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TITLE

Assessing Dyslexia at Six Year of Age

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KEYWORDS

Dyslexia, assessment, diagnostic criteria, treatment response, structured interviews, standardized test

SUMMARY

This research sets out a proposed protocol for the identification of dyslexia. The protocol is based on diagnostic and response to intervention models. The proposal involves using structured interviews and standardized tests for the assessment of reading and writing performance and determinant factors.

ABSTRACT

In recent years, there has been an increase in the prevalence of dyslexia at early ages in different countries and regions. This increase has serious consequences within school and family settings, due to the poor academic performance that characterizes people with dyslexia and the socio-emotional problems they sometimes display. One of the most frequent problems in the identification of the dyslexia is the lack of a common diagnostic protocol that encompasses specific criteria for the assessment of any child. The Learning Disabilities and Development Disorders research group at the University of Malaga has developed a protocol for the early detection of dyslexia. The protocol is based on the diagnostic and response to intervention models. Consequently, it takes into account diagnostic criteria agreed upon by some associations and committees of experts, as well as certain specific cognitive and language determinants that characterize people who present with dyslexia following adequate instruction, according to recent research. The action protocol is developed over several stages, and we propose the use of structured interviews with parents and teachers alongside standardized tests for the evaluation of intelligence, reading and writing, as well as the risk factors that determine the appearance of the problem. This action protocol provides a model for the detection of dyslexia, which seeks to distinguish it from other comorbid problems and identify its characteristics and determinants, in order to offer effective intervention and/or prevention from an early age.

INTRODUCTION

The DSM-5 establishes specific learning difficulties as a diagnostic category within neuro-

developmental disorders. Dyslexia has been considered one of the most common specific learning difficulties. It is characterized by difficulties with accurate and fluent word recognition, along with spelling and orthographical accuracy. It also entails difficulties in reading comprehension¹. These manifestations appear after the start of compulsory schooling, from the age of six onwards.

In recent years, there has been an increase in the prevalence of dyslexia at early ages. Some authors state that between 5% and 17.5% of school age children are affected by dyslexia^{2,3}. These percentages indicate the importance of considering early detection, since it has serious consequences within school and family settings, due to the poor academic performance that characterizes people with dyslexia and the socio-emotional problems they sometimes display.

In spite of this, there is often a lack of consensus about how to identify dyslexia. This is due to the on-going debate about the adequacy of identification criteria offered by the different explanatory models, derived from ambiguity in the definitions given in dyslexia. On the one hand, the traditional perspective advocates a model of diagnosis for the identification of these problems. More recently, however, the response to intervention model has emerged as an alternative for such purposes.

The diagnostic model considers several criteria when identifying dyslexia: the discrepancy criterion, the exclusion criterion and the specificity criterion (**Figure 1, Figure 2, Figure 3, Figure 4**).

[Place Figure 1 here]

[Place Figure 2 here]

[Place Figure 3 here]

[Place Figure 4 here]

The discrepancy criterion is based on the fact that people with dyslexia present a discrepancy between their intellectual potential and their performance. This criterion is not accepted by some authors who do not find it necessary to use IQ to determine the appearance of dyslexia^{4,5}. In contrast, other authors find that divergent children are more resistant to interventions than non-divergent children or that there are differences between them^{6,7}. Although the discrepancy criterion has been widely criticized, there does not appear to be consensus about its use. In our opinion, it is somewhat premature to dispense with IQ when it comes to identifying dyslexia. Discarding the use of IQ might make it hard to distinguish this problem from others such as intellectual disability. In this regard, discrepancy should be the first step in identifying dyslexia⁸.

The exclusion criterion refers to the difference between dyslexia and other specific disorders with which it occurs concomitantly. These disorders are usually sensory deficits, mental disability, emotional disturbances and socio-cultural or educational disadvantages^{1,9}. There is some controversy about the overlap between some of these disorders and dyslexia. Hence, for example, socio-emotional alterations and low social competence are sometimes included as characteristics of people with dyslexia, when it would actually appear that these difficulties are

being generated by dyslexia¹⁰. Advocates for the use of the exclusion criterion argue that there is a risk that dyslexia will fall into a catchall category that encompasses other comorbid pathologies¹¹ if they are not considered for its diagnosis.

