Chapter 3

Developmental Dyslexia in Spain

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Abstract

Spanish-speaking children learn to read words written in a relatively transparent orthography. Variations in orthographic transparency may shape the manifestation of developmental dyslexia. In Spanish, as in other transparent orthographies, reading speed/fluency seems to be more evident and relevant than accuracy problems. In addition, the prevalence of dyslexia is much lower in Spanish than in less consistent or less transparent orthographies. Spanish students with developmental dyslexia have numerous lags in several cognitive (e.g., phonological awareness, rapid naming, verbal and visual-spatial working memory, and executive functioning), academic (e.g., pseudoword reading, spelling, and vocabulary), and emotional (e.g., reading self-concept, engagement, and reading motivation) areas. Intervention programs developed with Spanish children with dyslexia have ranged from phonological-based programs to fluency-based programs, with and without a computer.

Keywords: developmental dyslexia, Spanish, cognitive deficits, motivation, intervention

1. Introduction

Spain is a European country with a Human Development Index of 0.87, which means it ranks 26th out of 188 countries. The Human Development Report [1] provides a composite measure of three dimensions of human development: living a long and healthy life, being educated, and having a decent standard of living.

In Spain, the Spanish language is spoken. Spanish is classified as an Indo-European language of the romance subfamily. Spanish has a shallow and fine-grained orthography. That is, the orthography-phonology mapping is completely rule-governed across the language, although it is less transparent in writing. Specifically, the Spanish orthography has 27 graphemes (five vowels

and 22 consonants), each of which represents a unique sound, and five digraphs (ch, ll, rr, gu, and qu). The last three are considered positional variants of the phonemes/r/, /g/ and /k/; two diacritical marks: stress mark or acute accent (ˊ), and dieresis (¨). Therefore, grapheme-phoneme correspondences are predictable in reading, but this does not occur in writing, where inconsistent phoneme-grapheme correspondences are added, producing phonemes that correspond to several graphemes. For example, eight consonant phonemes can be represented using more than one grapheme: /b/(B, V, W), /k/(K, QU, C), /g/(G, GU), /x/(G, J), /j/(Y, LL), /rr/(R, RR), /Ø/(Z, C), /s/(S, X).

In addition, Spanish is regarded as a syllable-timed language [2], whereas English is considered stress timed [3]. Syllables are the most consistent sub-lexical units in regular orthographies such as Spanish [4], and 88.73% of the Spanish syllables have a very simple syllabic structure with the CV, CVC, V, or VC combination [5]. The longest syllable has five graphemes with a maximum of two initial consonants that rarely appear in coda position. Some geographic varieties of Spanish differ from each other in terms of phonology, but this does not seem to cause comprehension problems between speakers [3]. Fundamental supra-segmental features are stress and intonation. The stress in Spanish marks intensity, and it falls on one of the last three syllables in the word, counting from the end (e.g., paroxytone words, oxytone words, and proparoxytone words). Intonation is the melodic curve the voice traces when uttering sentences. On the basis of their direction and the extent of the intonation contour, five types of final inflections have been distinguished that maintain distinctive characteristics surrounding the assertion, interrogation, exclamation, and appeal modes [6].

Thus, the grapheme-phoneme correspondence is predictable in reading. That is, an expert reader is capable of unequivocally determining the correct pronunciation of a written word or a pseudoword based on correspondence rules. However, this situation does not occur in writing, where inconsistent phoneme-grapheme correspondences are added, producing doubts because a single phoneme can correspond to several graphemes, which affects the transparency of the code.

Intercultural studies suggest that the level of orthographic transparency determines the reading performance of children with dyslexia [7–9]. Thus, the characteristics of the Spanish language influence, in part, the prevalence and manifestations of dyslexia in Spanish.

