

Neuropsychological program of english learning for students with dyslexia

**Estefanía Ibáñez Azorín¹, Pilar Martín- Lobo¹, Esperanza
Vergara-Moragues^{1,2}, Ana Calvo²**

1 Department of Educative Psychology and Psychobiology. Universidad Internacional de la Rioja
(UNIR)

2 Faculty of Health of Sciences. Universidad Internacional de la Rioja (UNIR)

Spain

Correspondence. Pilar Martín-Lobo. Universidad Internacional de La Rioja. Calle Almansa, 101. 28040.
Madrid. España. E-mail: pmartinlobo@unir.net ; pmartinlobo@gmail.com

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Abstract

In recent decades there has been great interest in the study of dyslexia and the difficulties with reading that are presented by students with this disorder. The results of various studies have found dyslexia to be a complex disorder with a multifactorial genesis in predominantly phonological difficulties, neuropsychological problems, and other learning, among which is the acquisition of a second language. At present, due to the global society in which we live, language skills are essential, particularly English, since this is the international language par excellence, and has various uses both inside and outside of Spain. Therefore, the importance and novelty of this work lies in the development of a preventive neuropsychological program to address the general cognitive and neuropsychological processes involved in students with dyslexia, and specifically, the proposal of a program to assist teachers English as a second language providing English guidance, methods, activities and materials in order to enhance the teaching and learning of students with dyslexia.

Keywords: dyslexia, reading, English, diagnosis, neuropsychology, learning.

Resumen

Durante las últimas décadas ha existido un gran interés en el estudio de la dislexia y de las dificultades que los alumnos con dislexia presentaban en la lectura. Fruto de los distintos estudios, se ha constatado la dislexia como un trastorno complejo con una génesis multifactorial en la que predominan dificultades a nivel fonológico, neuropsicológico y en otros aprendizajes, entre los que se encuentra la adquisición de un segundo idioma. En la actualidad, en la sociedad globalizada en la cual vivimos, el dominio de idiomas resulta fundamental, especialmente el inglés, dado que es la lengua internacional por excelencia, y tiene diversas utilidades tanto dentro como fuera de España. Por todo ello, la importancia y novedad del presente trabajo, radica en el desarrollo de un programa neuropsicológico preventivo para atender de forma general los procesos cognitivos y neuropsicológicos comprometidos en el alumnado con dislexia, y de forma específica, en la propuesta de un programa para favorecer el aprendizaje del inglés como segundo idioma, que proporcione al profesorado de inglés orientaciones, métodos, actividades y materiales con el objetivo de contribuir a la mejora de los procesos de enseñanza y aprendizaje del alumnado con dislexia.

Palabras Clave: dislexia, lectura, inglés, diagnóstico, neuropsicología, aprendizaje.

Introduction

In recent years, according to the International Dyslexia Association has been considered as a neurobiological alteration that causes difficulties in reading that are not a consequence of an intellectual deficit, nor of a specific personal or social condition of the person (IDA, 2017, Ferrer, Shaywitz, Holahan, Marchione and Shaywitz, 2010, Lyon, Shaywitz and Shaywitz, 2003). Thus, the fifth edition of the Diagnostic and Statistical Manual of mental disorders (DSM-5) conceptualizes it as a pattern of learning difficulties that are characterized by problems with the recognition of words in a precise and fluent way or spelling on the part of the students (APA, 2013). Both the concept and the diagnosis of dyslexia will be different depending on the area to which reference is made. Thus, within the health field it will be regarded as a reading disorder and a mental disorder, as it is included in the DSM-5 clinical manual, so that its diagnosis will be psychopathological, according to the our diagnostic criteria listed in Figure 1.

