a spelling task requiring them to use the inflectional morpheme '-ed' in pseudo-verbs that were previously heard in the context of brief 2 or 3 sentence-passages. The second study was conducted by Muter & Snowling, (1997) and it was part of a longitudinal project examining the development of phonological and literacy skills of 34 English-speaking children from the age of 4. In a follow up at age 9, grammatical sensitivity (Illinois Test of Psycholinguistic Ability Grammatic Clo-

sure subtest) was assessed concurrently with spelling ability (using an orthographic choice and a standardised spelling test). Phonological awareness skills were also assessed using a rhyme discrimination and a phoneme deletion test. The results indicated a strong predictive relationship between phoneme awareness and spelling ability. Grammatical sensitivity was also found to be an important concurrent predictor of differences in orthographic skills but not of spelling to dictation. The lack of appropriate control over differences in phonological skills, intelligence, and verbal STM skills, however, limits somewhat the validity of the results of the second study, because it is not possible to determine whether the amount explained by their measure of grammatical sensitivity was attributed to differences in grammatical skills or to differences in any of the other confounding factors.

The present set of analyses aimed to investigate the predictive relationship between syntactic awareness skills and the development of reading and spelling proficiency in the regular Greek orthography, at age 7 and age 9. Consideration of the orthographic structure of Greek prompted the hypothesis that the contribution of syntactic awareness skills would be very useful, most especially for the development of spelling competence. The Greek language is a highly inflected language where the selection of the appropriate inflectional morpheme depends heavily on their grammatical status (see Chapter 4). The selection of the appropriate grammatical affixes in Greek nouns, for example, is not restricted to the distinction between singular and plural, as in English, but in many other instances to mark a) differences to the gender of a noun (e.g. η βρύσ<u>η</u>=/'vrisi/= tap (feminine); vs. το σκυλ<u>ί</u>= /skɪ'lɪ/= dog (neuter); b) differences between verbs and nouns (πιάνω= /pianɒ/ = to catch =

verb; vs. Πιάνο = /pianɒ/ = piano = noun); c) a combination of differences in the gender and number (e.g. αυτοί = /a'ftɪ/ = these = masculine-plural vs. Αυτί = /a'ftɪ/ = ear = neuter-singular); or d) a combination of differences in the case and number of words (e.g. αυτόν = /a'ftɒn/ = this = accusative-singular vs. Αυτών = /a'ftɒn/ = these = genitive-plural). The high degree of accordance between the inflectional morpheme of the subject of a verb and all its referents in a sentence (e.g. αυτό (referent) το αυτοκίνητο (subject) είναι (verb) όμορφο (referent) και γρήγορο (referent) = this car is nice & fast is also worth mentioning because it highlights the high degree of interdependence between grammar, morphology and syntax, and the crucial importance of this type of information to the selection of the appropriate inflectional morpheme when writing Greek sentences or words. Thus, the prediction was made that syntactic awareness would yield a significant and independent predictive relationship to spelling, over and above that of phonological awareness. No prediction, however, could be made about the contribution of syntactic awareness to the development of reading competence because of the high degree of consistency between graphemes and phonemes. One possibility is that the development of appropriate syntactic and grammatical awareness skills may lead to an increased appreciation of the morphological structure of words, and thus to an increased ability to compose or decompose words into morphemes when reading. On the other hand, it is possible that because of the transparency of the Greek language children rely more on their highly successful phonological strategies (Goswami & Porpodas, submitted; Nikolopoulos, 1994), and for reading the contribution of syntactic awareness may not be as significant as that of phonological awareness.

Chapter 8.2 Results.

Chapter 8.2.1 The relationship between syntactic awareness, reading and spelling abilities.

According to the initial design of this study, six syntactic awareness tasks had been planned: i.e. recalling sentences, sentence assembly, word structure, stress assignment, distinction between feminine-masculine-neuter, & the subject-verb accordance violation test (see chapter 5). Descriptive statistics of all these six syntactic awareness tasks are given in Table 8.1. Because of ceiling effects and the absence of significant differences in the performance of grade-2 and grade-4 children, the last three tasks were excluded from the final syntactic awareness composite score (see bottom line of Table 8.1).

Table 8.1: Means and standard deviations of individual syntactic awareness tasks.

	GRADE 2	*GRADE 4*
MEASURES	Mean (SD)	Mean (SD)
Recalling sentences/ max. 78	58.6 (5.6)	63.6 (7.0) *
Sentence Assembly/ max. 42	27.4 (4.9)	33.2 (4.8) *
Grammatical closure/ max. 32	28.7 (2.3)	30.6 (1.9) *
Stress assignment test/ max. 9	8.5 (0.75)	8.9 (0.32)
Subject-verb accordance/ max. 6	5.9 (0.17)	5.9 (0.39)
Dist: Fem.-masc-neut/ max. 6	5.9 (0.27)	6 (0.00)
Synt.. Awar Composite/ max. 152	114.7 (9.8)	127.4 (11.9) *

* $p<0.05$, ** $p<0.01$, *** $p<0.001$.

A series of partial correlation analyses (controlling for differences in age & IQ) were performed to examine the predictive association between the composite score of syntactic awareness and reading or spelling ability and its relationship with

the other phonological measures. Intercorrelations between the variables for each grade separately (Grade 2 & Grade 4) are summarised in Table 8.2. A more detailed account of these intercorrelations is given in Table 7.1.

Table 8.2: Summary of Partial Correlations (Controlling for age & IQ) between Experimental Variables (Grade 2; Grade 4)

	Read	Spell	Nonw R	V. STM	Ph. Aw	Speech R	Rapid
Synt. Awar. *Grade 2*	.27*	.13	.15*	.54***	.48***	.43***	.16
Synt. Awar. *Grade 4*	.43***	.53***	.36**	.48***	.42***	.54***	.35**

(* p<0.001, **p<0.01, * p<0.05)**

Syntactic awareness' correlation with reading ability was relatively low at grade-2 (r= .27, p< .05) and significantly higher at grade-4 (r= .43, p< .001). On the other hand, its correlation with spelling ability was not significant at grade-2 (r= .17, ns) but highly significant at grade-4 (r= .53, p< .001). Significant correlations were also obtained between syntactic awareness and most phonological processing measures (ranging from a low r= .24, p< .05 to a high r= .54, p<.001).

Chapter 8.2.2 Syntactic awareness skills and reading development.

The predictive relationship between syntactic awareness and reading skill were further explored in a series of hierarchical multiple regression analyses, displayed in Table 8.3. In all regression equations, age and IQ were entered at step 1, to control for differences in these two factors. The measure of verbal STM was also used as a control variable, at step two, to reduce the confounding influence of

differences in verbal short term memory skills. Syntactic awareness and phonological awareness were then entered at either step 3 or step 4 (Set A & B). Because of the high correlation between syntactic awareness and phonological awareness skills, the second set of analyses (Set B: syntactic awareness placed after phonological awareness) served as a more stringent criterion of the predictive validity of the target variable: :i.e. syntactic awareness.

Table 8.3: Summary of hierarchical multiple regression analyses depicting the relationship between syntactic awareness and READING ABILITY.

		GRADE -2			GRADE -4	
		R^2Ch	Sign.		R^2Ch	Sign
			SET A			
1	Age & IQ	14%	.009	Age & IQ	16%	.000
2	VerbalSTM	5%	-	Verbal STM	20%	.000
3	Synt. Awar.	2%	-	Synt. Awar.	4%	.04
4	Phon. Awar	14%	.000	Phon Awar.	9%	.001
			SET B			
3	Phon. Awar	16%	.000	Phon Awar.	12%	.000
4	Synt. Awar.	-	-	Synt. Awar.	-	-

The above regression analyses reveal the predominance of phonological awareness skills over syntactic awareness skills. In most instances, syntactic awareness failed to predict a statistically significant amount of variance in reading ability. The only case in which syntactic awareness predicted reading skill was when it was entered ahead of phonological awareness skills in grade 4 (R^2Ch= 4%, $p<.04$) . Once differences in phonological skills have been partialled out its contribution was not significant.

Chapter 8.2.3 Syntactic awareness skills and spelling development.

Identical regression analyses to those reported above were also performed for spelling ability. These are summarised in Table 8.4.

Table 8.4: Summary of hierarchical multiple regression analyses depicting the relationship between syntactic awareness and SPELLING ABILITY.

		GRADE -2			GRADE -4	
		R^2Ch	Sign.		R^2Ch	Sign
				SET A		
1	Age & IQ	29%	.000	Age & IQ	16%	.000
2	VerbalSTM	-	-	Verbal STM	20%	.000
3	Synt. Awar.	1%	-	Synt. Awar.	13%	.001
4	Phon. Awar	10%	.002	Phon Awar.	16%	.000
				SET B		
3	Phon. Awar	11%	.001	Phon Awar.	24%	.000
4	Synt Awar	-	-	Synt. Awar.	5%	.01

In grade 2 syntactic awareness was not a reliable predictor of concurrent spelling attainment. Phonological awareness was a more powerful predictor accounting for 10% of the variance in spelling, even when it was placed after the measure of syntactic awareness (see Set A: Grade 2: R^2Ch=10%, $p<.002$; Grade 4: R^2Ch=16%, $p<.000$). It is important to note, however, that at grade 4 syntactic awareness predicted a unique 5% of variance in spelling ability., over and above that accounted for by the measure of phonological awareness (R^2Ch=24%, $p<.001$). In order to examine this predictive association in more depth, a separate regression analysis was performed entering all the other phonological processing measures ahead of syntactic awareness to see if its contribution was still significant (See Table 8.5). The results revealed that its contribution continued to be significant (R^2Ch=3%,

p<.01) even when entered after the measures of verbal STM, nonword reading, phonological awareness, speech rate, and rapid naming.

Table 8.5: Hierarchical Regression Analysis depicting the relationship between Syntactic Awareness and Spelling, in the presence of all phonological measures.

Variables.	R2Ch	Signif.
Age & IQ	6%	-
Verbal STM	18%	.000
Nonword R.	39%	.000
Phon Awar.	9%	.000
Speech Rate	-	-
Rapid Naming	2%	.04
Synt. Awar.	3%	.008

Chapter 8.3 Discussion.

During the past decade there has been increasing theoretical interest in the relationship between different aspects of metalinguistic skills (e.g. phonological, syntactic, pragmatic) and the development of literacy skills. The two previous chapters have addressed the issue of the importance of phonological awareness and other phonological processing skills in the regular Greek orthography. The present chapter aimed to investigate the relative importance of syntactic awareness skills in the development of both reading and spelling ability at age 7 and age 9.

There was a significant predictive relationship between this aspect of metalinguistic skills and concurrent reading and spelling attainment at age 9, but not at age 7. Phonological awareness on the other hand proved a much more powerful

predictor, explaining larger proportions of variance in reading and spelling at both ages.

The lack of any independent predictive relationship with reading ability at age 7 or age 9 appears to support the view of those advocating the predominance of phonological skills over that of other metalinguistic skills (Cottardo et al., 1996). By contrast, Tunmer et al., (1988, 1992) have argued that an awareness of the sentential constraints and the use of contextual cues, allows beginning readers to access the identity of a word from incomplete phonological information. In the present study, syntactic awareness consistently failed to predict reading ability, once differences in phonological skills have been controlled for. It should be stressed, however, that reading ability in the present research was assessed by a single-word reading test which precludes the use of contextual information. So it is possible that this discrepancy in the pattern of results may be due to the use of different criteria in the assessment of reading skill. Future research should address the issue of the relationship between syntactic awareness and reading comprehension skills in a regular orthographic system given the claims in the English literature that syntactic awareness affects reading comprehension via its effects on reading accuracy (Tunmer & Hoover, 1992).

Another explanation of the observed inconsistency in the pattern of results of the present study and those carried out in the English language (e.g. Tunmer et al., 1987, 1988, 1992; though see Cottardo et al., 1996 for a different view) may also be attempted on the basis of the existing differences in the orthographic structure of Greek and English languages. Greek language is a very regular language for reading, where the relationship between graphemes and phonemes is isomorphic and highly consistent. The argument thus can be made that, because of this regularity in

reading, Greek readers will apply their knowledge of grapheme-to-phoneme conversion rules very successfully and they need not to rely on other sources of information (e.g. syntactic, semantic) during reading is reduced. Corroborative evidence for this comes from a number of cross-linguistic studies in Greek (Goswami & Porpodas, submitted; Nikolopoulos, 1994) or other regular orthographies (e.g. Wimmer & Goswami, 1994) all indicating the predominance of phonological reading strategies in regular orthographies. Research on word recognition also reveals the existence of stronger context effects with increasing word difficulty, unfamiliarity or degradation (Perfetti et al., 1979; Simpson, Lorsbach & Whitehouse, 1983; Stanovich et al., 1981). The English language has a deep and highly inconsistent orthography, where the acquisition of reading skills poses a greater degree of difficulty than other more regular languages do for beginning readers (Goswami & Wimmer, 1994). Reference to the contextual or semantic information in English appears to be very helpful for the successful decoding of homographic words (e.g. cough, rough, dough) and exception words (e.g. pint, yacht) (Tunmer et al., 1988), but, by implication, it is not required for Greek.

Analyses examining the role of syntactic awareness in the development of spelling competence suggested a rather different pattern of results to that for reading ability. Although syntactic awareness failed to predict spelling at age 7 (grade-2), its contribution to the prediction of spelling skill at age 9 (grade 4) was highly significant and independent, not only of phonological awareness but also of other phonological processing measures.

The very strong contribution of most phonological measures indicates the primary importance of phonological skills in the development of spelling competence in Greek, and supports the claim that the development of good phonological skills

provides young children with a framework upon which to organize orthographic information (Snowling, 1994b). On the other hand, the independent contribution of syntactic awareness skills to the prediction of spelling skill appears to be at odds with the results of the Rego & Bryant (1993) study, who have reported that there was no significant predictive relationship between the two variables in the English language. The results of the present research are more in line with the findings of the other two studies in English (Muter & Snowling, 1997; Nunes et el., 1997) which also report a similar developmental progression in the appreciation of syntactic awareness skills.

The results supported the hypothesis that syntactic awareness would be useful for the development of spelling proficiency. Despite the very powerful and consistent contribution of phonological measures at both grades, syntactic awareness made an independent contribution to the prediction of variability in spelling skills at grade 4, but not at grade 2.

This pattern of prediction suggests that as children get older, and are asked to spell more difficult words that do not conform to the phoneme-grapheme conversion rules, they gradually start to appreciate the importance of other linguistic information (e.g. syntactic, grammatical, and possibly semantic) and use this knowledge to deal with the inconsistencies of their orthography. The one-sided regularity of the Greek language (regular for reading - less regular and predictable for spelling) offers a unique example of how the lack of consistency in the representation of phonological information can affect the degree with which different aspects of metacognitive skills (e.g. phonological, syntactic, semantic) contribute to the development of spelling abilities. In the present analyses for reading ability, where the relationship between graphemes and phonemes is highly consistent, syntactic awareness

failed to predict any unique amount of variance once differences in phonological skills have been partialled out. In the analyses for spelling ability, where there is a high degree of variability in the relationship between phonemes and graphemes, syntactic awareness at grade 4 made a significant and unique contribution to the prediction of spelling acumen.

While the present pattern of results suggests the strong and independent predictive association between syntactic and grammatical awareness and the development of spelling competence at grade 4, further research is needed to explore the nature of this association. The test used in the present experimental test battery to assess the spelling skills of Greek children included a wide variety of age-appropriate words which required children to select not only the correct inflectional morpheme but also the appropriate grapheme(s) in the stem of words. Therefore, it is not clear if the above relationship between syntactic awareness and spelling ability is rather specific (use of inflectional morphemes) or whether it reflects a much more general sensitivity to the orthographic structure of words. The use of the present spelling test does not allow any firm conclusion. One way of addressing this issue is by using two separate groups of words: one focusing primarily on the orthographic accuracy of grammatically and syntactically based inflectional morphemes (e.g. εσεις γράφ*ετε* = you write); and the other on the selection of the correct grapheme(s) in the stem of words, that have no bearing on the grammatical and syntactic identity of words (e.g. αστ*υ*νομία = police).

Another way of examining the relationship between syntactic awareness and spelling ability in Greek is by manipulating the contextual information in a sentence to prompt the use of homophones words (η παραγωγ*ή* = production = feminine singular - οι παραγωγοί = producers = masculine plural: all pronounced as /paraɣɒ'ɣi/).

For instance, one may use the verb of the sentence in singular to prompt the use of the relevant homophone word (e.g. Η παραγωγ*ή* του καπνού σημείωσε αύξηση αυτό τον χρόνο= singular= The tobacco production has increased this year) and then, a few weeks later, to give a different sentence with the verb in plural (e.g. Οι παραγωγ*οί* του καπνού σημείωσ**αν** κέρδη= plural = The tobacco growers made a profit this year). In cases where subtle differences would prove to be very difficult to young children, one could add an extra cue in the sentence (e.g. add a subordinate clause with an adjective, which in Greek has to take the same inflectional morpheme to that of the subject of the sentence: Οι παραγωγ*οί* του καπνού σημείωσαν κέρδη, ***και έγιναν πλούσιοι*** = The tobacco producers made a profit **and became *rich***) to see if children would take advantage of this extra syntactic cue-information (i.e. the inflection -οι in word πλούσι**οι**).

The present findings could also be enhanced with the adoption of a longitudinal design to address the issue of causality, and the inclusion of control measures to account for differences in semantic skills. One limitation of the tasks used in the assessment of syntactic awareness skills is that most of them are also measures of semantic skills (Gombert, 1992). This type of information appears to be very useful and sometimes the only point of reference for the selection of the appropriate graphemes in the stem of many Greek words (e.g. κόμμα= comma - κώμα= coma).

Summarising the results from the present investigation about the role of syntactic awareness in Greek orthography, it appears that the contribution of syntactic awareness skills are not so important to the development of reading ability as they are to the development of spelling ability in the later stages of literacy acquisition.

Chapter 9. THE MANIFESTATION OF READING AND SPELLING DIFFICULTIES IN THE REGULAR GREEK ORTHOGRAPHY.

Chapter 9.1 Introduction

The previous chapters have sought to establish the predictive relationship between metacognitive skills and the normal development of reading and spelling ability in Greek. In the present chapter the cognitive profile of Greek poor readers is contrasted either with that of average readers of the same chronological age or with reading age controls to validate the findings from the previous correlational and regression analyses, and to examine the manifestation of reading disorders in the regular Greek orthography.

A number of different explanations have been proposed to account for the cognitive deficits underlying reading disability, including dysfunctions in visual processing (e.g. Orton, 1925; Pavlidis, 1981); phonological processing (e.g. Wagner & Torgesen., 1987); semantic abilities (e.g. Donahue, 1986; Kavale, 1982) and syntactic awareness skills (e.g. Vellutino & Scanlon, 1987; Vogel, 1974). The consensus among researchers currently working in this area is that the language difficulties of dyslexic and other poor readers reflect, in most cases, a central impairment in the phonological language domain (Shankweiler & Crain, 1986; Snowling, 1987, 1995; Vellutino, 1979). Reading disabled children have consistently been reported to experience severe difficulties in a variety of tasks requiring the processing of phonological information, including tasks of speech perception (Brandt & Rosen, 1980; Reed, 1989; Tallal & Stark, 1982; Tallal, 1988), speech production (e.g. Blalock, 1982; Brady, Shankweiler, & Mann, 1983; Cicci, 1983; Snowling, 1981, nonword reading (Snowling 1980, 1981), phonological awareness (Bradley & Bryant, 1978), verbal STM (e.g. Jorm, 1983; Siegel & Linder, 1984), and tasks requiring the retrieval of phonological information from long-term memory (Denckla & Rudel, 1976; Snowling, Wagtendonk, & Stafford, 1988).

