Dyslexia Subtypes Based upon the Dual-Route Model of Reading

By David A. Kilpatrick

In recent years there has been increased interest in the school psychology field in diagnosing subtypes of dyslexia based upon the dual-route model of reading (Feifer, 2011, 2014; Mather & Wendling, 2012). There's even a new test that assists with that (Feifer & Nader, 2015). It is argued below that while there may be valid subtypes of dyslexia among acquired dyslexics (adults who lost some of their reading skills as a result of a stroke or head injury), subtypes of developmental dyslexia based upon the dual-route model lack adequate empirical support, despite their recent popularity.

Acquired dyslexia was first described in the 1970s in adults who had some neurological incident (e.g., stroke) who lost some of their reading capacity. A subset of acquired dyslexics fall into one of three patterns, *surface dyslexia* (Patterson, Marshall, & Coltheart, 1985), *phonological dyslexia* (Coltheart, 1996), and *deep dyslexia* (Coltheart, Patterson, & Marshall, 1980).

In brief, surface dyslexia involves the ability to read phonically regular words and nonsense words, but failure to remember the words that the adult previously knew. Phonological dyslexia involves remembering words previously learned, but difficulty sounding out new words and reading nonsense words. Deep dyslexics display difficulties with phonic decoding but also make semantic errors (e.g., reading "tree" for "bush").

The dual-route model of reading

The dual route model of reading parallels the skills described above. It proposes that there are two routes to reading, phonological and direct. The latter refers to instantly recognizing familiar words and the former involves sounding out unfamiliar words. Skilled

readers, children and adults, are competent in both. Struggling readers are weak in both. From a theoretical perspective, the dual-route does little more than describe these two patterns of interacting with words. Essentially, some words we know and instantly read them, and some words we don't know so we sound them out. These are not two alternative reading strategies. Instant recognition is effortless and pre-cognitive (the word is available to us before we even think about it), and thus not well described by the term "strategic." The word is available to the reader before any strategy can be selected. The phonological route can be a strategy that requires anywhere from a little effort to a lot of effort, depending on the individual's phonic decoding skills and the complexity of the word being read.

Importantly, the dual route theory is not a theory that tells us anything about the development of the direct route or the development of the phonological route. It only affirms that they exist. One needs to go beyond the dual-route theory to understand how reading actually happens cognitively as well has how it develops and why some students struggle with developing these "routes." As a result, the dual-route theory does not represent a useful instructional framework for reading.

Developmental dyslexia.

Developmental dyslexia refers to those who, unlike acquired dyslexia, never learned to read efficiently, despite appropriate instruction and effort. Is there evidence that some children can develop the direct route without the phonological route or vise versa?

Reading Research. Most school psychologists and other educational professionals are not familiar with the enormous, heavily grant-funded enterprise of empirical reading research. Tens of millions of grant dollars are spent each year in the US alone on the scientific study of reading. These studies are published in journals outside the school psychology field. The

empirical reading research field has been studying this issue of the existence of phonological and surface subtypes of dyslexia for over 30 years, and it seems that individuals in the school psychology and neuropsychology fields appear to approach this issue of dyslexia subtypes without apparent reference to the work that has already been done on this issue. Several reviews of research have not found substantial evidence to validate the phonological vs. surface subtyping scenario (e.g., Ahmed, Wagner, & Kantor, 2012; Fletcher, Lyon, Fuchs, & Barnes, 2007; Hulme & Snowling, 2009; van den Broeck & Guedens, 2012; Vellutino, Fletcher, Snowling, & Scanlon, 2004).

The research literature on subtypes is extensive and below are only some highlights as to why reading researchers generally do not accept the idea that dyslexia can be validly broken down into phonological vs. surface subtypes.

First, this subtyping scenario superimposes an adult, neuropathology-based model onto children who do not display similar neurological conditions. It cannot be assumed that this "fits" because acquired dyslexics successfully learned to read as children and lost part of their fully developed neurocognitive "system" that produced the skilled reading. Developmental dyslexics never had that system in place.

