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Early Reading Development in European Orthographies

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Introduction

Despite the diversity of human languages and writing systems, most research into literacy acquisition and dyslexia has focused on English. Even where other languages are studied there is typically a reliance on theoretical concepts and methods that derive from research on written English. This bias might not be too troubling if it could be argued that a common theoretical framework is applicable to the learning of all written languages. However, there may be good reasons to question the all-inclusive role of English as the paradigm case for the study of literacy acquisition. This is especially evident when considering the contrasts between English and logographic scripts such as Chinese, syllabaries such as the Japanese Kana, consonantal scripts such as Hebrew, and highly consistent alphabetic scripts such as Finnish.

This chapter has a more restricted focus, being concerned specifically with learning to read in the European orthographies. The intention is to provide a theoretical framework for the discussion of beginning literacy acquisition in the European languages and societies. The important questions for a theory of *European literacy* are how far the differences existing between societies, educational approaches, and, especially, spoken languages and writing systems, affect the way in which literacy is acquired or dyslexia is manifest.

Theoretically, the suggestion that there may be important contrasts between societies and languages implies that an inclusive model of European literacy acquisition may need to contain free parameters and options that would allow for language or orthography-specific variations. The goal of this chapter is to give a preliminary outline of an inclusive and flexible theory of this kind. Such a theory will need to take account of commonly debated issues relating to literacy acquisition, especially:

- *Causation*. The factors that influence progress in reading acquisition and the occurrence of dyslexia.
- *Linguistic units*. The elements of language that are emphasized in the mapping between written and spoken language.
- *Sequence of orthographic development*. Whether or not there are distinct phases in reading acquisition.

Causation

One of the most widely researched issues concerns the biological, cognitive, and experiential factors that determine success or failure in learning to read (Morton & Frith, 1995). Parenthood determines the genetic endowment. Nutritional, toxic, or pharmacological substances may affect brain development in the pre- and post-natal periods. These *biological* influences might be expected to be approximately constant across European cultures. However, there is the possibility that societies may differ in their range of genetic variation. Similarly, nutritional and toxic factors could, conceivably, differ between societies. If there were cultural differences affecting maternal diet, infant feeding practices, alcohol abuse, smoking, and do on, these might influence reading achievement via their effects on brain development.

A theoretically more interesting proposition is that language differences may produce cognitive effects that, in their turn, are reflected in the course of brain development and organization. This possibility is suggested by brain imaging studies of adult readers of Italian and English (Paulesu et al., 2000). Italian is written in a *shallow orthography*, with very consistent correspondences between letters and sounds, whereas English is written in a *deep orthography*, with complex and inconsistent relations between letters and sounds. Italian adults named words and nonwords faster than English-speaking adults. A PET-scan investigation suggested that reading of the shallow Italian orthography activated the left planum temporale region, commonly associated with phonemic processing, while reading of the deep English orthography activated the left inferior posterior temporal gyrus and the anterior part of the left inferior frontal gyrus, regions associated with naming and lexical/semantic processing. So it appears that differences between languages may result in differences in the development of specialized brain regions underlying reading behavior.

Comparisons of the development of reading skills across different languages and cultures require assessments at the *behavioral* level. Such assessments depend upon standardized psychometric procedures that are used to assess competence in reading, memory, language, and verbal and nonverbal intelligence. These measures are determined by historical, clinical, and educational traditions that differ between cultures. Thus, in the UK, there is a collection of reading and spelling tests that can be used to define reading progress. These include graded word lists as well as text-based assessments of reading accuracy, speed, and comprehension. These scales do not exist in some other countries. Indeed, the concept of a graded word list appears incongruous in the context of a regular orthography, such as Greek, where children rapidly learn to decode novel forms. In such cases,

the tendency is to define reading in terms of speed rather than accuracy, or some combination of the two measures, as in the Dutch *one-minute test* (Brus & Voeten, 1973). In other instances (Portugal, for example), there may be no formally standardized measures of reading ability at all. Similar considerations apply to assessments of intelligence, language, and memory. This lack of psychometric harmonization across Europe means that the way in which literacy (and dyslexia) are operationally defined is not equivalent in different countries.

Socio-economic status (SES) is known to be an important influence on reading (see Phillips & Lonigan, this volume). Duncan and Seymour (2000) investigated differences in basic literacy skills among groups differing in SES in the city of Dundee in Scotland. The study compared children in nursery and primary schools located in middle-class and disadvantaged areas. The literacy measures were letter knowledge, familiar word identification, and simple CVC nonword reading. Measures of metaphonology were included. There were large effects of SES on beginning literacy, including slower acquisition of letter-sound knowledge and delayed mastery of word and nonword identification. The gap between the middle-class and disadvantaged group was about one year of reading age. Progress in the low-SES sample was characterized by a developmental delay with performance of the two groups being identical when indexed against reading age. The same was true of metaphonological development, which was poorer in the low-SES group but entirely appropriate for the reading age achieved. This study makes it clear that social disadvantage has a major delaying effect on reading acquisition in English. It is essential, therefore, to take full account of this factor when considering contrasts between European languages, as inclusion of deprived groups will depress reading scores and exaggerate the apparent difficulty of learning to read in one language relative to another.

There are also *educational differences* between countries that affect when and how literacy is taught. Formal instruction in reading usually begins at the start of primary school education. However, the age at which children start school varies between countries. In the UK, children enter primary school at about 5 years of age and embark on formal reading instruction immediately. In most European countries the starting age is 6 years but is delayed until 7 years in some, most notably Germany and Austria and some Scandinavian countries. This introduces a difference in the *maturity* of children at the time when they start to learn to read. A further complication is that literacy learning may take place outside school. Whether or not this happens depends on cultural attitudes regarding appropriate activities for preschoolers. In Denmark there is a strong social bias against informal literacy instruction and a view that preschool education should emphasize general cognitive and linguistic development (Lundberg, Frost, & Petersen, 1988). In Finland children may receive some reading instruction in the home or kindergarten and a significant proportion arrive in primary school already able to read.

Educational policy also affects the way in which literacy is taught. There may be a centralized approach, such that all schools follow the same method and materials, as in Greece, or there may be scope for individual teachers or education authorities to choose their own preferred methods and reading schemes, as in Denmark. The methods fall on a contrasting dimension, which emphasizes wholistic meaningful approaches on the one hand or analytic phonic approaches on the other (see Snow & Juel, this volume, for a

further discussion). The first approach treats reading as the discovery of meaning in text and emphasizes the use of context and written words as signals for concepts. The favored method is to show children words on cards and in simple texts and teach them to discriminate and recognize them on the basis of differentiating graphic features. At the opposite extreme there is the phonic method in which instruction concentrates on helping the child to identify and discriminate the letters of the alphabet, the learning of the sounds associated with each letter, and the establishment of sequential decoding and assembly procedures.

