TEXAS SCOTTISH RITE HOSPITAL FOR CHILDREN

ORTHOGRAPHIC PROCESSING: A SUBCOMPONENT, NOT A SUBTYPE, OF DEVELOPMENTAL DYSLEXIA

WHAT IS ORTHOGRAPHY, ORTHOGRAPHIC KNOWLEDGE AND ORTHOGRAPHIC PROCESSING?

Orthography is the methodology of writing a language, which primarily consists of spelling, but includes, contractions, punctuation, and capitalization. Knowledge of orthography is stored in memory in the form of rules and representations of words or parts of words.[1] Orthographic processing, or coding, is the skill or facility to use orthographic knowledge to read and spell words.

ORIGINS OF THE TERM "ORTHOGRAPHIC DYSLEXIA"

The impetus to split the word reading problems of individuals with dyslexia into distinct subtypes can be traced to case reports of adults whose deficits occurred after brain injury.[2] Damage to left brain language regions produced patterns of reading and spelling errors that were explained by hypothetical models of cognitive processing that fell into two main categories, labeled "surface" and "deep dyslexia". Those with "deep dyslexia" appeared to have impairments in the ability to go "deep" within the word to use letter-sound associations (phonological) rules. This profile was later called "phonological dyslexia". Failure to use "surface" features or letter sequences (orthography) was recognized in those who were categorized as "surface dyslexics".[3]

When the word reading problems of children were subdivided, those with errors matching the surface pattern were labeled "developmental surface dyslexia", "dyseidetic dyslexia"[4] and more recently "orthographic dyslexia".[5]

With relative strengths in phonological processing and weaknesses in orthographic processing, individuals with "orthographic dyslexia" are recognized by their ability to read regular words better than irregular words, reduced sight vocabulary, slow reading rate, spelling errors that are phonologically correct but do not follow the conventions of written English.

ORTHOGRAPHIC PROCESSING IN THE PHASES OF READING DEVELOPMENT

Orthographic and phonological processing are utilized to produce printed (sight) word recognition, according to Ehri's model of reading development.[6] The relative contribution of each varies with a reader's developmental level, familiarity with the word being read and reading skill. Pre-readers rely on the visual and context features of a word. With phonics instruction, phonological processing permits words to be "sounded out" slowly, and eventually, accurately.

Phonological coding plays a role in establishing orthographic representations, as suggested by Share's self-teaching hypothesis.[7] After several successful attempts of decoding, the skilled reader recognizes the word efficiently by "sight" without pausing to consciously apply letter-sound associations. This has been called orthographic reading. This does not mean that skilled readers do not engage phonological processing, or that impaired orthographic processing is a cause of dyslexia that is independent of phonological skill.[8]

WHY IS ORTHOGRAPHIC PROCESSING A SUBCOMPONENT, NOT A SUBTYPE, OF DYSLEXIA?

Orthographic processing is one of several neurocognitive factors, along with phonological processing, that contribute to the ability to read words. Other neurocognitive processes include the use of meaning and context.[9] Dividing dyslexia into subtypes suggests that each category has unique underlying features. However, research has shown that dyslexia is almost always the result of deficits in multiple processes and that weak phonological processing is the most important causal factor.[10] The relative contribution of each neurocognitive process to the difficulty with reading and spelling varies from individual to individual, and even within individuals over time.[11] Research has also shown that difficulties attributable to orthographic processing, and related variability in naming speed, are largely the result of limitations in the environment, reading experience and print exposure.[12] This suggests that orthographic difficulty is better understood as a delay, rather than a genetically determined cognitive deficit.[13]

CONCLUSION

Processing of phonology, orthography and semantics/context contribute to word reading ability and dysfunction (dyslexia). The relative contribution of phonological and orthographic processing to dyslexia can be inferred by analysis of reading and spelling errors and formal measures.[14] Significant difficulty reading irregular/exception words relative to regular words is the most basic distinguishing feature of orthographic deficits. The pattern of orthographic deficits is frequently the result of insufficient exposure to written language, sometimes is present following intensive phonological training and rarely is produced by a biologically-based neurocognitive difference. Genetics plays a greater role in phonological processing; and environment, especially reading experience, is more influential in orthographic processing.[15]

Current research does not support the use of dyslexia subtypes, including surface or orthographic dyslexia, to guide assessment and intervention.[16] Diagnostic criteria for dyslexia subtypes were not included in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5). Definitions of dyslexia adopted by the International Dyslexia Association and written into Texas education code recognize that the word reading impairment in dyslexia

typically is the result of a deficit in phonological processing. Because pure developmental dyslexia subtypes are rare (i.e. only phonological, only orthographic) clinicians should be prepared to flexibly evaluate and remediate all factors contributing to the reading problems of children with dyslexia based on student needs, rather than rigidly following an approach dictated by a label. Recommended remediation techniques are listed following the endnotes.

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Endnotes

[1] Apel, K. (2011). What is orthographic knowledge? *Language, Speech and Hearing Services in Schools*, 42, 592-603.