2. Learning disabilities in Spain

In Spain, the term learning disabilities has been used for many years in a general sense. It has been considered synonymous with the broader concept of special educational needs [10–12]. According to this conceptualization, learning disabilities were not considered a specific diagnostic condition; instead, the term referred to problems or difficulties a student could have with learning, regardless of their cause. However, the publication of the *Ley Orgánica de Educación* (Organic Education Law) [13] and the *Ley Orgánica para la Mejora de la Calidad Educativa* (Organic Law for Improving the Quality of Education) [14] marked a major change because the term *special educational needs* was replaced by the expression *specific needs for educational support* due

to special educational needs, specific learning disabilities, giftedness, or late entrance into the school system [15]. Developmental dyslexia falls within the category of specific learning disabilities. Spain is organized into 17 autonomous regions and two autonomous cities. Some regional governments like Andalusia, Canary Islands, Catalonia, Murcia, and Navarra have adopted definitions of specific learning disabilities, based essentially on significantly lower achievement on an individualized normative test ($P_c < 25$) and exclusionary criteria (sensory impairments, intellectual disability, etc.).

The educational response to learning disabilities takes place through different service arrangements in schools. In Spain, treatment for learning disabilities involves evaluation, educational counseling, and educational support using ordinary resources such as small group attention or individual attention and extraordinary measures such as individual curricular adaptations (ACIs; *Adaptaciones Curriculares Individualizadas*). Children with learning disabilities receive some special classes in resource rooms during 3 h in a week.

In Spain, three types of interconnected professional groups provide support to children with learning disabilities: (a) special education teachers; (b) speech and language disorders teachers, who carry out individualized treatments; and (c) professionals in educational psychology. In Spain, they are called *Equipos de Orientación Escolar y Psicopedagógica* (School Counselling and Psychoeducational Teams) or *Servicios Psicopedagógicos Escolares* (School Psychoeducational Services) [10–12, 15].

3. Prevalence of dyslexia in Spain

Developmental dyslexia is a specific reading disorder of neurological origin that persists throughout life despite having adequate intelligence, education, and socioeconomic background to learn to read [16]. Individuals with dyslexia have difficulties with accurate or fluent word recognition [17, 18]. Thus, the most consistent and enduring core of any definition of dyslexia is probably its conception as an *unexpected* difficulty in reading [12, 17].

The prevalence of dyslexia has been estimated at 5–15% of school-aged children, depending on the language and culture [16]. Researchers have argued that the difference in the prevalence of dyslexia in different languages might primarily be due to inherent differences in the regularity of the grapheme-phoneme correspondence [8, 19]. As far as reading is concerned, Spanish is a clear example of a transparent orthographic system. The prevalence of dyslexia is much lower in transparent orthographies than in opaque orthographies [8]. Specifically in Spain, the estimated prevalence of developmental dyslexia ranges from 3.2 to 5.9% in elementary school students [20] and from 3.5 to 5.6% in secondary school students [21], or 11.8% if spelling difficulties are included with dyslexia [22].

In addition, dyslexia is typically more prevalent in males than in females in both referred and research-identified samples, and the ratio of males to females is greater in more severely affected samples [16]. Nevertheless, a recent study [23] provided little (1.4:1 male to female ratio) or no evidence for gender-related differences in the prevalence of reading disabilities in a transparent orthography.

4. Reading-related cognitive deficits in dyslexia and emotional problems

Although developmental dyslexia has traditionally been defined as an unexpected disorder in reading, accumulated evidence suggests that students with developmental dyslexia can show a range of reading-related cognitive deficits [24]. Students with reading disabilities have numerous lags in several cognitive (e.g., phonological awareness, rapid naming, verbal and visual-spatial working memory, and executive processing) and academic (e.g., pseudoword reading, spelling, and vocabulary) areas, compared to average reading students. However, reading speed/fluency is considered the main indicator of dyslexia in the Spanish language, whereas reading accuracy is relatively intact [24–28]. Furthermore, some studies [29, 30] have shown that the percentages of dyslexic subtypes in Spanish and opaque orthographies are quite different. Specifically, between 45.5 and 53% were classified as surface dyslexics, and between 18 and 22.8% were classified as phonological dyslexics, respectively.

The most important breakthrough was probably the discovery that the link between oral language and written language resided in the phonological structure of speech. Thus, children with dyslexia commonly present difficulties in acquiring phonological awareness. Because reading acquisition requires the child to learn the phoneme-grapheme correspondences, problems with phonological information lead to difficulties in reading acquisition. Different studies carried out in the Spanish language using reading-age- and chronological-age-matched designs have also found a deficit in phonological awareness in children with dyslexia [25, 26, 30–34]. However, some studies [34–36] have shown that the origin of this phonological deficit is a deficit in speech perception, as they also found temporal-processing problems in speech perception in children with dyslexia [35].