The specificity criterion implies certain restrictions with regard to the domains that are affected in dyslexia, such as language, reasoning and instrumental learning problems^{1,9}. Some authors argue that language problems should be included within the category of dyslexia^{12,13}. However, others believe that they should be differentiated and categorized as comorbid conditions, because language is acquired without formal education whereas other domains do require such instruction¹⁰. In this regard, dyslexia is characterized by problems with reading and writing, justified by difficulties in phonological processing^{14,15} or a general sensory deficit^{16,17}. Those who argue that dyslexia is a deficit in phonological processing indicate that dyslexics present difficulties in tasks involving the effective use of the phonological code, presenting a deficit in the creation of phonological representations of words. As a result, they present difficulties acquiring the alphabetical principle and remembering grapheme-phoneme correspondences¹⁰. Proponents of dyslexia as a general sensory deficit argue that people with dyslexia present difficulties in tasks that require the processing of auditory stimuli presented quickly, displaying difficulties of auditory perception, owing to a deficit in their rapid temporal processing¹⁰. These basic difficulties give rise to phonological problems, which explain the difficulties they face recognising words.

The response to intervention model (RTI) integrates evaluation and intervention within the school system by means of a multi-level prevention system that maximizes the performance of students and reduces behavioural problems¹⁸. This model can be used to identify pupils who are at risk of manifesting reading and writing difficulties, monitoring their progress and offering interventions based on the pupil's response. This model identifies people with dyslexia as subjects who do not respond to the intervention received by all students in the classroom and assume that it may be due to a cognitive or educational deficit¹⁹. The identification of dyslexia is a decision-making process, in which assessment will be interspersed with instruction. In each assessment stage, the progress made by students after each instruction stage is considered. So, if the performance assessment of the class as a whole is found to be adequate, the possible inadequacy of the instruction delivered is ruled out. Once it has been confirmed that instruction is adequate, the second stage involves identifying, by means of curricular measures, any students whose performance and progress is below that of their classmates, considering them to be students at risk of having dyslexia. In the third stage, individual curricular adaptations will be applied for these children. If these curricular adaptations are not sufficient, because the child is still not progressing, specialized educational measures are required, and the child is considered to be dyslexic¹⁹⁻²¹ (**Figure 5**). This model focuses on academic performance, eliminates the IQ-performance discrepancy and assessments of intelligence, and reduces the number of false positives⁸. However, there are few criteria to determine whether a child does or does not respond well to intervention over time. In addition, these problems coexist with other issues, and non-response to intervention could be due to the existence of comorbidity between them^{10,22,23}. These studies are sceptical about the use of the RTI model as a diagnostic instrument.

[Place Figure 5 here]

Therefore, there does not appear to be any consensus regarding the criteria that should be used to identify specific learning disabilities, and, in particular, dyslexia. Whereas diagnostic models use discrepancy, exclusion and specificity criteria, the response to intervention model considers poor performance in basic instrumental tasks following adequate instruction as a criterion. Both models have been criticized and present certain weaknesses. For this reason, the Learning Disabilities and Development Disorders research group at the University of Malaga has developed a protocol for the early detection of dyslexia, which considers the strengths of the diagnostic model and the response to intervention model.

In short, the aim of this paper is to present a proposed protocol to detect dyslexia at an early age. It sets out to provide an objective diagnostic procedure for the assessment of this neurodevelopmental disorder, in order to differentiate it from other comorbid disorders, from an early age. For the diagnosis of this specific learning disability, the protocol takes into account the evaluation of certain specific cognitive and linguistic determinants after adequate instruction in reading and writing (response to intervention model), as well as the discrepancy, exclusion and specificity criteria (diagnosis model). The action protocol is developed over several stages, following different types of instruction, and we propose the use of structured interviews with parents and teachers alongside standardized tests for the evaluation of intelligence, reading and writing, as well as the risk factors that determine the appearance of the problem. This action protocol provides a dynamic model for the detection of dyslexia, which seeks to distinguish it from other comorbid problems and identify its characteristics and determinants, in order to offer effective prevention at an early age.

PROTOCOL

This present study has been developed in accordance with the Helsinki Declaration, which establishes ethical principles for the development of research with humans. In addition, it follows the guidelines and was approved by the University of Malaga's Experimentation Ethics Committee (CEUMA).

NOTE: The protocol presented below should be carried out by psychologists within the school setting, beginning in the first year of Primary Education (6 years of age), and with the collaboration of teachers (**Figure 6**).

[Place Figure 6 here]

1. Stage 1: Assessment of instruction

1.1. Inform parents that their children will be assessed, in order to analyze whether they are at risk of having dyslexia.

1.2. Obtain informed consent from parents so that students can be assessed periodically.

1.3. Assess the reading and writing performance, based on the curriculum (CBM), of all the students in class, following adequate reading and writing instruction in their regular classroom²⁰, for two hours every day over the course of approximately six months. For the assessment of reading and writing performance based on the curriculum, use the indicators recommended by the National Reading Panel (NRP): phonological awareness, knowledge of the alphabet, vocabulary, reading fluency and comprehension²⁴.