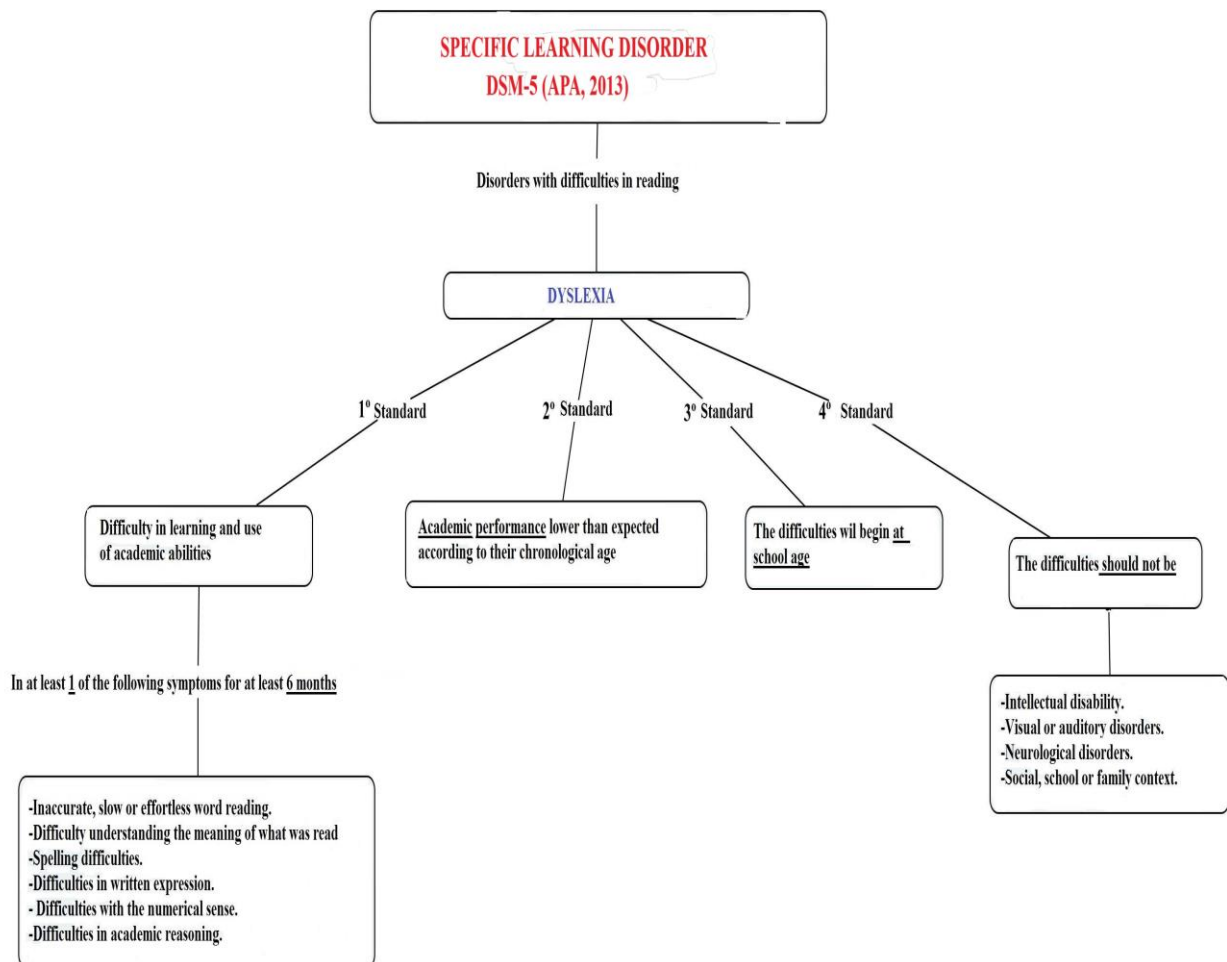


Figure 1. Diagnostic criteria according to the DSM- 5 manual (APA, 2013)

However, from an educational perspective, dislexia is defined as a learning difficulty and its diagnosis psychopedagogical (Martínez Miralles and Hernández Pallarés, 2015). Thus, the educational field, the initial diagnosis phase will begin with detection of risk indicators. This will involve the tutor and the teaching team, who should be aware these risk indicators in order to identify potentially dyslexic students as early as possible. The indicators are displayed in the following table (Table 1).

Table 1. *Indicators of suspicion in the different educational stages*

Pre-school Education	Primary Education	Secondary Education
<ul style="list-style-type: none"> ➤ Difficulties in processing, phonological awareness and syllabic segmentation. ➤ Difficulties in spatial and temporal orientation. ➤ Difficulties in fine motor skills. ➤ Delay in oral language. 	<ul style="list-style-type: none"> ➤ Symptomatology of the previous stage. ➤ Low Reading speed and difficulty in writing. 	<ul style="list-style-type: none"> ➤ Poor general linguistic competence.

Once the risk factor has been detected, the teaching team and the specialists will adopt different organizational and educational measures of support or reinforcement such as implementing flexible groupings and, support within their classrooms, including technologies that can be used in daily work, and alternative formats to the text book, to respond to their educational needs. If in spite of implanting said measures the students continue showing difficulties, the guidance of the center will carry out a psychopedagogical evaluation, applying different neuropsychological, pedagogical and logopédicos tests, evaluating cognitive, recognition, precision and decoding abilities, efficiency and reading speed, reading comprehension, laterality, development of executive functions, impact on other areas of the curriculum to establish the diagnosis. Next, Figure 2 shows the educational diagnostic protocol.

It is currently the school counselors who are responsible for evaluating and establishing a diagnosis at approximately eight or nine years when they are able to observe and compare the discrepancy of the reading level during a period of least two years. The clinical setting, it is possible to detect risk cases on the basis of genetic and scientific advances in neuroimaging that have identified certain genes such as: DYX1C1, KIAA0319, DCDC2 and ROBO1, all of which play a role in brain

development, and which show some type of anomaly in children with dyslexia (Giraud and Ramus, 2013).

