WRITING SYSTEMS, PHONEMIC AWARENESS, AND BILINGUALISM: CROSS-LINGUISTIC ISSUES IN DYSLEXIA

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ABSTRACT

Research suggests that more cases of dyslexia are diagnosed in populations that speak languages with highly opaque writing systems, such as the United States, the United Kingdom, or France, and fewer cases of dyslexia are diagnosed in populations that speak language with transparent writing systems, such as Italy, Spain, or Mexico. This disparity can be explained by the differences in how dyslexic people and non-dyslexic people read and by the many irregular combinations of letters in opaque orthographies that require memorization. Discussing these topics paves the way to considering issues of bilingualism and second language learning as they are related to dyslexia.

Introduction

Dyslexia is a learning disability that is often misunderstood. The popular perception of what dyslexia is or feels like is not in line with the reality of dyslexia. Dyslexia becomes an even more complex issue when multiple languages – and with them, multiple writing systems – are brought into play. My goal in this paper is to explore what dyslexia is, why dyslexia is different in various languages, how issues of multiple orthographies change dyslexia, the challenges faced by dyslexics who want to learn a second language, and the unique issues surrounding bilingualism in dyslexia. Throughout this exploration, it is inevitable to discover again and again that the unique characteristics of different writing systems are extremely influential in how dyslexia is manifested and even defined.

What is Dyslexia?

First, it would be valuable to give some background on what dyslexia is and what causes it. Most of the research done on dyslexia has been written in and about English speakers, partly because a large breadth of scholarly work is done in English and partly because English speakers, as a group, have a high prevalence of dyslexia as compared to speakers of other languages. As a result of this ample amount of work done on dyslexia in English speakers and because this paper is in English, I will talk about dyslexia in English speakers in this section. Dyslexia is defined as “unexpectedly low reading ability in people who have adequate intelligence, typical schooling, and sufficient sociocultural opportunities,” (Siok, Zhendong, Jin, Perfetti, and Tan, 2008, pg. 5561). Basically, dyslexia is only diagnosed after exhausting all other possible reasons for low reading levels.

Although the definition of dyslexia essentially labels it as a catch-all for poor readers, dyslexia is a specific impairment in reading and writing with its own unique characteristics. Most dyslexics struggle with issues of phonemic/phonological awareness. Far from the popular image of letters swirling around a page, impossible to catch and thus impossible to decipher, dyslexics actually have difficulty aurally distinguishing the phoneme [b] from [p] or [m] from [n] and so forth with other sounds that share multiple features. They also have issues in recognizing what a phoneme is. Dehaene (2009) gives the example of asking a child how many sounds they hear in the word “rich” and then asking how many they hear in the word “pitch.” For “rich,” most children will say three (r-i-ch), but for “pitch,” they will say...
four (p-i-t-ch) despite the fact that “rich” and “pitch” are minimal pairs and sound the same except for the first phoneme. This confusion results from having learned that [tʃ] can benotated as “ch,” but not yet realizing that it can also be written “tch,” so the children trick themselves into believing that they also hear a [t] in “pitch” as a result of a lack of understanding of grapheme to phoneme conversion. An adult with no language impairment would likely tell you that she hears three sounds for both “rich” and “pitch” because she has higher phonemic awareness than a child just learning to read. Dyslexics have trouble with these kinds of phonemic awareness tasks, generally answering in agreement with the child, and that difficulty is a defining characteristic of their condition.

Neurologically, Dehaene tells us, when dyslexics read, the left middle temporal gyrus is activated less than it would be in the brain of a non-dyslexic reader. To compensate for the low-performing left middle temporal gyrus, dyslexics overuse the left inferior frontal cortex (which contains Broca’s area). However, it does not seem to help them decode writing. Upon further examination, researchers have determined that dyslexics have more gray matter in the left middle temporal gyrus than have non-dyslexics. Unfortunately, this larger mass of gray matter seems to actually decrease productivity in the region because it is very unorganized and contains ectopias (misplaced neurons). The quantity of misplaced gray matter correlates positively with the severity of the reading impairment, which seems to go along with the idea that more gray matter in the left middle temporal gyrus decreases reading skill or productivity (2009).