1.4. For the evaluation of these indicators, administer the test to detect dyslexia^{25,26} either collectively or individually, informing participants of the instructions for performing each test.

1.5. Analyze the scores obtained. If the majority of the students have achieved similar appropriate scores in the assessment, rule out the possibility of inadequate teaching.

2. Stage 2: Multilevel assessment of student performance

2.1. Level 1: Screening

2.1.1. After analysing the scores obtained in stage 1, identify students who are at risk of dyslexia, according to the standards established for the tests administered.

2.1.2. Include students identified as being at risk in the next level.

2.2. Level 2: Assessment following group instruction

2.2.1. After any students identified as being at risk have received frequent reading and writing instruction in small groups, (30 minutes, three to five times a week, for approximately 10 sessions), evaluate their response to that instruction, either collectively or individually²⁴.

2.2.2. To perform this assessment, administer screening tests for dyslexia^{25,26}, which take the aforementioned indicators into account, informing the participants of the instructions to perform each test.

2.2.3. Identify students who present a risk of dyslexia determined on the basis of low test scores, following the instruction received.

2.2.4. Include the selected students in the next level.

2.3. Level 3: Assessment following intensive instruction

2.3.1. After students identified as being at risk have received even more frequent reading and writing instruction in smaller groups, evaluate their response to that instruction²⁴.

2.3.2. To perform this assessment, administer screening tests for dyslexia, collectively or

individually^{25,26}, which take the aforementioned indicators into account, informing the participants of the instructions to perform each test.

2.3.3. Identify students who present a risk of dyslexia determined on the basis of low test scores, following the instruction received.

2.3.4. Include the students selected in the next level.

3. Stage 3: Specific student assessment

3.1. To corroborate the diagnosis of dyslexia among students identified as being at risk, carry out the following assessment protocol for each student.

NOTE: Students who do not present any intellectual disabilities or sensory-motor handicaps, but who do perform poorly in reading comprehension and fluency and written accuracy, and present problems in most of the cognitive-linguistic variables evaluated, as well as possible socio-emotional, family and/or school repercussions, shall be classed as having dyslexia.

3.2. Interview with parents

3.2.1. To begin the specific student assessment protocol, inform parents that their child needs to be evaluated extensively because they have suspected dyslexia.

3.2.2. Obtain informed consent from parents so that students can be assessed specifically.

3.2.3. Conduct a structured interview with the student's parents, in order to gather information about their child in terms of their personal development (biological, motor, sensory, social, communicative-linguistic) and the family setting (family history, family organisation, expectations about their child's difficulties, family impact of the child's difficulties).

3.2.4. Have the psychologist ask the parents about their child's development, the existence of family history and the family setting.

3.3. Interview with the teacher

3.3.1. Conduct a structured interview with the teacher, in order to find out their opinion about the problem their student might present, their personal development (motor, sensory, social, communicative-linguistic, style of learning and motivation), the classroom environment (class organisation, position of the student within the classroom, materials used by the student, the student's integration in the classroom) and their school record (schools attended, academic performance, diversity management measures received and approach to schooling).

3.3.2. In this section, have the psychologist give the teacher the following instructions: "In order to obtain information and your opinion about the student, complete this structured interview

referring to the student's possible problem, their personal development, learning and motivation, their academic record and environment in the classroom".

3.4. Measure of Intelligence

3.4.1. Administer a cognitive scale²⁷ to assess intelligence in children, in accordance with the instructions set out in the test handbook, in order to rule out possible intellectual limitations.

3.4.2. Analyze the student profile obtained, in order to ascertain information about the cognitive and linguistic aspects (fluent reasoning, visual-spatial, working memory, processing speed and verbal comprehension) required to make the diagnosis and to establish the affected and unaffected cognitive-linguistic areas that would justify dyslexia and rule out other problems.

3.5. Measure of Reading and Writing

3.5.1. To measure reading fluency and comprehension, individually carry out a reading assessment²⁵ for children aged six.

3.5.2. In the reading fluency test, instruct the student to read a list of words and another list of pseudowords as fast as they can. Record the number they got right and the time they took to complete each test. Correct the answers in accordance with the correction criteria indicated in the test handbook.

3.5.3. For the reading comprehension test, instruct the student to read a text in silence and then answer questions about what they have read. Record the answers given by the student and correct them in accordance with the correction criteria indicated in the test handbook.

3.5.4. Analyze the student's reading profile in terms of accuracy, speed and comprehension, in accordance with the test instructions.

