In this paper we apply a developmental model of reading to the question of dyslexic subtypes. Groups of normal readers (n = 40) and dyslexic children (n = 50), matched on reading level and IQ, were given a comprehensive test battery measuring level of development of visual, phonological, and orthographic skills. As a group, dyslexics deviated from normal readers of equivalent reading achievement primarily in phonological skills (spelling-to-sound translation and phonemic analysis), although limited differences in knowledge of word-specific spellings were also observed. Dyslexics were superior to the younger normal readers in visual processing of print. Analysis of individual data by reference to the reading level control group revealed three major subgroups: a group with a specific deficit in phonological processing of print (52 percent), a group with deficits in processing both the phonological and orthographic features of printed words (24 percent), and a group with phonological deficits in language (8 percent). The remainder of the sample (16 percent) had specific deficits in visual or orthographic processing of print, in spelling, or did not differ from the control group. The data support the view that most developmental dyslexics have a specific language disorder involving some aspect of phonological processing. However, small subgroups with very different configurations of reading and nonreading difficulties may exist as well.

One of the continuing questions of interest in the field of dyslexia concerns the nature of possible subtypes of reading and language disability among the dyslexic population. It is now clear that dyslexic children...
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(as they have traditionally been defined) are a heterogeneous group (Boder 1973; Doehring et al. 1981; Lovett 1984; Satz and Morris 1981; Seymour and MacGregor 1984). Many researchers and educators recognize that we must understand this heterogeneity in order to cope more effectively with questions of diagnosis, treatment, and etiology.

A number of subtyping schemes have been proposed. Some focus on analysis of reading and spelling performance (e.g., Boder 1973; Doehring et al. 1981; Seymour and MacGregor, 1984), and some on patterns of neuropsychological test performance (Mattis, French, and Rapin 1975; Petrauskas and Rourke 1979; Satz and Morris 1981). At present there is lack of agreement on how best to categorize dyslexic children. A recent and promising approach can be found in the work of Frith and others (Frith 1985; Frith 1986; Seymour and MacGregor 1984; Snowling 1987), who have used a cognitive-developmental framework to analyze variations in reading, spelling, and language skills among dyslexics. In this paper, we will present a developmental model of reading and related skills, use it to derive predictions about the nature of subgroups, describe a comprehensive battery of tests derived from the model, and present data we have collected on dyslexic children and a control group of normal readers.

Model of Reading Development

Frith (1985, 1986) and Seymour and MacGregor (1984) assume that individuals learn to read and spell by means of three strategies, arranged in a developmental sequence. The earliest strategy, the logographic strategy, is visually based. The child recognizes words "by sight," that is by means of salient visual features such as the first and last letters, the outline of the word, etc.

The second strategy, the phonological (or alphabetic) strategy, involves sequential decoding of spelling units (letters and letter clusters) into the phonemes of the language. Once children have sufficient knowledge of spelling-sound correspondences and decoding rules, they can identify unfamiliar printed words that are in their speaking vocabulary.

The third strategy, the orthographic strategy, allows the reader to recognize words based on each word's unique pattern of letter identities and letter order, without the need to translate the letters into a phonological code. It is assumed that the reader stores information about each morpheme (a word or grammatical unit, such as -ed, contained in a word) in a mental lexicon and learns specific associations between the spelling of each morpheme and its meaning. It has been argued that this is the dominant strategy for skilled readers (Jorm and Share 1983; McCusker, Hillelenger, and Bias, 1981).

According to Frith (1985, 1986), immature readers employ only the logographic strategy. The phonological strategy actually develops first in the context of learning to spell and soon becomes the dominant method of