Seymour and Elder (1986) reported a study in which Scottish primary school children were taught to read using an exclusively whole-word method. There was no reference to the individual letters of the alphabet or their associated sounds and no attempt to teach decoding procedures. Under this regime of *logographic* learning many children acquired quite extensive sight vocabularies, often containing well over 100 words, but did not develop procedures for reading new words. Hence, their word recognition was restricted to words that had been taught. They were completely unable to read unfamiliar words. Errors were typically "don't know" responses or substitutions of words already established in the reading vocabularies.

This outcome contrasts with the effects of an exclusively phonic approach in which the emphasis is on *alphabetic* learning of letter-sound associations and the capacity to combine sequences of letter-sounds. A synthetic approach of this type predominates in Austria (Wimmer, 1993), Finland, and Greece. The initial product is a sequential left-to-right approach to reading in which individual letters are identified and converted to their associated sounds. The sound sequences are then combined to enable the pronunciation of written syllables. In some cases (e.g., in Finland) grouping into syllable-sized units is explicitly encouraged by printing beginning reading texts with physical demarcations between syllables as well as between words. It is apparent that, in a regular writing system, where it is approximately true that individual letters correspond reliably to individual sounds, this procedure quickly provides the learner with a method thatcan be used to pronounce all written words which may be encountered.

In the UK, the most commonly used method is an amalgamation of the two procedures in which children are simultaneously exposed to programmes of alphabetic and logographic learning. They are taught the letters of the alphabet and their predominant sounds and at the same time learn to recognize items from a vocabulary of 'sight words'. Seymour and Evans (1992) made a detailed analysis of learning under this dual approach. An examination of errors and reaction times in word and nonword reading during the first two years of instruction suggested that there was an initial phase during which two distinct processes developed, a logographic process of sight word recognition and an alphabetic process of letter-sound decoding. Later, as development proceeded, it appeared that these two functions converged into a single process that was capable of both word and nonword reading.

Instructional methods are likely to have large effects on comparisons between languages. The introduction of a phonic-oriented National Literacy Strategy in the UK has enhanced rates of progress and attenuated the contrast between English and German (see Landerl, 2000).

Language Effects

Language is the key environmental factor that is likely to influence the development of the cognitive systems underlying reading and spelling. In particular, there are between-language differences in how the sound structure of the spoken language, the *phonology*, is represented in writing, the *orthography*. The way in which meaning is conveyed through grammar and the internal structure of words, the *morphology*, may also be important.

Traditionally, cognitive models of language processing have assigned these three aspects to distinct processing domains or modules. This is evident in the architectures developed in cognitive neuropsychological research (Seymour, 1990) and in the "triangular" format of connectionist models (Plaut, McClelland, Seidenberg, & Patterson, 1996; Seidenberg & McClelland, 1989).

At the phonological level, a key concept in developmental models of reading is the system of *phonological representations* that is postulated in the phonological deficit theory of dyslexia (Snowling, 2000). European societies have different spoken languages that contrast in their phonological structure as well as in their vocabularies, grammatical organization, and morphology. The Romance languages (Italian, Spanish, Portuguese, French) typically have a simple syllabic structure, with a majority of open CV syllables and few initial or final consonant clusters. The Germanic languages (German, English, the Scandinavian languages) have a more complex syllabic structure, with more closed CVC syllables and more numerous consonant clusters in the onset or coda positions. One possibility is that different spoken languages result in different systems of phonological representation and that these differences affect the acquisition of literacy. Similar considerations apply to the influence of grammar and morphology where different linguistic organizations – for example, the contrast between the agglutinative morphology of Finnish and the inflectional and derivational morphology of English – may affect the semantic component and the relations with phonology and orthography.

The linguistic factor most likely to influence reading acquisition is the nature of the writing system. The European orthographies are all *alphabetic* insofar as they use graphic symbols (letters) to represent small abstract segments of speech, the vocalic and consonantal *phonemes* that combine to produce the full repertoire of syllables or words in each language. The variation between European orthographies is related to the complexity and consistency of the relationship between letters (graphemes) and sounds (phonemes). A simple and consistent alphabet provides a single distinct written symbol for each phoneme and is variously referred to as "shallow" or "transparent." An approximation to such an orthography occurs in Finnish, which is written so that each phoneme is associated with a single letter. Where significant departures from this straightforward system occur, the orthography is said to be "deep" or "opaque" (see Frost, this volume, for further discussion). Complexity arises if it becomes necessary to use combinations of letters (*complex graphemes*) to represent particular phonemes. In other instances, the pronunciation of a letter may vary depending on surrounding *context*, as in the case of "c" softening (*call* vs. *cell*), or on the presence of marker letters, such as the final -e in English (*mat* vs. *mate*). Usually, the critical variation is held to relate to the *consistency* of the mapping between

graphemes and phonemes (Katz & Frost, 1992). Thus, Frost, Katz, and Bentin (1987) commented:

> In a shallow orthography, the phonemic and orthographic codes are isomorphic; the phonemes of the spoken word are represented by the graphemes in a direct and unequivocal manner. In contrast, in a deep orthography, the relation of spelling to sound is more opaque. The same letter may represent different phonemes in different contexts; moreover, different letters may represent the same phoneme. (p. 104)

The concept of orthographic depth is in practice somewhat more complex than this. In a deep orthography spellings may serve to signal lexical identities, as in the contrasting orthographic forms of homophones (*choir* vs. *quire*, *weight* vs. *wait*), or morphological functions, as in the spelling of the past tense inflection as *-ed* irrespective of pronunciation (*toured*, *walked*, *sprinted*).

Thus, the European orthographies may be arranged along a complex dimension of *orthographic depth*, with languages such as Finnish located at the shallow end and a language such as English, which has numerous complexities, variations, and inconsistencies, located at the deep end. To date, there has been no comprehensive comparative computational linguistic investigation of European orthographies. Ziegler, Jacobs, and Stone (1996) quantified the consistency of pronunciation of the orthographic rime segments (feedforward consistency) and the consistency of the graphemic representation of each phonological rime segment (feedback consistency) in French and English (see also Ziegler, Stone, & Jacobs, 1997). They found that feedback inconsistency is typically more extensive than feedforward inconsistency. Shallow orthographies, such as Greek or Spanish, tend to display few or no feedforward inconsistencies but a number of feedback inconsistencies.