3.5.5. To assess written accuracy, carry out the copying and dictation test with the student²⁶, in accordance with the instructions indicated in the test handbook.

3.5.5.1. To carry out the copying test, instruct the student to copy out several texts by hand in a maximum of one minute. Correct the student's answers in accordance with the correction criteria indicated in the test handbook.

3.5.5.2. To carry out the dictation test, instruct the student to write down by hand the words they will hear in a maximum of two minutes. Correct the student's answers in accordance with the correction criteria indicated in the test handbook.

3.5.6. Analyze the numbers of right and wrong answers from both tests, in accordance with the correction criteria indicated in the handbook.

4. Cognitive-linguistic measures

4.1. After assessing reading and writing performance, evaluate the cognitive-linguistic variables that might explain the appearance of dyslexia^{24,28-31}: phonological awareness, knowledge of the alphabet, naming speed, short-term memory, vocabulary, and phonological and semantic fluency.

4.2. To assess phonological awareness, use a phonemic segmentation test²⁶.

4.2.1. In this test, instruct the student to repeat words after removing a certain syllable or phoneme.

4.2.2. Write down the answers given by the student and correct them in accordance with the correction criteria indicated in the test handbook.

4.3. To assess knowledge of the alphabet, use a letter reading test²⁵.

4.3.1. In this test, instruct the student to say the names of the letters shown to them on printed cards.

4.3.2. Record the answers given by the student and correct them in accordance with the correction criteria indicated in the test handbook.

4.4. To assess naming speed, use a test for the student to name pictures²⁶.

4.4.1. In this test, instruct the student to say the name of the pictures shown on cards as quickly as possible.

4.4.2. Make a note of any errors and the time they take. Correct the test in accordance with the correction criteria indicated in the test handbook.

4.5. To assess short-term memory, use an inverse digit test²⁶.

4.5.1. In this test, instruct the student to repeat in reverse order the sequence of digits they will hear.

4.5.2. Write down the answers given by the student and correct them in accordance with the criteria established in the test handbook.

4.6. To assess vocabulary, carry out a vocabulary test²⁶.

4.6.1. Instruct the student to simply mark the drawing that represents the word given by the examiner.

4.6.2. Correct the student's answers in accordance with the criteria established in the test handbook.

4.7. To assess phonological fluency, use a verbal fluency test²⁶.

4.7.1. In this test, instruct the student to say in one minute all the words that begin with the sound /p/.

4.7.2. Write down the answers given by the student and correct them in accordance with the criteria established in the test handbook.

4.8. To assess semantic fluency, carry out a semantic fluency test²⁶ and instruct the student to say in one minute all the animal names they know.

4.8.1. Write down the answers given by the student and correct them in accordance with the criteria established in the test handbook.

REPRESENTATIVE RESULTS

This next section sets out a series of representative results obtained by one student diagnosed with dyslexia, following the proposed action protocol.

Table 1 shows the scores obtained by Year 1 Primary students in phonological awareness, knowledge of the alphabet, vocabulary, and reading fluency and comprehension, after ordinary reading and writing instruction. The results indicate that most of the students achieve similar direct scores in the assessment, close to the average achieved by the group, according to the horizontal line indicated in **Figure 7**. This confirms that the instruction they received is adequate. However, we also see that some students present lower scores in most of the measures (subjects 5, 6, 10, 14, 16 and 21). These students are considered to be at risk of dyslexia and receive group instruction.

[Place Figure 7 here]

Table 2 shows that, after these students have received frequent adequate reading and writing instruction in small groups (intervention group), some of the students continue to obtain low scores in most of the variables evaluated (phonological awareness, knowledge of the alphabet, vocabulary, and reading fluency and comprehension) (Students 5, 6 and 16) whereas others have improved on their previous scores (students 10, 14 and 21) (**Figure 8**). These students are not considered to be at risk of having dyslexia and go back to receiving regular instruction only, whereas the others are considered to be at risk and will receive intensive instruction (students 5, 6 and 16). The table also shows that, after more frequent instruction in smaller groups (intensive intervention), one of the students selected above still achieves low scores (student 6), whereas the others improve their scores (students 5 and 16). The student who continues to achieve low scores is considered to be at risk of having dyslexia, whereas the ones who have improved their scores are not.

These data confirm that the Response to Intervention model facilitates the detection of dyslexia in children.

[Place Table 1 here]

[Place Table 2 here]

[Place Figure 8 here]

Below are the results of the specific assessment of student 6, selected as being at risk of dyslexia following the different types of intervention received, in order to corroborate the diagnosis of dyslexia.