The existence of such a pervasive phonological impairment in most poor readers has been found to have a detrimental effect on the development of their reading and spelling abilities. There is an abundance of evidence today which shows that children who have poor phonological (awareness) skills most often fail to develop an appropriate understanding of the systematic relationship between graphemes and phonemes in words, and to use this knowledge in an efficient way, as a self-teaching strategy, to 'break' the alphabetic code and advance their word recognition and spelling skills (Jorm & Share, 1983). While the realization of this relationship between phonemes and graphemes appears to develop relatively easily in normally developing children, this appears to be the stumbling block for most poor readers.

According to one influential theory of literacy acquisition, that proposed by Frith (1985), the reading/spelling difficulties of many developmental dyslexics are interpreted in terms of a developmental 'arrest' at the logographic stage, and the failure of these individuals to develop appropriate alphabetic reading strategies. Such an arrest is manifested in terms of their inability to read novel words, low frequency words, or pseudowords. The spelling proficiency of these individuals is also greatly affected by these deficits, to such an extent that many of their spelling errors often fail to represent the phonological structure of the target words: e.g. *believe*→ *beever* rough→*refet* (Bruck & Treiman, 1990).

Adults dyslexics with childhood histories of dyslexia have also been reported to have improved their word recognition skills, despite their persisting phonological problems (e.g. Campbell & Butterworth, 1985). Not all dyslexics, however, present this typical profile of phonological dyslexia (Frith, 1985; Seymour, 1986). There are instances in which some dyslexics appear to develop some degree of competence in alphabetic skills. These, so called developmental surface or morphemic dyslexics (Seymour, 1986) tend to rely heavily on a sounding-out strategy in reading and make a lot of phonetic errors in spelling. The evidence for a major impairment in the phonological language domain is nonetheless compelling. In some instances,

phonological deficits persist throughout adulthood, even in cases where reading accuracy problems are no longer present (Bruck, 1992, Pennington et al, 1990). The behavioural manifestation of these deficits may significantly vary according to differences in age, the severity of the phonological impairment and the development of compensatory strategies in the reading disabled individuals.

Cross-linguistic investigations carried out in orthographies other than English have recently alerted psychologists to the important effect of cultural influences on the development of literacy skills, and the possibility that the behavioural characteristics of reading disorders may also significantly vary because of the differences in the orthographic structure of languages. In a recent paper, Wimmer (1993) reported significant differences in the cognitive profile of Austrian dyslexics. By contrast to studies with English-speaking dyslexics, Austrian dyslexics did not appear to experience any reading or nonword reading accuracy problem, but exhibit a deficit in reading speed. Dyslexics also performed well on a pseudoword spelling task and a phonemic awareness task: i.e. a vowel substitution task. Digit naming speed on the other hand proved to be one of the best predictors of reading abilities, while no significant between-group differences were reported for the verbal STM and pseudoword repetition tasks.

The above differences in the cognitive profile of Austrian and English dyslexics (Wimmer, 1993) and recent reports of an increased level of phonological awareness in normally developing children learning to read in regular orthographies (e.g. Caravolas & Bruck, 1993), raises the question of the universal applicability of the findings reported in the English literature. Studies examining the cognitive profile of poor readers in regular orthographic systems are sparse, and therefore our knowledge of their cognitive deficits or the ways in which these difficulties are manifested and identified is very limited. If the development of phonological awareness skills or other phonological processing abilities is affected by differences in the degree of orthographic transparency of languages, then the phonological deficit hy-

pothesis that has been proposed as one of the major explanations of reading difficulties in English cannot be taken for granted in more regular orthographies.

The present study aimed to address some of the above issues in the Greek orthography. The cognitive profile of Greek poor readers was contrasted to that of a group of average readers of either the same chronological age or the same reading ability. One of the first questions was to establish whether Greek poor readers would manifest their reading difficulties primarily in terms of differences in word recognition speed, or whether they would experience difficulties with reading accuracy too. Wimmer's (1993) argument that differences in reading speed may be more important than differences in word recognition accuracy in regular orthographies is indeed very appealing, but further evidence is needed to substantiate this claim. Many of the reading tests used in the Wimmer (1993) study contained short, high frequency content words, function words, or numerals. Only one set of compound words comprised 11 more difficult words. The pseudoword reading test comprised 24 relatively easy pseudowords. It is possible that the stimuli selected were too simple. The reading test of the present study comprised a selection of high, of medium, and of low frequency words, some that also contained difficult consonant clusters.

Another major objective was to examine the development of phonological skills in Greek poor readers to establish whether the phonological deficit hypothesis would hold for Greek orthography, and to determine which of the phonological tasks would be sensitive enough to detect underlying cognitive deficits. Another issue of interest was to determine whether the difficulties of Greek poor readers would extend to other areas of cognitive functioning such as syntactic awareness and mathematical skills.

Chapter 9.2 Results

Chapter 9.2.1 Participants, Chronological age matched-pairs comparison: Group membership: Poor & Average readers

A chronological age matched-pairs comparison was performed first, to examine the cognitive profile of Greek poor readers. From the 132 participants of the main study (66 grade-2 & 66 grade-4), two groups were selected: a group of poor readers and a group of average readers. In order to be selected, children had to fulfill one of two criteria: 1) number of reading errors in the single word reading test, or 2) the time taken to read all 131 words of the test. An attempt was made to use the composite score of the two reading criteria, but this proved unsuccessful because of the very high degree of reading accuracy of most of the subjects, including those who seemed to be experiencing difficulties in reading, manifested by very slow but accurate decoding of words.

Participants in this matched-pair comparison were characterized as poor readers if they had a reading speed or/and a reading accuracy score at-or below the 16^{th} percentile. That is 1 standard deviation below the mean time or mean number of errors children of the same grade made on the same single-word reading test. To qualify as average readers, children had to have a reading score between the 16^{th} and 84^{th} percentile ranks. Sixteen grade-2 children (11 boys & 5 girls) and twelve grade-4 children (7 boys & 5 girls) were identified as poor readers. These twenty eight poor readers were then matched in terms of age and IQ (use of Ravens Standard Progressive Matrices: Ravens, 1976) to another group of twenty eight average readers (see Table 9.1, for a summary). There were no significant differences between the good and poor readers in age [grade-2: $t(30)= .42$, $p>0.1$); grade-4: $t(22)= .06$, $p>0.1$], or IQ [grade-2: $t(30)= .03$, $p>0.1$; grade-4 $t(22)= -.10$, $p>0.1$].

Table 9.1: Mean Chronological age and IQ of poor and average readers in Grade 2 and Grade 4.

	Grade 2		Grade 4	
	Poor readers	Average readers	Poor readers	Average readers
No of children in each group	16	16	12	12
Age (years): Mean (sd)	7.3 (0.47)	7.2 (0.47)	9.3 (0.30)	9.3 (0.27)
I.Q.: Mean (sd)	91.5 (11.6)	91.1 (12.9)	93.3 (13.6)	93.8 (13.1)

Chapter 9.2.2 The reading behaviour of Greek poor readers.

Descriptive statistics of the performance of the two groups on the reading and nonword reading tasks at each grade level are given in Table 9.2. Inspection of the mean accuracy percentage scores indicates the high degree of accuracy of most poor readers on both reading and nonword reading tasks. In most instances, poor readers read 90% of the words and nonwords correctly on a test of graded difficulty including very low frequency polysyllabic words (2- to 6-syllables) with many difficult consonant clusters (e.g. εκπυρσοκρότηση = detonation). It is important to note, nonetheless, that poor readers were still significantly less accurate than their chronological age matched peers, at both grades [$F(1,51) = 31.02$; $p<.001$].

Table 9.2: Poor and average readers' performance on single-word reading test.

	GRADE-2		GRADE-4	
means - (sd)	POOR	AVERAGE	POOR	AVERAGE
Reading Accuracy %	90	96	89	97
Reading errors	13 (8)	5 (3)	14 (8)	4 (3.5)
Reading Time (sec)	584 (145)	379 (139)	424 (105)	198 (42)
Reading Time/word	4.5. (1.1)	2.9	3.2 (0.8)	1.5 (0.3)

Poor reader's reading speed was much more impaired than their reading accuracy. Large differences were observed in the reading latencies of poor and average readers for both real words and nonwords. Grade-2 poor readers, for instance,

spent on average 4.5 seconds in decoding each word, while grade-2 average readers spent only 2.9 seconds. Similar differences were also observed at grade-4, with grade-4 poor readers spending 1.5 seconds per word and grade-4 average readers 3.2 seconds per word. A two-way analysis of covariance between groups with intelligence and reading accuracy as covariates yielded a statistically significant main effect of reading status [$F(1,50) = 47.04$; $p < .001$], confirming the above observations.

Poor readers of both grades also exhibited a high degree of accuracy in the nonword reading test too (Gr. 2 = 90%, Gr. 4= 86%); yet they were significantly less accurate than the average readers [$F(1.50) = 11.04$; $p < .005$], (see Table 9.3).

An identical analysis of covariance on nonword reading speed scores revealed significant differences in the speed with which nonwords were decoded by poor and average readers of both grades [$F(1.50) = 30.32$; $p < .001$]. Grade-2 poor readers spent on average 3.9 per nonword stimuli while average readers took 2.6 seconds. The difference in nonword reading latency at grade-4 was even larger, 3.1 sec. compared with 1.7 seconds per word.

Table 9.3: Poor and average readers' performance on the single nonword reading test.

	GRADE-2		GRADE-4	
means - (sd)	**POOR**	**AVERAGE**	**POOR**	**AVERAGE**
Nonword R. accur.	90%	96%	86%	96%
Nonword R. errors	6 (4)	3 (2)	7 (5)	2 (2)
Nonword R. Time	186 (55)	124 (32)	148 (43)	80 (15)
Nonword Time/word	3.9 (1.1)	2.6 (0.7)	3.1 (0.9)	1.7 (0.3)

Chapter 9.2.3 Individual Differences

Despite the significant between-group differences in the above analyses, not all poor readers exhibited a reading accuracy deficit. As can be seen from Table 9.4, 56% of the poor readers in grade-2 had reading speed deficits, 19% were both

inaccurate and slow, and only 25% experienced problems with reading accuracy only.

At grade-4, 8% of the poor readers experienced problems with reading speed only, 66% problems with both reading speed and accuracy, and 25% with reading accuracy only. This means that the use of a reading accuracy criterion alone would have resulted in a misclassification of 40% of the poor readers. Reading speed appears to be much more sensitive to differences in reading skill in a regular orthography, accounting for 75% of the affected cases in total.

Table 9.4: Summary of the number & percentage of poor readers experiencing problems with reading speed, reading accuracy, or both, at grade-2 and grade-4.

GRADE	Reading Accuracy	Reading Speed	Both
2	4 (25%)	9 (56%)	3 (19%)
4	3 (25%)	1 (8%)	8 (66%)

A qualitative error analysis was also carried out to examine the word recognition system of Greek poor readers in more depth. The errors were classified into one of two major categories: 1) *lexical substitution* errors, and 2) unsuccessful sounding out attempts. The first category of *lexical substitution errors* contained errors that were real-word responses. These errors were interpreted as reflecting the application of a visual reading strategy. They included (a) logographic errors, sharing at least 50% of the target letters irrespective of order: e.g. ηλεκτρικό /ɪlɛlktrɪ'kɒ/ = (electricity) → ηλεκτρονικό /ɪlɛktrɒnɪ'kɒ/ = (electronic), and b) visual/guessing errors, sharing fewer than 50% of the target letters: συγκοινωνία /sɪgɪnɒ'nɪa/ = (transportation) → συγκέντρωση /sɪ'gɛdrɒsɪ/ = (assembly). The second category - *unsuccessful sounding-out* attempts - was used for nonword responses which have resulted from the unsuccessful application of alphabetic reading strategies. This category consisted of the following error categories: (a) letter substi-

tutions {that is errors where one letter in a word is substituted by another letter: e.g. εγχείρηση /εγ'χιρισι/ (surgical operation)—› εγδείρηση /εγ'θιρισι/] (b) letter omissions [that is errors where one or more letters in a word is not pronounced at all: e.g. εκπυρσοκρότηση /εkpirsɒ'krɒtisi/ (detonation) —› εκπυρ_οκροτηση /εkpirɒ'krɒtisi/, (c) nonphonetic errors [errors where the unsuccessful reading attempt does not represent the phonological structure of the target word: e.g. εγκάθειρκτος (prisoner) —› έγκοτος, or υπερδιέργερση /ιρεrði'εγersi/ (overexcitation) as υπερ **δά γρε** ρση /ιρεr'ðaγersi/ (d) letter reversals [that is errors where two or more letters in a word are read in the reversed order: e.g. κατό**ρδ**ωμα /ka'tɒrθɒma/ = (achievement) —› κατό**δρ**ωμα, /ka'tɒθrɒma/ and (e) letter insertions, [errors where an extra phoneme/letter is added to the target word: e.g. pronouncing the word εμπρησμός /εbri'smɒs/ = (arson) as εμπορησμός /εbɒri'smɒs/.

Table 9.5: Percentage of errors in each group category.

	Grade 2		**Grade 4**	
	Poor	**Average**	**Poor**	**Average**
Lexical Substitutions	13%	16%	15%	9%
Unsuccessful sounding-out attempts	87%	84%	85%	91%

The results offered additional evidence for both the beneficial effect of the transparency of the Greek language on poor readers' word decoding skills and the existence of latent deficiencies in their word recognition system.

In line with the high degree of reading accuracy reported in the previous section was the absence of any reading refusals on the part of poor readers of both grades. Even in the more severe cases of reading difficulties the number of errors was relatively small . Moreover, in a number of instances (i.e. 74 in total), poor readers were also able to detect and self-correct some of their initial incorrect responses.

This, however, was not the case with all words. Despite the transparency of the Greek orthographic system, there were instances when Greek poor readers failed to read accurately not only difficult words but also relatively easy high frequency words such as τόπι (ball), μαμά (mum), ζωγραφίζω (to paint). The majority of errors in these relatively easy words were lexical substitutions: e.g. pronouncing the word τόπι /'tɒpɪ/ =(ball) as σπίτι /'spɪtɪ/ = (home); μαμά /ma'ma/ = (mum) as μητέρα /mɪ'tɛra/ = (mother); ζωγραφίζω /zɒɣra'fɪzɒ/ = (to paint) as ζωγραφιά /zɒɣraf'ia/ = (painting); τηλεγράφημα /tɪlɛ'ɣrafɪma/ = (telegram) as τηλεφώνημα /tɪ'lɛfɒnɪma/ = (telephone call), or ηλεκτρικό /ɪlɛlktrɪ'kɒ/ = (electricity) as ελικόπτερο /ɛlɪ'kɒptɛrɒ/ = (helicopter). In particular, thirteen percent (13%) of the errors made by poor readers at grade-2, and 15% of the errors made by poor readers at grade-4 were lexical substitutions (see Table 9.5). All the other errors fell into the second category of unsuccessful sounding-out attempts: i.e. 87% for the grade-2 poor readers and 85% for the grade-4 poor readers. It is also interesting to note that some signs of a visual cue reading strategy were also apparent in some of the unsuccessful sounding-out attempts of both average and poor readers. For instance, when reading a word (e.g. σπουδαίος = important) some children started with a visually similar, but still incorrect morpheme, ending up in this way with a nonword [e.g. pronouncing the word σπουδαίος /spu:'ðɛɒs/ = (important) as σκουπιδαίος /sku:pɪ'ðɛɒs/ : by using the stem of the word σκουπίδια /sku:'pɪðia/ = rubbish].

Average readers were also found to make a similar percentage of lexical substitution errors. Of the 86 errors made by the grade-2 average readers, 16% were lexical substitutions, while at grade-4 the corresponding amount of lexical substitution errors was somewhat smaller: 9% (see Table 9.5).

It was only when reading the more difficult words of the reading test that the reading difficulties of poor readers became more apparent. These difficulties were manifested primarily in terms of letter substitutions (36%), letter omissions [25%), nonphonetic errors (24%), letter reversals (4%), and letter insertions (5%).

Among this small number of unsuccessful reading attempts poor readers made more nonphonetic errors (24%) than average readers (4%) especially with low frequency words. Over half (62%) of their nonphonetic errors and letter omissions (56%) were made by the poor readers in the low frequency polysyllabic words with difficult consonant clusters such as εκχέρσωση /εk'χερσɒsι/ = (land reclamation), έγχορδος /'εγχɒrðɒs/ = (stringed), αγχιστεία /aγχι'stια/ = (affinity), εγκάθειρκτος /ε'gaθιrktɒs/ = (imprisoned), θραύσμα /'θravsma/ = (shell fragment), διεισδύω /ðιιs'ðιɒ/ = (permeate), εγχείρηση /εγ'χιρισι/ = (surgical operation), υπερδιέργερση /ιρερði'εγερsι/ = (over-excitation), εκτραχηλισμός /εktraxιlι'smɒs/ = (debauchery), ερασιτεχνικός /ερασιτεχνι'kɒs/ = (amaterish, or εκπυρσοκρότηση /εkpιrsɒ'krɒtισι/ = (detonation). Error percentages in the above words can be seen in Table 9.6.

Table 9.6: Reading performance of poor and average readers on low-frequency words (% of children reading incorrectly these words)

Word		**Poor %**	**Average %**
Θραύσμα	(shell fragment)	57%	11%
Εγχορδος	(stringed)	54%	29%
Αγχιστεία	(affinity)	54%	29%
Υπερδιέγερση	(overexcitation)	54%	7%
Εκχέρσωση	(land reclamation)	50%	43%
Εγκάθειρκτος	(prisoner)	50%	18%
Διεισδύω	(permeate)	43%	18%
Εγχείρηση	(surgical operation)	43%	18%
Καυσαέρια	(exhaust gas)	39%	4%
Εκτραχυλισμός	(debauchery)	36%	7%
Εκπυρσοκρότηση	(detonation)	32%	7%

This indicates that the reading behaviour of Greek poor readers approximates English dyslexics' severe difficulties in representing the phonological structure of words only in the case of low frequency polysyllabic words with difficult consonant clusters. Shorter words with a simpler syllable structure did not appear to stress their 'faulty' word recognition system: the percentage of children making nonphonetic errors in these words did not exceed 4%.

Chapter 9.2.4 The spelling behaviour of Greek poor readers.

Most of the Greek poor readers were also experiencing severe difficulties with spelling. Ten out of the twelve grade-4 poor readers had a standard score in spelling of 80 or less, while in grade-2, nine of the 16 poor readers (i.e. 56%) had a spelling score of 85 or less.