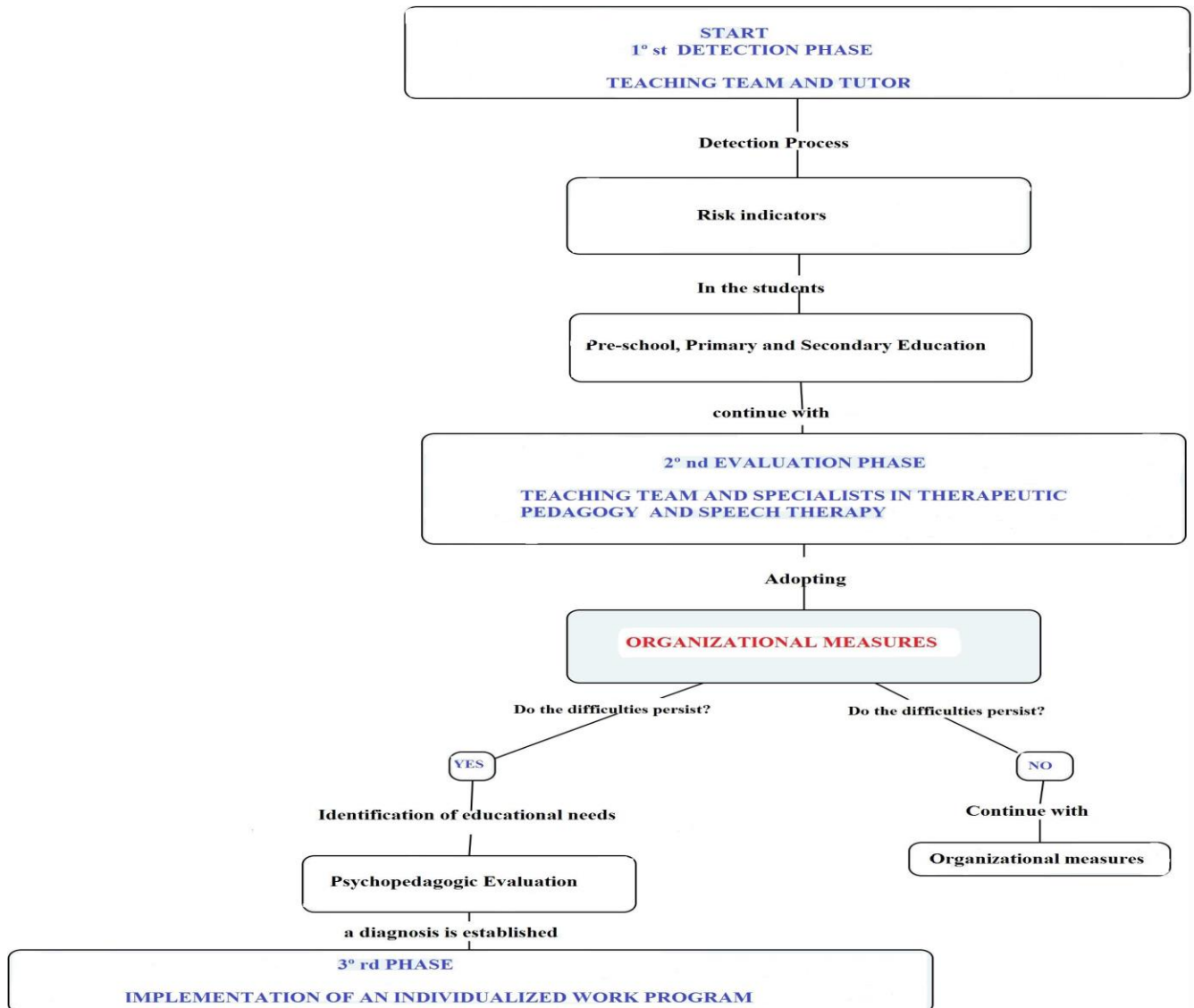


Figure 2. Phases of the diagnostic protocol dyslexia at the educational level

In summary, both psychopathological and psychopedagogical diagnoses, although different, will be valid within each field and compatible with the global and multidisciplinary interventions with students with dyslexia. Both diagnoses will not be conceived as a label for students with dyslexia, but instead can be regarded as tools that can be used to respond to the students in a manner that is adapted to their needs.

With respect to the etiology of dyslexia, for nearly thirty years, the model that explained the reading impairments shown by dyslexics was based on phonological difficulties (Shaywitz and

Shaywitz, 2005, Goswami, 2011). This deficit explained how people with dyslexia made errors of substitution and omission, due to their inability to perceive and manipulate sounds correctly hindering their reading fluency (Vellutino, Fletcher, Snowling, and Scanlon, 2004). At this time, various authors discussed the etiological aspects involved in dyslexia. Thus, the different studies that attempted to respond to the etiological causes of dyslexia group them into neurological-sensory causes and cognitive causes (Gayán, 2001). Next, we describe the consequences of deficits these cognitive and neurological processes for students with dyslexia. Following the information processing model developed by Luria (1980), which divides cognitive activity into three blocks: a) the optimal activation block of the cerebral cortex, b) the input block, and c) the programming block and control of activity, it is possible to provide an explanation of the cerebral functioning and the cognitive processes involved, making it possible to better understand the difficulties of students with dyslexia (Luria, 1980, Manga and Ramos, 2011). Based on this analysis, the functions are:

Neuromotor functions: neuromotor functions are the set of basic motor movements, balance and coordination responsible for helping the nervous system to mature correctly, to form and consolidate neuronal circuits for optimal development and learning. Therefore, its importance in development is fundamental, and authors such as Mayolas, Villarroya and Reverter (2010) have linked dyslexia with lack of lateral dominance, attributing this to the acquisition of reading and writing processes and academic performance. Thus, for example, laterality contributes to the interhemispheric connection, favoring the correct learning of reading, writing and reading comprehension (Martín-Lobo, 2006). On the other hand, there are other studies that establish the existence of a close relationship between perceptual and motor development and the development of the nervous system, thus considering, the motor and perceptual aspects to be fundamental elements of the neurodevelopment of the students in the first stages of their lives (Ferré and Aribau, 2008, Goddard, 2005).

Visual functions: visual functionality is understood as the set of visual skills, which, when properly developed can coordinate vision with the other senses. Therefore, inadequate functionality may lead to visual, reading, writing or performance problems in general (Martín Lobo, 2003, Santiuste, Martín Lobo and Ayala Flores, 2006). In this regard, some authors have suggested that visual problems and visual attention deficit are critical factors in dyslexia, giving that the basic deficits of dyslexia could be found in the mechanisms of capturing visual attention, which are crucial for reading (Gori & Facoetti, 2015; Facoetti, Ruffino, Perú, Paganoni & Chelazzi, 2008; Bosse & Valdois, 2009; Vidyasagar & Pammer, 2010; Vidyasagar, 2013).

Auditory and motor functions involved in reading and language: the phonological path of the brain acts on the auditory, motor, memory and language functions, all of which are necessary for the processes of reading, writing, memorizing a specific content, learning a language, or other types learning. The auditory system is essential for students to understand what information they are hearing for coding it to learn correctly in their classroom, and for understanding the language or expressing it clearly and effectively. Thus, dyslexia is related to auditory problems (Schulte-Körne and Bruder, 2010). Therefore, the visual, auditory, tactile and motor system will favor the sensory integration of the different information necessary to optimize learning. (Martín-Lobo, 2003). Reading and writing, exclusively human feats requires mastery of a series of skills and processes. The development of writing will require visual and motor development, that is adequate muscle tone, postural control, development of the vestibular area and visual-motor coordination (Martín-Lobo, 2003). All this highlights the need to work on the problems of linguistic codification (Shaywitz and Shaywitz, 2005, Ziegler and Goswami, 2005) and speed of processing (Suárez Coalla and Cuetos Vega, 2012) that can manifest in students with dyslexia and that will impact on their reading and writing development.