These ectopias in the left middle temporal gyrus led researchers to the genetic causes of dyslexia, which include abnormal neuronal migration. During pregnancy, neurons migrate from the ventricles to where they are supposed to end up in the cortex. Ectopias are formed when the neurons go too far and “crash” land. Essentially, the excess unorganized gray matter around the left middle temporal gyrus in the brains of dyslexics is formed by neurons that were not told how to migrate correctly. Neuronal migration is dictated by some sections of DNA. Of the four genes that have been isolated and connected with dyslexia, three of them are involved in neuronal migration. If any of those three genes do not give the correct information and the neurons do not migrate how and where they are supposed to migrate, excess gray matter is formed around the left middle temporal gyrus while the child is still in the womb, later causing dyslexia (Dehaene, 2009).

There is more than one type of reading impairment, so it is important for anyone who is studying dyslexia to understand what other types of impairment there are, especially in terms of understanding when dyslexia is involved and when the impairment is something else. When I mention dyslexia in this paper, I am talking about developmental dyslexia, which is genetically transferred in the way that I have described above and present from birth. However, there are also many types of acquired dyslexia that usually result from brain lesions, either in the posterior region of the dominant hemisphere for language (usually the left) or in the dominant perisylvian region, meaning the area around the sylvian fissure (Coslett, 2000):
alexia (alexia without agraphia), neglect dyslexia, and attention dyslexia. All three types of peripheral dyslexia are caused by lesions, usually in the posterior region of the dominant hemisphere (as a lesion in the occipital lobe would disrupt the travel of some visual stimuli to other areas of the brain). Pure alexia is characterized by reading very slowly, letter by letter (Dehaene, 2009). Neglect dyslexia is characterized by missing the beginning of a string of letters. This form of dyslexia is sometimes affected by what the string is, so someone with neglect dyslexia could not be able to read a non-word like “tiggle” but be able to read a real word like “giggle”. Neglect dyslexia is sometimes affected by what the string is, so someone with neglect dyslexia could not be able to read a non-word like “tiggle” but be able to read a real word like “giggle” if she was sensitive to the letter “g” (Coslett, 2000).

Someone with attention dyslexia, the third type of peripheral dyslexia, could read a word on its own, but not when it is surrounded by words. Similarly, she could identify letters individually, but not in the context of a word (Coslett, 2000). Not much is known yet about the exact workings of the brains of people with these acquired dyslexias, but they are certainly related to visual difficulties, which developmental dyslexia usually is not.

In the category of central dyslexias, we find three specific types: deep dyslexia, phonological dyslexia, and surface dyslexia. All three of these dyslexias are also acquired, but phonological dyslexia and surface dyslexia are quite similar to developmental dyslexia. Deep dyslexia is characterized by semantic errors (giving “knight” as an answer when asked to read “castle”), visual errors (reading words as visually similar words, e.g. reading “scale” as “skate”), morphological errors (reading “scolded” as “scolds” or “governor” as “government”), reading words that describe tangible objects (“hat,” “car”) more easily than words that describe intangible ones (“wish,” “thought”), reading nouns more easily than adverbs/adjectives, which in turn are read more easily than verbs (though this difference in difficulty may be as a result of the tangible/intangible issues), having a hard time reading function words (which again, could have to do with the tangibility issue), and having great difficulty reading pseudo-words. This is a very wide range of symptoms, so there are several proposed explanations for what processes exactly are disrupted in deep dyslexia, but the most likely answer seems to be that the process of converting from graphemes to phonemes is disrupted, some semantic impairment is involved, and visual processing issues also persist. Deep dyslexia is usually caused by lesions in the dominant perisylvian region (Coslett, 2000, pg. 238-9).

As we can see based on the symptoms, deep dyslexia and the peripheral dyslexias are not very similar to developmental dyslexia. Phonological and surface dyslexia, however, are slightly more similar. Phonological dyslexia is characterized by not being able to read non-words. Although people with phonological dyslexia can read 85-95% of words correctly, they sometimes perform as poorly at 10% correctness on pseudo-words (Coslett, 2000, pg. 239). Usually this difficulty stems from confusing a non-word with a real word that looks similar to it or from converting graphemes to phonemes incorrectly (e.g. pronouncing the non-word “stime” as [stɪm] to rhyme with “him” rather than [stæm] to rhyme with “lime”). Phonological dyslexia is also usually caused by lesions in the dominant perisylvian region, but most phonologic dyslexics also have lesions in the angular and supramarginal gyri as well as the superior temporal lobe (Coslett, 2000, pg. 239-40).