In addition to segmental phonology, recent studies have shown the role of suprasegmental phonology or prosody, such as skills in detecting accents, pauses, or intonation, in the population with dyslexia. For example, one recent study [37] showed that Spanish children with dyslexia performed worse on stress awareness in words and pseudowords than control children.

Naming speed, defined as the ability to name highly familiar visual stimuli as fast as possible, has been shown to be a strong concurrent and longitudinal predictor of reading ability in both consistent and inconsistent orthographies (see review [38]). In addition, many studies have indicated that reading disabilities appear to be accompanied by impairments in naming speed, and these impairments are found regardless of the orthography of the language in which children learn to read. Several studies carried out in Spanish have shown that naming speed tasks (e.g., rapid automatized naming) are capable of discriminating between children with dyslexia and reading-age- and chronological-age-matched typical readers [26, 39–42].

Other studies have shown that children with dyslexia who show both phonological and naming speed deficits have greater reading difficulties than those with only one deficit [41, 43, 44].

Processes related to memory, specifically verbal working memory and phonological short-term memory, have been some of the most extensively researched cognitive processes in children with reading disabilities in the past 30 years. Recent studies carried out in Spanish [26, 30, 33] indicated that children with reading disabilities showed impairments on short-term measures

requiring the recall of digit sequences or repetition of Latin words, and on working memory measures requiring the simultaneous processing and storage of digits within sequences and final words from unrelated sentences.

In recent years, a growing body of evidence suggests that children and adolescents with developmental dyslexia also manifest difficulties with executive functioning. Executive function is a multidimensional construct involving skills such as planning, initiation, working memory, self-control (inhibition and monitoring of performance), processing speed, attention, and task switching, all of which are important in the deliberate control of goal-oriented actions [45]. Some studies [46, 47] using behavioral rating questionnaires of executive functioning showed that children and adolescents with dyslexia were rated by both parents and teachers as having more frequent executive function problems in day-to-day life, with these difficulties centering on metacognitive processes (initiation, working memory, planning, task monitoring, and planning organization), rather than on the regulation of emotion and behavior.

Recent studies [48, 49] revealed that dyslexia persists into adulthood. In general, these studies showed that Spanish adults with dyslexia present problems in reading words, pseudowords, reading comprehension, fluency, and reading motivation. In addition, Spanish-dyslexic adults, as in opaque orthographies, continue to have difficulties on phonological awareness tasks, rapid naming, short-term memory, working memory, executive functioning, reading, and spelling.

In recent decades, a large body of research has focused on the cognitive consequences of dyslexia. However, less research has focused on analyzing the motivational consequences of dyslexia, even though expanded cognitive-learning models have included motivational beliefs. Some studies [49–51] have shown that children with dyslexia have a more negative self-concept, experience greater feelings of helplessness, avoid reading activities, and show less emotional self-regulation. In addition, two very distinct attributional profiles in students with learning disabilities (the helplessness profile and the adaptive profile) have been described [52].

More specifically, a recent study [53] using a reading self-report scale showed that children with dyslexia had more negative perceptions of themselves as readers: they saw themselves as less competent in reading, had more difficulty with reading, and liked to read less than their peers. Therefore, children with developmental dyslexia may be less motivated to engage in reading activities. Likewise, teachers of children with dyslexia consider that they have less reading motivation, both extrinsic and intrinsic, than their average peers, and that they are less engaged in reading activities [54].

5. Intervention trends in developmental dyslexia in Spain

In Spain, a noteworthy effort has been made in recent decades to develop intervention programs and analyze their effectiveness that had not previously been seen in the field of learning difficulties. Clearly, this increase in intervention studies did not occur by chance, but rather it has accompanied advances made in characterizing the problems experienced by

children with reading problems [55]. Although evidence-based intervention programs for children with dyslexia are scarce, they seem to reflect the different explanatory theories for reading difficulties.