Inspection of the type of errors revealed the predominance of phonetic spelling errors. There was not a single instance of a non-phonetic error. All participants were able to represent the phonological structure of the target words, no matter how poor they were in the use of orthographic knowledge. The majority of their errors resulted from the selection of the wrong grapheme of phonemes with more than one spelling representations: e.g. writing the word φωνή (voice) as φονή, or the word καιρός (weather) as κερός. Another common error was the incorrect spelling of common digraphs like ευ = /εf/ (e.g. writing εφχαριστώ instead of ευχαριστώ) or the omission of double letters (e.g. writing κόκινο instead of κόκκινο, or σύνεφο instead of σύννεφο).

Given the highly inflectional nature of the Greek language and the extensive use of single- or multi-letter inflectional morphemes in both verb morphology (e.g. σηκώνω /sɪ'kɒnɒ/ = to raise, απλώνω /ap'lɒnɒ/ = to spread, τεντώνω /tɛ'dɒnɒ/ = to stretch) and noun morphology (e.g. τελευταίος /tɛlɛ'ftɛɒs/ = last. ωραίος /ɒ'rɛɒs/ = nice), the performance of poor and average readers on some of the words of the spelling test containing common inflectional morphemes was contrasted to examine their sensitivity to larger orthographic units which have a high occurrence in their orthography. This comparison included three major sets of inflectional morphemes* (see Table 9.7 for a summary).

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* All words were selected from the single-word spelling test used in the main study (see Chapter 5)

Set A comprised words containing very easy single-letter or two-letter inflectional morphemes used in noun morphology to mark differences in the gender of nouns (see Set A of Table 9.7). Two of them (i.e. **-ος** & **-ης**) are used in masculine nouns [e.g. ο δάσκαλ**ος** (teacher), ο μαθητ**ής** (pupil), respectively]; one (i.e. - **η**) in feminine nouns [e.g. η βρύσ**η** = (tab)]; and the remaining two (**-ο** & - **ι**) in neuter nouns [e.g. το σχολε**ίο** (school) & το παραμύθ**ι** (fairy-tail), respectively]. These five morphemes were considered to be the easiest because of their extensive use from the first days of primary school and their grammatical and syntactic status. Set B comprised two of the most highly used inflectional morphemes in verbs: i.e., -αίνω, -ώνω. SET C comprised seven mixed frequency multi-letter noun inflectional morphemes: -ώνας, -ικό, -αίρι, -αίος, -ωμή, ήριο, -ωση (see Table 9.7). The major difference between the inflectional morphemes in Set A and those in Sets B and C is that those in the last two groups are not syntactically determined morphemes. Their major linguistic characteristic is their rhyming status and their frequency in the Greek language.

Because of the lack of frequency data in the Greek language, a linguistic analysis was carried out on the six sets of language books used in the Greek primary school. The number of occurrences of each of the above inflectional morphemes (in a total of 147237 words found) can be seen in parentheses in the first column of Table 9.7

Table 9.7 Percentage of correctly spelled noun and verb inflectional morphemes/endings for good and poor spellers.

	POOR	AVERAGE
SET A		
- ος (3772)	89%	89%
- ης (2681)	89%	89%
- η (9404)	82%	86%
- ο (19681)	93%	93%
- ι (19323)	64%	86%
SET B		
- αίνω (749)	25%	64%
- ώνω (649)	54%	79%
SET C		
- ικό (369)	35%	65%
- αίος (51)	4%	50%
- αίρι (46)	18%	50%
-ώνας (44)	36%	71%
- ήριο (34)	25%	61%
- ωμή (22)	22%	78%
- ωση (51)	11%	35%
-είο (255)	53%	78%

Chi-square test (with continuity correction) was performed on each of these inflectional morphemes. Significant differences were found between poor and average readers on most inflectional morphemes of Set B and Set C, but not of set A which proved very easy for both poor and average readers (all p's > .1). In relation to Set B, poor readers made significantly more errors when spelling the multi-letter inflectional morpheme -αίνω (x^2 = 7.23, df =1, p< .007) and -ώνω (x^2 = 3.92, df =1, p< .05).

Significant differences between the two groups were also found on most of the more difficult and less frequent inflectional morphemes of Set C. Poor readers were consistently poorer than their chronological age peers when spelling the inflectional morphemes of -ικό (x^2 = 6.06, df =1, p< .01), -αίος (x^2 = 13.11, df =1, p< .000), -αίρι (x^2 = 5.10, df =1, -ώνας (x^2 = 5.82, df =1, p< .02), p< .02), -ήριο (x^2 = 5.90, df=1, p< .01), -ωμή (x^2 = 3.92, df =1, p< .05), but not when spelling the inflectional morpheme -ωση (x^2 = 2.73., df =1, ns) or -είο (x^2 = 2.86, df =1, ns). In the case of -ώση (e.g. απογείωση - take-off) both groups found this morpheme very difficult to spell, while the inflectional morpheme -είο (e.g. σχολείο= school) was relatively easy for both groups.

Chapter 9.2.5 The cognitive profile of poor readers in the regular Greek orthography: Chronological age (CA) matched-pairs comparison.

Having examined the reading and spelling behaviour of poor readers the next major objective was to examine their performance on a variety of phonological awareness, phonological processing and syntactic awareness measures, and a test of basic number skills.

A series of two-way analyses of covariance between grade 2 and 4 poor and average readers were performed on all measures, using IQ and reading accuracy scores as covariates to adjust for differences in these two variables (see Table 9.8).

Table 9.8: Poor and average readers' performance on all main composite scores at each grade level (Standard scores).

	GRADE 2		GRADE 4	
	Poor	**Controls**	**Poor**	**Controls**
Spelling	*85.0 (9.3)*	*101.0 (12.3)*	*77.6 (9.2)*	*106.7 (6.9)*
Phonol. Awar	*84.4 (11.0)*	*98.0 (8.0)*	*79.9 (11.8)*	*106 (11.0)*
Speech Rate	*85.3 (7.6)*	*92.3 (9.9)*	*92.1 (9.3)*	*115.1 (9.4)*
Rapid Naming	*91.4 (12.9)*	*104.1 (15.2)*	*80.4 (10.6)*	*98.8 (8.9)*
Verbal STM	*95.6 (16.9)*	*97.2 (14.4)*	*86.5 (16.9)*	*97.7 (156)*
Syntactic Aw.	*91.3 (14.2)*	*94.4 (13.2)*	*86.8 (16.5)*	*103.3 (10.7)*
Mathematics	*93.9 (10.8)*	*100.8 (15.4)*	*85.4 (17.2)*	*103.1 (6.5)*

Significant main effects of reading status were obtained for the measure of rapid naming [F(1.50) = 5.79; p< .05] and the mathematical skills subtest [F(1.50) = 7.49; p< .01] indicating the existence of significant differences in performance on these two measures between the poor and average readers in both grade-2 and grade-4. Significant two-way interactions of reading status (poor-average) and grade (grade 2 -grade 4) were observed for the measures of spelling [F(1.50) = 5.81; p< .02], phonological awareness [F(1.50) = 5.63; p< .05], and speech rate [F(1.50) = 5.13; p<.03]. Simple main effects indicated that the reason for this interaction on all three occasions was due to the even wider differences in performance at grade-4 between the poor and average readers on spelling [F(1.53) = 53.2; p< .001], phonological awareness [F(1.53) = 38.6; p< .001], and speech rate [F(1.53) = 28.0; p< .001] compared to smaller reading group differences in grade 2. No significant main effects of reading status, on the other hand were obtained for the measure of verbal STM [F(1.50) = 1.98; ns] and syntactic awareness [F(1.50) = 1.41; ns].

The mean scores of the poor readers and their controls on the seven individual phonological awareness tasks are summarised in Table 9.9.

Table 9.9: Mean percentage scores of poor and average readers on the seven phonological awareness tasks.

	GRADE-2		GRADE-4	
mean - (sd)	**POOR**	**AVERAGE**	**POOR**	**AVERAGE**
Syllable Counting	96% (8.5)	97% (7.6)	94% (16.1)	99% (1.8)
Syllable Deletion	82% (14.4)	96% (8.5)	87% (18.0)	97% (6.5)
Phoneme Counting	85% (16.7)	87% (14.1)	81% (16.9)	93% (9.6)
Phoneme Deletion	84% (10.9)	99% (2.5)	88% (9.9)	99% (1.7)
Phoneme Substitut.	59% (21.3)	80% (10.0)	65% (22.4)	91% (7.7)
Spoonerisms	31% (22.2)	48% (11.5)	29% (14.2)	62% (8.3)
Consonant Segment.	54% (10.8)	65% (13.7)	67% (20.2)	80% (4.1)

Table 9.9 shows that poor readers at both grades were very accurate in their responses in the syllable and phoneme counting and deletion tasks, with scores ranging from 82% - 96% at grade-2, and from 81% - 94% at grade-4. Their performance was lower however in the more cognitively demanding tasks of phoneme substitution, spoonerisms and consonant segmentation tasks, on which they scored between 31% - 59% correct in grade-2 and from 29% - 65% correct in grade-4 (see Table 9.9).

The statistical significance of the differences in the performance of poor and average readers in these seven phonological awareness tasks was examined in a series of two-way analyses of covariance (grade: 2, 4 X status: poor, average; reading ability and IQ as covariates. No significant main effects of grade or status were obtained for the syllable counting [$F(1.50) = 1.94$; ns]; syllable deletion [$F(1.50) = 2.80$; ns]; or phoneme counting tasks [$F(1.50) = .127$; ns]. Significant main effects of status, however, were obtained for the measures of phoneme deletion [$F(1.50) = 20.18$; $p < .001$]; phoneme substitution [$F(1.50) = 9.58$; $p < .005$]; consonant segmentation task [$F(1.50) = 9.25$; $p < .005$]. An interaction of grade and status was apparent for the spoonerism measure [$F(1.50) = 7.30$; $p < .001$]. Post-hoc analyses indicated that this was due to the significant between-group differences at grade-4 [$F(1,53) = 27.38$; $p < .001$] but not at grade-2 [$F(1,53) = 2.72$; $p > 1$].

In the case of the consonant segmentation task, separate analyses were also performed on each of the two set of word stimuli included in it (see Chapter 5). Poor readers of both grades were found to experience significant difficulties only with the set of words whose syllabification required the segmentation of the consonantal sequence into two parts, one of which had to go in the end of the first syllable and the other in the beginning of the second syllable [$F(1,50) = 10.73$; $p < .005$](SET B, Closed syllables). No significant differences, however, were observed on the first set of words whose segmentation left the preceding syllable open [$F(1,50) = 1.07$; $p > 1$] (SET A).

When administering the phonological awareness tasks of phoneme and syllable counting and deletion it became apparent to the experimenter that not all participants took the same time to complete the tasks. Some children were very consistent and fast in their responses. Others, however, needed much more time before deciding what the answer was. Others, after giving an incorrect response, were able, even with difficulty, to correct their first response and provide the experimenter with the correct answer. This raised the question of the usefulness of response latencies as an additional diagnostic criterion in the assessment of phonological awareness skills. As these differences in reaction times became apparent during the administration of the phoneme and syllable counting and deletion tasks it was not possible to keep a record on all phonological awareness tasks. Reaction times were recorded for the phoneme substitution and spoonerisms tests which were administered last and were measured to the nearest second using a stopwatch. The average time per trial for grade-2 and grade-4 average and poor readers in these two tasks are given in Table 9.10. Items that were either incorrect or partially answered (i.e. substitution made only in one of the two positions) were excluded from these analyses.

Table 9.10: Mean reaction times (per trial) in the phoneme substitution & spoonerism test (time in seconds)

	GRADE 2		GRADE 4	
	POOR	AVERAGE	POOR	AVERAGE
Means (sd)				
Phoneme Subst.	9.5 (11.3)	5.1 (2.8)	5.9 (2.9)	3.3 (1.3)
Spoonerisms	33.4 (16.3)	26.8 (11.9)	36.8 (16.8)	18.5 (11.9)

Inspection of the means revealed that, in most instances, poor readers took twice as much time to answer correctly. A two-way analysis of variance (grade: 2,4 X status: poor, average) confirmed the significance of the above differences in reaction times for both the phoneme substitution and the spoonerism tests. Significant main effects of status were found for the phoneme substitution [$F(1,52) = 4.25$; $p < .05$] and the spoonerism tests [$F(1,52) = 8.92$; $p < .001$]. The interaction between the two factors was not significant. No significant main effects of grade, however, were found for both these tasks [$F(1,52) = 2.50$; ns] & [$F(1,52) = 3.60$; ns], respectively}.

Identical analyses to those performed for the individual phonological awareness tasks were also performed for the individual tests employed in the rapid naming and syntactic awareness composite scores (see Table 9.11). In relation to the rapid naming tasks, a significant main effect of status was obtained in object naming task [$F(1.50) = 5.64$; $p<.05$], while a significant two-way interaction of grade and status was found for the digit naming task [$F(1.50) = 7.27$; $p<.01$] (see Table 9.11). Post hoc analyses indicated that this interaction was due to the small between-group differences [$F(1,53) = 1.81$; $p> 0.1$] at grade-2, and the highly significant differences in performance [$F(1.53) = 20.76$; $p<.001$] at grade-4. No significant main effects of status, on the other hand, was obtained for the rapid naming of colours and letters (both F's >1.0).

No significant differences were obtained for any of the syntactic awareness tasks apart from the recalling sentences test where a significant two-way interaction [$F(1.50) = 6.32$; $p<.05$] emerged. In this case, poor readers' performance was not

significantly different from that of average readers at grade-2 [F(1,53) = 1.00; p> 1.0], but significantly poorer than the average reader at grade-4 [F(1,53) = 8.51; p< .005].

In order to see whether the lack of significant differences in the stress assignment test would also be accompanied by a high level of competence in the use of the stress symbol in writing, a further analysis was carried out on the number of misplaced or missing stress-marks on the words in the spelling test. The results revealed that poor readers omitted/misplaced the stress mark significantly more than average readers of the same age [(1,52) = 14.55; p<.000].

Table 9.11: Means and standard deviations of all individual rapid naming and syntactic awareness tests.

	GRADE 2		GRADE 4	
	Poor	**Controls**	**Poor**	**Controls**
	Individual Rapid Naming Tasks (in seconds)			
Objects	74.6 (19.1)	60.0 (12.7)	66.8 (14.0)	50.0 (5.6)
Digits	38.5 (5.99)	34.8 (8.1)	35.8 (7.8)	24.0 (3.5)
Letters	66.5 (14.7)	57.7 (15.7)	50.9 (12.0)	39.7 (9.8)
Colours	58.6 (12.0)	54.7 (13.2)	51.2 (6.8)	48.2 (8.2)
	Individual Syntactic Awareness Tasks (Standard scores)			
Rec. Sent	97.3 (17.3)	93.8 (16.3)	86.4 (14.2)	103 (12.5)
Sent. Ass.	89.5 (14.2)	101 (15.2)	87.3 (19.7)	101 (10.5)
Grammat.	87.9 (17.1)	90 (14.7)	98.8 (19.9)	108.7 (9.2)
Stress ass.	97.6 (13.8)	102 (16.2)	100 (15.3)	100 (15.3)
Violate S-V	100 (15.2)	100 (15)	103.1 (21.2)	98
Viol. gender	100 (15.2)	100 (15)	100.1 (15.2)	103.2 (15.4)

Chapter 9.2.6 Reading age (RA) matched pairs comparison .

A reading-age matched pairs comparison was also performed as a more stringent comparison, to examine the pattern of cognitive deficit characteristic of poor readers in the phonological, syntactic and mathematics domain. All but one grade-4 poor reader was matched to a younger grade-2 children on reading speed, being the most sensitive criterion of reading ability in the Greek language. All grade-2 poor readers had to be excluded because there were no younger children to provide controls. In total eleven grade-4 poor readers were contrasted to eleven grade-2 children of the same reading age (see Table 9.12). No significant differences in performance were found on either the matching variable of reading speed [t(20) = .08; p> .1] or the measure of general intelligence [t(20) = -.61; p> .1].

Table 9.12: Reading age comparison: Summary of matching criteria

	POOR READERS (Grade 4)	**R. A. CONTROLS** (Grade 2)
	11 poor readers	11 average readers
Age in years & months	9 y. sm. (0.3m)	7y. 3m (0.6m)
IQ: Ravens standard score	95 (13.7)	99 (15)
Reading speed in seconds	404 (82)	401 (79)

Non-parametric statistical procedures were used (i.e. Wilcoxon matched-pairs test) to examine possible differences in the cognitive profile of the Grade-4 poor readers and reading-age controls. Table 9.13 summarises the performance of the two groups on the main variables and the individual phonological awareness tasks. Significant differences were found for the measures of nonword reading accuracy (Z= -2.04; p<.05, 2-tailed), composite phonological awareness (Z= -2.26; p<.05), the repetition of 4-syllable words in speech rate[1] (Z= -2.34; p<.05), and the basic number skills (Z= -2.26; p<.05). Of the seven phonological awareness tasks, significant

[1] The differences in performance on the composite score of speech rate (2-, 3- & 4- syllable word-pairs) was no significant, indicating that it Greek poor readers had trouble in repeating the longer 4-syllable words only.

differences in performance were observed only in the measure of phoneme deletion (Z= -2.19; p<.05), and spoonerisms (Z= -2.66; p<.01). Non-significant differences, on the other hand, were obtained on all the other phonological awareness, rapid naming and syntactic awareness measures (all p's > 1.0)

Table 9.13: Summary of results of the reading age matched-pairs comparison

Measures	POOR READERS		R.A. CONTROLS		Signif.
Main Variables					
Nonword Reading (in seconds)	138.2s	(25.9s)	134.6s	(29.7s)	ns
Nonword errors	6.6	(5.2)	3	(2.4)	.04
Spelling /72	19.1	(10.9)	25.8	(8.9)	ns
Phonological Awareness	105.9	(16.9)	122.9	(6)	.02
Speech Rate Total	1.7	(.18)	1.58	(.17)	ns
Speech rate 4-syll. Words	1.24	(.12)	1.38	(.10)	.02
Rapid Naming	51.7	(7)	53.3	(10)	ns
Verbal STM	15.8	(3.3)	15.1	(2.2)	ns
Syntactic Awareness	136.8	(14.7)	134.1	(11.2)	ns
Basic number skills	12.6	(3.8)	17.6	(4.2)	.02
Individual Phonological Awareness tasks					
Syllable Counting	15.1	(2.7)	15.6	(.92)	ns
Syllable deletion	15.7	(3.4)	17.0	(1.3)	ns
Phoneme counting	16.1	(3.5)	17.2	(2.8)	ns
Phoneme deletion	20.4	(2.4)	22.7	(.64)	.03
Phoneme substitution	9.6	(3.5)	12.4	(1.9)	ns
Spoonerisms	8.8	(6.3)	16.8	(1.9)	.001
Consonant segmentation skills.	20.2	(4.4)	21.1	(3.6)	ns

Chapter 9.2.7 The classification of poor and average readers in a regular orthography.