The last type of dyslexia, and the most similar to the majority of cases of developmental dyslexia, is surface dyslexia. It is characterized by relative ease reading phonologically regular words and non-words, but difficulty reading irregular words. Some people with surface dyslexia are only able to grasp the meaning of a written word after they have found its phonological form by saying it aloud or thinking it (Coslett, 2000, pg. 240-1). These issues with phonological forms seem to stem from difficulty accessing the lexical route, which is one of the two ways that readers process written language. To read a word, we either go through the lexical route or the phonological route in the brain. The phonological route is the way that non-dyslexic elementary schoolers read: sounding the words out to get their meaning. The lexical route is more like how non-dyslexic adults read: seeing a word on the page leads directly to its meaning without the phonological middle man. Most
non-dyslexic adults do not read only with the lexical route, but some words do become more automatic and can take the lexical route, which some longer and less frequent words still need to be sounded out to be understood (Dehaene, 2009). The issue of phonological route vs. lexical route is an important one in the discussion of dyslexia because so many dyslexics have difficulty accessing the lexical route.

In summary, dyslexia in English speakers is an issue of difficulty in converting graphemes to phonemes. It is caused by excess unorganized gray matter in the left middle temporal gyrus, which does not activate as much as it would in a non-dyslexic while reading. The excess gray matter is a result of poor neuronal migration, which, in turn, is a result of poorly laid plans by some strands of DNA. There are six types of acquired dyslexia, two of which (phonological and surface dyslexia) are similar to developmental dyslexia, which is the reading impairment that this paper discusses. Dyslexia seems to exist on some sort of spectrum, so there can be more severe and less severe cases (which we judge in English by the amount of excess gray matter surrounding the left middle temporal gyrus).

**Differences in Dyslexia Across Languages**

As I mentioned earlier, English speakers have higher rates of dyslexia than do speakers of other languages. This fact seems odd at first, but there is a simple explanation. A language whose writing system has graphemes mapping almost one-to-one onto phonemes is called a transparent writing system (e.g. Spanish, Italian), while a writing system where graphemes have many phonetic interpretations or phonemes have many graphemic interpretations is called an opaque writing system (e.g. French, English). As stated before, dyslexia is primarily an issue of phonemic awareness and converting graphemes to phonemes, so languages with transparent writing systems are the ones whose speakers have relatively low rates of dyslexia because it is easier to convert graphemes to phonemes when there is an almost one-to-one correspondence. As an example, Italian has 33 ways to spell its 25 sounds while English has approximately 1,120 ways to spell its 40 sounds (Helmuth, 2001, pg. 2064). This disparity in number of irregular combinations of letters helps to explain why there are fewer cases of dyslexia in Italy than in the United Kingdom or the United States.

Of course, having low rates of diagnosis of dyslexia does not mean that there are no dyslexics in Italy. Dyslexia still exists in the same form in Italy; the brains of Italian dyslexics (whether diagnosed or not diagnosed) have the same characteristics as the brains of English dyslexics with excess gray matter and ectopias in the left middle temporal gyrus. However, dyslexia, as stated before, exists on a spectrum. Paulesu, a knowledgeable scholar in the field of Italian vs. English dyslexia, suggests that mild dyslexia may be “aggravated” by opaque orthographies like English or French (2001, pg. 2167) so that mild dyslexia may not be obvious in some Italian readers while it would be in an English or French reader. This difference in display but similarity in condition can be seen from testing dyslexic speakers of different languages on reading comprehension and on phonemic awareness. In one study, Italian, English, and French dyslexics performed equally poorly on phonological tasks, but the Italian dyslexics performed better on reading comprehension tasks than did the speakers of languages with opaque writing systems, showing that while the condition of dyslexia is the same in these three languages, it is more clearly manifested in languages with opaque orthographies (Johansson, 2006, pg. 33). In fact, even in non-dyslexic, fully grown readers, there is a reading speed difference between languages with transparent orthographies and languages with opaque orthographies (Frost, Katz, and Bentin, 1987), so the issue may be less about dyslexia and more about transparent writing systems being easier to process than opaque ones. Regardless, there are less diagnosed cases of dyslexia in countries where a language with a transparent writing system is spoken than countries were a language with an opaque writing system is spoken.