Second, the evidence put forth to support the phonological vs. surface distinction has been plagued with methodical issues. After adjusting for these methodological issues, any apparent distinction typically disappears (van den Broeck & Guedens, 2012; van den Broeck et al., 2010). As mentioned, the original support for dyslexia subtypes,[1] were clinical cases of adult

[1]Another dyslexia subtyping scenario involves looking at students with rapid naming difficulties but no phonemic awareness issues and those with the reverse pattern, and those who struggle with both of these. This has had much more empirical support but is still far shy of being considered a valid way to subtype dyslexia, despite extensive research on this issue. This issue will not be addressed here, so mention of subtypes will be restricted to distinguishing phonological from surface presentations of dyslexia.

neurological patients. Applying this to developmental dyslexia came later, and used chronological aged (CA) controls (Castles & Coltheart, 1993; Heim et al., 2008). Results indicated that some students fit the phonological and surface subcategories, while most had a mixture of symptoms (i.e., poor at the phonological and direct routes). But there are significant confounds with the CA control design (e.g., Stanovich, Siegel, Gottardo, Chiappe, & Sidhu, 1997; van den Broeck & Guedens, 2012). To address these confounds, it became popular for over 20 years to use reading-aged controls. This involves matching older dyslexics with younger students who had the same score on a word identification test. Using this research design, very few students fit the phonological subtype, while the surface subtype more or less disappeared. Most students fit the more generic combined type (Stanovich et al., 1997; van den Broeck & Guedens, 2012).

Over the past few years, a researcher from Belgium who specializes in research design, along with his colleagues has demonstrated quite convincingly that the RA matched control design produces the phonological subtype (see van den Broeck & Guedens, 2012, van den Broeck et al., 2010). If you match an older elementary student (say fourth, fifth, or sixth grader) with a second grader on a word identification subtest, there is a serious confound. The older students have had many years of exposure to common first and second grade level words, so eventually they become familiar and they can thus match an average second grader on such a test. However, they are really very poor at the skills that underlie reading as their poor nonsense word reading shows. If their nonsense word reading is at a first grade level while their word identification subtest is at a second grade level, this is deemed evidence for the phonological subtype of dyslexia because the second graders have both nonsense word reading and word identification at the second grade level. The perception is that those older

students' phonic decoding is worse than their real word reading. As mentioned, this does not account for a number of confounds, including extra years of reading instruction. Van den Broeck and his team developed two non-confounded experimental designs (see van den Broeck & Guedens, 2012, van den Broeck et al., 2010) and with each design, the surface and phonological dyslexia subtypes disappeared. They showed, consistent with an extensive base of research with studies numbering in the thousands (Fletcher et al., 2007; Hulme & Snowling, 2009; Vellutino et al., 2004) that dyslexia is based upon the phonological-core deficit.

In addition, their findings are consistent with another area within the reading research literature regarding word learning/orthographic learning (Ehri, 2005, 2014; Kilpatrick, 2015; Share, 1995). By contrast, the traditional subtyping scenario was developed long before the advances in word learning research over the last 30 years and it seems to reflect a theoretical understanding of reading that predominated the literature in the 1970s and 1980s. Research has moved well beyond just acknowledging that some words are familiar and instantly read and some are not and phonically decoded, which is the core of the 1970s derived dual-route hypothesis. For the last 30 years, researchers have been refining their understanding of the phonological-core issues (phonemic awareness, phonological blending, rapid automatized naming, phonological working memory, nonsense word reading) that contribute to both phonic decoding and storing words for later, instant retrieval (i.e., both "routes").

Despite these problems of methodology, and the lack of clear findings in the literature, some authors have presented the phonological and surface subtypes of dyslexia without adequately indicating the serious questions surrounding this subtyping scenario. Rather it is presented in a matter-of-fact way as if it were well-established in the research (e.g., Feifer, 2011, 2014; Mather & Wendling, 2012).

Third, the dual-route dyslexia subtyping model appears to make assumptions about various orthographic tasks that reflect an earlier understanding of the meaning of those tasks. Orthographic tasks include deciding among homophones (e.g.,. "Which is a body part, *brane* or *brain*?") and determining what are orthographically correct possibilities (e.g., "Which of the following two is more like a real word, *yat* or *tya*?"). These assumptions have largely been abandoned as a result of updated research. In the classic subtyping model, orthographic skills are treated as if they are a reading-related sub-skill, alongside phonemic awareness, letter-sound knowledge, rapid naming, and vocabulary. In general, the research supports the notion that orthographic task performance is a *by-product* of learning to read, not a cause. A review of the research by Jennifer Burt (Burt, 2006) seems to have been a turning point in the research literature on this issue. Burt demonstrated that there was no substantial evidence to support the notion that orthographic skills were a contributing factor in learning to read, independently of letter-sound knowledge, phonemic awareness, and reading experience. Numerous studies have since confirmed her review.