To assess the adequacy of predictor variables for separating normal children from children with reading disorders in the Greek orthography, the data from second and fourth grades were subjected to discriminant function analyses. The first set of analyses examined the discriminative power of the main variables at grade-2 or grade-4.

The inclusion of all main variables (i.e. nonword reading, spelling, phonological awareness, rapid naming, speech rate, verbal STM, syntactic awareness, mathematical skills) in the analyses produced a highly significant discriminant function at both age groups, classifying correctly 87.5% of the cases at grade-2 (x^2 = 26.8, p<.001), and 100% of the cases at grade-4* (x^2 = 38, p<.001) (see Table 9.14). Because syntactic awareness and verbal STM proved to be poor predictors of reading in the regression analyses reported in Chapter 7 & 8, these two measures were then excluded from the analyses to see if their absence would affect the predictive power of the discriminant function. With these two measures out of the analyses, the new discriminant function at grade-2 (x^2 = 30.4, p<.001) correctly classified 91% of the cases, while at grade-4 it still correctly classified 100% of the children (x^2 = 39, p< .001).

Table 9.14: Summary of results of the discriminant function analyses at grade 2 & grade 4

GRADE 2				GRADE 4	
			Main Variables		
All main variables	**87.5%**	.001	All main variables	**100%**	.001
All main variables except syntactic awareness & verbal STM	**91%**	.001	All main variables except syntactic awareness & verbal STM	**100%**	.001
			Individual Phonological Awareness Tasks		
Phoneme deletion Phoneme substitution Spoonerisms Consonant Segm.	**91%**	.001	Phoneme deletion Spoonerisms	**96%**	.001
			Rapid Naming Tasks		
Object naming	**69%**	.05	Object naming Digit naming Letter naming	**92%**	.001
			Individual Syntactic Awareness Tasks		
Recalling Sentences Sentence Assembly	**65%**	.05	Recalling Sentences Sentence Assembly	**79%**	.01

* Predicting the same group of poor or average readers as took part in this chapter.

A similar procedure was followed for the seven individual phonological awareness tasks. When all seven tasks were in the analyses, the discriminant function correctly classified 87.5% of the cases at grade-2 ($x^2 = 30.6$, $p<.001$), and 91.7% of the cases at grade-4 ($x^2 = 20.7$, $p<.01$). Based on the evidence from the previous regression analyses in Chapter 6 and the values of the standard canonical discriminant function coefficients of each individual test, an attempt was made to eliminate from the discriminant function those variables not contributing any unique amount of variance. With the gradual exclusion of syllable counting, phoneme counting, and phoneme substitution tasks from the grade-2 discriminant function analysis, 91% of the cases were correctly classified ($x^2 = 30.2$, $p<.001$). At grade-4, the exclusion of all the above tests and that of syllable deletion, and consonant segmentation also led to an increased classification rate of 96% ($x^2 = 38$, $p<.001$), indicating that the measures of phoneme deletion and spoonerisms alone could adequately identify 96% of the cases at age 9.

When all four individual rapid naming tasks were entered into the analysis, the discriminant functions for the grade-2 data proved non significant ($x^2 = 5.87$, ns). The same was not the case with grade-4 data, where the discriminant function was significant ($x^2 = 18.46$, $p<.001$)., correctly classifying 92% of the children. Re-running the analyses without the measures yielding very low standard canonical discriminant function coefficients at grade-2, that is colour, digit, and letter naming, the discriminant functions became significant ($x^2 = 5.77$, $p<.05$), correctly classifying 69% of the cases. The exclusion of the colour naming test, on the other hand, at grade-4 had only a minimal impact on the predictive power of grade-4 discriminant function ($x^2 = 18.55$, $p<.001$).

Syntactic awareness tasks also proved not very powerful diagnostic tools in separating poor from average readers. When all syntactic measures were entered into the analyses the discriminant functions at grade-2 was non significant ($x^2 = 7.5$, ns), while that at grade-4 only marginally significant ($x^2 = 38$, $p<.001$) correctly classifying 75% of the children. After the exclusion of the grammatical closure test

from the analyses a small increase was only observed in the classification rate of the grade-4 discriminant function (x^2 = 8.21, $p<.01$) which now correctly classified 79% of the cases, while that of grade-2 became marginally significant (x^2 = 6.5, $p<.05$).

On the whole, the results of all these discriminant function analyses appear to support the results of the multivariate analyses for normally developing children, as well as those carried out in the matched pair comparisons, indicating the primary importance of phonological awareness and other phonological processing measures to the prediction of literacy skills and the identification of poor readers in a regular orthography.

Chapter 9.3 Discussion

Studies examining the cognitive profile of poor readers in other languages than English are relatively limited. Consequently, little is known about the manifestation of reading difficulties and the exact nature of poor readers' underlying cognitive deficits when learning to read in regular languages. The present study addressed these two issues in the highly transparent Greek orthography.

Greek poor readers were found to be very accurate in their attempts to read both real words and nonwords. Their mean accuracy score was remarkably high, i.e. 90%, making on average 13 errors at grade-2 and 14 errors at grade-4 on a single reading test of 131 words of increasing difficulty. The number of non phonetic errors, lexical substitutions, letter omissions, reversals or intrusions was very small, even in the most severe cases of reading difficulties. In these cases too there was not a single instance of reading or nonword reading refusal, while the maximum reading error rate was close to 80%. A very high degree of accuracy was also found on the nonword reading test (:i.e. 90%).

This evidence demonstrates that decoding does not pose the same difficulty to Greek poor readers as it does to English poor readers. The high reading and nonword reading accuracy of Greek poor readers, after only one year of reading

instruction, stands into stark contrast to the results of many studies with English-speaking participants whose nonword reading accuracy score is significantly lower: ranging from 40 to 60% (Juel, 1988; Rack et al., 1992; Treiman, Goswami, and Bruck, 1990. Adults with childhood histories of dyslexia have also been reported to continue to find nonword reading particularly difficult, reaching an accuracy score of about 65% (Bruck, 1990). It appears that the transparency of the Greek language renders the application of simple grapheme-to-phoneme conversion rules highly successful not only for normally developing children but also for poor readers. It is important, however, to note that it is wrong to think that reading does not pose any difficulty to the Greek poor readers. In agreement with the Wimmer's (1993) results, in this study significant differences were found in the speed with which poor readers read words or pseudowords. Greek poor readers were very slow, trying in many instances to decode words or nonwords syllable by syllable, letter by letter. The adoption of such a reading strategy resulted in accurate responses but also lengthy reading times. In most instances, poor readers needed an additional 3 to 4 minutes to read the same set of 131 words. This was particularly true for the grade-2 poor readers, half of whom made very few errors but had extremely long reading times. Most of the grade-4 poor readers, on the other hand, were both less fast and accurate in reading.

Despite the small number of errors made , most Greek poor readers were in fact significantly less accurate than their chronological age peers. The occurrence of reading errors in high frequency words indicated the existence of underlying deficiencies in their word recognition system. Moreover, not all poor readers manifested their reading difficulties in terms of differences in reading speed. Twenty-five percent (25%) in each grade manifested their difficulties solely in terms of reading accuracy problems. Due to the transparency of the Greek language the assessment of reading accuracy in Greek appears to be problematic. The tendency of poor and average readers in the present study to make a large proportion of their errors on the most difficult words of the reading test suggests the need for including low fre-

quency polysyllabic words with difficult consonant clusters, to make reading tests in regular orthographies more 'sensitive' to differences in the severity of reading difficulties. There is also evidence to suggest that the underlying cognitive deficits of 'rate' disabled children are not identical to those of 'accuracy' disabled children (Lovett, 1987). Recently, Wolf (1997) has proposed a double-deficit hypothesis suggesting that individuals with deficits in both naming speed and phonological coding are substantially more impaired then individuals with weaknesses in only one domain.

Greek poor readers' spellings also suggested they had not developed well specified orthographic representations. The majority of poor readers experienced difficulties with both reading and spelling. This was particularly true for the fourth grade poor readers whose spelling ability was even more depressed than that of the second grade poor readers. Inspection of the type of spelling errors revealed the absence of non-phonetic errors, letter reversals or letter omissions in the spelling of words with consonant clusters. Their errors were phonetic in nature: being in most cases the result of the selection of the wrong grapheme in vowels having more than one graphemic representation or spelling. The absence of any difficulty with the spelling of consonant clusters or any other segmentation-based spelling difficulty on the part of Greek poor readers needs to be emphasized because it indicates the beneficial effect of the transparency of the Greek language on the development of high levels of phonemic segmentation skills. English poor spellers have consistently been reported to experience difficulties spelling consonant clusters in English (e.g. Kibel & Miles, 1994). Such differences in this aspect of spelling behaviour of English and Greek poor readers suggest that the latter, after one year of 'phonics'-oriented reading instruction and exposure to a highly regular orthography, have acquired competence in letter-sound mapping, being able to use this knowledge not only in reading but also in spelling.

Another basic characteristic of Greek poor readers' spelling behaviour was their insensitivity to very frequently occurring spelling patterns. As Greek is a highly

inflected language where various single- or multi-letter inflectional morphemes are extensively used in, both, noun and verb morphology. The two major features of the multi-letter inflectional morphemes, that is their high occurrence in many nouns (e.g. μεσ**αίος**, τελευτ**αίος**, ωρ**αίος**, διαρετ**αίος**) or verbs (μαθ**αίνω**, κατεβ**αίνω**, πηγ**αίνω**, κουτσ**αίνω**) and their rhyming quality, attribute to these multi-letter orthographic units a similar linguistic status to that of the rime unit in English monosyllabic words.

The poor readers' ability to spell correctly various inflectional morphemes became the focus of the second part of the spelling error analysis to see if there would be differences in performance between poor and average readers. The results indicated significant between-group differences in most cases, except in the case of single morphemes which are used to indicate differences in the gender of nouns. Poor readers were found to experience significant difficulties not only in spelling relatively difficult inflectional morphemes but also very easy and commonly used multi-letter morphemes. Their performance was not only significantly poorer than that of their chronological-age peers, but in many instances, grade-4 poor readers were found to experience the same or even more severe difficulties to those experienced by younger normally developing children in learning the same spelling patterns.

This evidence indicates Greek poor readers' insensitivity to the highly occurring spelling patterns of their orthography and it appears to be in line with recent conceptualizations of literacy acquisition that emphasize the importance of the statistical properties of words (Brown & Loosemore, 1994; Seidenberg & McClelland, 1989; Treiman et al., 1995). The importance of the lexical statistics in the English orthography has been mainly examined either in studies contrasting the saliency of rime unit to that of other linguistic units (see Goswami, 1997; Treiman, 1992 for reviews), or, in studies examining the effects of neighbourhood consistency or inconsistency in the rime of English monosyllabic words (e.g. Laxon, Coltheart, and Keating, 1988; Nation, 1997; Treiman et al., 1995). The results of most of these investigations

have documented the high degree of saliency of the rime unit in the English orthography. The evidence from the present study extends the validity of the above theoretical formulations and research evidence in English by showing the importance of the appreciation of the statistical characteristics of words in a language of a different orthographic structure where the notion of rime unit is not applicable. The observed differences in the spelling of high frequency multi-letter inflectional morphemes between poor and average Greek readers was based on evidence from multisyllabic words and not monosyllabic words which are exclusively used in English investigations.

The present findings also appear to bear some relevance to the results of some recent cross-orthographic comparisons (e.g. Goswami, Porpodas, & Wheelwright, in press; Goswami, Gombert, & Fraca de Barrera, in press) which have reported the low level of saliency of rime unit in regular orthographies like Greek, Spanish and French (see Chapter 3). In accounting for all this cross-linguistic evidence, Usha Goswami (1997) has arrived at the conclusion that " ... *the development of orthographic representations developed by young readers of Greek are the grapheme-phoneme units, and that orthographic sequences that reflect rhymes have no representational status* (in Greek) (p. 143). The first part of the conclusion appears to be justified on the basis of her results on her nonword reading test, and the results of the present investigation which indicate Greek readers' competence in using grapheme-to-phoneme correspondence rules in reading or spelling, or their increased level metalinguistic awareness at the phonemic level. The general applicability of the second part of her conclusion, however, is problematic in the light of the evidence from the present investigation of poor and average readers' ability to spell high frequency multi-letter inflectional morphemes of a similar linguistic status to that of the rime unit in English. The results of the present analysis indicate that orthographic sequences that reflect rhyming in Greek do have a representational status, but the degree of their saliency and importance varies according to the existing differences in the degree of consistency of grapheme-to-

phoneme correspondences in the two modalities: i.e. in reading and spelling. This evidence shows that cross-linguistic evidence from languages with one-sided regularity may be as informative as evidence from studies carried-out in languages that are either regular or irregular in both modalities. Within-language comparisons offer the advantage of the same phonology, orthography, and syntax, the only difference being (at least in the case of Greek language) the degree of consistency in the representation of phonemes-graphemes. The above pattern of results are also interesting because they are in line with some recent models of literacy acquisition which emphasise the importance of lexical statistics to the development of reading and spelling competence (Treiman et al., 1995).

The development of phonological awareness skills, phonological processing skills, and syntactic awareness skills in Greek poor readers was also of particular interest. The results indicated the existence of pervasive deficiencies in the phonological domain, but not in syntactic awareness. When contrasting the cognitive profile of poor readers with that of their chronological age peers significant differences were found on all phonological measures but the verbal STM task. Their difficulties on some of these measures (i.e. phonological awareness, speech rate & spelling) were so profound that the magnitude of differences in their performance was even wider at grade-4. Non significant differences, on the other hand, were found in most of the syntactic awareness tasks, with the exception of the recalling sentences test at grade-4. The reading-level matched pairs comparison also confirmed the existence of an underlying phonological deficit. Significant differences were found between poor and younger average readers of the same reading age on the phonological awareness composite score, the 4-syllable speech rate task, the decoding accuracy in the nonword reading task.

The above pattern of results indicates that the phonological deficit hypothesis as a major explanation of most poor readers' reading and spelling difficulties is valid not only in the deep English orthography in which it has been formulated, but

also in languages with a more transparent orthography. The similarities in the cognitive profile of Greek poor readers and English dyslexics (e.g. Snowling, 1995) are impressive, given the significant differences in the orthographic structure of the two languages. These findings offer unequivocal support to those theorists who view dyslexia as a universal phenomenon and as a deficit the outward symptoms of which may be culturally influenced-determined (Frith, 1997). Although the present study was not a direct cross-linguistic comparison, a number of its findings indicated the existence of significant differences in the manifestation of the underlying cognitive deficits: the most revealing of which being those of phonological awareness skills

On the whole, this set of analyses indicates that the transparency of Greek orthography exerts a beneficial effect not only on the development of phonological reading skills in Greek poor readers but also on the development of their phonological awareness skills. The evidence that one of the most discriminant measures in Greek was the spoonerism test, which is most often used with adult dyslexics in English because of its cognitive complexity (e.g. Gallagher, Laxon, Armstrong, and Frith, 1996), implies that the cognitive deficit underlying the written language difficulties of English and Greek poor readers is the same, but the degree of its severity and the way in which is manifested in regular orthographies is different. It appears that the consistent and isomorphic relationship between Greek phonemes and graphemes and the phonics-oriented reading instruction allow Greek readers a better conscious awareness of the phonological structure of words at the syllable and phoneme level, leading them to an increased level of competence on many phonological awareness tasks that most English dyslexics find difficult. This raises the issue of the sensitivity of many linguistic measures in regular orthographies and warns against the uncritical acceptance of those diagnostic tools and performance criteria that have been constructed and used in languages with a different orthographic structure. Not all linguistic measures that are used extensively in English were sensitive enough to detect the existence of underlying phonological deficits in Greek: e.g. verbal STM, phoneme counting, syllable awareness tasks. In addition to this evidence, two find-

ings in the present set of analyses are also indicative of the need for constructing and/or using linguistically adapted assessment procedures and criteria.

In the reading-level comparison significant differences in performance were found in the speech rate task only on the 4-syllable word-group, but not on the other two groups requiring the participants to repeat as fast as possible word-pairs of 2- or 3-syllables. This difference in the discriminative power of this task may be attributed to the length of Greek words which tend to be rather long. It is possible that because of the high preponderance of multi-syllabic words in the Greek language, which in some instances have eight or more syllables, the repetition of word-pairs with stimuli of two or three syllables might not have stressed the phonological skills of Greek poor readers.. Evidence supporting this view comes indirectly from studies which indicate that real words, which have established lexical entries in long-term-memory, are recalled and rehearsed better than stimuli which do not (nonwords) (McDougall et al., 1994). The argument can be made that the phonological system of Greek-speaking children may be 'accustomed' to the establishment and processing of multi-syllable representations, so that the fast repetition of short words required by the speech rate task may might not have posed any 'challenge' to the system of normally developing children and of children with phonological deficits. The same argument can be made also for the verbal short-term memory task because the same set of words was used in both tasks. Research evidence indicates that word span is sensitive to word length (e.g. Baddeley, Thomson, and Buchanan, 1975, McDougall et al., 1994). Verbal STM was also found not to be discriminative of reading difficulties in the Wimmer (1993) study. In this case too, short-term memory was assessed using the digit span test comprising monosyllable and disyllable words in a language where polysyllabic words of eight and nine syllables are not uncommon.

The second finding of interest was the evidence of significant differences in the reaction times of poor and average readers on the phoneme substitution and spoonerism tasks. Poor readers were found to be not only significantly less accu-

rate on these two tasks, but also significantly slower even in those cases that were able to respond correctly. In many instances poor readers of both grades required the experimenter to repeat the word stimuli again in order to continue their attempts to answer. This hardly happened with most average readers, whose responses were both fast and accurate. In some other instances poor readers either they had to reflect before answering, or, after giving a first incorrect response they needed again to spend some time before giving their answer.

Such differences in the response latencies on phoneme awareness tasks of poor and average readers are very important because they suggest the existence of significant differences in the quality of their phonological representations. The fast and unhesitant responses of most average readers on spoonerisms and phoneme substitution reveal the clarity with which phonological and orthographic information is represented in their word recognition system. On the other hand, poor readers' delay in providing accurate responses indicates that, despite the transparency of the Greek language and their increased ability to manipulate the phonological structure of words, their phonological representations were not as clearly defined as those of average readers, so extra time was required to think about the task and reply. The present pattern of results suggests that the examination of underlying phonological deficits in regular orthographies, by means of phonological awareness tasks, may require both the traditional accuracy and latency measures, especially in those cases where an increased level of accuracy does not allow any inference about the status of underlying phonological representations.

One of the seven measures used in the present study to assess the development of phonological awareness skills was a newly developed task aiming to assess children's' ability to segment sequences of consonants into phonologically acceptable ways. Children were asked to syllabify words orally, and by doing so to segment the consonantal sequences that were present in one of the words' syllable boundaries. The statistical analyses examining the predictive relationship of phonological awareness tasks in Chapter 6, showed that this task was one of the most powerful

and independent predictors of reading skill at grade-2, but not at grade-4. The absence of predictive power at this later stage of development was interpreted in terms of the masking effect of the use of a set of syllabification rules that are extensively taught at grade-3 and 4. The present set of analyses provided further evidence on the diagnostic validity of this test.