Executive functions: the development of executive functions begins in childhood and becomes fully development in adulthood when the maturation of frontal brain areas occurs (Bausela-Herrera, 2014). In this regard, different studies conducted, in recent years, on the influence of executive functions on the academic performance of students have revealed significant scientific (Clair-Thompson, 2011, Miranda-Casas, Fernández, Robledo, García-Castellar , 2010, Reiter, Tucha and Lange, 2005). Thus, for example, the study by Best, Miller and Jones (2009) established that mathematical and reading and writing difficulties were related not only to working memory but also to the capacity for inhibitory control and planning.

Educational neuropsychology to serve students with dyslexia

A neuropsychological program would be a suitable curricular measure, by developing systems such as vision, hearing, motor, touch, interhemispheric integration through laterality, all executive functions that are compromised in students whit dyslexia (Martín Lobo, 2003). In this regard, neuropsychology applied to the educational field begins with the knowledge of the information processing model developed by Luria (1980), which allows for evaluating, diagnosing e and subsequently applying intervention programs in the student population, providing scientific knowledge and methods that allow for a better understanding of cognition, motivation and the varios processes in-

volved in learning. Therefore, the initiation of a neuropsychological program will start with a series of requirements that ensure its effectiveness. Among those that can be highlighted (Howard-Jones, 2010):

- Advice from a neuropsychological expert, who contributes to the planning and organization of the program.
- Participation and effective involvement of the educational community: centre, family and students.
- Establishment of training sessions for the implementation and follow-up phase, providing teachers with models, strategies, activities and materials.
- Adequacy of the criteria to carry out the groupings of the students following a criterion of homogeneity in age or level of development.
- Taught and coordinated by different professionals of the educational centre.
- Incorporation of Information and Communication Technologies in the program.

At this point, and once the deficits in neuropsychological and cognitive processes have been identified, along with an agreement of to intervene from neuropsychology perspective, we can ask ourselves questions such as: Do students with dyslexia have difficulties with other learning? Why? Do they manifest difficulties in the acquisition of English? Next we will explain how the process of learning a second language is established in students with dyslexia.

Process of acquisition of English as a second language in students with dyslexia

As previously mentioned, dyslexia is a real problem in the classroom, and produces alterations in the cognitive and neuropsychological processes that affect the learning of students with dyslexia, and as a consequence other learning such as languages may be compromised. For this reason, in recent years, the learning of English has been the subject of numerous studies (Bygate, Skehan and Swain, 2001; Cook, 2008; Gass, Behney and Plonsky, 2013; Rutherford, 2014). The linguistic study of languages suggests that they differ in at least two dimensions: alphabetic versus non-alphabetic and the predictability dimension of grapheme-phoneme conversion rules. Thus, in alphabetical languages, it is accepted that spelling is the system through which the relationships between graphic units (such as letters, graphemes, blank spaces, diacritics) and sound units at their different levels are regulated (phonemes, syllables and words). In this regard, the main differences in the spelling of alphabetic languages are centered on what is meant by orthographic depth, thus finding transparent or opaque

languages (Serra, Serrat & Sole, 2013). In the case of transparent languages, defined in this way, due to their high degree of consistency in their alphabetic principle, grapheme-phoneme correspondences predominate one by one, with very few cases in which grapheme-phoneme correspondences are not biunivocal (Jiménez González and Muñetón Ayala, 2010). This fact will make it easier to read than to write in Spanish, and will ensure that students will make more spelling mistakes (Suárez -Coalla and Cuetos Vega, 2012). The opaque languages are those that present a deep orthography, given that, the relations between the graphic level and the sound level are complex.

The relations that are established between the graphical, sonorous and linguistic units are decisive for reading and writing, having more of an impact in the reading processes. Thus, in languages with transparent spelling, such as Spanish, students with dyslexia will show less severe deficits than readers of languages with opaque spelling, such as English. Language studies such as Italian (Paulesu et al., 2001; Tressoldi, Stella and Faggella, 2001), Dutch (De Jong and Van der Leij, 2003), French (Sprenger-Charolles, Cole, Kipffer-Piquard, Pinton and Billard, 2009), Greek (Constantinidou and Staint-horp, 2009), Spanish (Serrano and Defior, 2008) and Portuguese (Sucena, Luis Castro and Seymour, 2009) have indicated that the dyslexic readers of transparent languages were capable of achieving a greater accuracy due to the phonological information that opaque languages do not provide, since, readers of transparent languages would not need to form orthographic representations (Wang, Castles and Nickels, 2012). Table 2 shows the differences between both types of languages.

Table 2. *Differences between transparent and opaque languages*

Spanish	English
<ul style="list-style-type: none"> ❖ One letter corresponds almost always to a phoneme. ❖ Transparent spelling. ❖ Spelling is not necessary. 	<ul style="list-style-type: none"> ❖ To a phoneme corresponds several graphemes or vice versa. ❖ Deep-opaque spelling. ❖ They use spelling to disambiguate their composition in graphemes.