After the parents signed the informed consent, they reported that their daughter did not present any physical, sensory or motor problems. They stated that she had a lingual frenectomy and received speech therapy, due to her difficulties with language and speech. There is no similar family history. The family acknowledged their daughter's situation and was collaborative and interested. These data indicate that the student might present a problem of dyslexia, ruling out other problems, in accordance with the criteria of specificity and exclusion (**Figure 9**).

[Place Figure 9 here]

Following the interview with the teacher, it was clear that she recognizes the student's problems with oral and written language, that the student respects school rules and norms, that she recognizes her limitations, that she feels comfortable in class, that she needs constant reinforcement, that she works slowly if not stimulated, that she needs some of the materials to be adapted, that she feels close to the teacher, and that she previously attended another school, where she received speech therapy sessions. These data indicate that the student might present a problem of dyslexia, and other problems can be ruled out, in accordance with the criteria of specificity and exclusion (**Figure 9**).

After assessing her level of intelligence using a cognitive scale²⁷, we found that the student did not present any intellectual disabilities, with a GAI score of 103. In the scales measuring Verbal comprehension, Perceptual reasoning, Working memory and Processing speed, the score achieved was above 85, which confirms that her intellectual capacity is adequate, thus confirming that she might have dyslexia (**Figure 10**).

[Place Figure 10 here]

The results obtained in the assessment of reading processes²⁵ indicate that the student presents difficulties in reading fluency. This is shown by the scores obtained in Accuracy and Speed of reading words and pseudowords (PC=5, respectively), which is below the normal range, in accordance with the correction instructions in the handbook. This student also presented a low score in the Text comprehension test (PC=5). Furthermore, the results of the Copying and

Dictation evaluation in the test to detect dyslexia²⁶ indicate that the student presents difficulties in writing (PC=10 and 5, respectively), in accordance with the test criteria. These results show that the girl has dyslexia, since she does not present any intellectual disabilities, but does have difficulties with reading and writing performance (discrepancy and specificity criteria), scoring below the 50th percentile in the reading and writing tests.

With regard to the possible factors that could explain her dyslexia, the results indicate that the student presents difficulties in the Knowledge of Letters test²⁵ (PC=3), in accordance with the scoring criteria set out in the handbook. In addition, according to the dyslexia detection test used²⁶, the student presents low scores for Phonological awareness (PC=5), Naming speed (PC=2), Short-term memory and Phonological fluency (PC=1 and PC=2, respectively). She also presents difficulties in Semantic Fluency and Vocabulary (PC=2 and PC=4, respectively). These results confirm the existence of a diagnosis of dyslexia, due to the difficulties she presents in phonological processing, and as a result of reading comprehension problems, since she scores below the 50th percentile in the evaluation of the factors considered **Figure 10**).

[Place Figure 10 continuation here]

In conclusion, following adequate instruction in reading and writing in the regular classroom setting, group settings and intensively, we found that one of the students presented low scores in reading and writing, thus displaying a risk of dyslexia. According to data compiled from parents and her teacher, the student might present dyslexia, since possible sensory, intellectual and/or socio-emotional problems that could justify her reading and writing problems have been ruled out, and she displays problems in terms of her oral language and a need for education support. This information is verified after the specific evaluation conducted, wherein no intellectual difficulties were observed, but difficulties in reading and writing were detected, associated with phonological processing (knowledge of the alphabet, phonological knowledge, naming speed, short-term memory, phonological fluency), which leads to reading comprehension problems (semantic fluency, vocabulary). These results would confirm a diagnosis of dyslexia, based on the response to intervention model and the diagnostic model.

Figure 1. Criterion of Diagnostic Model

Figure 2. Discrepancy Criterion

Figure 3. Criterion of Diagnostic Model (Exclusion Criterion)

Figure 4. Criterion of Diagnostic Model (Specificity Criterion)

Figure 5. Multilevel System of Model "Response to Intervention"

Figure 6. Stage of Protocol of Evaluation of Dyslexia

Figure 7. Direct scores obtained by students in a classroom in the indicators considered, with

an indication of the group average, following group intervention.

Figure 8. Direct scores gained by subjects at risk of dyslexia in the selected indicators, following different types of instruction.

Figure 9. Result of Specific assessment of student at risk (Parents and Teacher Interview)

Figure 10. Result of Specific assessment of student at risk.