Recently, there has been an attempt to arrive at intuitive estimates of the relative depths of the European orthographies. This was undertaken by a European research network, the COST Action A8 (1995–1999), which involved literacy and dyslexia researchers from a range of European languages (Niessen, Frith, Reitsma, & Öhngren, 2000). The COST A8 consortium reviewed the evidence of departure from the principle of transparency (one letter/one sound) in each language and arrived at a designation of the probable variation on a shallow → deep dimension. This was cross-referenced with the phonological contrast between simple syllable structure and complex syllable structure to yield the hypothetical scheme suggested in table 16.1 (from Seymour, Aro, & Erskine, 2003).

Linguistic Units

An important insight has been the suggestion that literacy acquisition depends on a child's capacity to develop an awareness of linguistically important segments in the stream of spoken language. This dates back to Mattingly's (1972) proposal that literacy is a secondary skill that maps onto speech and requires a *metalinguistic awareness* of the content and structure of the primary activities of speaking and listening. An implication is that

Table 16.1 Hypothetical Classification of Participating Languages Relative to the Dimensions of Syllabic Complexity (Simple, Complex) and Orthographic Depth (Shallow to Deep) (from Seymour et al., 2003)

	Orthographic depth					
	Shallow . . . . . :. . . . . : . . . . . :. . . . . *Deep*					
Syllabic structure						
Simple	Finnish	Greek Italian Spanish	Portuguese	French		
Complex		German Norwegian Icelandic	Dutch Swedish	Danish	English	

the structure may exist at two levels, a *primary* level that supports the natural and unconscious use of speech in communication, and a *secondary* level that is adequate to support the artificial skill of learning to read. These levels are commonly referred to as "implicit" and "explicit." Gombert (1992) used the term *epilinguistic* to refer to the first level and the term *metalinguistic* to refer to the second level. Commonly, it is a failure to develop the second level of representation that is viewed as the cause of reading disability and dyslexia.

Phonological awareness (or metaphonological skill) depends on the system of phonological representations that is postulated in the phonological deficit theory of dyslexia (Snowling, 2000). Phonological representations are assumed to contain linguistically defined sublexical segments of speech. A common view is that a hierarchical structure may be involved, either a two-level structure identifying the *syllable* and an array of *phonemes* or a multilevel structure with intervening levels corresponding to the *onset*, *peak*, and *coda*, or higher groupings referred to as the *rime* (peak + coda) or the head *body* (onset + peak) (Duncan, Seymour, & Hill, 1997; Treiman & Zukowski, 1991). A question in the present context is whether the development of phonological representations is likely to be approximately the same across different European languages or whether there may be differences that could affect the course of literacy acquisition.

The standard theory, termed the *progressive* model by Seymour and Evans (1994), is that there is a universal trend for development to advance down the hierarchy from representation of large segments (syllables) towards representation of small segments (phonemes). This view was supported by Liberman, Shankweiler, Fischer, and Carter's (1974) observation that the capacity to count syllables emerges before the capacity to count phonemes. Subsequent discussion suggested that development proceeded through an intermediate level of onset-rime segmentation. According to this view, phonological representations develop in a large-to-small unit sequence in response to internal pressures to store and discriminate an expanding speech vocabulary (see Metsala & Walley, 1998). Empirical support for this account has been provided by Treiman and Zukowski (1991).

Children were presented with pairs of spoken words and asked to indicate which pairs sounded similar. On positive trials, the similarity could be present at a syllabic level, or in onsets or rimes, or at the level of individual phonemes. The results clearly supported the notion of a large-to-small unit (syllable → onset-rime → phoneme) developmental sequence.

The progressive theory is widely acknowledged and claims to provide a *universal* account of metaphonological development (i.e., one that is applicable to all of the European languages). Nonetheless, there are reasons to question its general applicability:

- No account is taken of contrasting properties of languages and the possible effects on the phonological representations.
- The distinction between implicit (epilinguistic) and explicit (metalinguistic) levels of representation is not acknowledged.
- The impact of literacy acquisition on phonological representation is not considered.

Duncan, Seymour, and Hill (1997, 2000) have argued that the account of *metalinguistic development* set out by Gombert (1992) has the potential to provide a more inclusive framework takes better account of the data and has the capability to handle differences between European languages.

Gombert's framework postulates successive levels of representation referred to as: (1) first linguistic skills, (2) epilinguistic awareness, and (3) metalinguistic awareness. One important point is that the first linguistic skills are the infant's response to the characteristics of his spoken language. These provide the basis for the subsequent levels of representation that, accordingly, might be expected to incorporate language-specific features. The second point is that achievement of the higher, metalinguistic level is not viewed as a natural development but as an optional development that occurs in response to a special "demand" imposed by communication needs (Duncan et al., 2000).

The model raises questions about the *tasks* used to assess phonological awareness. Some tasks require only global awareness of similarity or difference. Examples are the matching task used by Treiman and Zukowski (1991) or the odd-word-out task used by Bradley and Bryant (1983). Other tasks require the isolation and manipulation of specific linguistic segments, examples being the segmentation task (Seymour & Evans, 1994), the deletion task (Bruce, 1964; Morais, Cary, Alegria, & Bertelson, 1979), the inversion task (Alegria, Pignot, & Morais, 1982), and the common unit task (Duncan et al., 1997, 2000). Global tasks are capable of being performed on the basis of an implicit (epilinguistic) level of representation. Tasks demanding the isolation and manipulation of specific linguistic segments require an explicit (metalinguistic) level of representation.