Poor readers of both grades were found to perform very poorly on this test. Item analyses indicated that their difficulties were specifically associated with the segmentation of those sequences of consonants that were not permissible syllable-onsets in their language and which had to be segmented into two parts (e.g. **nj** , as in the syllabification of the English word en/joy; and that of χαρ/τί [paper] in Greek). No significant differences, on the other hand, were found on those words containing permissible consonant sequences (e.g. str) the segmentation of which required these sequences to be preserved (by being syllabified with the second syllable) leaving the preceding syllable open (as in the word a***str***ology --› a / ***str***o / lo / gy, or the word α/στρο/λο/γί/α in Greek). The above results present some interest because they suggest the possibility not only of poor segmentation skills but also poor reader's insensitivity to the phonological constraints and statistical regularities that govern their language. Analysis of the cognitive requirements of this test indicates that successful completion of this task requires subjects among other things to a) identify the individual phonemes in the sequence, b) segment it into various ways c) refer to the phonological constraints and statistical regularities of his language to decide which of the possible letter combinations are legal or illegal syllable onsets in their language (e.g. c/tr or ct/r, ctr: respectively), and d) then decide where to put the boundary in words. Given the evidence that Greek readers are very competent in identifying the individual phonemes in words (as evidenced by their accurate performance on the phoneme counting test) the claim can be made that their difficulties on this task are related to their deficits in appreciating the phonological status of these sequences, and in particular in appreciating the importance of the phonological constraints and statistical regularities of their language. This appears to be in line with the evidence

from the spelling analyses where poor readers were also insensitive to the highly occurring orthographic sequences of their language.

In the case of the second type of words (SET A of test), the acoustic or syllable boundaries coincide with the syllable boundaries of the words (e.g. poster –› po / ster = **CV** - CCV). This means that children can perform this task, not only because they are aware of the phonological status of the sequence they are asked to segment, but simply following the 'syllabic' rhythm of the Greek language. This is not however the case with the other type of words because the syllable boundaries do not coincide with the acoustic/speech boundaries (e.g. lobster –› lob / ster = **CV<u>C</u>** - CCCV in English, τάγ / μα = CVC - CV = /'ta/γma/ in Greek).

The second major objective of the examination of the cognitive profile of Greek poor readers was to examine whether poor readers will experience problems with syntactic awareness. The results revealed the absence of any significant differences between poor and average readers on most syntactic awareness tests. The discriminant function analyses confirmed the low discriminative power of these tests in separating poor from average readers. This evidence indicates the absence of any major syntactic awareness deficits in Greek poor readers, supporting the claims of those theorists who advocate the primary importance of phonological impairments as a major explanation of poor readers' written language difficulties (e.g. Mann, Shankweiler, and smith, 1984; Shankweiler et al., 1994-95. The only instance that poor readers scored significantly lower than their chronological-age peers was on the recalling sentences task at grade-4. In this as well in all the other instances their mean performance scores (even though lower to those of average readers) were never below the cut-off point of 85. A similar pattern of results was also obtained on the BAS subtest of basic number skills. Even though poor readers performed significantly more poorly than average readers in both the chronological-age and reading-level comparisons, their mean accuracy scores in most cases were within the age-expected norms. In grade-2, for instance, the mean score of poor readers

was 93 while that of average readers 100. In grade-4, the mean for the first group was 85 while that of the second 103.

One possible explanation for the above significant differences in poor readers' and average readers' performance on the syntactic awareness and basic number skills tests is in terms of Stanovich's (1986) notion of 'Matthew effects' - where poor (readers) get poorer and 'rich' get 'richer' - and his hypothesis that reading difficulties can lead to increasingly global performance deficits. A crucial element in this hypothesis is the adverse effects reading difficulties have on poor readers' motivation. Prolonged reading failure has been reported to have a pervasive effect on children's general self-esteem, motivation, and task persistence (e.g. Butkowsky & Willows, 1980; Fowler & Peterson, 1981), leading - according to Stanovich (1986) - to a generalized inability to deal with educational, cognitive, and linguistic tasks of all types. When administering the tests of our experimental test-battery, it became apparent that many poor readers were less persistent in their attempts to answer questions, less confident and motivated in general, and more prone to give an 'easy' answer. So it is possible that the observed differences in performance between poor and average readers may reflect the gradual loss of interest and/or of task persistence. It is likely that poor readers gradually lag behind not only in the domain where their major deficits are but also in other domains where average readers appear to progress normally.

In relation to syntactic awareness the claim has also been made that the ability to comprehend complex syntactic structures is in part the result of reading experience (e.g. Mann, 1986; Perfetti, 1985). The present analyses also support this view. One of the few syntactic awareness tests in which poor readers scored significantly lower than their chronological-age peers was the recalling sentences task, at grade-4. These differences, however, did not hold in the reading-level comparison. Once grade-4 poor readers were matched on reading ability with younger grade-2 children, the differences in performance were not significant.

The results of one of the three newly developed syntactic awareness tests, that of stress assignment, also presented some interest. The aim of this test was to examine poor readers' sensitivity to differences in the placement of stress in sound-alike words (e.g. γέρος = /'jɛros/ -γερός = /jɛ 'ros/); contrast it with their ability to use the stress mark in spelling; and see whether difficulties in using this punctuation mark in writing will reflect a specific insensitivity to this linguistic feature of their language. The Greek language provided this opportunity, because every Greek word of more than one syllable carries a stress mark which indicates which syllable is accentuated more. The results indicated that Greek poor readers did not experience difficulties with the stress assignment task, even though they omitted or misplaced the stress mark in spelling significantly more than the average readers who made very few errors. This suggested that their difficulty, at least with this punctuation mark, was not the result of a specific linguistic insensitivity. One possible interpretation of this result is that poor readers, because of their well documented deficits in the representation of phonological and orthographic information., find the spelling task so demanding that most of their attention is directed to finding the correct orthographic representation of the word they want to write that they forget to put the stress mark.

Although the present analyses failed to uncover a specific deficit in this rather subtle aspect of linguistic development, one should stress the importance of examining similar or other aspects of children's' phonology (both input and output) and their relationship to written language difficulties. A large body of evidence indicates that young children with speech and language impairments in many instances go on to demonstrate reading difficulties (e.g. Aram & Hall, 1989; Catts, 1991). The challenge that lay ahead of those researchers working in this field is to examine and disentangle the complex relationship between speech and language difficulties; identify the commonalities and differences in the locus of these deficits; and construct assessment procedures that could be used from an early stage in development as reliable indicators for identifying children who are at risk of literacy skills.

The construct validity of the present experimental strategy for the identification of poor readers in the regular Greek language, was assessed in the present study in a series of discriminant function analyses. The results suggested a success rate of 90% at grade-2 while a 100% at grade-4 for either the main all the individual phonological awareness tasks. The discriminative power of the rapid naming and syntactic awareness tasks proved rather low at both ages, with the exception of the rapid naming tasks at grade-4 which correctly identified 92% of the children. On the whole, the results confirmed the evidence from the correlational and multivariate analyses carried out for all 132 participants of the study, indicating the primary importance of phonological processing skills in the prediction of differences in reading skill. The high success-rate in classifying poor and average readers in both grades also suggests the usefulness of most cognitive and linguistic measures of the present experimental test-battery in the identification of reading and spelling difficulties in the Greek orthography.

Chapter 10. GENERAL DISCUSSION

Chapter 10.1 Overview

The last two decades have seen a remarkable rebirth of psychological interest in the process of reading and spelling and the cognitive factors that may affect or predict literacy development. Numerous studies have been conducted in English (see Goswami & Bryant, 1990 & Wagner et al., 1987 for reviews) as well as in other more regular orthographies (e.g. Caravolas & Bruck, 1993; Wimmer, 1993; Wimmer & Goswami, 1994) or logographic scripts (e.g. Mann, 1986; Read et al., 1988). Perhaps one of the most important contribution of the growing number of cross-linguistic studies has been the realization that the existence of significant differences in the linguistic structure of languages may significantly affect the development of literacy or other metacognitive skills.

Set in this context of general interest about the development of literacy skills in other more regular orthographies, the present research aimed to study the development of reading and spelling abilities in the Greek language, the predictive relationship between various phonological awareness, phonological processing and syntactic awareness measures and the development of literacy skills at age 7 and age 9, and, finally, the manifestation and underlying cognitive deficits of Greek reading disabled children.

Chapter 10.2 The main findings in the study

Chapter 10.2.1 The development of literacy skills in Greek: evidence from normally developing children

The present study in the Greek language reveals that learning to read and spell in a regular orthography does not pose the same degree of difficulty, as they

do other languages with a less consistent orthography. The orthographic transparency of the Greek language was found to exert a profound effect on the development of many cognitive skills, and in particular the development of literacy skills. One of its first and rather striking results was the fast pace and ease with which Greek average or poor readers developed their alphabetic reading skills. From the first months of the second year of primary school, Greek readers are so competent in reading that neither difficult low-frequency polysyllabic words of the reading test nor nonword stimuli pose any difficulty on them, at least from an accuracy point of view. The highly isomorphic relationship between Greek graphemes and phonemes and the predominance of open CV syllables in many Greek words render the phonological structure of many Greek words very transparent, and the application of grapheme-phoneme correspondence (GPC) rules to word decoding easy and highly successful. This means that the acquisition of even the most basic GPC rules is sufficient for the successful decoding of many Greek words, leading to high levels of reading accuracy. Alphabetic skills are also applied very skillfully by most Greek children in spelling. There was not a single instance of dysphonetic errors in the spelling efforts not only of average readers but also of poor readers.

The fast rate and ease in the development of alphabetic reading or spelling skills in Greek appears to be directly connected to the linguistic characteristics of the Greek language because the same ease is not observed in other languages with a less transparent orthography. English beginning readers, for instance, experience significantly more problems in the mastery of literacy skills (e.g. Adams, 1990; Bissex, 1980). In most direct cross-linguistic comparisons (e.g. Goswami, Porpodas, Wheelwright, in press; Goswami, Gombert, Fraca de Barrera, in press; Wimmer & Goswami, 1994) English-speaking children have been found to develop their literacy skills in a much slower and laborious way. Due to the high degree of irregularity of their orthography, children learning to read in English spend a significant amount of time in understanding how print maps onto sound and in learning how to use successfully the frequent arbitrary grapheme-phoneme correspondences of their orthography.

As a result, they tend to be error-prone and to develop reading and spelling skills very slowly. The results of the present study indicate that the same does not happen with Greek readers. The argument has been made that successful decoding of new words acts as a 'self-teaching' strategy which enables beginning readers to become more independent readers (Jorm & Share, 1983). Given the regularity of the Greek language, one can put forward the argument that the orthographic transparency of the Greek language acts as 'self-teaching' strategy on its own, allowing Greek beginning readers to develop a very powerful word recognition system early in literacy development.

Another contributing factor to the development of such a robust word recognition is also the influence of the 'phonics'-oriented regime of reading instruction in Greek, which also draws the attention of Greek beginning readers to the constituent syllables or phonemes of words. From the first days in primary school Greek children are introduced to the letters of the Greek alphabet, and to those letter sequences that they may find difficult in word decoding (e.g. 'ρτ', 'σμ', 'τσ', 'τζ', 'στρ', 'κτρ', 'γκρ', 'κδρ'). Word segmentation also forms a basic element of every day reading practice. Beginning readers are systematically taught to segment words into syllables, phonemes, or how to blend these smaller segments to derive the pronunciation of words. So the claim can be made that the combined effect of the orthographic transparency of the Greek language with the adoption of a 'phonics'-based reading instruction, offers Greek beginning readers a very favourable linguistic environment within which to develop their literacy skills.

The regularity of the Greek language also exerts a significant influence on Greek readers' processing strategies in reading. Frith's (1985) developmental theory of reading acquisition in English describe the initial steps to literacy in terms of a prolonged developmental arrest at the logographic stage. In the context of this irregular orthography, segmenting words on the basis of grapheme-to-phoneme correspondences is often unreliable and confusing. For this reason English beginning

readers tend to rely more on a direct word recognition strategy to deal with the inconsistency of their language. The present pattern of results indicates that the same does not happen in Greek. The orthographic transparency of the Greek language allows Greek readers a higher degree of confidence and competence in the use of grapheme-phoneme correspondences, facilitating the employment of a sublexical reading strategy from an early stage in literacy development. Similar results with younger grade-1 children have also been reported in the Greek language (Porpodas et al., 1990) or other regular orthographies such as German (Wimmer & Hummer, 1990), Portuguese (e.g. Pinheiro, 1990), French (Sprenger-Charolles, Casalis, 1997). The consistency in the above cross-linguistic evidence suggests that the existing theories of literacy acquisition that have been formulated to describe the development of literacy skills in the 'deep' English orthography are not entirely suitable for accounting for the observed quantitative and qualitative differences in the development of literacy skills in other more regular orthographic scripts. The available cross-linguistic evidence indicates that the functional importance of the logographic stage in the context of regular orthographies is relatively limited, as the majority of beginning readers learning to read in transparent linguistic environments proceed to the alphabetic phase much sooner than most English-speaking children usually do. Furthermore, it suggests the need for these models to be adjusted to the linguistic structure of the language in which they are used and the type of reading instruction that is favoured in each educational system.

Having made this statement, however, it should be stressed that the above results do not completely refute the existence of the logographic phase in the Greek language. Despite the transparency of the Greek language and the phonics-oriented reading instruction in Greek, 16% of the errors made by average readers at grade-2 and 9% of the errors made by average readers at grade-4 were lexical substitutions, indicating the use of a logographic strategy, at least for a certain number of words. These differences in the percentage of lexical substitutions at these two ages suggests the possibility of an even stronger involvement of a logographic reading strat-

egy in the earlier stages of literacy development: i.e. grade-1. The functional importance of the logographic reading strategy may not be as important to the users of a regular orthography as it is to English-speaking readers, but certainly exists even in these more regular linguistic environments.

Another major characteristic of Greek children's reading behaviour is reading speed. Despite their high reading accuracy, most Greek readers differ in the speed of decoding words and nonwords in the reading tasks. Reading speed on the whole is a more sensitive measure of variability in reading skill. Significant differences in reading latencies were apparent not only between the grade-2 and grade-4 readers, but also among children of the same age. Not all children experiencing reading problems exhibit their difficulties in terms of reading errors. Ten out of the twenty-eight poor readers in the present study had slow reading latencies scores but accurate reading scores. All this evidence supports a similar pattern to that reported in other regular orthographies such as German (Wimmer, 1993), Greek (Goswami, U., Porpodas, C., & Wheelwright, S., in press) French or Spanish (Goswami, U., Gombert, J. E., & deBarrera, L. F., in press) and suggests that the reading speed criterion is of primary importance in the assessment of reading skill in regular orthographies. Furthermore it indicates that even in those favourable linguistic conditions the development of reading ability still remains a highly complex cognitive process which requires many years of practice before it develops to the full. The transparency of the Greek language, and other regular orthographies, may indeed facilitate the development of sublexical skills but it appears that there is more to reading than just the ability to apply skillfully simple grapheme-to-phoneme correspondence rules. The significant differences in reading latencies in the absence of difficulties in decoding accuracy suggests the possibility that it is the fast and accurate decoding/encoding of larger orthographic units that poses more difficulty to beginning readers. This is in agreement with most conceptualizations of reading acquisition which view automatic skilled reading as the outcome of the amalgamation of various

sources of information (e.g. phonological, orthographic, semantic, etc.) (e.g. Ehri, 1992) and the mastery of multi-letter orthographic units and other complex morphemic structures (Seymour, 1997). The present data do not allow any firm conclusions on this issue and further research is needed to substantiate the above hypothesis in Greek.

Chapter 10.2.2 Phonological awareness, phonological processing, and syntactic awareness skills as cognitive determinants of literacy skills in the regular Greek orthography.

Because the Greek language is so regular significant quantitative and qualitative differences are also observed in the development of phonological awareness skills. Greek readers develop impressive levels of awareness of the phonological structure of words very early in literacy development. The way in which phonological awareness and other phonological processing skills relate to the development of concurrent reading or spelling attainment is also greatly affected by the linguistic characteristics of the Greek language.

The highly syllabic nature of the Greek language and the fact that the syllable boundaries of many words coincide with the speech boundaries offer Greek readers a very favourable linguistic environment for the development of syllable awareness skills. This is evidenced by the ceiling effects of both age groups on the two syllable awareness tasks. The fact that Greek readers' performance is so high on most syllable tasks (and phonemic awareness tasks) from age 7 also suggests that this level of competence on both types of phonological awareness skills must have been developed much sooner, that is from the beginning of grade-1 or even sooner. Even though the present study does not address the issue of the development of phonological awareness skills in preschool children, research in other languages with a similar syllabic structure supports this hypothesis. In particular, the studies of

Cossu et al. (1988) in the Italian language, and Cardoso-Martins (1995) in the Portuguese language have reported higher levels of syllabic awareness skills for the Italian or Spanish kindergarten and nursery school children than those that have been reported for English-speaking children (e.g. Liberman et al, 1974). This evidence indicates that oral language input also exerts a beneficial effect on the development of certain types of phonological awareness skills. One point that needs to be stressed, however, is that because of the fact that syllables are natural linguistic units in most alphabetic scripts, the observed cross-language differences in the development of metaphonological skills are not as impressive as the ones usually found at the phoneme level after the beginning of formal reading instruction when the influence of a languages' phonological and orthographic input is much more profound (Caravolas & Bruck, 1993, Cossu et al., 1988). The findings of the present study support this developmental trend. The Greek language's impact on the development of phonological awareness skills was much more drastic on the development of phonemic awareness skills than that of syllable awareness skills. A few months of phonics-based reading instruction and exposure to this highly transparent orthography prove sufficient for the fast development of high levels of phonemic awareness in Greek readers. Most of the participants in the present study were very accurate on most phonemic awareness tasks, including the most cognitive demanding tasks of phoneme substitution, deletion and spoonerisms. The impact of the orthographic transparency of the Greek language on phonological awareness development is so significant that even poor readers are very accurate on many phonemic awareness task from age 7.