Table 1. Direct scores obtained by students in a classroom in the indicators considered. PA= Phonological awareness ($P_{\max} = 12$); KA = knowledge of the alphabet ($P_{\max} = 20$); Vo = Vocabulary ($P_{\max} = 16$); RF = Reading Fluency ($P_{\max} = 88$); RC = reading comprehension ($P_{\max} = 16$)

Table 2. Direct scores obtained in the indicators considered by the selected students who are at risk of dyslexia, following different types of instruction. PA= Phonological Awareness ($P_{\max} = 12$); KA = Knowledge of the Alphabet ($P_{\max} = 20$); Vo = Vocabulary ($P_{\max} = 16$); RF = Reading Fluency ($P_{\max} = 88$); RC = Reading Comprehension ($P_{\max} = 16$)

DISCUSSION

In this study, we presented a proposed dyslexia detection protocol to be applied from Year 1 in Primary Education within the school setting. This action protocol considers the strengths of the diagnostic model^{8,13,32} and the response to intervention model^{21,22,33-36} and makes it possible to achieve a valid differential assessment of dyslexia. As a consequence, the psychological intervention received by students with dyslexia will be more effective, and parents and teachers may also receive more useful recommendations.

This protocol is not just a static assessment of reading and writing performance, and the determinants thereof (diagnostic model), which is frequently applied. It also considers a dynamic assessment, which takes into account the student's response following different types of instruction (ordinary, group, intensive) received over a given period of time.

The discrepancies between expert psychologists regarding the criteria to be used in the diagnosis of dyslexia found in studies conducted in different countries³⁷⁻³⁹, the confusion between children with dyslexia and other comorbid disorders^{22,23} and its high prevalence² justify the need for this protocol, in order to provide professionals with a useful unanimous procedure, based on scientific results, for a valid assessment of the symptoms of dyslexia.

One minor limitation of this protocol is the time required to diagnose dyslexia. It might appear that students who are at risk of dyslexia would have to wait a long time for intervention since a definitive diagnosis is not immediate. However, it is important to remember that children who are deemed to be at risk are receiving instruction at all times through different modes of intervention, and are attended to throughout the entire process²⁴.

Future lines of research on dyslexia should use subjects diagnosed according to this Protocol, in order to ensure that the sample is representative. It would also be useful if studies conducted with these samples also analyzed the predictive value of other cognitive variables considered in this study.