Discussions about the course of metaphonological development need to take account of the tasks used to assess awareness, and, in particular, whether it is the implicit or explicit level that is being tested. Often, large units (rimes, syllables) are assessed using an epilinguistic procedure, such as matching or odd-word-out, while small units (phonemes) are assessed using a metalinguistic procedure (deletion, segmentation). This approach tends to favor the progressive, large-to-small unit account of phonological development. When explicit tasks are applied in a procedurally common way to all units (see Hulme et al., 2002), somewhat different results are found. Seymour and Evans (1994) tested preschool-

ers and Primary 1 and 2 English-speaking children (in Scotland) on a segmentation task with instructions to divide monosyllabic words (or nonwords) into two parts, three parts, or as many parts as possible. The task could not be performed at all by prereaders and the performance of beginning readers suggested early emergence of phonemic segmentation, no special adherence to the onset-rime division in two-part segmentation, and no evidence that segmentation developed progressively down the levels of the intrasyllabic hierarchy. Similarly, Duncan et al. (1997) presented children with pairs of monosyllabic words in a common unit task. The common unit could be a whole rime segment ("goat" – "boat" → "oat") or an initial or final phonemic segment ("bill" – "bone" → "buh"; "bake" – "dock" → "kuh"). Again, prereaders could not perform the task and the developmental trend among primary school children favored small units (phonemes) at first and rime units only at a later stage (Duncan et al., 2000).

Cross-Language Differences in the Development of Linguistic Awareness

An important question for European literacy is how far spoken language differences affect the course of metaphonological development. As already noted, a crucial distinction relates to syllable structure and the contrast between the open CV syllables of the Romance languages and the closed CVC and more complex syllable structure of the Germanic languages. In recent studies, Lynne Duncan and Pascale Colé and colleagues have compared English- and French-speaking children at the preschool and early primary school ages on tasks assessing metaphonological awareness of syllable structures and boundaries (Duncan, Colé, Seymour, & Magnan, submitted). A common unit procedure was used in which children were presented with pairs of spoken bisyllables and asked to report the common segment. The common unit was a whole syllable in some instances but a smaller unit (a rime or initial phoneme) in others. English-speaking prereaders were unable to perform this task. By contrast, French-speaking prereaders, aged 4 or 5 years, performed the task of reporting common syllables almost perfectly. In an additional task, spoken bisyllabic words were presented under the instruction to segment the utterance into two parts. Prereaders in both languages were able to perform this task. However, while French children were entirely consistent in placing the division at a standard juncture (prior to the largest available consonantal onset group), this was not true of English-speaking children who located the boundary in many different places.

These data accord with previous studies (Bruck, Genesee, & Caravolas, 1997) in implying that there are differences in the phonological representations developed by French-speaking and English-speaking children in the period before they learn to read. For French speakers these representations include a precise segmentation into clearly defined syllabic units. This structure is absent from the representations of English-speaking children. It is important to note that this distinction refers to the explicit (metalinguistic) level of representation. In Gombert's (1992) framework, establishment of a metalinguistic representation of a unit (here, the syllable) is normally held to be a response to some kind of special "demand" imposed by language use and communication. If so,

it may be that producing and listening to the French language, perhaps supported by games and songs involving syllabification, induces an explicit awareness of syllables and syllable boundaries. One possibility is that the contrast reflects the distinction between the simple syllable structure of the Romance languages as against the complex syllable structure of the Germanic languages. Alternatively, it may reflect metrical distinctions between syllable-timed languages, such as French, and stress-timed languages, such as English (Abercrombie, 1967; Ramus, Nespor, & Mehler, 1999).

As already noted, an assumption in Gombert's framework is that the establishment of the metalinguistic level of representation for a given unit is not normally the product of a simple process of maturation and experience but rather a response to a specific "demand." With regard to explicit awareness of *phonemes*, the most likely possibility is that this demand is imposed by the task of learning to read. This presumption is supported by the study by Morais et al. (1979) of Portuguese literate and illiterate adults. Morais et al. used an initial phoneme deletion task with nonword stimuli as a measure of explicit phoneme awareness. The important outcome was that literate adults could perform the task, whereas illiterate adults could not. This is consistent with numerous studies which show that capacity to perform explicit phoneme manipulation tasks, such as deletion, inversion, or common unit identification, normally emerges coincidentally with the onset of literacy (Duncan et al., 1997; Perfetti, Beck, Bell, & Hughes, 1987).

The finding that learning to read and spell promotes phonemic awareness suggests that the timing of the onset of explicit phonemic awareness will vary across European societies in line with the socioeducational variations in the *ages* at which reading is formally taught. This point can be illustrated by referring again to the work by Duncan et al. (submitted) on metaphonological development in English and French. In the UK, formal instruction in reading begins at the age of 5 years, whereas, in France, the starting age is 6 years. Metaphonemic awareness was assessed using the common unit task in which the shared segment was the initial consonant phoneme of two bisyllabic words. Capacity to isolate and report back this segment appears at 5 years in English-speaking children but not until 6 years in French-speaking children. This is not a difference in phonological capacity between the two samples (recall that the French children were much better at reporting common syllables) but seems instead to be a simple effect of the difference in the age at which reading is taught.

The emergence of phonemic awareness will also depend on the extent to which an *alphabetic* approach to teaching is adopted. Bruce (1964) long ago noted that primary school children educated in a school that favored whole-word methods were much less able to perform phoneme deletion tasks than children receiving phonic instruction. Similarly, Alegria et al. (1982) reported that Belgian French-speaking children who learned in a phonic regime were able to transpose the positions of phonemes, whereas children who learned according to a whole-word regime were not. The implication is that whole-word methods, which do not emphasize mappings between letters and subword speech segments, do not create a demand for the development of an awareness of phonemes. In the mixed method used in the UK, it appears that the alphabetic component is normally sufficient to induce metalinguistic awareness of speech segments. Duncan et al. (1997) studied the transition from nursery school into primary school in Scottish children learning by a logographic and alphabetic method and found that the teaching encouraged the

formation of analytic decoding processes and the awareness of phonemic segments in speech.

Models of Literacy Acquisition

Various models of reading acquisition have been formulated, generally with a reference to learning to read in English and without an explicit goal of encompassing learning to read in different languages (see Byrne, and Ehri, this volume, for discussions of theories of literacy acquisition). It seems important that such models should acknowledge (1) that there may be early (foundational) processes in learning to read, (2) that approaches to teaching may make a difference, (3) that there is an interactive relationship between orthography and linguistic awareness, and (4) that the eventual achievement is the fluent reading of complex (multisyllabic, multimorphemic) words. Here it is proposed that the question of literacy development across different European languages should be considered in the context of an inclusive framework deriving from previous research by Seymour and colleagues (see Seymour, 1990, 1993, 1997, 1999; Seymour & Duncan, 2001).