Most interventions have been designed to remediate the *phonological-processing deficit*, proposed as the main deficit in all dyslexics. These studies have evaluated the efficacy of different approaches to treatment, mainly based on a combination of training in phonological skills and phonemic awareness. The first programs developed for students with dyslexia incorporated instruction in identifying phonemes, adding phonemes, and writing a word. The results showed that instruction produces a significant improvement in the subject's ability to write down dictated sentences and passages. Although this training favored the acquisition of metalinguistic skills (tasks such as reversal, addition, and omission of phonetic sounds), the children's reading level did not improve [56–58]. Thus, training in phonemic awareness does not have a positive effect on reading in children with dyslexia. These results are consistent with the conclusions of a meta-analysis on reading intervention studies with children with learning difficulties [59]. They suggest that phonemic awareness is an important skill, but not sufficient to improve reading, especially in older children with reading difficulties.

Some researchers have suggested that the difficulties experienced by children with dyslexia could be based on a specific difficulty with the perceptual processing of speech. Therefore, one of the components introduced in phonological skill-training programs involves training in speech perception. For example, the effects of two types of phonological training on children with dyslexia were examined [60]. The two programs consisted of intensive, systematic instruction in letter-sound correspondence and phonemic awareness using five different tasks (see description in **Table 1**).

Letter-sound correspondence. First, a trainer showed a consonant and vowel combination on a magnetic board. The children had to give the sound for each letter and each combination of letters. The linguistic structure of these combinations could consist of consonant-vowel, vowel-consonant-vowel, consonant-consonant-vowel, considering all the possible or likely phonemic combinations in the Spanish language.

Phoneme identification. The children were shown a magnetic lowercase letter and had to say words that began with this letter. Then, the trainer read them six or seven words aloud, and the children had to say whether each word contained the phoneme and where.

Segmentation. The children had to pronounce all the phonemes in a word read aloud by the trainer. As they pronounced each phoneme, the trainer provided them with visual feedback for the phoneme by placing the corresponding letter on the magnetic board. The task contained seven words that were presented to the children.

Phoneme deletion. This task consisted of 13 words. In the first six words, the children had to delete the final phoneme, and in the following seven words, they had to delete the initial phoneme (e.g., "Say Cat. Now say it again, but don't say/K/"). After the child had said each word with the missing phoneme, the trainer provided him/her with a feedback by putting the word on the board and removing the deleted phoneme.

Phoneme blending. In each session, one of the children was provided with a magnetic board where a word with the phoneme being taught was placed. That child had to pronounce each phoneme in the given word. The other children had to guess the word and say it out loud. Visual feedback for each word was provided by the child who was presenting the word on the magnetic board. Seven words were presented in this task.

Table 1. Description of letter-sound correspondence and phonemic awareness training tasks.

Subjects differed only in speech perception training, which was introduced only in the second training condition. The first part of each session involved instruction in three tasks that trained speech perception (see description in **Table 2**). There were 20 training sessions lasting for 20 min each in both intervention conditions over a period of 4 weeks. The children received training in a specific phoneme in each training session, following this order of presentation: /m/, /f/, /ř/, /b/, /n/, /p/, /l/, /s/, /d/, /t/, /k/, /g/, /x/, /r/, /Ø/. In the last five sessions, the most difficult phonemes were reviewed. In the training sessions, words with different syllabic structures (consonant-vocal, consonant-vocal-consonant, and consonant-consonant-vocal) were presented. The results of this study [60] indicated that both experimental groups improved on phonemic awareness compared to the control group, but only the children with speech perception plus letter-sound correspondences with phonemic awareness scored higher than the control group on reading. Thus, speech perception training shows promise for use with children with dyslexia.

On the other hand, some researchers [61, 62] have used computerized speech-based reading in experiments on dyslexia remediation. Specifically, the program called TEDIS (Tratamiento Experimental de la Dislexia; in English, Experimental Treatment of Dyslexia) has been investigated. The participants were randomly assigned to five groups: (a) the whole-word training group, (b) the syllable training group, (c) the onset-rime training group, (d) the phoneme training group, and (e) the untrained control group. For 30–40 min for 5 days a week, they were individually trained. The control group followed the standard reading program, which included oral comprehension, spelling, reading aloud, and reading comprehension activities. However, they did not receive any of the sound spelling units in which the experimental participants participated. During 15 sessions in the TEDIS program, children are trained with this "talking" computer program, which provides support and feedback through digitized speech in four experimental conditions: full word, phonemes, syllables, and onset-rime segments. Children could request more speech feedback by clicking the mouse on each item. During the computer-based word reading, when the child made three mistakes in the same word, a new word was presented. The results indicate that the experimental groups that participated in the phoneme and syllable conditions improved their word recognition in comparison with the

