
Fact Sheet

Reading Difficulty and Disability

Shortly after World War Two, a team of researchers attempted to build a machine that could scan text and read it to the blind. After two decades of research, they learned that human speech was far too complex for the technology of the time to duplicate. However, these efforts provided the basis for a new research field that led to an understanding of why many children have difficulty with reading.

Yesterday

- Researchers discovered that the words we speak are composed of individual wisps of sound woven together so seamlessly that our technology could not measure them. Roughly 40 such sound units, known as phonemes, provide the basis of the English language. Unconsciously and automatically, the brain strings phonemes together to produce thousands of words.
- Researchers discovered that some children needed to be taught “phonemic awareness,” i.e., that spoken words are made up of smaller segments of sound.
- Kindergarten children who lacked phonemic awareness were more likely to have difficulty reading in the later grades.
- Straightforward tests of children’s ability to manipulate phonemes could predict reading aptitude later in life, and simple techniques to show children how to identify phonemes resulted in improvements in reading.
- Developing children’s phonemic awareness skills appeared to prepare them to master the next step in learning to read, phonics. Readers skilled in phonics can decode words they haven’t seen before, without first having to memorize them.
- Within the hemisphere, reading activity involves three brain regions working together. One area processes phonemes, another area appears to “map” phonemes to the letters that represent them, and the third area serves as a long-term storage system. Once a word is learned, this 3-part center recognizes it automatically, without first having to decipher it phonetically.
- Brain scans have shown that as readers become more skilled, this automatic recognition center becomes more active. Poor readers, however, have difficulty accessing the automatic recognition center and instead rely on the phoneme center and the mapping center to process the words they see. For poor readers, recognizing words is not an automatic process.
- Instruction in phonemic awareness, phonics, and other reading skills can activate the automatic recognition process. After undergoing such training, brain scans of people who were once poor readers begin to resemble those of good readers.
- Environmental factors—such as a child’s early exposure to language and classroom experience—play a significant role in most types of reading difficulty. In the majority of poor readers, the brain regions controlling reading were capable of normal function but were not activated through early exposure.
- NIH-sponsored research helped to define reading disability as a specific, brain-based difficulty in learning to recognize and decipher printed words that may occur in persons of average and even above average intelligence.

Today

- Throughout the 1990s, NIH-funded researchers used new brain imaging technology to identify three brain regions that are active during reading in the brain’s left half, or hemisphere.

- Specific genetic variations are associated with reading disability. For example, some cases of reading disability are associated with an alteration of the DCDC2 gene, which is located in an area of chromosome 6 previously implicated in reading disability. The gene plays a role in prenatal brain development, and the finding suggests that some cases of reading disability may be caused by an early “miswiring” of the brain.
- In 1997, Congress asked the NIH to review the scientific evidence on reading and, based on that evidence, to identify the most effective ways to teach children to read. In response, the NIH established the National Reading Panel. Along with instruction in phonics and phonemic awareness, the panel outlined other effective approaches for teaching children to read. One approach, guided oral reading, involves having children read aloud while receiving guidance from skilled readers. Other approaches involve teaching children vocabulary and strategies for comprehending text.
- Those who need more targeted intervention may receive one on one special education. This approach seeks to provide each child with the appropriate level of instruction required for his or her individual needs.
- The NIH funds multidisciplinary Learning Disability Research Centers (LDRCs) to undertake studies on defining, classifying and understanding, learning and related disorders. Currently there are 4 centers actively engaged in researching various aspects of reading disabilities. In addition, these centers are examining the effectiveness of RTI as a means of identifying and teaching students with reading difficulties.
- Other NIH-sponsored studies of reading and reading disability include:
 - The use of brain imaging technology to better understand the processes that take place in the brain during reading. This research examines the differences between good readers and those with difficulty reading. Related projects are looking at changes in brain patterns that occur as children progress from beginning to advanced readers. Researchers are using multiple types of brain imaging technology to more fully understand the brain-based differences between good readers and people with reading disability.
 - Identification of specific genes that are affected in individuals with reading disability. Researchers are trying to understand the interplay of genes and environment in contributing to reading difficulties, both to identify individuals at risk of reading disability and to develop effective interventions.
 - Developing and testing new approaches and investigating the effectiveness of existing approaches, such as RTI on kindergarteners, older children, adolescents, adults, and bilingual groups.

Tomorrow

- The Individuals with Disabilities Education Improvement (IDEA) Act is the primary federal program authorizing state and local aid for special education. The act was revised in part as a result of NIH-funded research, which showed that evaluating children based on a discrepancy between their reading ability and results on a general intelligence test failed to identify many children with reading difficulty or disability.
- The IDEA Act now provides for the use of Response to Intervention (RTI) models to identify and assess children. RTI consists of tiered instruction where children who have difficulty learning to read after having received high quality reading instruction are ultimately provided with small group, intensive instruction.

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