[2] Marshall, J.C. & Newcombe, F. (1973). Patterns of paralexia: A psycholinguistic approach. *Journal of Psycholinguistic Research, 2*, 175-199.

[3] Coltheart, M., Masterson, J., Byng, S., Prior, M. & Riddoch, J. (1983). Surface dyslexia. *Quarterly Journal of Experimental Psychology*, *35A*, 469-95.

[4] Boder, E. (1973). Developmental dyslexia: A diagnostic approach based on three atypical reading-spelling patterns. *Developmental Medicine and Child Neurology*, *15*, 663-687.

[5] Roberts, R. & Mather, N. (1997). Orthographic dyslexia: The neglected subtype. *Learning Disabilities Research and Practice, 12,* 236-250.

[6] Ehri (1995). Phases of development in learning to read by sight. *Journal of Research in Reading*, *18*, 116-125.

[7] Share, D.L. (1999). Phonological recoding and orthographic learning: A direct test of the self-teaching hypothesis. *Journal of Experimental Child Psychology* 72, 95-129.

[8] Burt, J.S. (2006). What is orthographic processing skill and how does it relate to word identification in reading? *Journal of Research in Reading,* 29, 400-417.

[9] Plaut, D.C., McClelland, J.L., Seidenberg, M.S. & Patterson, K. (1996). Understanding normal and impaired word reading: Computational principles in quasi-regular domains. *Psychological Review*, 103, 56-115.

[10] Peterson, R.L., Pennington, B.F., & Olson, R.K., (2013) Subtypes of developmental dyslexia: Testing the predictions of the dual-route and connectionist frameworks. *Cognition*, 126, 20-38.

[11] Manis, F.R., Seidenberg, M.S., Stallings, L., Joanisse, M., Bailey, C., Freeman, L., Curtain, S. & Keating, P. (1999). Development of dyslexic subgroups: A one-year followup. *Annals of Dyslexia*, 49, 105-134.

[12] Manis, F.R., Seidenberg, M.S., Doi, L.M., McBride-Chang, C. & Peterson, A. (1996). On the bases of two subtypes of developmental dyslexia. *Cognition*, 58, 157-195.

[13] Bailey, C.E., Manis, F.R., Pedersen, W.C., & Seidenberg, M.S. (2004). Variation among developmental dyslexics: Evidence from a printed-word-learning task. *Journal of Experimental Child Psychology*, *87*, 125-154.

[14] Mather, N. & Wendling, B.J. (2012). Essentials of Dyslexia Assessment and Intervention. Hoboken, N.J.: John Wiley and Sons, Inc.

[15] Castles, A., Datta, H., Gayan, J. & Olson, R.K. (1999). Varieties of developmental reading disorder: Genetic and environmental influences. *Journal of Experimental Child Psychology*, 72, 73-94.

[16] Peterson, R.L., Pennington, B.F., Olson, R.K. & Wadsworth, S. (2014). Longitudinal stability of phonological and surface subtypes of developmental dyslexia, *Scientific Studies of Reading*, 18, 347-362.

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Remediation Techniques for Children with Orthographic Processing Difficulties

Instructional content for struggling readers with orthographic processing difficulties should be delivered to address the students' specific needs. The educator will want to target intervention with the following characteristics and methods in mind.

If the student has…

- **adequate phonological abilities, phonemic awareness, and decoding skills**
  - *an intensive phonetic approach to reading instruction that emphasizes phonemic awareness and phonics is not needed*
- **confusion of similar graphemes (e.g., p/q)**
  - *explicitly teach letter formation and provide handwriting practice*
- **difficulties with rapid recognition of high frequency words**
  - *teach word study with an emphasis on morphological awareness (e.g., base words, roots, prefixes, and suffixes) and spelling patterns*
  - *practice automaticity with Fry's/Dolch list of instant words*
  - *use repeated reading to develop automatic recognition of word patterns*
- **problems recognizing syllables and morphemes**
  - *provide word building activities with prefixes, roots, and suffixes*
  - *teach derivative rules for spelling when adding a suffix (e.g., adding [running], dropping [saving], and changing rule [cried])*
  - *teach derivative rules for spelling of words that share a common root or base word (e.g., instruct/destruction, know/knowledge)*
- **problems with spelling accuracy, more related to morphological awareness, semantic awareness, and mental graphemic representations (sight words)**
  - *use a structured approach (sequential and systematic) to teach spelling*
  - *practice sight words with the see it, say it, write it while saying it, write it from memory sequence (Fernald technique)*
  - *build awareness of word meaning and differences for homophones (there, their, they're; road, rode)*
- **over-use of unconventional spelling units**
  - *use a structured approach to spelling with emphasis on conventional spelling rules*
- **over-reliance on reading phonetically or sounding out each word**
  - *promote speed in word recognition using rapid word recognition charts with irregular words*
- **difficulties with text reading fluency (and associated comprehension problems)**
  - *practice and monitor progress of oral reading with repeated readings of continuous text*
  - *provide explicit instruction and strategies for reading comprehension*