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DISCLOSURES

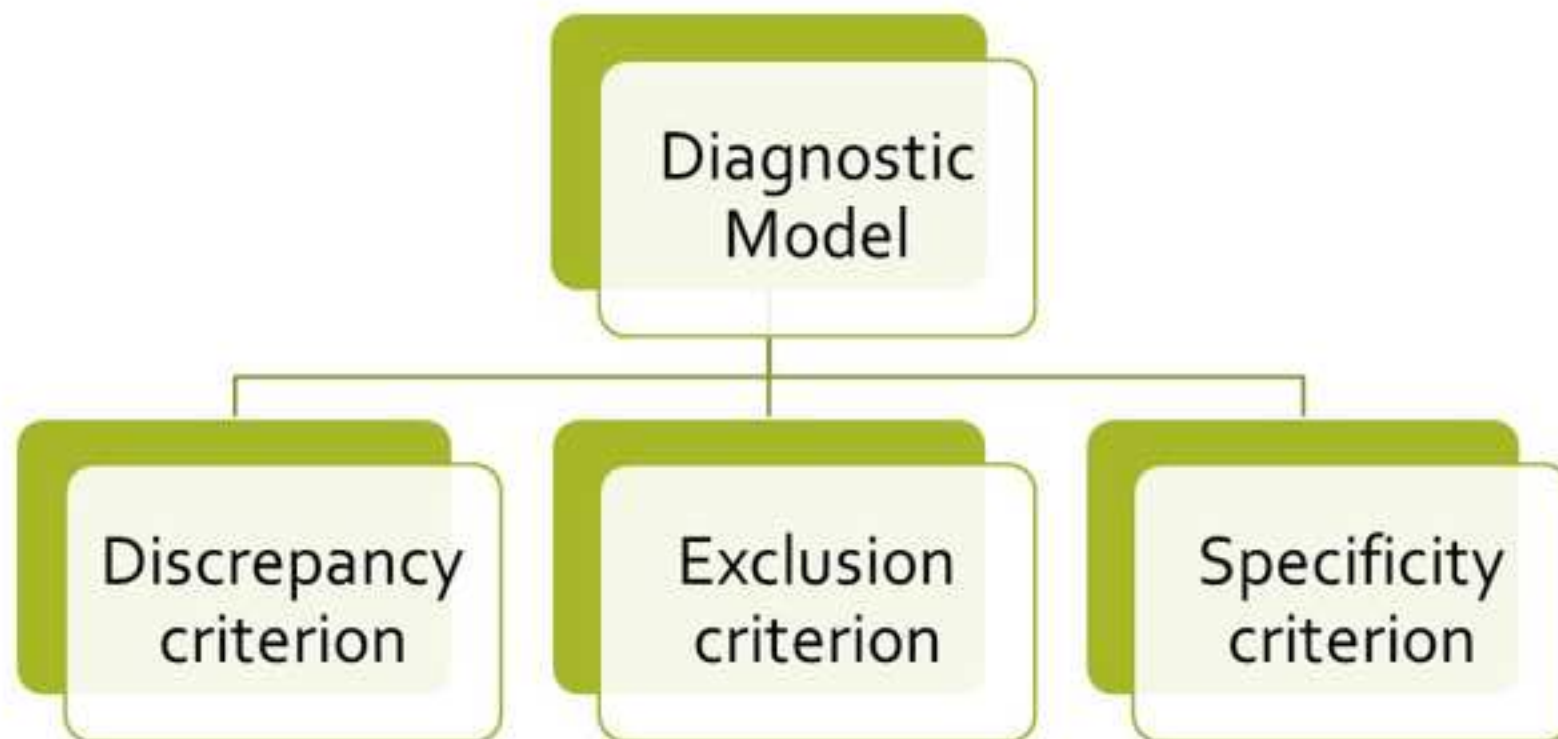
The authors have nothing to disclose

REFERENCES:

1. American Psychiatric Association. *Manual Diagnóstico y Estadístico de los Trastornos Mentales. DSM-5. [Diagnostic and Statistical Manual of Mental Disorders]* (5th ed.). E. Médica Panamericana. Madrid (2014).
2. Katusic, S.K., Colligan, R.C., Barbaresi, W.J., Schaid, D.J., Jacoben, S.J. Incidence of reading disability in a population-based birth cohort 1976-1982. Rochester, Minn. *Mayo Clinic Proceedings*. **76**, 1081-1092 (2001).
3. Shaywitz, S.E., Shaywitz, B.A., Fletcher, J., Escobar, M. Prevalence of reading disability in boys and girls: results of the Connecticut Longitudinal Study. *Journal of American Medical Association*. **264**, 998-1002 (1990).
4. Siegel, L.S. Issues in the definition and diagnosis of learning disabilities. *Journal of Learning Disabilities*. **32**, 304-319 (1999).
5. Jiménez, J.E. et al. Do the effects of computer-assisted practice differ for children with Reading disabilities with and without IQ-achievement discrepancy? *Journal of Learning Disabilities*. **36**, 34-47 (2003).
6. Swanson, H.L., Horskyn, M., Lee, C. Interventions for students with learning disabilities: A meta-analysis of treatment outcome. Guilford. New York, NY. US (1999).
7. Stuebing, K.K. et al. Validity of IQ-discrepancy classifications of reading disabilities: A meta-analysis. *American Educational Research Journal*. **39**, 469-518 (2002).
8. Speece, D.L., Case, L.P., Molloy, D.E. Responsiveness to general education instruction as first gate to learning disabilities identification. *Learning Disabilities Research & Practice*. **18**, 147-156 (2003).
9. National Joint Committee for Learning Disabilities Collective Perspective on Issues Affecting Learning Disabilities: Position Papers and Statements. Austin, TX: Pro-Ed (2001).
10. Soriano, M. *Dificultades en el Aprendizaje*. Grupo Editorial Universitario. Granada (2006).
11. Kavale K.A., Forness, S.R. What definitions of learning disabilities say and don't say. A critical analysis. *Journal of Learning Disabilities*. **33**, 239-256 (2000).
12. Fletcher, J.M. et al. Classification of learning disabilities: An evidence-based evaluation. In *Identification of learning disabilities. Research disabilities. Research into practice*. Edited by Bradley, R., Danielson, L., Hallahan D.P., LEA. Mahwah, N.J. (2002).
13. Lyon, G.R., Fletcher, J.M., Barnes, M.C. Learning disabilities. In *Child Psychopathology*.