Phoneme discrimination in syllables. The trainer read aloud a series of eight syllables that differed only on the initial phoneme (e.g., pe, te, le, me, se, te, me, le) and contained a target syllable (e.g., me). The children had to raise their hands if they heard the target syllable. This task presented four sets of syllables and four target syllables. In each set of syllables, the possible linguistic structures were CV, CVC, or CCV.

Word pair categorization. This task was designed to teach the discrimination of consonant contrasts in word pairs. The task contained four pairs of words: two differed only on one consonant (e.g., alba, alga) and two were the same (e.g., toga, toga). The children listened to a pair of words and had to give an oral response of *same* or *different* after each trial.

Phoneme discrimination in words. The trainer read a set of five words aloud; of them, only one was different (e.g., puente, puente, fuente, puente, puente). The children had to raise their hands if they heard the word that was different. After each trial, the trainer provided a feedback by saying the set of words and having the children repeat them. This task contained three sets. In each set, the two words differed on only one consonant. The presentation of the sets was from less to more difficult (e.g., set 1/m/contrasted with/g/; set 3/p/contrasted with/b/.

Table 2. Description of speech perception training tasks.

control group. In addition, dyslexics who participated in the phoneme, syllable, and onset-rime conditions made a greater number of requests during computer-based word reading under conditions that required extensive phonological computation (low-frequency words and long words). However, the reading time was higher for long words in the phoneme group. These results show that training in phonological processes improves word recognition in children with dyslexia who learn to read in a consistent orthography.

Another study [63] analyzed whether the *Tradislexia* videogame affected phonological awareness, considering separately the complexity of the syllable structure and the type of phonological awareness task, and word recognition in children with dyslexia. The results showed that when the phoneme position was controlled, multimedia training in segmentation and blending with words that include consonant-vowel syllables was a better predictor of improvements in word-decoding processes.

Unfortunately, programs designed to remediate the deficit in phonological processing, although beneficial, are not sufficient to achieve fluent word recognition in children with dyslexia. In fact, 90% of intervention studies include measures of reading accuracy, but not reading fluency [64]. Consequently, in recent years, some studies [65–68] have analyzed the efficacy of intervention programs mainly designed to improve reading fluency.

For example, one study analyzed the efficacy of a multicomponent program to improve reading fluency in Spanish children with dyslexia, called Velocilector [65–68]. This program integrates multiple instructional components that meet rigorous scientific standards for effectiveness (see **Table 3** for a description of instructional components). Special needs teachers were trained in the application of the program. Instruction was delivered one to one. The effects of the training program were evaluated using gains in scores on word and pseudoword reading and text-reading fluency, as well as on a text comprehension test. Results showed that children who participated in the intervention obtained statistically significant gains on the reading measures used, with the exception of text comprehension, spelling, and reading motivation [62, 66–68].

Another study [65] analyzed the effectiveness of a computerized reading acceleration program (RAP), which is a different approach to improving reading fluency problems. The Spanish version consists of 600 sentences with comprehension questions with three alternative answers. Each child was trained during 20 sessions lasting for 30 min each over a period of 4 weeks (about 10 h of training). In each session, the children worked individually on the computer with 30 sentences with the corresponding questions, under the supervision of a previously trained graduate student. The sentences appeared one at a time on the computer screen. After reading a sentence, the children pressed the space bar, and the text disappeared. Next, a comprehension question appeared with three alternative answers. The children had to choose the correct answer by pressing a key on the computer. During the training, all the children were presented with the same set of sentences in the same order. The results of the accelerated reading training showed that children with dyslexia improved their reading speed on sentences, their level of reading comprehension, and their naming speed on letter and pseudoword-reading time, providing empirical evidence for the acceleration phenomenon in Spanish.