The framework derives from earlier analyses of reading acquisition, including stage models (Frith, 1985), decoding models (Gough & Hillinger, 1980), accounts of 'sight word' learning (Ehri, 1992, this volume), acquisition of the alphabetic principle (Byrne & Fielding-Barnsley, 1989; Byrne, this volume) as well as contemporary connectionist approaches (Plaut et al., 1996; Seidenberg & McClelland, 1989). It contends that (1) literacy acquisition involves an ongoing interaction between developing orthographic systems and phonological representations in which implicit (epilinguistic) structures become explicit (metalinguistic) in response to demands created by the structure of the orthography; (2) orthographic development may involve a series of overlapping phases in which increasingly complex structures are formed:

Phase 0: *Letter-sound knowledge.* The essential prerequisite for all subsequent literacy development is the establishment of a knowledge base of the letters of the alphabet and their links with sounds.

Phase 1: *Foundation literacy.* This is a preliminary phase during which the basic elements of (a) familiar sight word recognition and storage (logographic process), and (b) sequential decoding (alphabetic process), are established.

Phase 2: *Orthographic literacy.* During this phase, a framework for definition of legitimate spellings of syllables is assembled and structured around linguistic units, especially onset-peak-coda or onset-rime elements. This is viewed as an internal reorganization that builds on structures established during the foundation phase, including stored word exemplars and letter-sound correspondences.

Phase 3: *Morphographic literacy.* The focus of the third phase is on the formation of representations of complex words in which syllables are combined, stress is assigned, and free and bound morphemes are identified and combined.

The demand for the formation of explicit (metalinguistic) representations is expected to alter as development proceeds through these phases. In Phase 1, the introduction of

the alphabetic principle and decoding procedures creates a demand for the establishment of explicit *phonemic* representations (Byrne & Fielding-Barnsley, 1989). In Phase 2, there is a requirement for an organization defined in terms of syllables and the internal structure of the syllable (i.e., metalinguistic representations of *onset* and *rime*, or *onset*, *peak*, and *coda*). Finally, in Phase 3, there is a requirement for the coordination of syllabic and morphological elements, or a *metamorphemic* representation. The assumption of the model is that these explicit representations build on preexisting (epilinguistic) levels of awareness and normally arise in response to demands reflecting the current emphasis in orthographic development.

Language Effects on Orthographic Development

There is, as yet, no comprehensive study of early literacy acquisition in the European orthographies. Most existing studies involve only comparisons within subsets of languages. For example, Wimmer and Goswami (1994) compared reading of number names and nonwords by 7-, 8-, and 9-year-old children in German and English. Nonword reading was significantly slower and more error prone in English at all three age levels. Frith, Wimmer, and Landerl (1998) used structurally equivalent sets of 1-, 2-, and 3-syllable nonwords in English and German and again found consistently poorer nonword reading in English. Analogous findings are reported for comparisons of English with Spanish and French by Goswami, Gombert, and de Barrera (1998), and with Greek by Goswami, Porpodas, and Wheelwright (1997). Recently, Spencer and Hanley (2003) compared the learning of English and Welsh (which is written in a shallow orthography) and found faster development in Welsh, although this difference reduced in the later stages of development.

The COST A8 project included a wider range of languages and directly addressed the beginnings of reading (foundation literacy, phases 0 and 1). The samples consisted of first-grade primary school children who were learning under standard teaching conditions in each country. Foundation literacy was operationally defined in terms of three indicators:

- *Letter-sound knowledge.* Accuracy and speed in identifying the letters of the alphabet by giving the dominant sound (or name) and speed of labeling the letters in a list.
- *Sight word identification (logographic process).* Accuracy and speed of reading sets of very familiar words, subdivided between content words and functors, such as occur in beginning reading materials in each language.
- *Decoding unfamiliar forms (alphabetic process).* Accuracy and speed of reading simple nonwords of one syllable (VC, CV, or CVC structure) and two syllables (VCV, CVCV, VCVC structures).

The items were presented as short vertical lists for reading aloud and errors were recorded as well as the time to complete the list (time per item). The data were collected towards the latter half of the first school year.

Phase 0: letter-sound knowledge

In the model, letter-sound knowledge is regarded as the essential basis of alphabetic literacy and the sine qua non for subsequent development (Duncan & Seymour, 2000; see also Byrne, this volume). In the study of Seymour et al. (2003), the mean accuracy for letters was over 90% in all language groups, English included (94% for the Scottish grade 1 class). Although the ages of the various groups differed, age was only very weakly related to success in letter learning. Further, there was no systematic effect of either syllabic complexity or orthographic depth on letter accuracy. Seymour et al. (2003) also measured fluency of letter identification. The rate of sounding or naming letters averaged about 1 sec/item. Speed was unrelated to age within the main group of languages (English excluded), and there were no systematic effects of orthographic depth or syllabic complexity (e.g., the rate was slower in Finnish, at 1.48 sec/item, than in most other languages). However, the Scottish children had the slowest rate overall, at 1.88 sec/item. Given that they were younger than the other children, this may suggest an effect of immaturity on fluency of letter processing.

Although children may know some letters in kindergarten, acquisition of the full alphabet normally occurs at the start of formal schooling and depends on educational factors (when letter learning starts, and at what pace and in what order the letters are introduced). Socioeconomic disadvantage may delay the achievement of full mastery of the alphabet. It is possible that there are some children, referred to as instances of *literal dyslexia* by Seymour and Evans (1999), who have difficulty in acquiring the letter sounds. This could occur in any language and would be expected to have damaging effects on subsequent development in all cases.

Phase 1: foundation literacy

Sight word identification (logographic process). In the study of Seymour et al., the logographic (word identification) process was assessed by the reading of very common words such as occur in children's beginning reading materials. There are alternative models regarding the impact of language differences on this process. One possibility is that early words might be learned as patterns differentiated on the basis of visual or other features (Frith, 1985; Gough & Hillinger, 1980; Seymour & Elder, 1986). This process might be independent of effects of complexity or consistency. If so, factors such as regularity should not influence learning, and it might be expected that all children would acquire a sight vocabulary in the same way, irrespective of the depth of the orthography. The alternative view is that sight word learning is alphabetically based and exploits knowledge of letter-sound relationships (Ehri, 1992). In this account it seems reasonable to predict that sight word learning might proceed more rapidly in a simple orthographic environment than in a complex environment (cf. Rack, Hulme, Snowling, & Wightman's [1994] finding that beginners learn to read regular words more easily than irregular words).