Although writing about how languages with transparent orthographies tend to have less dyslexic readers than languages with opaque writing systems do is very interesting, we do have to remember that cause and effect are not always so clear. In one study of predictors of
reading skill across several languages, an author cautioned his readers with one possible explanation of why literacy skills may be higher in countries with languages that have transparent writing systems:

[One] explanation may be that an interaction between literacy levels and phonological skills leads to variation in the ability of measures to assess these skills across languages. Hence, a highly transparent orthography leads to high-level literacy as well as good phonological skills in certain areas but not in others requiring more complex literacy and variable phonological measures to assess these varying skill levels (Smythe, Everatt, Al-Menaye, Xianyou, Capellini, Gyarmathy, and Siegel, 2008, pg. 184)

Though it is certainly possible that the only reason why there are less cases of dyslexia in languages with transparent orthographies may be that these languages are easier for dyslexics to read, it may also be possible that having a highly transparent orthography may allow for more opportunities for learning of literacy and phonological skills than a dyslexic reading a language with a relatively opaque writing system would have.

Most of this discussion of dyslexia so far has been focused on languages with alphabetic writing systems, but there are many languages in the world with logographic systems or systems somewhere in between alphabetic and logographic. Mandarin Chinese is an interesting example because it is a widely spoken language with a mostly logographic writing system. Since readers of Chinese do not perform a lot of conversion from graphemes to phonemes because their writing system is non-alphabetic, dyslexia in Chinese is somewhat related to phonological problems, but is more an issue of low levels of activation in the left middle frontal gyrus, where visuospatial and verbal working memory is coordinated (Siok, Zhendong, Jin, Perfetti, and Tan, 2008, pg. 5564). This area may be recruited to deal with Chinese characters because they require memorization. Unlike dyslexia in English, there is also component of impaired reading in the right hemisphere. Non-dyslexic readers of Chinese react strongly to writing in the right midinferior frontal gyrus, while dyslexics react more strongly in the right inferior occipital cortex (Siok, Zhendong, Jin, Perfetti, and Tan, 2008, pg. 5564). It seems that the right midinferior frontal areas of the brain are involved in fluent reading of Chinese, while the right inferior occipital areas are involved in the visual processing of the characters, suggesting that dyslexic Chinese readers have issues processing the characters before even dealing with the phonological processing (if they need to use the phonological route at all). Dyslexia in Chinese may also be related to handwriting skill because to learn and memorize characters, Chinese children copy the characters out many times over in school (Siok, Zhendong, Jin, Perfetti, and Tan, 2008, pg. 5564). These huge differences in cause of reading impairment across writing systems raise a fascinating question: is dyslexia a different condition in readers of Chinese versus readers of English? Not enough research has been done yet to give a confident answer to this interesting idea, but it is important to keep this question in mind when discussing cross-linguistic issues of dyslexia.

When Scripts Intersect

The differences between writing systems and how we read differently depending on what kind of script we are reading is fascinating, but what happens when our brain deals with more than one orthography? Japanese is a language that has three scripts: kanji, hiragana, and katakana. Kanji is a logographic script borrowed from Chinese. Hiragana and katakana can be encompassed under one name: kana. Kana is a syllabic script that is completely regular and transparent: one character is one syllable and the character always means the same sound. No more than one character relates to one sound. There is a perfect one-to-one correspondence of grapheme to sound. Readers of Japanese probably process kanji in the same way that readers of Chinese process their writing, while Japanese readers likely process kana similarly to a highly transparent alphabetic script. Because of these two scripts that are processed in very different ways, Japanese has a very unique writing system.

The Japanese kana system may give dyslexics a chance to re-interpret phonemes and give them a tool for understanding writing, thus
causing less dyslexia in Japan than in other countries (Johansson, 2006, pg. 35). Because Japanese has two writing systems that do not generally cause people with phonemic awareness issues to be diagnosed with dyslexia (since the kana system is transparent and the kanji system is logographic, which does not require phonological skill), the numbers of diagnosed dyslexics in Japan are lower than in English-speaking countries (Wydell and Kondo, 2003, pg. 38). Wydell and Kondo found a college student who is natively bilingual in Japanese and English and has severe reading problems in English, but no issues in Japanese (2003). This lack of reading problems in Japanese is likely caused by their subject (1) not having the memory issues or handwriting issues that would cause problems for a reader of Chinese or other logographic writing systems and (2) the extreme regularity and transparency of the kana system.