Component	Instructional steps			
Repeated readings Material: letters/ syllables, words, passages/texts.	(a) The child read the material aloud. (b) The teacher provided a model of fluent reading (prosodic reading). (c) The child reread the material four times (silent reading). (d) The child read the material from the session aloud again. (e) The teacher gave the correct answers for reading errors. To do so, the teacher said the words correctly and asked the student to repeat them. Feedback was provided about each child's improvements in reading speed or accuracy.			
Phonemic awareness and grapheme-phoneme rules	The following sequence is used on the mistakes the student makes: (a) The child reads the word aloud, with help if necessary. (b) The child pronounces the word in syllables with the support of letters. (c) The child pronounces the word's phonemes with the support of letters (phoneme-grapheme correspondence rules). (d) The child rereads the word silently three times and, finally, reads the word aloud. (e) Finally, the child blends the phonemes to say the whole word. If incorrect, s/he has to repeat it			
Motivation	**Adaptive attributions**		**Maladaptive attributions**	
Social reward and attribution retraining	**Success**	**Failure**	**Success**	**Failure**
	Effort	Low effort	Luck/help from others	Not talented enough
	Strategy use	No strategy use	Easy task	Bad luck

Table 3. Instructional components of the Velocilector multicomponent program.

6. Conclusions

Spanish-speaking children learn to read words written in a relatively transparent orthography. That is, the orthography-phonology mapping is completely rule-governed across the language, although it is less transparent in writing. Thus, to some extent, the characteristics of the Spanish language influence the prevalence and manifestations of dyslexia in Spanish.

Mainly during the past three decades, many studies have addressed the analysis of the characteristics and manifestations of dyslexia in Spanish. In general, the research carried out has followed in the wake of studies developed in less transparent languages [65], although there was no educational legislation in Spain that explicitly includes specific learning difficulties such as dyslexia [10–12]. Thus, several studies have shown that in Spanish, as in other transparent orthographies, reading speed/fluency seems to be more evident and relevant than accuracy.

In addition, the prevalence of dyslexia is much lower in Spanish than in less transparent orthographies, ranging from 3 to 6%, approximately, with little (1.4:1 male to female ratio) or no evidence of gender-related differences in transparent orthographies. Therefore, the existence of dyslexic subtypes could be the consequence of differences in orthographic systems, and the percentages of dyslexic subtypes in Spanish and opaque orthographies are quite different [69]. For this reason, surface dyslexics were classified between 45.5 and 53% and phonological dyslexics between 18 and 22.8%, respectively.

Different studies using reading-age- and/or chronological-age-matched designs have also found that Spanish students with developmental dyslexia have numerous lags in several cognitive (e.g., phonological awareness, speech perception, temporal processing, rapid naming, verbal and visual-spatial working memory, and executive functioning domains) and academic (e.g., pseudoword reading, spelling, and vocabulary, prosody) areas. In fact, these cognitive and academic difficulties persist into adulthood.

Many children who feel like failures in school, for one reason or another, tend to have low expectations of learning achievement, a poorer academic self-concept, a maladaptive attributional pattern for their successes and failures, and little motivation to read or be involved in school activities that require reading. Thus, children with dyslexia have a lower self-concept, and even a lower-reading self-concept, presumably caused by their academic failure. Moreover, studies that have analyzed the attributional patterns of children with dyslexia show that although some students have an adaptive attributional pattern, other students with dyslexia have a completely maladaptive pattern. In other words, they explain their successes by referring to external causes (luck, low difficulty level of the task, help from others, etc.), and their failures tend to be attributed to internal and uncontrollable causes, such as low ability.

Finally, research carried out to analyze the efficacy of intervention procedures with students with dyslexia in the Spanish language is quite scarce, compared to research developed to characterize their difficulties in different areas [55]. Most interventions have evaluated the efficacy of different treatment approaches, mainly based on a combination of intensive, systematic training in letter-sound correspondence, phonemic awareness, and even speech perception. In recent years, different fluency-based programs have emerged. One of them is a multicomponent program that combines repeated readings with phonemic awareness and grapheme-phoneme rules, along with a motivational component with social reward and attributional retraining. Another one is the application of a computerized-reading acceleration program. In general, the remediation research developed in Spain follows the program development tendencies found in international research, especially in less transparent languages.

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