Figure 16.1 displays accuracy levels for familiar word reading in the simple syllable and complex syllable series of languages (Seymour et al., 2003). These data are contrary

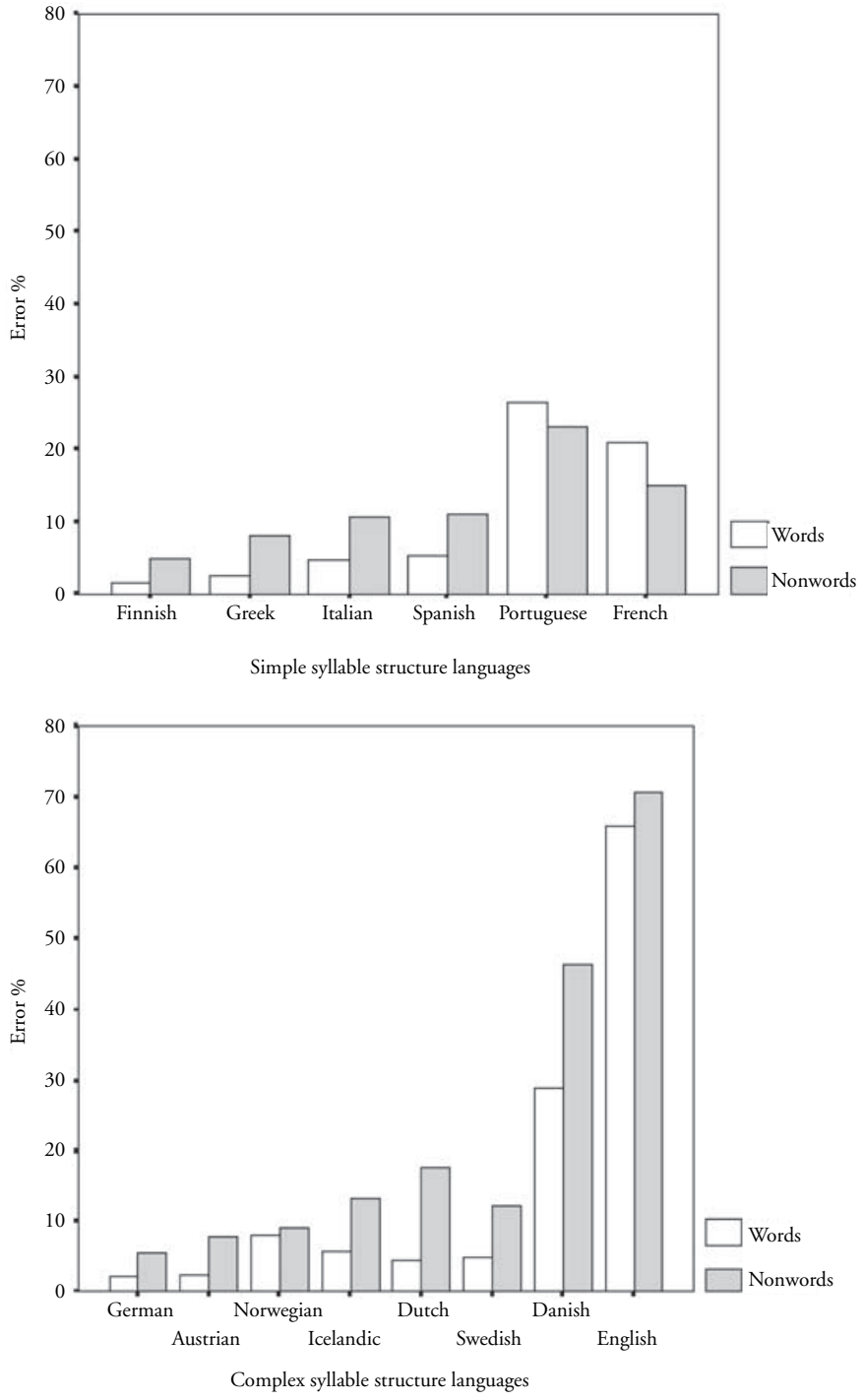

Figure 16.1 Error rates (%) for familiar word and simple nonword reading by simple syllable language groups and complex syllable language groups.

to models in which early sight word learning is a pattern discrimination process independent of orthographic depth. In most European orthographies children read familiar words very accurately (>95% correct) and fluently (1.6 sec/item) before the end of the first school year. These levels are substantially lower in Portuguese, French, and Danish (approx 75% correct), and far lower in English (34% in grade 1, rising to 76% in grade 2). Syllable structure appeared not to have a damaging effect. Further, there was no significant relationship with age (Scottish data excluded). It seems that orthographic depth directly retards the rate at which a sight vocabulary is learned.

The results for English appear grossly different from the other European languages. In the Scottish sample, analysis suggested that two or more years of experience were needed before word identification in English matched the accuracy and fluency levels achieved in the majority of languages before the end of the first school year.

Simple decoding (alphabetic process). Decoding (the alphabetic process) was assessed by measures of accuracy and speed of reading very simple nonwords. The monosyllables were 2- or 3-letter items such as 'op' and 'fip' in English and equivalent forms in the other languages. The bisyllables were 3- or 4-letter items, such as 'uba' and 'afen'. The nonwords contained no consonant clusters and no orthographically complex forms. They were intended to be simple forms that could be decoded on a one-letter, one-phoneme basis.

Two theoretical possibilities can be identified. The first is that the alphabetic process might be a straightforward elaboration of letter-sound knowledge. Children might establish an isolated mechanism for scanning letter arrays left-to-right, converting graphemes to phonemes, and blending the outcome into a response. Such a mechanism could be assembled without regard to the complexity of the orthography. If so, we would expect to find that the basic decoding mechanism could be established in an approximately equivalent way by beginning readers in each of the European languages. The alternative possibility is that the development is affected by the overall complexity of the orthographic and phonological environment from the very beginning of learning. In this case, we would expect mastery of even the most simple decoding tasks to emerge more slowly in complex orthographies than in shallow orthographies.

Figure 16.1 summarizes the error scores for decoding simple nonwords by the grade 1 samples (from Seymour et al., 2003). It can be seen that, while decoding is performed accurately, at about 90% correct for monosyllables and 80% for bisyllables, there are notable exceptions. Among simple syllable languages, performance was poorer in French and Portuguese than in Finnish, Greek, Italian, or Spanish. In the complex Germanic set, there was a higher rate of error in Danish than in the other languages, and a huge effect in English. The differences were also reflected in the fluency measure. There was evidence of dysfluency in Portuguese and French and in Danish and English.