The development of such high phonemic awareness skills in Greek average or poor readers is impressive when it is contrasted to that of English readers, who usually develop equivalent levels of of phonemic awareness skills at a much later stage. When English speaking children are asked to perform similar phonological awareness tasks to those used in the present study their performance on all tasks is significantly poorer (Muter & Snowling, 1997, Wagner et al., 1987). Moreover, in

most cross-linguistic comparisons children learning to read in regular orthographies not only consistently outperform their English-speaking counterparts but their performance on most phonemic tasks is also strikingly high (Caravolas & Bruck, 1993; Wimmer, 1993). The highly irregular nature of the English language prevents beginning readers from establishing fully specified orthographic representations at the phonemic level. Because of this irregularity, English beginning readers are forced to rely more on a direct visual word recognition strategy which is underpinned at the syllabic or intra-syllabic level. Under the influence of such a linguistic input, there is a tendency for their initial orthographic representations to be organised on the basis of larger orthographic units than phonemes, such as those of syllables or rimes. This explains why onset and rime are salient linguistic units in the deep English orthography (e.g. Goswami & Bryant, 1990; MacLean, Bryant & Bradley, 1987; Treiman & Zukowski, 1991), but not in the context of more transparent orthographies such as German (Wimmer et al, 1994), Greek (Goswami, Porpodas, Wheelwright, in press), or Spanish (Goswami, Gombert, Fraca de Barrera, in press). By contrast, the regular nature of the Greek language and the adoption of a 'phonics'-based reading regime in Greek permits the fast employment of a sublexical reading strategy which is underpinned at the phonemic level. This explains why Greek-speaking children develop competent phoneme awareness skills so quickly and why the transition from syllable to phoneme awareness is easier, faster, and more direct, and not via the onset-rime unit as in the deep English orthography (Goswami & Bryant, 1990; though see Seymour & Duncan, 1997 for an opposite view). This pattern of results is in line with the massive body of evidence which indicates that the development of phonemic awareness skills is contingent upon the acquisition of the alphabetic code (e.g. Alegria, Pinot, & Morais, 1982; Liberman et al., 1974; Mann, 1986, Morais et al., 1979, 1986, Read et al, 1986). This also explains why of the two types of phonological awareness skills assessed in the present study, phonemic awareness proves a much more powerful predictor of literacy skills than syllable awareness. One of the reasons for the poor predictive relationship between syllable awareness skills and read-

ing and spelling ability in Greek is that because syllable awareness is too easy, this type of metalinguistic awareness does not correlate with reading very well due to the ceiling effects, and in this way it does not predict concurrent reading or spelling attainment. On the other hand, because phonemic awareness is much harder, approximating the difficulty young readers have in using these linguistic units in reading, the predictive relationship between phonemic awareness skills and literacy development is much stronger.

On the whole, the results from this set of analyses on phonemic awareness support Goswami's argument that the orthographic transparency of a language affects the process of sublexical reorganisation of phonological representations at the phoneme level that is so critical in all orthographies (Goswami, 1997, p.150). The primary importance of phonemic awareness skills to the development and prediction of literacy skills in the deep English orthography has recently been emphasized by a number of studies, despite previous claims that the most critical linguistic unit in the early stages of literacy acquisition are the intra-syllabic units of onset and rime (Goswami & Bryant, 1990). Seymour and Duncan (1997), for instance, have presented evidence that English preschool children with well established rhyming skills at nursery have greater difficulty in segmenting nonwords at the onset-rime level than at the onset-peak-coda level, at grade-1. Furthermore, two studies examining the predictive relationship between metaphonological skills and literacy development (Muter et al, 1997; Nation & Hulme, 1997) have also reported evidence indicating that phonemic segmentation skills are much more powerful predictors of reading and spelling ability in English than rhyming skills, which appear to gain some predictive value only in the later stages of development. This growing body of evidence suggests that even in this highly irregular and inconsistent orthography, where the application of grapheme-phoneme correspondences is not as highly successful as in regular orthographies, phonemic segmentation skills units are still important to the development of reading ability. The issue of which linguistic units are the most important determinants of early literacy skills in English is still open, and further em-

pirical evidence is needed to substantiate the exact pattern of developmental predictions in these early stages of development. From a theoretical point of view, the results of the Dundee longitudinal study (Seymour & Duncan, 1997) support Gombert's (1992) theory of metaphonological awareness where the development of conscious 'metalinguistic' awareness is the outcome of the external demands which are imposed by the acquisition of literacy skills, and not so much the outcome of internal factors as hypothesized by Karmiloff-Smith's (1986) theory. The results of the present study also concur with Gombert's (1992) theory. The faster, easier, and more direct development of phonemic awareness skills in the Greek language reflects the drastic impact of the external demands imposed by the linguistic characteristics of the Greek language and the adoption of a phonics-oriented reading regime in Greek.

The present research also contributes to our knowledge of the cognitive determinants of literacy skills by showing how differences in the orthographic transparency of languages may affect the predictive validity of various metacognitive skills. The examination of the role of phonological awareness, phonological processing and syntactic awareness skills to the development of reading and spelling ability in the Greek language revealed an interesting pattern of results. The results, on the whole, reveal the primary importance of metaphonological skills to the development of literacy skills in the Greek language. Throughout this research, phonological awareness and other phonological processing skills prove much more significant predictors than syntactic awareness skills. Children who performed well on phonological awareness and other phonological awareness tasks also performed better on reading, nonword reading and spelling than children with depressed phonological scores. The unique and rather independent contribution of these measures to the prediction of concurrent reading and spelling acumen indicates that the ability to read and spell in Greek depends greatly on the quality of underlying phonological representations. A strong predictive relationship between phonological awareness measures and

reading or spelling has consistently been reported in English (e.g. Bradley & Bryant, 1978; Fox & Routh, 1983; Stanovich, Cunningham, & Cramer, 1984) and in a number of other more regular orthographies such as Spanish (Cardoso-Martins, 1995), Swedish (Lundberg et al., 1988), German (Wimmer et al., 1994). So it appears that the awareness of the segmental nature of words and the establishment of high quality phonological/orthographic representations are the two most crucial universal factors underlying reading and spelling development in most alphabetic scripts. The results of the present study support and at the same time extend the available cross-linguistic evidence in various ways. Studies examining the cognitive determinants of literacy skills in regular orthographies have restricted the scope of their investigation to the examination of the role of phonological awareness skills in the early years of literacy acquisition: preschool and grade-1 (e.g Caravolas & Bruck, 1993; Cardoso-Martins, 1995; Cossu et al., 1988; Lundberg et al., 1988, Wimmer, Landerl, Linortner, & Hummer, 1991). Consequently, very little evidence is available about the development of these skills at later stages. The present study adds to this body of evidence by showing that, apart from the most commonly used phonological awareness tasks, other phonological processing measures such as speech rate and rapid naming can also be used as reliable indices of phonological skills and predictors of reading and spelling ability at different ages. Furthermore it shows that, in the context of regular orthographies, not all phonological measures are sensitive enough to detect underlying differences in the development of phonological skills. This was the case with some of the phonological awareness tasks (e.g. phoneme counting) or phonological processing tasks (e.g. verbal STM) used in the present study. Moreover, it reveals some interesting changes in the way in which phonological awareness and phonological processing skills relate to reading ability in Greek, at age 7 or age 9. Phoneme deletion, one of the most powerful and most commonly used measures in English, proved a significant determinant of reading ability only in grade -2, but not in grade-4. The spoonerism test, on the other hand, one of the most cognitive demanding tasks that is usually used with older children

or adults in English, was the only measure which accounted for most of the variance in reading or spelling ability at age 9 (grade-4). This indicates that, because of the high degree of transparency of the Greek language, it is only the more cognitive demanding tasks that stress the phonological system of Greek readers and as a result the only measures that are highly sensitive to individual differences in this regular linguistic environment. Furthermore, the unique contribution of phonological awareness' composite score to the prediction of concurrent reading attainment at grade-2, but not at grade-4 indicates that the predictive validity of phonological awareness, one of the most stable predictors of reading ability in English (Wagner et al., 1997), in the context of regular orthographies, is developmentally limited. In relation to this last issue, the present findings reveal that a sound knowledge of the phonological structure of words is a crucial determinant of reading competence primarily in the early stages of literacy acquisition, when children still try to understand how print maps onto phonology. In regular linguistic environments, this is a quite straight-forward task. As children progress very quickly to higher levels of reading competence and the differences in the development of these abilities are primarily manifested in terms of the speed and not so much in terms of reading accuracy, measures that are indices of automaticity gain a unique predictive validity to concurrent reading attainment.

On the whole, the above evidence indicates that differences in the linguistic structure of languages exert a very powerful effect not only on the pace of development of alphabetic reading skills or the way with which phonological skills develop, but also on the way in which phonological awareness and phonological processing skills relate to the development of literacy skills at different points in development. Both these skills are required for successful reading (Bowers, 1995). The present results reveal that phonological awareness is a crucial determinant and powerful index of how good children will develop alphabetic reading skills in the early stages of literacy acquisition, while rapid naming an index of how children will be at developing automaticity that is critical for adult fluency.

The present study also shows evidence about the contribution of syntactic awareness to the development of literacy skills in the Greek language. Most cross-linguistic studies have focused so far on the examination of phonological skills. As a result, there is limited knowledge on how syntactic awareness skills contribute to literacy development in regular orthographies. Bishop (1991) has also expressed her concern about the unbalanced interest of reading research in English on phonological skills.

The one-sided regularity of the Greek language (i.e. regular for reading, less consistent - predictable for spelling) proved an interesting testing case of how differences in the degree of consistency in the representation of phonological information may affect the way in which various metacognitive skills contribute to the development of literacy skills. The statistical analyses examining the role of syntactic awareness at age 7 and age 9 revealed the lack of any predictive relationship between syntactic awareness and concurrent reading attainment at age 7 or age 9. An independent and highly significant predictive association was only fount with spelling attainment at age 9. These results indicate that in the Greek language the contribution of syntactic information offers very little to successful word decoding. Perhaps, the more consistent grapheme-to-phoneme correspondences are in an orthography, the more important phonological information becomes, and the less need there is for readers to rely on other sources of information to derive the pronunciation of words. Research in English also leads to this conclusion. The high degree of inconsistency in the English grapheme-to-phoneme correspondences renders syntactic awareness a useful source of information to word decoding (e.g. Muter & Snowling, 1997). The contribution of syntactic awareness to the prediction of concurrent spelling attainment in Greek (where the consistency in GPC is significantly lower) was small but highly significant. The independent amount of variance accounted for syntactic awareness, over and above that of phonological awareness skills, suggests that there is more to spelling than just the ability to apply skillfully single-grapheme correspondences. Skilled orthographic spelling in Greek appears to be a much more

complex process than word decoding. The higher degree of variability of the Greek phoneme-to-grapheme correspondences in spelling and the highly inflectional nature of the Greek language, require from Greek spellers not only a sound knowledge/awareness of the phonological structure of words but also the assimilation of other types of linguistic information such as morphological, syntactic, grammatical, and semantic. The highly significant relationship between syntactic information and spelling at grade 4 but not at grade 2 confirms this, revealing at the same time a clear developmental increase in the appreciation of this kind of linguistic information in Greek spellers. The absolute predominance of phonological skills at age 7, indicates that young reader's interest and attention during the first years of literacy acquisition is primarily directed to the phonological domain. As children get older and are asked to spell more difficult words the spelling of which transcends grapheme-to-phoneme correspondence rules their attention and interest is also directed to other aspects of their language. The present research indicates that an appreciation of other types of linguistic information than phonological awareness becomes increasingly important to the development of literacy skills, primarily in instances when the consistency in GPC rules is violated and the application of simple grapheme-phoneme knowledge provides insufficient information.

Chapter 10.2.3 The cognitive profile of Greek poor readers.

Having examined the predictive relationship between various metacognitive skills and the development of literacy skills in normally developing children, the study then went on to examine the cognitive profile of Greek poor readers (in chapter 9). The orthographic regularity of the Greek language was also found to beneficially affect the degree of severity of their reading and phonological deficit.

As with the normally developing readers in the main study, Greek poor readers were also found to be very accurate, but not so fast, when reading real

words, nonwords, and when responding to questions about the phonological structure of words. In the reading and nonword reading tasks their mean accuracy score was as high as 90%, while that on many phonological awareness tasks (e.g. phoneme or syllable counting or deletions tasks) well over 80%. Non significant differences between poor and average readers were also observed on the phoneme counting and syllable counting and deletion tasks, or on the verbal STM task. Such a high competence in all these measures is not typical of English poor readers who usually experience much more severe problems with reading and/or spelling (Bruck, 1990; Bruck & Treiman, 1990; Kibel & Miles, 1994; Snowling, 1980), and the processing of phonological information (e.g. Frith, 1985; Snowling, 1991). All this indicates that the beneficial effect of the regularity of the Greek orthography is not restricted to normally progressing children but also to reading disabled children. The present pattern of results suggests a milder handicap for most Greek poor readers, at least in the development of reading and phonological awareness skills. The accurate performance of these children on the reading and nonword reading tasks from age 7 and the small percentage of logographic errors or reading refusals suggests that Greek poor readers, despite their difficulties, develop a high degree of competence in the use of alphabetic reading skills. This indicates that these children's development of reading skills is not arrested at the logographic stage - like that of most English developmental dyslexics - but rather at a more advanced phase of literacy development. The fact that most Greek readers are highly accurate in reading and their reading or spelling errors are phonetic in nature suggests a developmental arrest at phase 2 or even phase 3a (see Figure 1-2) at least from a reading accuracy point of view. This means that the reading profile of most Greek poor readers does not resembles the reading profile of English developmental dyslexics, but rather Frith's (1985) subtype of 'developmental dysgraphia' or type-B spellers. The orthographic transparency of the Greek language allows Greek poor readers a much more successful start to literacy acquisition to that offered by the irregular English orthography to English dyslexics, affecting the degree of severity of their reading difficulties.

Having made the above statement, however, it should be noted that, despite the small number of reading errors, poor reader in the present study made significantly more errors than their chronological-age peers on both reading tasks, and significantly more errors than their reading-age peers on the nonword reading task. Yet a number of their reading errors were lexical substitutions indicating signs of a logographic reading strategy at grade-2 or even grade-4, at least for a certain number of words (visually similar). This evidence indicates that, despite the development of a high competence in the use of grapheme-phoneme correspondences in most Greek-speaking children, Greek poor readers' word recognition system is not as highly developed as the one of average readers. The above pattern of reading behaviour suggests that despite the beneficial effect of the orthographic transparency of the Greek language Greek poor readers fail to develop the complex set of connections between phonemes and graphemes that characterizes the lexicon of the reader within the orthographic phase.

Depressed scores were also obtained by most poor readers on the spelling test. These written language difficulties were found to be associated with severe deficiencies in the phonological domain, as evidenced by their poor performance on most phonological processing measures such as speech rate, phonological awareness and rapid naming. Greek readers' slower reaction times in providing the correct answers on the phoneme substitution and spoonerism tests also revealed the existence of poorly-specified phonological representations. A similar degree of insensitivity to the highly occurring rhyming orthographic units of their language was also exhibited by these children in both grades, supporting the claims of recent models of literacy acquisition which place particular emphasis on the statistical regularities of a language (e.g. Seidenberg & McClelland, 1989; Treiman et al., 1995). The existence of all the above deficiencies in the phonological, but not in the syntactic awareness domain, clearly indicates that despite the existing differences in the development of alphabetic reading skills and syntactic awareness skills in children learning to read in different linguistic environments, the phonological deficit hypothesis (Stanovich, 1988)

still remains a viable framework for the explanation of reading and spelling failure universally.

On the whole, the existence of so many differences and similarities in the cognitive profile of Greek poor and average readers, or in the way in which literacy and other metacognitive skills develop in different linguistic environments reveals the crucial importance of cross-linguistic evidence to the search of the cognitive determinants of literacy acquisition. Languages differ in the degree of complexity of their phonology, orthography, morphology, syntax and grammar. Hence, certain aspects of literacy acquisition appear to be easier in certain linguistic contexts while more difficult in others. It is only by studying other languages that we can get useful insights about the common elements in literacy acquisition across orthographies and those that are attributable to the linguistic and/or instructional peculiarities of a language.

During the last two decades research into literacy has made significant advances in accounting for the significant effects of orthographic variation. Some of the initial attempts to examine the pattern of development of literacy skills in other alphabetic scripts than English did not prove ready to accept and interpret the significant cross-orthographic differences, underplaying their importance (e.g. Cossu et al, 1988). The gradual increase in the number of cross-orthographic comparisons has gradually led researchers to question the validity of many of the research findings, such as the importance of the logographic stage in the German (Wimmer & Hummer (1990), or other more regular orthographies (e.g. Pinheiro, 1995) or to reconfirm the existence of phonological deficits in German dyslexics (Wimmer, 1993). The focus of many cross-linguistic investigations has been devoted primarily to the search of the existing differences across languages and their impact on literacy development. The results of the present study and some other more recent investigations in regular orthographic systems (e.g. Goswami, 1997) have indicated not only the existence of significant differences but also of striking similarities in the cognitive

profile of Greek and English readers. This evidence strongly suggests the need for a more balanced view on the part of cross linguistic research to identify and at the same time emphasise/acknowledge the importance of these similarities, which are as revealing as the differences.

Chapter 10.3 Implications of the present study - suggestions for future research.

The present study in the Greek language has contributed to our knowledge of reading and spelling acquisition in Greek, the way in which various metacognitive skills affect the development of literacy skills, and, finally, the way in which reading difficulties are manifested in the context of this regular orthography.. This evidence was based on data from the concurrent assessment of cognitive and literacy skills at age 7 and age 9. The adoption of a cross-sectional design restricts the value of the above observations to these two points in development. Much still needs to be known about how children develop reading and spelling or other meta-cognitive skills at different stages in development. It will be interesting, for instance, to examine the development of phonological awareness skills prior to the commencement of formal reading instruction (i.e. kindergarten), a few weeks after, and again at about the end of grade 1. This, in conjunction with the assessment of reading and spelling abilities at the last two testing sessions, will give us an estimate of the effect of Greek language's written language input on the development of phonological awareness skills and vice-versa. Of interest would also be to administer some other phonological processing measures that do not require awareness (e.g. speech rate, rapid naming, nonword repetition) to see if these measures could also be used as precursors of literacy development later on. If this proves to be the case, then such

measures will be very useful for screening, and in particular for the early diagnosis of reading/spelling problems.

The assessment of phonological awareness and phonological processing skills in subsequent stages of literacy development - i.e. grade-5, grade-6) is also of some interest, given the present evidence of a different pattern of developmental predictions between phonological awareness, rapid naming and literacy development in the Greek and English orthographies, or the evidence indicating the diminishing predictive relationship of rapid naming in the English language (Wagner et al., 1997). It would be interesting for instance to see if rapid naming would continue to be a more powerful predictor of reading ability, or which other aspects of phonological processing would correlate with reading and spelling competence in this later stages of reading acquisition.

The present study also provided some evidence that Greek spellers are sensitive to multi-letter inflectional morphemes of a rhyming status. This was based on data from our spelling test. Further research is needed to examine the role of rhyming skills to the development of reading and spelling acumen in the context of regular orthographies. The present argument of the special saliency of multi-letter rhyming morphemes could certainly be enhanced with a wider selection of inflectional-morphemes that may be embedded in nonwords, or the adoption of a longitudinal design which will give us a more complete picture of when children start to make the connection between these rhyming units and their orthographic knowledge. The role of these units could also be examined from a syntactic point of view, given the highly inflectional nature of the Greek orthography. One way is by using two different sets of inflectional morphemes, one with inflectional morphemes of a rhyming status only (as with those used in the present analyses: e.g. -ώνας, as in the word χειμώνας= winter or αγκώνας = elbow), and another group of words ending in inflectional morphemes of a rhyming and syntactic/grammatical awareness status (e.g. ώνω, as in the words τελειώνω, σηκώνω). Administering these two sets of words to

a group of average and a group of poor spellers one can examine the extent to which children of differing levels of competence rely on other sources of linguistic information (syntactic, grammatical) in order to select the correct orthographic representation of words.

