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DYSLEXIA AND THE PHONOLOGICAL MODELOver one hundred years ago, in November 1896, a doctor in Sussex, England, published the first description of the learning disorder that would come to be known as developmental dyslexia. “ Percy F.

,... aged 14,.

.. has always been a bright and intelligent boy,” wrote W. Pringle Morgan in the “ British Medical Journal,” “ quick at games, and in no way inferior to others of his age. His great difficulty has been–and is now–his inability to learn to read. (Sec 3) In that brief introduction, Morgan captured the illness that has intrigued and frustrated scientists for a century.

In 2000 as in 1896, reading ability is taken as a substitute for intelligence; most people assume that if someone is smart, motivated and schooled, he or she will learn to read. But the experience of millions of dyslexics, like Percy F., has shown that assumption to be false. In dyslexia, the relation between intelligence and reading ability breaks down. Early explanations of dyslexia in the 1920s, held that defects in the visual system were to blame for the reversals of letters and words thought to typify dyslexic reading. Eye training was often prescribed to overcome these alleged visual defects. Later research has shown, however, that children with dyslexia are not unusually prone to reversing letters or words and that the deficit responsible for the disorder is related to the language system.

In particular, dyslexia reflects a deficiency in the processing of the distinctive linguistic units, called phonemes that make up all spoken and written words. Current linguistic models of reading and dyslexia now provide an explanation

of why some very intelligent people have trouble learning to read and performing other language-related tasks. Over the past twenty years, a consistent model of dyslexia has emerged that is based on phonological processing. The phonological model is consistent both with the clinical symptoms of dyslexia and with what neuroscientists know about brain organization and function. To understand how the phonological model works, one first has to consider the way in which language is processed in the brain. Researchers theorize the language system as a hierarchical series of modules or components, each devoted to a particular aspect of language. At the upper levels of the hierarchy are components involved with semantics (vocabulary or word meaning), syntax (grammatical structure) and discourse (connected sentences). At the lowest level of the hierarchy is the phonological module, which is dedicated to processing the distinctive sound elements that constitute language.

The phoneme, defined as the smallest meaningful segment of language, is the fundamental element of the linguistic system. Different combinations of just 44 phonemes produce every word in the English language. The word “ cat,” for example, consists of three phonemes: “ kuh,” “ aah,” and “ tuh.” (Linguists indicate these sounds as | k|, | ae| and | t|.

) Before words can be identified, understood, stored in memory or retrieved from it, they must first be broken down, or parsed, into their phonetic units by the phonological module of the brain. In spoken language, this process occurs automatically, at a preconscious level. As Steven Pinker of the Massachusetts Institute of Technology has argued, language is instinctive–all that is necessary is for humans to be exposed to it(Sec 6). A genetically

determined phonological module automatically assembles the phonemes into words for the speaker and translates the spoken word back into its underlying phonological components for the listener.

In producing a word, the human speech mechanism–the larynx, palate, tongue and lips– automatically compresses and merges the phonemes. As a result, information from several phonemes is combined into a single unit of sound. Because there is no obvious clue to the underlying nature of speech, spoken language appears to be seamless. Therefore, an oscilloscope would register the word “ cat” as a single burst of sound; only the human language system is capable of distinguishing the three phonemes embedded in the word.

Reading reflects spoken language, as Alvin M. Liberman of Haskins Laboratories in New Haven, Conn., points out, but it is a much harder skill to master(Sec 3). Although both speaking and reading rely on phonological processing, there is a significant difference: speaking is natural, and reading is not.

Reading is an invention and must be learned at a