These results are contrary to the predictions of the model assuming development of an isolated decoding mechanism. From the beginnings of learning, the alphabetic decoding process develops more slowly and less efficiently in some languages than in others. The effect may be in part attributable to the phonological distinction between the simple and complex syllable languages. The inefficiency is much greater in Danish and English than in French and Portuguese, and, within the remaining languages, accuracy was marginally better for the simple syllable set (92% vs. 89%) and there was an advantage in

speed (1.97 vs. 2.81 sec/item). The effect may also be a consequence of the differences in orthographic depth. French has a deeper orthography than Spanish, and, despite the equivalence of the age at which learning starts, grade 1 nonword reading is less accurate and slower (85% vs. 95% correct, 4.13 vs. 1.44 sec/item). Danish is written in a deeper orthography than German, and this again is associated with large differences in accuracy and speed (54% vs. 94% correct, 4.58 vs. 1.45 sec/item).

The most extreme disadvantage occurs in English. Although the Scottish grade 1 children were ahead of age expectation, they read only 29% of nonwords correctly and were extremely dysfluent (6.69 sec/item). Grade 2 children, aged 6.56 years, read only 64% of nonwords at a rate of 3.17 sec/item, well below all other languages tested (except for the Danish grade 1 group). Seymour et al. estimated that the reading age needed to match the level of the majority of European languages was above 7.5 years, implying that the English-speaking groups needed 2.5 years of learning, or more than twice as much time as most other languages, to establish a most minimal and basic decoding function.

These outcomes make it clear that there are very significant differences among the European orthographies in the ease with which the basic (foundational) elements of literacy are acquired. From a theoretical viewpoint, a critical question is whether the cognitive effects of linguistic complexity should be viewed as continuous or dichotomous. Orthographic depth might be described as a continuous variable (see Frost, this volume), measurable by some appropriate metric of complexity, which produces a graded delaying effect on rates of foundation literacy acquisition. Alternatively, it is possible that the cognitive effects of increasing complexity may be discontinuous, such that there is a range of low degrees of complexity, collectively classifiable as *shallow* orthographies, and then a threshold level of complexity that marks the boundary for a group of *deep* orthographies. Seymour et al. (2003) noted that their results for familiar word and simple nonword reading appeared consistent with a discontinuous account of this kind. The majority of European orthographies yielded approximately equivalent levels of good performance and a narrow range of individual variation. There then appeared to be a step change to a subset of orthographies in which acquisition was substantially more difficult and characterized by a large amount of individual variation. Seymour et al. suggested that this threshold separated English, Danish, French, and Portuguese (the *deep* European orthographies) from the remaining languages in their sample (the *shallow* European orthographies).

If this line is followed, table 16.1 can be reassembled as a 2×2 designation in which languages may be classified by reference to syllable structure (simple, complex) and orthographic complexity (shallow, deep). It is hypothesized that the course of early reading acquisition will vary depending on which cell is occupied by a given language. One possibility is that the deep orthographies require the development of a dual (logographic + alphabetic) foundation, while, for shallow orthographies, a unitary (alphabetic) foundation suffices. The reason for the establishment of the dual process is that too high a proportion of words encountered early in learning violate the alphabetic principle of one letter, one sound. It becomes necessary to build up a store of word forms that can be recognized and reproduced in addition to establishing a basic decoding procedure. This suggestion is consistent with the contention of Paulesu et al. (2000) that different brain functions may be developed by readers of deep and shallow orthographies. It is also consistent with the observation that contrasting reading patterns may be found in

normally developing readers and readers with dyslexia in English. Seymour and Evans (1999) observed that the lexicality effect (difference between familiar words and simple nonwords) was positive in some normal readers (word reading accuracy much higher than nonword reading accuracy) and negative in others (nonwords considerably better than words). These effects were exaggerated in some dyslexic readers, suggesting contrasting patterns of *alphabetic dyslexia* and *logographic dyslexia*. Such a contrast might be expected in the deep orthographies, where a dual foundation is implemented, but not in the shallow orthographies, where a unitary (alphabetic) foundation is implemented.

The phonological contrast between the simple and complex syllable structures appears to influence the development of the alphabetic process. Seymour et al. (2003) suggested that this could be because the presence of clearly defined syllables containing few consonant clusters is optimal for the establishment of grapheme–phoneme correspondences and their merging into speech segments. In a language with complex syllables this process is more difficult because the basic correspondences are often embedded in onset and coda clusters and because the syllable boundaries are ambiguous.

An additional point is that *individual variability* is much greater in the deep orthographies than in the shallow orthographies. This effect is shown in the report by Seymour et al. (2003) that illustrates a 'normal' range for accuracy of familiar word and simple nonword reading in the main group of shallow European orthographies (defined as within ±1.75 sd of the mean). The bulk of children score above 80% for words and 70% for nonwords and the scores of the tail of outliers lie above 40% and 30% respectively. Nonreaders are seldom if ever found in these orthographies. The results for the deeper orthographies contrast in showing much higher variability, with the normal range extending down to 40–50% in Portuguese and French, and the tail approaching the nonreader zone (defined as <10%). In English and Danish, the normal variation among Primary 1 children extends over almost the whole range of possible scores and includes appreciable numbers of nonreaders.

Phase 2: orthographic level

The orthographic level is envisaged as a structure in which the legitimate orthographic forms of monosyllables are represented. This is directly comparable to the process of internalization of orthographic knowledge that has been simulated in the connectionist models (Plaut et al., 1996; Seidenberg & McClelland, 1989). This level can be tested using words of average or lower frequency (relative to primary school populations) and corresponding nonwords that reflect the range of phonological complexities (syllable structures) and orthographic complexities (multiletter graphemes, inconsistencies, irregularities) that occur in a given language. The rate of development should be influenced by phonological complexity (syllable structure) since the construction of a model of the legitimate spellings of monosyllables will depend on the size of the space required to specify all possibilities. If a syllable is defined by the presence of a peak (vowel), an (optional) onset (initial consonant group), and an (optional) coda (final consonant group), then the size of the space will reflect (a) the number of vowel forms in the phonology of the language, (b) the number of legitimate onsets, and (c) the number of legitimate codas. In the

Romance languages, the space will be relatively small because there are few possible onsets and mainly open syllables. In the Germanic languages, the space will be much larger because of the wider range of possible onset and coda clusters. In addition, the representation of monosyllables is likely to be facilitated in those languages, such as French, in which syllables are clearly and precisely defined and are objects of metalinguistic awareness for preliterate children.