The results of the present investigation of the cognitive profile of Greek average and poor readers also appear to hold some implications for the identification of reading difficulties in the Greek or other regular orthographies. A major problem at the moment in Greece is the identification of dyslexia and other reading difficulties on the basis of scientifically and research-based criteria. This is due to the lack of standardised reading, spelling, or other cognitive tests, and the lack of extensive research on normal and abnormal reading development. Therefore, much confusion exists about how to identify children experiencing learning difficulties.

The existence of significant differences in the predictive validity and diagnostic sensitivity of many cognitive measures in the present study suggests the need for the construction of tests and diagnostic criteria that are adapted to the linguistic properties of the language in which they are used. In relation to reading ability, the significant differences in the reading latencies of Greek readers in the present study or those that have been reported by other researchers (e.g. Wimmer, 1993; 1996; Wimmer & Goswami, 1994) indicate that when assessing the development of reading abilities in orthographically transparent languages differences in reading latencies should also be taken into account, especially in those cases where reading errors are absent. In relation to the assessment of phonological awareness skills, the present evidence indicates that it is the most cognitively demanding tasks of phoneme deletion and spoonerisms that should be used in experimental or clinical settings, as these tests are the most sensitive to individual differences. The significant differences in reaction times between poor and average readers when performing the phoneme substitution and spoonerism tests also indicate that differences in the reaction times when performing phonological awareness tasks may also be a very useful

index of the quality of underlying representations, especially in those instances (e.g. regular orthographies) where the successful application of grapheme-phoneme correspondences may lead, in the end, to an accurate response. Moreover, the fact that phonological awareness and rapid naming are differentially related to the development of reading ability in the Greek language also indicates that a priority should be given to the former measures only in the early stages of literacy development, while more emphasis to the rapid naming measures primarily in the later stages of literacy development.

The high success rate in the classification of poor and average readers on the basis of the present experimental test battery indicates that most of these tests can be used with a certain degree of confidence in the identification of reading and spelling difficulties in the Greek language.

The study's results also appear to hold some educational implications. The high level of competence of Greek poor readers in the use of grapheme-to-phoneme correspondence rules and their insensitivity to the high frequency orthographic patterns indicate that remedial action should draw the attention of these readers to multi-letter spelling units in a structured, cumulative, and multisensory way from an early stage in their literacy development. Given the present evidence for a close relationship between the use of syntactic/grammatical information and the development of orthographic competence, teaching the systematic relationship between syntax, grammar and those spelling patterns that transcend grapheme-to-phoneme rules may also be very useful source of information that may facilitate the development of orthographic proficiency of average and poor readers.

The results of this study also indicated a close predictive relationship between the ability to segment consonantal sequences and the development of reading ability at grade-2. Greek poor readers were also found to experience significantly more difficulties when performing the consonant segmentation task. All this evidence indicates that teaching consonant segmentation skills to Greek poor readers in

a more systematic and multisensory way to that currently adopted in mainstream primary schools may also boost their word decoding skills.

In conclusion, the results of the present investigation provide insight and foundations for future research into the cognitive determinants of literacy skills in the Greek language and the manifestation of reading and spelling difficulties at age 7 and 9. The predictive relationship of these meta-cognitive skills changes in the context of a regular linguistic environment as children move to higher levels of reading and spelling competence needs further investigation. To this end, a follow-up study is being planned to take forward the empirical work in this study (Nikolopoulos, Goulandris, Snowling, in progress).

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Chapter 12. APPENDICES

Chapter 12.1 Appendix A: Greek Alphabet

GREEK ALPHABET

The Greek Alphabet has 24 letters:

Capital letters	Lower-case letters	Phonetic equivalent
Α	α	a
Β	β	v
Γ	γ	ɣ
Δ	δ	ð
Ε	ε	ɛ
Ζ	ζ	z
Η	η	ɪ
Θ	θ	θ
Ι	ι	i
Κ	κ	k
Λ	λ	l
Μ	μ	m
Ν	ν	n
Ξ	ξ	ks
Ο	ο	ɒ
Π	π	p
Ρ	ρ	r
Σ	σ, (ς)	s
Τ	τ	t
Υ	υ	i
Φ	φ	f
Χ	χ	x
Ψ	ψ	ps
Ω	ω	ɒ

Phoneme - Grapheme Correspondence

Vowels

/a/	α
/ɛ/	ε, αι
/ɒ/	ο, ω
/ɪ/	η, ι, υ, ει, οι, υι
/u:/	ου

Chapter 12.2 Appendix B: Matched Children

Grade 2 matching

POOR READERS			**Matched AVERAGE READERS**			
Subject #	**Age**	**IQ**	**Subject #**	**Age**	**IQ**	**Read**
133	8.7	18	83	8.8	16	87.2
135	6.8	11	28	6.8	10	91.0
55	6.8	12	24	6.8	13	93.1
85	6.8	14	41	7.1	17	95.4
58	7.0	16	19	6.8	18	98.8
60	7.0	23		7.1	26	98.8
36	7.1	35	5	6.9	35	99.9
54	7.2	13	53	7.1	11	101.4
80	7.2	30	39	7.1	31	103.0
59	7.3	19	71	7.3	18	103.7
82	7.3	22	22	7.3	21	103.7
117	7.3	31	67	7.3	32	106.9
111	7.3	31	49	7.3	29	109.2
61	7.5	23	42	7.3	26	110.9
78	7.6	12	23	7.5	12	113.6
46	7.7	31	47	7.2	33	114.1

IQ Raven's raw score

POOR READERS			Matched AVERAGE READERS			
Subject #	**Age**	**IQ**	**Subject #**	**Age**	**IQ**	**Read**
63	8.8	28	105	8.9	29	89.2
77	8.9	19	121	8.8	20	108.1
106	8.9	39	37	9.3	38	99.1
87	9.1	30	108	9.3	34	111.1
66	9.2	45	6	9.1	45	107.1
103	9.3	24	13	9.2	23	112.3
99	9.3	30	10	9.7	31	105.5
104	9.4	47	64	9.4	46	113.0
98	9.5	18	89	9.5	19	101.8
86	9.6	23	96	9.6	23	96.9
65	9.7	43	91	9.6	43	102.5
126	9.8	37	114	9.1	37	95.9

IQ: Raven's raw score

Chapter 12.3 Appendix C: Single Word Reading Test

έλα	μαμά	εδώ	είναι
ώρα	μήλο	παίζω	δασκάλα
φως	πες	λέω	ένα
όχι	λάθος	ναι	τότε
λένε	όλα	πάμε	ήλιος
που	άλογο	ημέρα	χορεύω
πάπια	νησί	τόπι	γάτα
τώρα	πότε	βάλε	τυρί
κότα	τύχη	μηδέν	ρόδα
φεύγει	χωριό	χαρά	σχολείο
πουλί	τάξη	παιδί	βιβλίο
θάλασσα	καλοκαίρι		αυτοκίνητο.
φίλος	ζωγραφίζω	εξοχή	δένδρο
πατάτα	καπέλο	ποτήρι	κήπος
μητέρα	καρότο	τραπέζι	τάξη
κανάτα	καπέλο	χωράφι	φαγητό
δυνατός	δάσος	μουσική	δρόμος
αυλή	ταξίδι	ταχυδρόμος	γλάστρα
μαθητής	κουτσαίνω	οικογένεια	σπουδαίος.
περίπτερο	άντρας	εκδρομή	περιοδικό
χαμόγελο	άνθρωπος	ελπίδα	πεινασμένος
εργοστάσιο	περήφανος	πειραχτήρι	καυσαέρια
παρακαλώ	κάθομαι	τραγουδώ	γυρίζω
γύχρα	ηλεκτρικό	ταξιδεύω	τηλεγράφημα.
περίπατος	κράτος	κατόρθωμα	μακρινός
θύελλα	μετανάστης	παράξενος	φημισμένος
συγκοινωνία	επιστροφή	φαρμακείο	ηρωικός
αυξάνω	συναυλία	εξαναγκασμός	παραλληλόγραμμο
μεσαιωνικός	χαρακτηρισμός	το αίτημα	υιοθετώ
αυτοκράτορας	διεισδύω	εμπρησμός	αστραπόβροντο
εμβαδόν	έγχορδος	εκπυρσοκρότηση	εγχείρηση
εκτραχυλισμός	αισχροκέρδεια	υπερδιέργερση	δυσχεραίνω
εκχέρσωση	θραύσμα	αγχιστεία	εγκάθειρκτος.

Chapter 12.4 Appendix D: Nonword Reading Test

2-SYLLABLE NONWORDS.

νάλα	λότα	ρήλο	τήτη
τάκα	νόγα	γήκο	κήφη
λέτρα	γάδρο	πόφτης	μάσπη
γλήκτρο	τράχτης	φλωστή	βλάστρα

3-SYLLABLE NONWORDS.

Σαράβι	ξήμερα	φεμόνι	γασέλα
ταράνι	κηζέρα	μεμόλι	χασέδα
πάσκανο	κάσκαλος	μάπλωμα	ζάτραχος
βρεμάστρα	δάβγισμα	κρόμβωση	φλαστικό

4-SYLLABLE NONWORDS.

βηλέφωνο	παραμέλα	ροκολάτα	κεμονάδα
φαχτυλίδι	λοναστήρι	κολυθρόνα	βετραχήλι
δηλέγωνο	σαρακέλα	λοκολάμα	φελονάδα
βοσκίνισμα	λοπρόσκυλο	κρομοκράτης	μασπόλουτρο

Chapter 12.5 Appendix E: Single WordSpelling Test

Εγώ	όχι	πόδι	Κόκκινο	χάρτης	μήνας.
μαθητής	μητέρα	κοιτάζω	Μάχη	καρπούζι	σύννεφο.
Καιρός	φωνή	χειμώνας	Δυνατός	δάχτυλο	μηχανή
πρόσωπο	όνειρο	μαχαίρι	Λαιμός	κλειδί	απλώνω.
Πρώτος	μαθαίνω	γειτονιά	πονάω	αστυνομία	κάθομαι
άνθρωπος	τελευταίος	τώρα	ποτήρι	πληρωμή	πάτωμα.
Προσευχή	άρρωστος	υπόγειο	κάθισμα	καταλαβαίνω	πειράζω
τραγικός	θάλασσα	νυστάζω	πλυντήριο	βαλίτσα	κιμωλία
Οικοδομή	πεινάω	Εξωση	καλλιεργημένος	συμπάθεια	
αγωνία	αγκώνας	Εντύπωση	άσχημος	τοίχος	
είδηση	παντοπωλείο				
τραγωδία	δηλητήριο	Σημείωμα	Συναυλία	ωφέλιμος	πρωθυπουρ
φαρμακείο	στρατιωτικός	Πιθανώς	γυμναστική	απειλητικός	επιχειρώ

Chapter 12.6 Appendix F: Phonological Awareness test Battery

SYLLABLE COUNTING.

OPEN		CLOSED	
-cl	**+cl**	**-cl**	**+cl**

Trial: όνομα, πατάτα, ντουλάπα, έκθεση, αστραπή, καρφίτσα

μάτι ..... κα/πνός ..... 2 βάρ/κα ..... χάν/δρα .....

σαλάτα ..... μα/γνήτης ..... 3 βεν/ζίνη ..... μεμ/βράνη .....

σοκολάτα .....περί/πτερο ..... 4 συν/δετήρας ..... αρ/θριτικά .....

περιπολικό ..... πεζο/δρόμιο ..... 5 χαλ/κομανία..... ανθρωποφάγος.....

SYLLABLE DELETION.

TRIAL WORDS: **μά**τι ..... νε**ρό** .....
δρόμος ..... κύ**κλος** .....
πα**τά**τα, μα**γνή**της,

3-SYLLABLE WORDS.

καπάκι ..... σα**λά**τα ..... κανα**πές** .....
πλάτανος .....πά**πλω**μα .....φαλά**κρα** .....

4-SYLLABLE WORDS.

καμινάδα ..... σο**κο**λάτα ..... καραμέ**λα** .....

τροχονόμος ..... κατά**στη**μα ..... κτηνία**τρος** .....

5-SYLLABLE WORDS.

περιπολικό ..... φωτο**βο**λίδα ..... πονοκέφα**λος** .....
προφυλακτήρας ..... τηλε**γρά**φημα ..... κουκλοθέα**τρο** .....

PHONEME COUNTING.

TRIAL ITEMS: όνομα, τόπι, σκύλος, μπότα, τζάμι, γκόλ.

θα	.....	σε	.....	και	.....	που	.....
ένα	.....	όχι	.....	άντε	.....	είναι	.....
μήλο	.....	ακτή	.....	μπάλα	.....	κουμπί	.....
λύκος	.....	πλάτη	.....	γράμμα	.....	μπαμπάς	.....
ποτάμι	.....	δρόμος	.....	γκαζόζα	.....	τζιτζίκι	.....

PHONEME DELETION.

Set A (CV)	Number of Phonemes	Set B(FromClusters)

TRIAL ITEMS: όνομα, **γ**έλα, **κ**ότα, π**λ**άτη, βά**ζ**ο, πόρ**τ**α.

Position				Position		
I	**φ**ως	.....	3	I	**σ**τη	.....
M	έ**ν**α	.....	3	M	β**ρ**έ	.....
F	Κως	.....	3			
I	**π**όπι	.....	4	I	**β**ρες	.....
M	μή**λ**ο	.....	4	M	ακ**π**ή	.....
F	ώμος	.....	4	2nd	χ**θ**ες	.....
I	**λ**ύκος	.....	5	I	**φ**ρένο	.....
M	**β**έλος	.....	5	M	τάβ**λ**ι	.....
F	κήπος	.....	5	2nd	φ**λ**όγα	.....
I	**κ**αράβι	.....	6	I	**β**ράχος	.....
M	χελώ**ν**α	.....	6	M	καπ**ν**ός	.....
F	άνεμος	.....	6	2nd	κ**ρ**άνος	.....

PHONEME SUBSTITUTION

Trial items: *μέλι › χ › χέλι* *name - Νίκος › κ › Κίκος*
νερό › γ › γερό *πανί › ζ › ζανί*

	CV				CL	
ρόδα	- π -	--›	**π**όδα	πρίζα - τ	--› **τ**ρίζα	.....
κότα	- λ -	--›	**λ**ότα	τρένο - κ	--› **κ**ρένο	.....
μάτι	- χ -	--›	**χ**άτι	κλαδί - π	--› **π**λαδί	.....
λαγός	- σ -	--›	**σ**αγός	στέγη - φ	--› **φ**τέγη	.....
νερό	- φ	--›	**φ**ερό	φράχτης β	--› **β**ράχτης	.....

.....

πα**τ**ά**τ**α	- χ -	πα**χ**ά**χ**α	.....	**π**ρο**π**όνηση	- κ -	**κ**ρο**κ**όνηση	.....
λου**κ**άνι**κ**ο	- ζ -	λου**ζ**άνι**ζ**ο	.....	εκδρο**μ**ή	- λ	εκδρο**λ**ή	.....
πλε**κ**τρι**κ**ό	- φ -	πλε**φ**τρι**φ**ό	.....				

Spoonerism Test

Trial items: *ζεστό - γωμί --› γεστό ζωμί ..... πανί - καράβι --› κανί παράβι .....*

φρέσκο - τυρί --› τρέσκο φυρί ..... τραγανό - κουλούρι--› κραγανό τουλούρι .....

ζεστή - **μ**ωνιά	--›	**γ**εστή **ζ**ωνιά	.....
βαθύ - ποτάμι	--›	**π**αθύ **β**οτάμι	.....
Καλό - Πάσχα	--›	**Π**αλό **κ**άσχα	.....
σάπιο - μήλο	--›	**μ**άπιο **σ**ήλο	.....
μαχαίρι - πιρούνι	--›	**π**αχαίρι **μ**ηρούνι	.....
χρόνια - πολλά	--›	**π**όνια **χ**ολλά	.....
τρύπια - κάλτσα	--›	**κ**ρύπια **τ**άλτσα	.....
κρύο - φαγητό	--›	**φ**ρύο **κ**αγητό	.....
πλατύ - φύλλο	--›	**φ**λατύ πύλλο	.....
κρέμα - γάλακτος	--›	γρέμα **κ**άλακτος	.....

CONSONANT SEGMENTATION TEST

SET A (open syllables)	SET B (closed syllables)
τί/γρης	τάγ/μα
νω/θρός	βαθ/μός
κα/πνός	χαλ/βάς
ρό/μπα	ρόμ/βος
πέ/ντε	πέν/θος
φό/δρα	χαρ/τί
ρά/φτης	δάφ/νη
στά/χτη	δραχ/μή
ε/κλο/γή	εκ/βο/λή
συ/γκρό/τη/μα	συγ/γρα/φέ/ας
κά/φτρα	άρ/κτος
α/στρα/πή	χάν/δρα
κα/λύ/πτρα	θελ/κτι/κός
έχ/θρός	Αμ/βρα/κι/κός
έ/κρη/ξη	εκ/βλά/στη/ση

Chapter 12.7 Appendix G: Sort Term Memory Task: word Span

2-SYLLABLE WORDS.

μπάλα - κότα .....
τόπι - νύχι. .....

κράνος - μωρό - κήπος .....
κέρμα - κότα - νύχι. .....

μπάλα - κράνος - τόπι - κήπος .....
κότα - μωρό - κέρμα - νύχι. .....

κήπος - τόπι - κράνος - κότα - μπάλα .....
νύχι - κέρμα - μωρό - μπάλα - κήπος .....

κέρμα - κότα - μπάλα - τόπι - κήπος - νύχι. .....
κράνος - κήπος - μωρό - νύχι - κότα - μπάλα. .....

νύχι - κότα - κήπος - μπάλα - κράνος - μωρό - τόπι .....
τόπι - κότα - κέρμα - κήπος - μπάλα - νύχι - κράνος. .....

κότα - κέρμα - μπάλα - τόπι - κράνος - μωρό - κήπος - νύχι .....
κήπος - κράνος - νύχι - μωρό - κέρμα - κότα - τόπι - μπάλα. .....

3-SYLLABLE WORDS.

ποτήρι-καρότο .....
καράβι-τραπέζι. .....

ντουλάπα-κόκορας-ποτήρι .....
καμπάνα-μπαστούνι-καρότο. .....

καράβι-ντουλάπα-τραπέζι-κόκορας .....
ποτήρι-καμπάνα-καρότο-μπαστούνι. .....

μπαστούνι-καρότο-τραπέζι-κόκορας-ποτήρι .....
καμπάνα-ποτήρι-καρότο-τραπέζι-ντουλάπα. .....

καρότο-ποτήρι-κόκορας-ντουλάπα-τραπέζι-καράβι .....
μπαστούνι-καμπάνα-καράβι-τραπέζι-καρότο-ποτήρι. .....

καμπάνα-τραπέζι-ντουλάπα-καρότο-ποτήρι-κόκορας-καράβι. .....
καρότο-ντουλάπα-τραπέζι-καμπάνα-μπαστούνι-καράβι-κόκορας. .....

κόκορας-καρότο-ντουλάπα-ποτήρι-καράβι-καμπάνα-τραπέζι-μπαλκόνι .....
μπαλκόνι-τραπέζι-καμπάνα-καλάμι-κόκορας-ποτήρι-καρότο-ταμπέλα. .....