It is fairly uncommon for scripts to intersect except when looking at bilingualism, so I will only discuss one other example of a language that can be written with more than one script that illustrates a very different point from the example of Japanese. Currently, Serbian is written with Cyrillic characters and Croatian is written with Roman characters, but in the 1980’s when Feldman and Turvey performed a study on this issue, Serbian and Croatian were one language, Serbo-Croatian, that could be written either with the Cyrillic alphabet or with the Roman alphabet. Because of this variance in ways to write the language, children learned how to write their language with both alphabets in school, so they were all essentially “bigraphic.” Serbo-Croatian is highly transparent, so it is very easy to agree on how non-words should be read and non-words should be read fairly quickly. In the way of writing at the time, there were some characters that were the same in the two writing systems and signified the same sound: A, E, O, J, K, M, and T. There were also some characters that looked the same in the two systems, but meant a different sound: H, P, C, and B. This means that there were eleven letters in total with overlap between the Cyrillic alphabet and the Roman alphabet. The scholars performing the study had “bigraphic” readers of Serbo-Croatian read several words that they had selected that only used letters from the eleven overlapping characters. Some words would convey real meaning if they were read as written in the Cyrillic alphabet but would be non-words in the Roman alphabet. Other words were real words in the Roman alphabet but non-words in the Cyrillic. The “bigraphic” readers took twice as long to read any of these overlapping words as they took to read words that contained clear indicators of Cyrillic (e.g. Ъ, Ы) or Roman (e.g. S, D). This study suggests that the phonological route is very important in Serbo-Croatian as a shallow language because the participants did not recognize the words via the lexical route, which would have saved them time (Feldman and Turvey, 1983).

Second Language Learning

Although the popular conception is that to learn multiple languages, you must be somehow intelligent, intelligence is not necessarily related to skill for language learning, which means that there may be some other inherent skill for language learning. It seems that the number one predictor of overall skill in a second language (L2) is read and written native language (L1) proficiency, but speed of native language learning is also a significant predictor of L2 skill (Sparks, Patton, Ganschow, Humbach, and Javorsky, 2006). This piece of information obviously has important implications for dyslexics who want to learn a second language, since their reading and writing skills are less developed than those of non-dyslexics. However, there are ways to combat this language-learning disadvantage, since knowledge of vocabulary in the native language and familiarity with the L2 writing system also play a role in predicting second language proficiency (Kahn-Horwitz, Shimron, and Sparks, 2006, pg. 177-8). Dyslexics could focus on learning a lot of vocabulary in their first language before attempting to learn a second language and try to choose a language with familiar writing system. Of course, most children who learn a second language transfer their reading difficulties and phonological processing issues over from L1 (Chung and Ho, 2010, pg. 195). In fact, Chinese dyslexics seem to be at high risk for a reading deficit in L2 despite the fact that the writing systems are so different. It also seems that the
level of difficulty involved in reading in L1 seems to be reflected in L2 (Chung and Ho, 2010, pg. 206). So regardless of coping strategy, these issues do present significant difficulties to dyslexics who seek to learn a second or third language.

Bilingualism

Bilingualism and dyslexia is the combination of everything that has been discussed in this paper: dyslexia, differences in dyslexia between languages, intersections of writing systems, and learning a second language. Combining the knowledge that we now have about all of those topics will allow us to understand the unique issues surrounding bilingual (and multilingual) dyslexics.

Bilingualism in itself is an interesting area of study with as many popular misconceptions attached to it as there are misconception about dyslexia. The main false belief about bilingualism is that raising a child to be bilingual will hurt the child’s development because learning more than one language at once will be too overwhelming. This is a concern that is often raised when discussing bilingual dyslexics. Some might say that if children cannot learn to read in one language, how can they learn to read in two or more languages? Cline (2000) provides a response:

We might hypothesize that the additional challenges will overload children with dyslexia and increase the likelihood of failure. But an alternative hypothesis is possible— that such children will benefit from varied reading experiences and will be more likely to engage successfully with print, generalizing from one form to another (pg. 8-9).

Dyslexics could be overwhelmed by multiple languages and “self-destruct” when it comes to reading or they could learn from multiple language experiences and use their knowledge to cope with their disability. So, to find the answer to this issue, the questions that we should be considering about bilingualism and dyslexia seem to be: (1) Do dyslexic bilinguals transfer their dyslexia across languages? and (2) Do dyslexic bilinguals perform worse, better, or the same on reading tasks as dyslexic monolinguals?

In terms of the question of whether dyslexia is transferred across languages, we have already seen that dyslexia is transferred across languages with the information on the Chinese-English bilingual dyslexics who tended to have similar reading difficulties in L1 and L2 (Chung and Ho, 2010, pg. 195). Another study with dyslexic and hyperlexic Kannada-English bilinguals showed that these bilinguals showed similar reading impairments in both languages that they spoke (Joshi, Padakannaya, and Nishanimath, 2010). However, Wydell and Kondo’s subject who was a Japanese-English bilingual was dyslexic in English but not in Japanese (2003). I suspect, however, that this lack of obvious dyslexia in Japanese was not actually a mystical absence of dyslexia in Japanese, but rather, a lack of obvious dyslexia in Japanese. Much like Italian dyslexics who do not manifest easily seen difficulties in reading because of the high level of transparency of their writing system, Wydell and Kondo’s subject likely did have some level of dyslexia in Japanese but it did not show because of the extreme transparency of the syllabic kana system and the lack of reliance on phonological representations inherent in the logographic kanji system.