It is self-evident that orthographic development will be affected by orthographic complexity. The connectionist model predicts that the rate of learning will be a continuous function of a graded index of complexity and not a dichotomous outcome of the kind proposed for the foundation level. In closed syllable languages, the rime structures will be relatively numerous and complex and a focus for variations in consistency (Treiman, Mullennix, Bijeljac-Babic, & Richmond-Welty, 1995; Ziegler et al., 1997). The prediction is that, insofar as this occurs, there will be a demand for the formation of rime units as objects of metalinguistic awareness and a move toward the capacity to perform explicit phonological tasks, such as common unit identification, in which rime units are targets (Duncan et al., 2000). The capacity to make this shift will, in turn, depend on preliterate implicit (epilinguistic) awareness of rime. Thus, Duncan et al. found that early measures of implicit riming, using the oddity task, were selectively related in fixed order multiple regression analyses to later postliterate measures of explicit rime awareness, using the common unit task. These developments appear less likely to occur in simple syllable languages and shallow orthographies (Goswami et al., 1998).

Phase 3: morphographic level

The morphographic level is hypothesized as a structure in which syllable-sized segments may be combined to form complex multisyllabic words. A distinction may be made between monomorphemic multisyllables (such as *elephant*) and morphologically complex forms (such as *indisputable*) that can be analyzed into segments corresponding to free and bound morphemes (tense or number inflections, prefixes, derivational suffixes). The organization of the morphographic level is uncertain, but could consist of whole-word forms, or combinations of syllables, or combinations of morphemes. The way in which this level is constructed is likely to depend on the degree to which the spelling system of the language represents lexical and morphological features as distinct from phonological features. Finnish has a very complex morphology in which stems are combined with arrays of bound morphemes. However, these elements are written in a phonologically transparent manner. Consequently, a syllable-based representation would appear to be sufficient and the morphographic level might be defined simply as a mechanism for combining syllabic segments. This will not be true for deep orthographies where spelling may signal lexical identity as well as morphological structure. An additional issue is posed by the assignment of stress in multisyllables. In some languages, stress assignment may follow a regular pattern. In others (e.g., Greek or Spanish), departures from the standard pattern are marked by diacritics in the writing system. English is more complex, since stress is not marked and may vary, so that, for example, most bisyllables have first-syllable stress but some (e.g., *canoe*) have second-syllable stress. This means that the correct allocation of

stress when pronouncing a multisyllable depends on lexical identification. To the extent that this is true, a morpheme- rather than syllable-based organization may be preferred.

We can speculate, therefore, that the cognitive effort required to form the Level 3 morphographic framework will depend on the degree to which lexical and morphological features are implicated in the spelling system. In shallow orthographies with a clear syllabic structure this level may be built by combining the syllabic segments that are already available. The learning time required may simply be a function of the number of possible syllables and combinations. Where syllable structure is poorly defined and where spelling is lexically or morphologically determined, then a more complex and time-consuming process may be required, in which word forms internalized within the logographic process are scanned and analyzed in order to construct a new morpheme-based system.

Conclusions

This chapter has set out a theoretical framework for the discussion of cultural and language differences that exist within the context of *European literacy*. This has been approached by outlining a developmental model in which linguistic segments are at the forefront during successive phases of development.

It is likely that phonological differences affect the content of the system of phonological representations developed during childhood. These representations may exist at (at least) two levels, an implicit (epilinguistic) level, necessary for normal language use, and an explicit (metalinguistic) level that permits the isolation and manipulation of linguistic units. Languages that have a clear and well-defined syllabic structure induce a metalinguistic representation of syllabic segments in prereaders. The metalinguistic representation of phonemes is normally facilitated by the task of learning to read in an analytic, alphabetic mode. This is a common outcome in all European languages, although the timing is contingent on the age at which reading instruction begins and the point at which alphabetic teaching is introduced.

The subset of languages discussed here may be grouped according to a 2×2 categorization of syllabic structure (simple, complex) and orthographic depth (shallow, deep). Acquisition may differ between the languages in each cell of this scheme at each of four hypothetical phases. The initial step of letter-sound acquisition (Phase 0) is common to all alphabetic orthographies. It is probably not affected by language differences but is affected by educational factors (age of starting, teaching method), social factors (SES), and, possibly, cortical maturity and dyslexia. Foundation literacy (Phase 1) differs across languages. Elementary decoding (the alphabetic process) is established more slowly in complex than in simple syllable languages and more slowly in deep than in shallow orthographies. This early stage of development depends on education (provision of alphabetic teaching at a given age). Sight word acquisition is slowed in orthographies that exceed a threshold level of depth or complexity. It is hypothesized that deep orthographies induce the formation of a dual foundation containing distinct logographic (sight word) and alphabetic (decoding) processes. This results in slowed acquisition and exaggerated individual variation among normally developing readers and readers with dyslexia.

Orthographic literacy (Phase 2) also differs between languages. The construction of an internal model of the spellings of all possible monosyllables will occur more rapidly in simple syllable than in complex syllable languages, and will be further delayed in proportion to the degree to which spelling departs from the principle of one letter/one sound. Morphographic literacy (Phase 3) is likely to be more difficult in languages having a complex and poorly defined syllable structure and in languages in which spelling signals lexical identity and morphological function.

According to this formulation, we would expect the rate and efficiency of literacy acquisition to differ between languages in the ranking (1) simple syllable shallow orthographies (Finnish, Greek, Italian, Spanish); (2) complex syllable shallow orthographies (German, Norwegian, Icelandic, Swedish, Dutch); (3) simple syllable deep orthographies (Portuguese, French); and (4) complex syllable deep orthographies (Danish, English). An unresolved issue is whether the dramatically outlying results for beginning reading in English are explicable within this scheme. It seems clear that difficulties arise for learners of English at each phase of the developmental process:

- *Phase 0*: Immaturity due to early school entry may impede the achievement of fluency in processing letter-sounds.
- *Phase 1*: A dual foundation is required, causing slower learning. Sight word acquisition is impeded by a high proportion of words that violate the one letter / one sound principle. Elementary decoding is adversely affected by complex syllabic structure.
- *Phase 2*: The number of possible syllables is very large and the language contains numerous monosyllables with inconsistent rime spellings.
- *Phase 3*: Spelling is used to signal lexical identity and to identify bound morphemes. Additional complications arise from stress assignment and a complex and ambiguous syllabic structure.

This accumulation of difficulties may be sufficient to explain the deviant results for English. If not, it may be that there are relevant contributions from social or educational factors that somehow exaggerate these difficulties.