4-SYLLABLE WORDS.

καραμέλα-τηλέφωνο .....
καναρίνι-κασετίνα. .....

μανταρίνι-κοτόπουλο-παράθυρο .....
περίπτερο-κασετίνα-καραμέλα. .....

κασετίνα-παράθυρο-περίπτερο-καναρίνι. .....
κοτόπουλο-τηλέφωνο-μανταρίνι-κασετίνα. .....

μανταρίνι-παράθυρο-περίπτερο-κασετίνα-κοτόπουλο. .....
καραμέλα-κασετίνα-καναρίνι-κοτόπουλο-τηλέφωνο .....

τηλέφωνο-καραμέλα-παράθυρο-μανταρίνι-περίπτερο-κοτόπουλο .....
καναρίνι-περίπτερο-κασετίνα-παράθυρο-καραμέλα-τηλέφωνο. .....

κοτόπουλο-περίπτερο-κασετίνα-καναρίνι-καραμέλα-παράθυρο-τηλέφωνο .....
καραμέλα-τηλέφωνο-κασετίνα-παράθυρο-κοτόπουλο-μανταρίνι-περίπτερο.
.....

μανταρίνι-περίπτερο-καραμέλα-τηλέφωνο-κασετίνα-καναρίνι-παράθυρο-κοτόπουλο .....
τηλέφωνο-κοτόπουλο-κασετίνα-παράθυρο-μανταρίνι-περίπτερο-καραμέλα-μανταρίνι .....

Chapter 12.8 Appendix H: Speech Rate

2-SYLLABLE WORDS.

* μπάλα - κότα

* κράνος - μωρό

* τόπι - κέρμα

* κήπος - νύχι

3-SYLLABLE WORDS.

* ποτήρι - καρότο

*ντουλάπα - κόκορας

* καράβι - τραπέζι

*καμπάνα - μπαστούνι

4-SYLLABLE WORDS.

* τηλέφωνο - καραμέλα

* περίπτερο - κασετίνα

* καναρίνι - παράθυρο

* κοτόπουλο - τετράδιο

Chapter 12.9 Appendix I: Rapid Naming Task

1. PICTURE NAMING

ομπρέλα , γαλίδι , κλειδί , μπάλα , βρύση , κλειδί , γαλίδι , βρύση , μπάλα , ομπρέλα
γαλίδι , ομπρέλα , μπάλα , βρύση , κλειδί , γαλίδι , ομπρέλα , κλειδί , βρύση , μπάλα
βρύση , κλειδί , ομπρέλα , μπάλα , ομπρέλα , βρύση , κλειδί , γαλίδι , μπάλα , γαλίδι
μπάλα , βρύση , γαλίδι , ομπρέλα , κλειδί , ομπρέλα , μπάλα , κλειδί , γαλίδι , βρύση
κλειδί , μπάλα , ομπρέλα , κλειδί , γαλίδι , μπάλα , βρύση , ομπρέλα , βρύση , γαλίδι

Where ομπρέλα = umbrella, γαλίδι = scissors, κλειδί = key, and μπάλα = ball

2. COLOUR NAMING

Μαύρο	Κίτρινο	Μπλέ	Κόκκινο	Καφέ	Μπλέ	Κίτρινο	Καφέ	Κόκκινο	Μαύρο
Κίτρινο	Μαύρο	Κόκκινο	Καφέ	Μπλέ	Κίτρινο	Μαύρο	Μπλέ	Καφέ	Κόκκινο
Καφέ	Μπλέ	Μαύρο	Κόκκινο	Μαύρο	Καφέ	Μπλέ	Κίτρινο	Κόκκινο	Κίτρινο
Κόκκινο	Καφέ	Κίτρινο	Μαύρο	Μπλέ	Μαύρο	Κόκκινο	Κίτρινο	Μπλέ	Καφέ
Μπλέ	Κόκκινο	Καφέ	Μπλέ	Κίτρινο	Κόκκινο	Καφέ	Μαύρο	Κίτρινο	Μαύρο

Where: Μαύρο = Black, Κίτρινο = Yellow, Μπλέ = Blue, Κόκκινο = Red, Καφέ = Brown

3. DIGIT NAMING

92745 72494 29547 29457 54294 94725 74572 54279 57929 75294

4. LETTER NAMING

εσολε βοσβσ εβλοβ σεβολ ολσβο λσοσλ σολεβ ολελε λβσβ σεβεο

Chapter 12.10 Appendix J: Syntactic Awareness

RECALLING SENTENCES

1) Ο σκύλος κυνήγησε τη γάτα. .....

2) Κλώτσησε το αγόρι τη μπάλα ; .....

3) Η έκθεση γράφτηκε από τον μαθητή. .....

4) Ακούστηκε τίποτα από το μεγάφωνο ; .....

5) Δεν έφαγε το μωρό το φαγητό ; .....

6) Η σκεπή δεν έπεσε απο τον αέρα. .....

7) Το αγόρι και το κορίτσι μάζεψαν τα παιχνίδια. .....

8) Δεν πιάστηκε ο κλέφτης απο την αστυνομία ; .....

9) Εχει πουληθεί το σπίτι απο τον μεσίτη ; .....

10) Εαν το καπέλο είναι μεγάλο, το αγόρι δεν θα το αγοράσει. .....

11) Το ύφασμα σκίστηκε απο το αγόρι ή το κορίτσι. .....

12) Ο άνθρωπος που έβαψε το φράχτη ήταν καλός. .....

13) Το σκυλί κυνήγησε τη μπάλα και η γάτα δεν ακολούθησε. .....

14) Το κορίτσι δεν συμπαθούσε το αγόρι που ζούσε στον πρώτο όροφο .....

15) Το μεγάλο καφέ σκυλί κυνήγησε την κόκκινη μπάλα. .....

16) Ο άνδρας σταμάτησε να αγοράσει λίγο γάλα έστω κι αν ήταν αργοπορημένος για τη δουλειά. .....

17) Οι τρομπέτες και τα βιολιά παίχτηκαν απο τους μουσικούς. .....

18) Εαν η μητέρα είχε φήσει μερικά μπισκότα, θα είχανε φαγωθεί. .....

19) Το αγόρι έστειλε ένα γράμμα στην κυρία που μετακόμισε τον προηγούμενο χρόνο. .....

20) Τα παιδιά έκοψαν και κόλλησαν τις εικόνες και τις κρέμασαν κάτω από τις παλιές. .....

21) Η κοπέλα έχει διαβάσει τα δώδεκα μεγάλα, βαριά, καφέ βιβλία. .....

22) Ο άνθρωπος που κάθεται δίπλα στην ελιά είναι ο δάσκαλός μας. .....

23) Αφού η οικογένεια είχε τελειώσει το βραδινό, αποφάσισαν να πάνε για μια βόλτα στην εξοχή. .....

24) Στο αγόρι που δεν ήλθε στην προπόνηση, δεν του επιτράπηκε να παίξει στην ομάδα παρά μόνον μια εβδομάδα αργότερα. . .....

25) Ο ταχυδρόμος ξεχώρισε, σφράγισε, πακετάρισε, και παρέδωσε τα περιοδικά. .....

26) Ο άνθρωπος του δίπλα σπιτιού υποσχέθηκε να ποτίζει τα λουλούδια μας κατά τη διάρκεια των διακοπών. .....

WORD STRUCTURE

A) REGULAR PLURALS.

* ο ναύτης —› οι ναύτες
* ο σκύλος —› οι σκύλοι
* η βρύση —› οι βρύσες
* το βέλος —› τα βέλη
* το γαλίδι —› τα γαλίδια
* ο καναπές —› οι καναπέδες
* το γράμμα —› τα γράμματα

B) IRREGULAR PLURALS.

* η στάση —› οι στάσεις
* ο κουρέας —› οι κουρείς.

C) NOUN POSSESSIVES. Non applicable.

D) PERSONAL PRONOUNS.

* Το κορίτσι έχει ένα καινούργιο καπέλο. Το καπέλο ανήκει σε ΑΥΤΗΝ.(Trial)
* Το κορίτσι έχει ένα καινούργιο ρολόι. Το ρολόι ανήκει σε ΑΥΤΗΝ.
* Το αγόρι έχει καινούργια σκι. Τα σκι ανήκουν σε ΑΥΤΟΝ.
* Αυτοί έχουν ένα ράδιο για να μοιραστούν. Το ράδιο ανήκει σε ΑΥΤΟΥΣ.

E) POSSESSIVE PRONOUNS.

* Το αγόρι αγόρασε έναν καινούργιο σκύλο. Ο σκύλος είναι ΔΙΚΟΣ ΤΟΥ. (Trial)
* Ο πατέρας του παιδιού αγόρασε ένα καινούργιο παλτό. Το παλτό είναι ΔΙΚΟ ΤΟΥ.
* Η μητέρα αγόρασε ένα φόρεμα. το φόρεμα είναι ΔΙΚΟ ΤΗΣ.
* Αυτοί αγόρασαν ένα αυτοκίνητο. Το αυτοκίνητο είναι ΔΙΚΟ ΤΟΥΣ.

F) THIRD PERSON SINGULAR.

Εγώ παίζω μπάλα.
Πως θα γίνει άμα θέλω να πω/χρησιμοποιήσω αντί του εγώ το εσύ ??
Εσύ ΠΑΙΖΕΙΣ μπάλα. (Εγώ, εσύ, αυτός, εμείς, εσείς, αυτοί).

G) REGULAR PAST TENSE.

* *Εδώ είναι ο Νίκος που γράφει ένα γράμμα.*
  Αυτό είναι το γράμμα που (Που τι έκανε ο Νίκος ?) ΕΓΡΑΨΕ ο Νίκος.

* Εδώ είναι ο Κώστας που φτιάχνει ένα αεροπλάνο.
  Αυτό είναι το αεροπλάνο που ΕΦΤΙΑΞΕ ο Κώστας.

H) IRREGULAR PAST TENSE.

* Εδώ είναι ο Κώστας που τρώει το φαγητό του.
  Αυτό είναι το πιάτο στο οποίο ΕΦΑΓΕ ο Κώστας.

* Εδώ είναι η Μαρία που ανεβαίνει την σκάλα.
  Αυτή είναι η σκάλα στην οποία ΑΝΕΒΗΚΕ η Μαρία.

* Εδώ είναι ο Νίκος που βλέπει ένα έργο στην τηλεόραση.
  Αυτή είναι η τηλεόραση στην οποία οποία ο Νίκος (τι έκανε ??)
  ΕΙΔΕ το έργο.

I) AUXILIARY + ing ----› ΘΑ (Future)

* Νίκος έχει να διαβάσει δύο μαθήματα για το σχολείο: τώρα διαβάζει το ένα.
  Μπορείς να μου πείς τι θα κάνει ο Νίκος αύριο, βλέποντας την εικόνα ?
  Αύριο ΘΑ ΔΙΑΒΑΣΕΙ το άλλο.

* Εδώ ο Νίκος βλέπει τηλεόραση. Αύριο στις επτά η ώρα έχει την αγαπημένη του εκπομπή.
  Τι θα κάνει αύριο στις επτά η ώρα Νίκος ?? ΘΑ ΔΕΙ τηλεόραση.

J. DERIVATION OF NOUNS FROM VERBS.

* Αυτός ο άνθρωπος μπογιατίζει. (Picture J)
  Τι δουλειά κάνει ?? είναι ??
  Το όνομα της δουλειάς που κάνει είναι ΜΠΟΓΙΑΤΗΣ

* Αυτός ο άνθρωπος τραγουδά.
  Τι δουλειά κάνει ?? είναι ??
  Το όνομα της δουλειάς που κάνει είναι ΤΡΑΓΟΥΔΙΣΤΗΣ.

K) ADJECTIVE DERIVATION.

* *Η Μαρία είπε: Νίκο έχεις πολλή τύχη*
  Θα μπορούσε να είχε πεί: Νίκο είσαι πολύ ?? ΤΥΧΕΡΟΣ.

* *Η μητέρα είπε: Δεν μπορείς να φας γιατί τα χέρια σου είναι γεμάτα βρωμιές.*
  Θα μπορούσε να είχε πει: Δεν μπορείς να φας γιατί τα χέρια σου είναι ??
  ΒΡΩΜΙΚΑ.

L) FORMATION OF COMPARATIVE AND SUPERLATIVE.

* Αυτός ο άνθρωπος είναι δυνατός
  Αυτός όμως είναι ακόμη δυνατότερος.
  Και αυτός, σε σύγκριση με τους άλλους είναι ο ΔΥΝΑΤΟΤΕΡΟΣ
  Ο ΠΙΟ ΔΥΝΑΤΟΣ
  από όλους.

* Αυτός ο δρόμος είναι φαρδύς.
  Αυτός είναι ακόμη φαρδύτερος.
  Και αυτός εδώ είναι ο ΦΑΡΔΥΤΕΡΟΣ από όλους.
  ΠΙΟ ΦΑΡΔΥΣ

M) DEMONSTRATIVES.

* Ο Νίκος είπε: Δεν θέλω εκείνα τα μήλα.
  Θα πάρω μερικά απο ?? ΑΥΤΑ.
* Η Μαρία είπε: Θέλω αυτό το βιβλίο, και θέλω και ΕΚΕΙΝΟ το βιβλίο.

*) DISTINCTION BETWEEN FEMININE-MASCULINE-NEUTER.

* Το παγωτό ήταν νόστιμο και δροσερή (ΔΡΟΣΕΡΟ).
* Η κούκλα αυτή είναι φτηνή και καλό (ΚΑΛΗ).
* Ο Νίκος είναι κουρασμένος και άυπνη (ΑΥΠΝΟΣ)
* Αυτή η δασκάλα είναι πολύ όμορφο (ΟΜΟΡΦΗ).
* Το πακέτο που μου έδωσες ήταν ανοιχτή (ΑΝΟΙΧΤΟ).
* Ο υπάλληλος του μαγαζιού ήταν έξυπνη (ΕΞΥΠΝΟΣ).

**) VIOLATION OF THE SUBJECT - VERB ACCORDANCE.

* Η Μαρία τραγουδούν (ΤΡΑΓΟΥΔΑΕΙ) ωραία Maria sing very nice.
* Αυτοί οι μαθητές παίζετε (ΠΑΙΖΟΥΝ) μπάλα.
* Ο Νίκος διαβάζεις (ΔΙΑΒΑΖΕΙ) πολύ.
* Οι καλοί μαθητές πάντα διαβάζει (ΔΙΑΒΑΖΟΥΝ) τα μαθήματά τους.
* Η Ελένη παίρνεις (ΠΑΙΡΝΕΙ) πάντα καλούς βαθμούς.
* Ακουσες αυτό που σου είπαν (ΕΙΠΕ) η δασκάλα ??

***) DISTINCTION BETWEEN VERBS/NOUNS/ADJECTIVES.

* χώνει --- **χωνί**	* **φύλλο** --- φιλώ	* γέρος--- **γερός**
* **γέρνω** --- γερνώ	* **πίνω**--- πεινώ	* **μήλα**---μιλά
* ώμος---ωμός	* στύλος---**στυλός**	* **πλάτη**---πλατύ

SENTENCE ASSEMBLY

1. είδε , το αγόρι , το κοριτσι
2. το παιδί , το σκυλί , κυνηγήθηκε από
3. στο κοθτί , η μπάλα , είναι
4. γηλό , δυνατό , το παιδί , είναι
5. είδαν , να φάνε , βρδυνό , τηλεόραση , πρωτού
6. το δώρο , αγόρι , έδωσε , το , κοριτσι
7. τα κορίτσια , τα αγόρια , περπατούσαν , με
8. τα αγόρια , στην ομάδα , να μπούν , πρόκειται
9. το κόκαλο , χαθεί , έχει , του σκύλου
10. το αγόρι , την κούρσα , να κερδίσει , πρόκειται , δεν
11. τον φράχτη , να πέσει , πρόκειται , το κορίτσι , από
12. και , κάθεται , σηκώνεται , το αγόρι , το κορίτσι
13. κόβει , βάφει , και , ο άνδρας , η γυναίκα , το χορτάρι , το σπίτι
14. το αμάι , μου , αγόρασε , ο πατέρας , αρέσει , που
15. την λάμπα , η γυναίκα , στο τραπέζι , έωαλε , δεν , πάνω
16. και , έπαιξαν , η αδελφή , ο αδελφός , και την κιθάρα , το πιάνο
17. κορίτσι , έστειλε στο , αγόρι , ένα γράμμα , το
18. το , αυτό , θέλω , έστω κι αν , ακριβό , είναι
19. το αγόρι , το κορίτσι , είχε χαθεί , του οποίου , από , χτυπήθηκε , ο σκύλος

Chapter 12.11 Appendix K: Mathematics Ability Test

$2 + 7 =$ $9 + 5 =$ $6 - 3 =$

$18 - 5 =$ $2 \times 7 =$ $6 : 2 =$

$$\begin{array}{r} 2 \\ +\ 3 \\ \hline \end{array} \qquad \begin{array}{r} 15 \\ +\ 23 \\ \hline \end{array} \qquad \begin{array}{r} 38 \\ +\ 57 \\ \hline \end{array}$$

$$\begin{array}{r} 13 \\ +\ 99 \\ \hline \end{array} \qquad \begin{array}{r} 4 \\ -\ 1 \\ \hline \end{array} \qquad \begin{array}{r} 17 \\ -\ 5 \\ \hline \end{array}$$

$$\begin{array}{r} 22 \\ -\ 16 \\ \hline \end{array} \qquad \begin{array}{r} 71 \\ -\ 52 \\ \hline \end{array} \qquad \begin{array}{r} 2 \\ \times\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 12 \\ \times\ 3 \\ \hline \end{array} \qquad 8 \,\big|\, 4 \qquad 96 \,\big|\, 3$$

$$\begin{array}{r} 35 \\ \times\ 5 \\ \hline \end{array} \qquad \begin{array}{r} 77 \\ \times\ 15 \\ \hline \end{array}$$

$85 \,\big|\, 5$ $96 \,\big|\, 16$

$$\begin{array}{r} 12{,}2 \\ +17{,}6 \\ \hline \end{array} \qquad \begin{array}{r} 45{,}01 \\ +57{,}89 \\ \hline \end{array}$$

$\frac{2}{3} - \frac{1}{3} =$ $\qquad$ $\frac{1}{8} + \frac{1}{4} =$

$$\begin{array}{r} 66{,}66 \\ -\ 7{,}77 \\ \hline \end{array} \qquad \begin{array}{r} 12{,}9 \\ \times\ 8 \\ \hline \end{array}$$

$\frac{1}{2} + \frac{1}{4} =$ $\qquad$ $\begin{array}{r} 24{,}7 \\ \times\ 0{,}2 \\ \hline \end{array}$

$$\begin{array}{r} 13{,}9 \\ \times\ 1{,}2 \\ \hline \end{array} \qquad 1\ \frac{4}{5} + \frac{9}{10}$$

$$\begin{array}{r|l} 15{,}63 & 0{,}3 \\ \hline & \\ & \\ & \end{array} \qquad \begin{array}{r|l} 19{,}92 & 20 \\ \hline & \\ & \\ & \end{array}$$