Complementing the above, and with the aim of shedding light on the question of teaching second languages, it is necessary to start from the concept of interlanguage (Gass et al., 2013) understood as an independent linguistic system since its rules are not found to be present in either in the mother tongue or in the language that the student uses when expressed in a second language. From this definition, the process of interlanguage in the acquisition of English as a second language, oc-

curs when the student perceives the English language and automatically tries to associate it with his or her knowledge in Spanish and according to Cummins (1979), there is then the transference of the grapho-phonetic correspondence from Spanish to English. All the arguments presented make it possible to affirm that the mother tongue, as well as the orthographic structure of a language or individual differences such as age, motivation, aptitude, teaching methodology, all play a decisive role in learning a second language in student with dyslexia. As a consequence, the incorporation of literacy in English must be carried out later or more gradually in comparison with the development of literacy in the mother tongue (Martínez Miralles and Hernández Pallarés, 2015). Reaching similar conclusions, the International Dyslexia Association (IDA, 2013) established that students with dyslexia with difficulties in more than four skills in their mother tongue (reading, writing, listening and speaking) would manifest significant difficulties in the acquisition. of foreign languages. In a asimilar vein, the hypothesis of linguistic interdependence, proposed by Cummins (1979) that students transfer their abilities to read and write in their first language to the second language. The previously described aspects of dyslexia and the influence of this disorder on the acquisition of a second language form the theoretical basis of the present work. Next, we explain the objective of the proposals for neuropsychological intervention with students with dyslexia.

Objective

In current schools, the principles of inclusion and attention to diversity must be given priority, in order to give pupils with dyslexia an educational response that meets their needs. Therefore, the objective of this work will be to develop a program of neuropsychological intervention of the affected cognitive and neuropsychological processes and, in particular, of learning English, providing teachers with the knowledge and tools necessary for providing early preventive measures to compensate for the difficulties faced by students with dyslexia.

General proposal of a neuropsychological program for the development of cognitive and neuropsychological processes in students with dyslexia

Following the information processing model of Luria (1980), the program will establish a logical order of work in response to the processes of neurobiological maturation of the student with dyslexia. Table 3 displays the neuropsychological program with the processes to be developed, the methodological aspects, type of tasks, printed materials, technological resources and web pages of consultation.

Table 3. *Neurologycal program for the developmen of cognitive and neuropsychological processes for students with dyslexia*

Neuropsychological program of english learning for students with dyslexia

Cognitive and neurological processes	Contents	Methodology	Activities	Printed materials, technological resources and web pages
Neuromotor processes	<ul style="list-style-type: none"> ▪ Body scheme. ▪ General perceptive structuring, spatial, manual, and motor dynamic coordination. ▪ Basic motor patterns. ▪ Tonicity. ▪ Postural control. ▪ Balance. ▪ Fine and gross motor skills. 	<ul style="list-style-type: none"> ▪ Adapted to the real motor skills and rate of students development. ▪ Game sessions. ▪ Suitability of the spaces, materials used and time. ▪ The sessions can be divided into 5 minutes of presentation, 30 minutes of activities and 5 minutes of relaxation. 	<ul style="list-style-type: none"> ▪ Recognize, indicate and name parts of the body. ▪ Play symmetric model of a given figure. ▪ Search and recognition of errors in 2 drawings. ▪ Improve the knowledge of basic coordinates by indicating on paper and moving in space. ▪ Games with gripping movements, manual agility, coordinated actions such as throwing and receiving an object with one hand and the other. ▪ Tangram, sensory integration games. ▪ With parts of letters of inverse symmetry. ▪ Make straight, wavy, circular strokes. ▪ Draw borders, to organize the graphic directionality. ▪ Copy geometric drawings. ▪ Write equal/ symmetrical letters, first in isolation, then in syllables, then in words. 	<ul style="list-style-type: none"> ▪ <i>Edusport Project</i> of the Ministry of Education (MEC, 2010). ▪ <i>ADI Program</i> (Support and Development of Intelligence), (Martín Lobo, 1999).
Visual processes	<ul style="list-style-type: none"> ▪ Ocular motor. ▪ Accommodation. ▪ Convergence. ▪ Visuomotor perception and coordination. 	<ul style="list-style-type: none"> ▪ The time of each exercise can range between 5 and 10 minutes. ▪ Activities will be combined, with a game component, of motor, accommodation and convergence with another for example of visual motor and perceptual coordination. 	<ul style="list-style-type: none"> ▪ Adequacy of the direction of the eye with left-right movements; up and down and right (follow lights, name objects on a line). ▪ Search for a certain word in the text. ▪ Constructions of figures. ▪ Visual discrimination of graphemes - Perception figure-background. ▪ coordination ▪ Sort cards (sizes, colors, time) from left to right. ▪ Identify identical / symmetric figures and letters. 	<ul style="list-style-type: none"> ▪ <i>Workshop of reading and writing and visual construction</i> de Andrés Sardinero Peña (2010, Gesfomedia). ▪ <i>Training For your Eyes</i> (Nintendo, 2007). ▪ <i>NeuroRacer</i> (Universidad de California, 2013). ▪ <i>Visual skills and reading comprehension</i> (Trempe, 2014) ▪ Visual Attention Therapy http://tactustherapy.com/app/vat/
Auditory, touch, rhythm and language processes	<ul style="list-style-type: none"> ▪ Favoring touch. ▪ Auditory development: of words with rhythm, sounds, musical auditions, singing, dance, auditory laterality. ▪ Breathing, praxias, significant verbal memory and phoneme articulation. 		<ul style="list-style-type: none"> ▪ Modeled with plasticine. ▪ Playing rhythms with instruments, with hands, feet. ▪ Discrimination of different frequencies: bass and treble sounds. ▪ Identification of sounds of the environment, of animals, of daily activities. ▪ Perform certain movements depending on different auditory signals. ▪ Discrimination of words, with rhythm as they move. ▪ Identify pairs of words that have similar auditory phonemes. ▪ Learn small songs, songs or tongue twisters. 	<ul style="list-style-type: none"> ▪ <i>Verbal-Auditive-Musical Program (V.A.M)</i>, (Navarro y Gallardo, 1990). ▪ <i>Program DECO-FON</i> (Etchepareborda, 2003). ▪ <i>Method Berard de Reeducación Auditiva</i> (Berard, 1960). ▪ <i>Method Tomatis</i> (Tomatis, 1950). ▪ <i>Alphabets</i>. It offers games that include hearing, sight, tactile charac-