As stated before, many people would expect dyslexic bilinguals to perform worse on language tests than dyslexic monolinguals because the bilinguals could be confused by speaking two languages. However, there is evidence that in at least one study, dyslexic bilinguals performed better on English tests than their dyslexic monolingual counterparts. A group of Arabic-English dyslexic bilinguals were compared to a group of dyslexic English monolinguals. The bilinguals learned to read English in school (as did the monolinguals) and Arabic at a three hours/week Arabic Heritage Language school. The researchers tested a group of non-dyslexic Arabic-English bilinguals against a group of non-dyslexic English monolinguals using word and pseudo-word reading tests and general language proficiency. These two groups performed at a similar level. However, when comparing the dyslexics, the Arabic-English bilingual dyslexics performed better than the English monolingual dyslexics on the same tests (although both groups performed worse than the non-dyslexics). The researchers
suggest that the highly regular orthography of Arabic may have helped the bilinguals to develop better literacy skills (Abu-Rabia and Siegel, 2002). So in some cases, bilingual dyslexics do perform better than monolinguals. Unfortunately, this area of study is still small, so I was unable to find any other studies specifically comparing reading skills of dyslexic bilinguals and monolinguals.

Another interesting case of bilingualism is the case of Hebrew and English. In a study of non-dyslexic Hebrew-English and English-Hebrew bilinguals, both the bilinguals whose first language was English and the bilinguals whose first language was Hebrew read English faster than Hebrew, even though bilinguals usually suffer some sort of speed and accuracy deficit in their second language (Shimron and Sivan, 1994). Shimron and Sivan theorize that reading Hebrew takes more time because of its ambiguity when unvoweled (Hebrew, like the other Semitic languages, is traditionally written without vowels and the vowels must be inferred), its complex affixes that require extra mental “unpacking,” and its right-to-left orientation (words seen in the right visual field are processed more quickly because they go straight to the left hemisphere of the brain where language is centered) (1994). Regardless of why this difference in reading speed occurs, it runs counter to the typical situation where L2 is slower to read than L1, so Hebrew gives us an interesting forum in which to compare bilingual dyslexics and bilingual non-dyslexics.

In one study by Oren and Breznitz, Hebrew(L1)-English(L2) dyslexic bilinguals were compared to Hebrew-English non-dyslexic bilinguals. The dyslexics performed poorly on speed, phonological processing, and orthographic ability both in Hebrew and in English. While dyslexics were slower in reading Hebrew than the non-dyslexics, their accuracy was the same as non-dyslexics. In English, both reading rates and accuracy were lower for dyslexics than non-dyslexics. The dyslexics’ reading rates in English were also slower than their reading rates in Hebrew, a contrast from the non-dyslexics who read faster in English (2005). In an analysis of their data, Oren and Breznitz explained that in skilled readers, reading proficiency in English does not have to follow the typical L2 profile and readers can, in fact, be more proficient in English than in Hebrew (L1). However, in impaired readers, the demands for phonemic awareness in English and decreased automaticity that comes with a second language cause more reading problems than Hebrew does. They bring this conclusion into the practical sphere by saying that we cannot ignore the unique constraints and characteristics of each human language since reading difficulties vary widely by orthography, as we have seen over and over again in this paper (2005).

**Conclusion**

Orthography is key in understanding dyslexia. Since dyslexia is a learning disability that can vary widely from language to language, orthography and the specific writing-related features of the languages must be kept in mind during study, diagnosis, and treatment of dyslexia. Second language learning and bilingualism in dyslexia are of special interest to teachers of dyslexic bilinguals and students seeking to learn a second, third, or fourth language, but are also enlightening topics for all of those people who study dyslexia because of the cross-linguistic issues that they bring up. From the few cases of dyslexia in Italy to the different challenges required in reading Chinese and the neurological effects of intersecting scripts, we have seen in this paper that dyslexia exists not only on a spectrum of mild to severe, but on a plane of many different symptoms. Dyslexia is a truly variable disability, and this fact must be kept in mind when studying it.

**References**