Fourth, the phonological/surface dyslexia distinction seems to assume that word reading is based in some important way on visual memory. Indeed, if a student supposedly can remember words well despite being a phonological dyslexic, how is he doing it if not via some sort of visual memory? One author says the surface dyslexic under-relies on "the orthographical or spatial properties of the visual word form" (Feifer, 2014, p. 157). Precisely what "orthographical" means here is not clear, but there is no evidence that any spatial or visual word "form" properties are involved in how familiar words are established in memory. The "visual word form area" of the brain (i.e., the left fusiform gyrus) is not related to visual word forms and was thus an unfortunate early mis-naming of a new discovery (see footnote

later), that is, the discovery of the area of the brain that activates when we see familiar words. We know from countless studies that familiar words are stored orthographically (i.e., a memory for a familiar *letter order* of a word, regardless of the "look" such as case, font, print or manuscript, etc.), not visually.

A very serious concern about the phonological/surface subtyping model pertains to the instructional recommendations. Glezer et al. (2015) made a substantial contribution to showing on fMRI scans how as unfamiliar words become familiar, different areas of the brain activate. However, in their discussion section, they skip over hundreds of studies that they must not be familiar with when they make the following intuitive suggestion, "These findings have interesting implications for reading remediation in individuals with phonologic processing impairments because they suggest the possibility that these individuals might benefit from visual word learning strategies to circumvent the phonologic difficulties and directly train holistic visual word representations in the VWFA[2]" (p. 4971). They do not cite an article to support this recommendation because such an article does not exist. It is completely inconsistent with a massive amount of research suggesting that to competently read an alphabet-based written language—which involves characters designed to represent phonemes, not words—poor access to phonemes makes reading difficult. There is no efficient visual memory alternative to this. If there were, it would be very difficult to explain why the

[2]VWFA = visual word form area. As mentioned, it is an unfortunate quirk of reading research history that with the discovery that the left fusiform gyrus activates when familiar words are seen, this area was improperly named the *visual word form area*. We have no evidence to suggest that the visual form of the word plays any role in the initial storage or subsequent activation of known words. There is ample evidence to show it is *the precise letter order* that is instantly recognized in known words, as a holistic letter sequence. Thus, *bear, BEAR,* ***bear***, ***BEAR***, *bear, BEAR,* and even *bEaR* all provide the same activation—as a holistic familiar letter sequence—because they all represent the same letter order, despite their dramatically different visual word forms. Interestingly, Glezar et al., 2015 showed in their study that the now familiar sequences were all processed first phonologically before they became unitized orthographically familiar wholes. There was nothing in their study to suggest that phonology can be bypassed in this learning process, nor is there anything in the broader reading research literature to suggest this.

average student graduating high school who is deaf attains only a third grade reading level (Lederberg, Schick, & Spencer, 2013; Leybaert, 2000). Those who are deaf are as skilled in visual memory as those who are hearing, and decades of attempts of using a visual memory strategy for learning words has not worked with either students who are deaf or those who are hearing.

Conclusions

It seems that the enterprise of diagnosing phonological and surface subtypes of dyslexia lacks empirical support. This notion is common in the neuropsychology literature, yet articles published in that area frequently display no interaction with the broader enterprise of reading research mentioned above. As a result, the conventional dual-route based subtype model does not reflect research advances in the last 20-30 years regarding word-reading development, orthographic skills, and the role (or non-role) of visual skills in reading, nor does it take account of the research literature on word-reading intervention effectiveness. Despite its recent popularity in the field of school psychology, practitioners should not feel the need to establish a dyslexia subtype when evaluating students who struggle in word-level reading.

Note: A fuller discussion of this and related issues will appear in a book chapter by David A. Kilpatrick in the upcoming fourth edition of Contemporary Intellectual Assessment edited by Dawn Flanagan (2018).