			<ul style="list-style-type: none"> Breathing activities, praxies and articulatory 	<p>teristics and pronunciation through the mouth.</p> <ul style="list-style-type: none"> <i>RePe</i>. It is a game of musical memory that exercises the eyes, ears, memory and attention.
Reading and writing processes	Phonological processes	<ul style="list-style-type: none"> Flexibility in the instructional processes, autonomy, participation and motivation of the participants. Use of accessible technological aids. 	<ul style="list-style-type: none"> With contrasted phonemes select the graphemes that form a syllable previously heard. Associate an oral syllable with the written one. Identify similar syllables within words. Decide if a string of letters is a word 	<ul style="list-style-type: none"> <i>Program COGNITIVA. PT. Lectoescritura</i> (Torres, 2004). <i>Training program in Phonemic Awareness</i> (Castro, 2003). <i>Programa Aprendiendo a Leer. Nivel 1 y 2</i> (Defior y otros, 2011). Let's play with ... the words, the syllables, the sounds and the letters (García Celada, 2003) <i>Reading Comprehension Program</i> (Vidal Abarca, 2012). <i>Neuropsychological program for the improvement of reading speed.</i> (Álvarez, 2014). <i>Multicomponent program based on specific deficit theories</i> (Soriano, 2007). <i>Dysegxia</i> (Bayarri, Rello y Azuki, 2012). <i>Method Glifing</i> (Neurotec). <i>Tradislexia</i> (Jiménez, Antón, Guzmán, Hernández- Valle, Ortiz, Rojas, O'Shanahan, Díaz, Rodrigo, Rodríguez y Muñetón). <i>Dislexia-Breal</i> (Torque Game Engine). <i>Lea Mejor</i> (IDECC). <i>Programas de la Editorial Yalde</i> (Nájera y Álvarez, 2006). <i>SICOLE-R</i> (Jiménez, Antón, Díaz, Guzmán, Hernández, Ortiz, Rodríguez y Muñetón). <i>Tradislexia</i> (Jiménez, Antón, Guzmán, Hernández- Valle, Ortiz, Rojas, O'Shanahan, Díaz, Rodrigo, Rodríguez y Muñetón).
	Lexical and semantic processes		<ul style="list-style-type: none"> Group, select, associate, identify words with their category. Form augmentative, diminutive, synonyms, contrary. Establish lexical and semantic relationships. 	
	Reading comprehension and written production		<ul style="list-style-type: none"> Reading at increasing speed of words, phrases and texts. With phrases: cloze-like activities, verbal absurdities, cause-consequence of a phrase. With texts: order phrases to form a story, analysis of paragraphs, making outlines of stories and texts. 	
	Syntactic processes		<ul style="list-style-type: none"> Sort phrases. Comprehension of sentences with different grammatical structures. Association of sentences with drawings. Identify incorrect matches in a text. 	

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				<ul style="list-style-type: none"> ▪ <i>Dislexia-Breal</i> (Torque Game Engine). ▪ <i>Ortoflash</i>. Online spelling application that poses tasks that range from the correct use of letters to accentuation or punctuation.
Executive processes	<ul style="list-style-type: none"> ▪ Focused attention. ▪ Selective attention ▪ Alternating attention in the visual and oral modalities. ▪ Verbal and visual memory. ▪ Reasoning. ▪ Decision-making. 	<ul style="list-style-type: none"> ▪ They will adapt, graduate the activities and the necessary execution time to be able to carry them out, providing self-instructions and different ways to present the information. 	<ul style="list-style-type: none"> ▪ Realization of conceptual maps and maps. ▪ Analysis of situations, using different formats in which a problem has to be solved or three needs to be reflection on the performance. ▪ Logical reasoning, abstract and mental operations. 	<ul style="list-style-type: none"> ▪ <i>Cogmed</i> (Instituto tecnológico de Georgia, 2012). ▪ <i>Rehabilitation proposed by the ENFEN test</i> (Portellano, 2009). ▪ <i>Executive Function Workshop</i> (Andrés Sardinero Peña 2010, Gesfomedia). ▪ <i>Attention, concentration and memorization</i> (Alfredo Gozalbez Celdrán, 2006, CEPE). ▪ <i>Cmaptools</i> (Institute for Human and Machine Cognition, IHMC). ▪ <i>"Learning to think" program</i> (Sánchez, 1992). ▪ <i>EntusiasMAT</i> (Colegio Monserrat, Barcelona, 2013) ▪ <i>Memorando</i>. It is an application that favors brain games that help train the working memory and improves brain connectivity. ▪ <i>Flowfree</i>. It is an application that favors the development of planning skills. ▪ <i>Isecuencias</i>. It stimulates the executive functions of organization, planning, temporality, causal thinking and sequences.
Accessibility technical aids	<ul style="list-style-type: none"> ▪ <i>Ditres</i>: composed of three programs (Ditex, DiDoc y DiLet). Available in different languages (Editorial Rehasoft). ▪ <i>ClaroRead Plus</i>: multisensory program that facilitates reading and writing tasks. Integratek. Available in different languages. ▪ Free converters: <i>DSpeech, Read for me, Voice dream reader</i>. ▪ Complementary applications such as pocket scanner or <i>Tiny Scanner</i>. ▪ To make audio recordings: <i>Soundcloud, Spreaker, Donwcas.t</i> ▪ <i>Dyslexie Open Dyslexic and Sarakanda</i> (specific typography for dyslexics). ▪ Spell checkers. 			

Aproposed neuropsychological program of learning English in students with dyslexia

Before beginning to detail the most appropriate teaching methods for students with dyslexia, it is essential to start with the difficulties in learning English that these students manifest : deficits in phonological awareness, difficulties in auditory discrimination, impact on the speed of the linguistic process, deficit in working memory and difficulty into maintaining concentration during explanations or tasks (Vallespir Salas, 2010).

