Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition, spelling and decoding abilities. Research findings agree that these and other observed behavioral manifestations largely result from a deficit in the phonological component of language. However, conflicting theories on the exact nature of the phonological deficit have given rise to divergent treatment approaches. Recent advances in functional brain imaging and genetics have allowed these theories to be examined more closely. If implemented appropriately, commercial programs can be effective in identifying dyslexia. Treatment of dyslexia has been advanced through neuroscience, yet further study is needed to provide rigorous, reproducible findings that will sustain approaches. Multisensory teaching is one important aspect of instruction for dyslexic students that is used by clinically trained teachers. Effective instruction for students with dyslexia is also explicit, direct, cumulative, intensive, and focused on the structure of language. Multisensory learning involves the use of visual, auditory, and kinaesthetic-tactile pathways simultaneously to enhance memory and learning of written language. Links are consistently made between the visual (language we see), auditory (language we hear), and kinaesthetic-tactile (language symbols we feel) pathways in learning to read and spell.

KEYWORDS: Impact, Selected Approaches, Children, Dyslexia.

What is developmental dyslexia?

The definition of dyslexia itself has been the subject of much study, as selection criteria for dyslexics influence research findings and estimates of prevalence (currently 5–10% in the U.S. and the U.K.). In 1969, a formal definition of reading failure was put forward by Critchley with a neurobiological etiology in mind: "Specific Developmental Dyslexia: A disorder manifest by difficulty in learning to read despite conventional instruction, adequate intelligence, and socio-cultural opportunity. It is dependent upon fundamental cognitive disabilities which are frequently of constitutional origin". A definition currently supported by the National Institutes of Health states that dyslexia is inaccurate and/or slow, with speech and reading is applied at other levels of language learning as well. Students may learnhand gestures to help them memorize the definition of a noun. Students may manipulate word cards to create sentences or classify the words in sentences by physically moving them into categories. They might move sentences around to make paragraphs. The elements of a story may be taught with reference to a three-dimensional, tactile aid. In all, the hand, body, and/or movement are used to support comprehension or production of language.

The neurobiological basis of dyslexia

Specific regions of the genome have been shown to be involved in a number of reading-related processes, and linkages have been replicated at independent laboratories across the world. The multidimensional nature of dyslexia is likely to be one explanation for its observed heterogeneity and its coexistence with disorders of attention. Brain imaging studies are driven by observations of behavioral manifestations of dyslexia. In the last 30 years, classroom- and laboratory-based studies have converged on the critical role of phonological processing in successful reading acquisition. Phonological awareness (PA), the ability to identify and manipulate sounds or letter patterns by saying sounds for letters they see, or writing letters for sounds they hear. As students learn a new letter or pattern, they may repeat five to seven words that are dictated by the teacher and contain the sound of the new letter or pattern; the students discover the sound that is the same in all the words. Next, they may look at the words written on a piece of paper or the chalkboard and identify the letters or patterns that contain the sound. They then carefully trace, copy, and write the letter(s) while saying the corresponding sound. The sound may be dictated by the teacher, and the letter name(s) given by the student. Students then read and spell words, phrases, and sentences using these patterns to build their reading fluency. Teachers and their students rely on all three pathways for learning rather than focusing on a “whole word memory method,” a “reading method,” or a “phonetic method” alone. The principle of combining movement with speech and reading is applied at other levels of language learning as well. Students may learn hand gestures to help them memorize the definition of the word. Students may manipulate word cards to create sentences or classify the words in sentences by physically moving them into categories. They might move sentences around to make paragraphs. The elements of a story may be taught with reference to a three-dimensional, tactile aid. In all, the hand, body, and/or movement are used to support comprehension or production of language.
Researchers have demonstrated the value of explicit, structured language teaching for all students, especially those with dyslexia. Programs that work differ in their techniques, but there are several principles that are common. The multisensory principle is that a valued by experienced clinicians has not yet been isolated, controlled, or validated. Studies in reading instruction, but most programs in reading do include multisensory practice for symbol learning. Instructional approaches that are effective use direct, explicit teaching of letter sound relationships, syllable patterns, and meaningful word parts, and provide a great deal of successful practice of skills that have been taught. Fluent building exercises, vocabulary instruction, language comprehension, and writing are all included in comprehensive programs of instruction and intervention. Word recognition and spelling skills are applied in meaningful reading and writing sentences and text passages, and students receive immediate feedback if they make mistakes. Guessing at words and skipping words is discouraged and replaced by knowledge of how to analyze and read unknown words. Other key principles of instruction are listed below.

What are the principles of a multisensory, structured language approach? Teaching uses all learning pathways in the brain (i.e., visual, auditory, kinaesthetic, tactile) simultaneously or sequentially in order to enhance memory and learning. Multisensory language instruction requires that the organization of material follows the logical order of the language. The sequence must begin with the easiest and most basic concepts and progress methodically to more difficult material. Each concept must be based on those already learned. Concepts taught must be systematically reviewed to strengthen memory. The inferential learning of any concept cannot be taken for granted. Multisensory language instruction requires direct teaching of all concepts with continuous student-teacher interaction. The teacher must be adept at flexible or individualized teaching. The teaching plan is based on careful and continuous assessment of the individual's needs. The content presented must be mastered step by step for the student to progress. Multisensory, structured language programs include both synthetic and analytic instructions. Multisensory instruction presents the parts of the language and then teaches how the parts work together to form a whole. Analytic instruction presents the whole and teaches how these can be broken down into its component parts. All levels of language are addressed, often in parallel, including sounds (phonemes), symbols (graphemes), meaningful word parts (morphemes), word and phrase meanings (semantics), sentences (syntax), longer passages (discourse), and the socialises of language (pragmatics).

Studies of phonologically based approaches
In its annual review of reading instruction (2000), the National Reading Panel (NRP) screened 1,962 citations on PA studies and reviewed that satisfied research methodology criteria. These showed that PA-based instruction significantly improved the reading performance of poor readers in first grade. Most intensive instructional approaches for students with dyslexia include the same strategies as recommended by the NRP for the general classroom. However, the way in which phonology and other language structures are explicitly and systematically taught, the amount of practice given, the mode of delivery (small group or one-on-one) and the use of mult-sensory enhancing techniques that link listening, speaking, reading, and writing. The efficiency of these different approaches has been assessed, and findings show that reading accuracy can be significantly improved in younger and older poor readers using several phonologically based methods. However, reading rate and to some extent, reading comprehension have proven to be more difficult to treat, and research is needed to understand why reading fluency is difficult to achieve. Although intensive, structured, explicit, phonologically based reading instruction has been validated, the neurobiological mechanisms by which this approach operates are largely unknown.

Studies of perceptual training
One prevailing approach in neuroscience research has involved the study of the relationship between early sensory processing of verbal and non-verbal sounds and its effects on phonological processing. Studies of individuals with specific language impairment (defined by poor oral language and frequently accompanied by reading problems) show that these individuals require longer use of inter-

REFERENCES