REFERENCES

Ahmed, Y., Wagner, R. K., & Kantor, P. T. (2012). How visual word recognition is affected by developmental dyslexia. In J. S. Adelman (Ed.), *Visual word recognition: Vol. 2. Meaning and context, individuals and development* (pp. 196–215). New York, NY: Psychology Press.

Castles, A., & Coltheart, M. (1993). Varieties of developmental dyslexia. *Cognition, 47*, 149–180.

Coltheart, M. (1996). Phonological dyslexia: Past and future issues. *Cognitive Neuropsychology, 13*(6), 749-762.

Coltheart, M., Patterson, K., & Marshall, J. C. (Eds.) (1980). *Deep dyslexia.* London: Routledge & Kegan Paul.

Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading, 9*(2), 167–188.

Ehri, L. C. (2014). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning, *Scientific Studies of Reading, 18*(1), 5–21.

Feifer, S. (2010). How SLD manifests in reading. In D. P. Flanagan, & V. C. Alfonso (Eds.), *Essentials of specific learning disability identification* (pp. 21-41). Hoboken, NJ: Wiley.

Feifer, S. (2014). Selecting and tailoring interventions for students with reading difficulties. In J. T. Mascolo, D. P. Flanagan, & V. C. Alfonso (Eds.), *Essentials of planning, selecting and tailoring intervention: Addressing the needs of the unique learner* (pp. 151-176). Hoboken, NJ: Wiley.

Feifer, S. G., & Nader, R. G. (2015). *The Feifer assessment of reading.* Lutz, FL: PAR, Inc.

Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2007). *Learning disabilities: From identification to intervention*. New York, NY: Guilford Press.

Glezer, L. S., Kim, J., Rule, J., Jiang, X., & Riesenhuber, M. (2015). Adding words to the brain's visual dictionary: Novel word learning selectively sharpens orthographic representations in the VWFA. *Journal of Neuroscience, 35*(12), 4965–4972.

Heim, S., Tschierse, J., Amunts, K. Wilms, M., Vossel, S. Willmes, K., Grabowska, A., & Hube, W. (2008). Cognitive subtypes of dyslexia. *Acta Neurobiologiae Experimentalis, 68*, 73-82.

Hulme, C., & Snowling, M. J. (2009). *Developmental disorders of language learning and cognition*. Malden, MA: Wiley-Blackwell.

Kilpatrick, D. A. (2015). *Essentials of assessing, preventing, and overcoming reading difficulties.* Hoboken, NJ: Wiley & Sons.

Lederberg, A. R., Schick, B., & Spencer, P. E. (2013). Language and literacy development of deaf and hard-of-hearing children: Successes and challenges. *Developmental Psychology, 49*(1), 15–30. doi:10.1037/a0029558

Leybaert, J. (2000). Phonology acquired through the eyes and spelling in deaf children. *Journal of Experimental Child Psychology, 75*, 291–318.

Mather, N., & Wendling, B. J. (2011). *Essentials of dyslexia assessment and intervention.* Hoboken, NJ: Wiley & Sons.

Patterson, K. E., Marshall, J. C., & Coltheart, M. (Eds.) (1985). *Surface dyslexia: Neuropsychological and cognitive studies of phonological reading.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Share, D. L. (1995). Phonological recoding and self-teaching: Sine qua non of reading acquisition. *Cognition, 55*, 151–218.

Stanovich, K. E., Siegel, L. S. Gottardo, A. Chiappe, P. & Sidhu, R. (1997). Subtypes of developmental dyslexia: Differences in phonological and orthographic coding. In B. A. Blachman, (Ed.) *Foundations of reading acquisition and dyslexia* (pp. 115-141). Mahwah, NJ: Erlbaum.

Van den Broeck, W., & Geudens, A. (2012). Old and new ways to study characteristics of reading disability: The case of the nonword-reading deficit. *Cognitive Psychology, 65*, 414–456.

Van den Broeck, W., Geudens, A., & van den Bos, K. P. (2010). The nonword-reading deficit of disabled readers: A developmental interpretation. *Developmental Psychology. 46*(3), 717–734.

Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades? *Journal of Child Psychology and Psychiatry 45*(1), 2–40.