To compensate for these difficulties, the following methods of teaching English are suggested. The first, Multisensory Structured Language (MSL) (Sparks and Miller, 2000) intends for the student to use as many senses as possible, to enhance and promote their learning. In the same vine, the Total Physical Response model (Canga Alonso, 2012) characterized by the association between language and movement, creates a relaxed atmosphere to facilitates the assimilation of learning, giving priority to the oral aspect of communication. This method could be an alternative for students with dyslexia at an early age, since its fundamental premise is to not force the performance od student, thus avoiding situations of anxiety. From these two approaches, English teachers must take into account in their classes the following methodological considerations (Martínez Miralles and Hernández Pallarés, 2015):


- ✓ *Motivate* students with dyslexia to want to communicate and start from the *current maturation* that you have in your mother tongue to start reading and writing in English.
- ✓ *Develop phonological* awareness with the use of words with a more transparent spelling to gradually give way to more complicated words that require greater use of visual-orthographic memory.
- ✓ *Participate in seminars and language immersion stays.*
- ✓ *Inform the rest of the students* of the difficulties involved in having dyslexia.
- ✓ *In relation to the evaluation of learning:* the written tests must be adapted to their possibilities, being able to have access to small grammar summaries; the visual memory must be worked on in the different units; the use of technological resources; the multiple-choice format will be prioritized in responses that assess skills such as listening comprehension, vocabulary, grammar and reading comprehension; Adaptations will be made in written expression exercises.



- ✓ *Procedures to run simultaneously with the delivery methods*, the purpose of which is to reduce the work of the students with an awareness of their slow speed of processing. In addition, there is a proposal to apply compensatory methods, designed to overcome the disadvantages that may arise due to their difficulties, and which will consist of the use of technical aids such as audio books, digital slates, and text converters, among others.
- ✓ *Learning through the promotion of the eight multiple intelligences of Gardner*. We must not forget that this brain dysfunction causes them to have limited functions or skills. With this methodology, we will focus on responding to their educational needs by capitalising on their strengths. For example, if we have a student with serious problems in understanding a written text, but we realize that their oral capacity is intact, through this methodology they could improve by being given the oral exam.
- ✓ *Cooperative learning, project-based learning and learning based on problem solving*. This type of methodology benefits students with dyslexia because in learning the tasks are diversified and different skills and processes are put into practice through different types of information processing, intervenes in the tasks depending on what they know how to do whilst being motivating.
- ✓ *E learning or use of new information and communication technologies*. With students with dyslexia this will contribute towards using to use those brain areas that or have higher performance. This methodology encourages learning according to their intellectual profiles, the processing or their cognitive and learning styles. Teaching them tools to overcome their difficulties.

Based on the combination of these methodologies and considering different methods, the following neuropsychological program for learning English for pupils with dyslexia is proposed (Table 4).

Table 4. *Neuropsychological program for teaching English to students with dyslexia*

Cognitive and neuropsychological processes	Activities for the 1st section of Primary Education: Unit “The family”																																
<p>Motor processes</p>	<p><u>Activity type 1: We learn routines!!</u></p> <ul style="list-style-type: none"> ▪ Giving simple orders: Stand up! Sit down! Touch your friend! and complex orders: Touch D's nose! Who is wearing blue today? How many blue colours have you got? ▪ Students can learn hand gestures to help memorize the definition of a noun, adjective or other category. 																																
<p>Visual processes</p>	<p><u>Activity type 2: Listen, circle and write the number.</u></p> <div style="text-align: center; margin: 10px 0;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td>brother</td><td>sister</td><td>father</td><td>brother</td><td>mother</td><td>brother</td><td>cousin</td><td></td> </tr> <tr> <td>sister</td><td>sister</td><td>cousin</td><td>cousin</td><td>father</td><td>sister</td><td>sister</td><td></td> </tr> <tr> <td>cousin</td><td>brother</td><td>cousin</td><td>cousin</td><td>brother</td><td>brother</td><td>cousin</td><td></td> </tr> <tr> <td>father</td><td>mother</td><td>mother</td><td>mother</td><td>mother</td><td>father</td><td>father</td><td></td> </tr> </table> </div> <ul style="list-style-type: none"> ▪ With this activity we will favor the perceptive processes, where the student will have to select the number of times the word has been written correctly detecting the errors. 	brother	sister	father	brother	mother	brother	cousin		sister	sister	cousin	cousin	father	sister	sister		cousin	brother	cousin	cousin	brother	brother	cousin		father	mother	mother	mother	mother	father	father	
brother	sister	father	brother	mother	brother	cousin																											
sister	sister	cousin	cousin	father	sister	sister																											
cousin	brother	cousin	cousin	brother	brother	cousin																											
father	mother	mother	mother	mother	father	father																											
<p>Hearing, touch, rhythm and language processes</p>	<p><u>Activity type 3: We learn routines!!</u></p> <ul style="list-style-type: none"> ▪ To establish the routines to which we have referred in the neuromotor processes, at the beginning and end of each session, a review of the terms learned during the unit will be made using songs, rhymes, or games. ▪ Students to learn the syllabic segmentation of words in an unconscious way to create a song that groups those words according to the number of syllables. 																																

<p>Reading and writing skills</p>	<p>Phonological processes</p>	<p><i>Activity type 4: Flash Cards of family members.</i></p> <p>With the QUIZLET tool we have created family cards that allow us to include text and images of family members. The tool automatically develops activities and games that allow the entertainment of students with dyslexia and their individualized evaluation.</p>  <p style="text-align: center;">https://quizlet.com/ 51aid3</p> <ul style="list-style-type: none"> ▪ Given the difficulty that students with dyslexia present in phonological awareness, in this activity or similar, the English teacher will exaggerate their pronunciation of each member of the family, modifying the tone and volume, so that students are able to recognize each of the syllables of each word. ▪ With the Educaplay tool https://es.educaplay.com we can create dialogues to be interpreted by the students about the unit.
	<p>Lexical and semantic processes</p>	<p><i>Activity type 5: Finding the word loss.</i></p> <ul style="list-style-type: none"> ▪ Before beginning the unit, the teacher will place in an assigned corner the images of the vocabulary of the unit with the name written below. In such a way that students with dyslexia can become familiar with it. In the activity the student must unite the image with his corresponding written word. ▪ The activity that we have created with the QUIZLET tool https://quizlet.com/ 51aid3 allows the student to associate the concept with his image while working his name in English.

		
	<p>Syntactic processes</p>	<ul style="list-style-type: none"> ▪ Students could manipulate word cards to create sentences or classify words into phrases by physically moving them into categories. ▪ They could move around to make paragraph sentences. ▪ The elements of a story could be taught with reference to an aid (visual, auditory, tactile and kinesthetic) in such a way that the hand, the body and / or the movement are used to support the understanding and production of the language. ▪ With the tool created with QUIZLET you will be able to work on written and spelling processes. 

Conclusions

The present work develops a specific way a neuropsychological program designed for the early optimization of the teaching and learning processes of a second language such as English in children with dyslexia by taking into account their needs. Therefore, the processes of identification and early treatment will be key to helping students with dyslexia to succeed in school. According to the International Dyslexia Association (IDA, 2017), the identification and early educational intervention of students who show risk symptoms will be decisive for these students to achieve better results in the future. In particular, the the programs implemented in the first years of Primary Education, which use multisensory language teaching (Multisensory Structured Language) in different types of learnings, may contribute to improving both the cognitive and neurological critical skills of these students. In fact, it has been demonstrated, that the success rates of intervention in children with more advanced dyslexia is lower than in small children (Milla, 2006).

Another aspect to take into account, is the high incidence of students with dyslexia in the classroom and the lack of knowledge that teachers may have about their difficulties. Therefore, associations and parents demand greater training in the teaching staff that serves them. In line with this claim, the study "Low-achieving students: Why they are-and how to help them succeed", published recently by the Organization for Economic Cooperation and Development (OECD, 2016) is the first to focuses on the origin of low performance and how to address it, and notes that systems that equitably distribute educational resources and show higher levels of inclusion of students with special needs have lower numbers of underachievement. It states that all countries can improve the performance of their students, as long as there is a clear willingness to put into practice the appropriate educational policies, including the identification of students with low performance and the design of an adequate early educational strategy. Thus, if we taking into account what has just been described from the foregoing, that is, the importance of early and preventive intervention along with the design of effective educational strategies that contribute to promoting academic performance, the design and implementation of early neuropsychological programs and preventive measures could be a viable measure for students with dyslexia. In particular, this would be an appropriate way on responding to deficits in neuropsychological and cognitive processes, and could also facilitate other forms of learning such as the acquisition of a second language.

Thus, the effectiveness of different neuropsychological programs has been demonstrated in students with learning difficulties, which we have analyzed and on which we have based our educational proposal. One such program, that of improving the motor and laterality aspects, was implemented by Prado and Montilla (2010), which included components such as laterality and the development of temporal space notions. It was applied to a total of 15 children aged six years for six weeks. Following the application, it was found that 100% of the students had defined their laterality and that 77% scored high on the maturity test. Cumandá (2012) carried out a laterality program during the 2001-2011 academic year with activities of manual, visual, auditory and foot laterality, confirming the elimination of specific errors in learning. In this regard, current work to develop learning and improve Cumandá (2012) carried out a laterality program during the 2001-2011 academic year with activities of manual, visual, auditory and foot laterality, confirming the elimination of specific errors in learning. In this regard, current work to develop learning and improve reading and reading comprehension to yield positive results through teaching must be based on the teacher providing a correct reading model, directing and modeling the understanding of the students in specific contexts, reflecting on the strategies that they are using, and providing feedback on the activities in an appropriate way (Cerdán, Vidal-Abarca, Martínez, Gilabert and Gil, 2009). Marina and Pellicer (2015) have designed an intervention program with positive results in students incorporating functions such as cognitive activity, attention, and motivation, which underlie the executive model of intelligence.

Further, given that, during the acquisition of a second language such as English, students with dyslexia will present greater difficulties in their acquisition and mastery (IDA, 2017), second language learning programs for students with dyslexia must necessarily have a teaching approach that is different from that used in most classrooms. For Margaret Byrd Rawson, former President of the International Dyslexia Association, when it comes to learning and teaching a second language, students with dyslexia will require slow learning and explicit, direct, cumulative, and intensive instruction through multisensory learning. (*Multisensory Structured Language*), which involves the simultaneous use of visual, auditory, tactile, and kinesthetic pathways to improve memory and the learning of the written language. Similarly, in the proposal that has been designed here it is recommended to the English teachers that they should base their instruction on the four pathways for learning instead of focusing only on one method of memorizing a complete word, a method of tracking, or a phonetic method by itself. Cur-

rent research through the National Institute of Child Health and Human Development (NICHD) has placed value on the method *Multisensory Structured Language*, for the teaching of languages in students with dyslexia. Therefore, the importance of this work lies, on the one hand, in its contribution to the visibility of students with dyslexia in the classroom and, on the other, in a contribution to the educational field with the design of neuropsychological programs as an inclusive educational measure for promoting prevention, the development of potential, and the acquisition of competence in a foreign language for students with dyslexia.

In the future it would be advisable for the different institutions to agree on a protocol for coordinating educational and health actions for early detection and diagnosis, since such a system is not currently in place in any Spanish community. Such an initiative would serve to combine diagnostic decisions and put into practice at the educational level the various scientific advances that contribute towards optimizing the teaching of students with dyslexia.

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