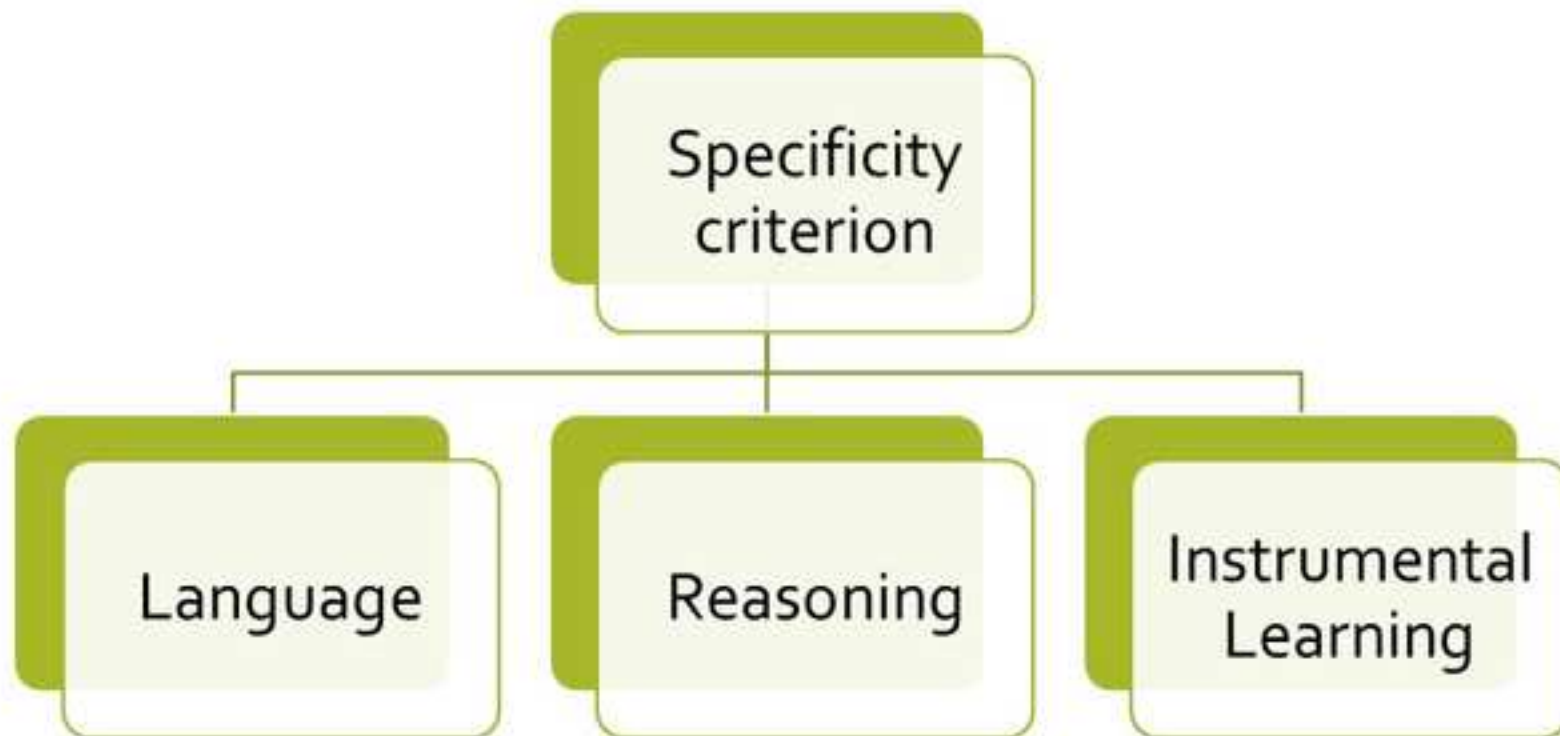
- 572 Edited by Mash, J., Barkley, R.A., Guilford Press. New York (2003).
- 573 14. Fawcett, A. J., Nicolson, R.I. Persistence of phonological awareness deficit in older children
574 with dyslexia. *Reading and Writing: An interdisciplinary Journal*. **7**, 361-376 (1995).
- 575 15. Rack, J.P., Snowling, M.L., Olson, R.K. The nonword Reading deficit in developmental
576 dyslexia: a review. *Reading Research Quarterly*. **25**, 28-53 (1992).
- 577 16. Fawcett, A., Nicholson, R. Dyslexia: The role of the cerebellum. *European Journal of*
578 *Research in Educational Psychology*. **4**, 35-58 (2004).
- 579 17. Virsu, V., Lahti-Nuuttila, P., Laasonen, M. Crossmodal temporal processing acuity
580 impairments aggravates with age in developmental dyslexia. *Neuroscience Letters*. **336**, 151-154
581 (2003).
- 582 18. Jiménez, J.E. *Modelo de respuesta a la intervención. Un enfoque preventivo para el*
583 *abordaje de las dificultades de aprendizaje*. Pirámide: Madrid (2019).
- 584 19. Fuchs L.S., Fuchs, D. Treatment Validity: A unifying concept for reconceptualizing the
585 identification of learning disabilities. *Learning Disabilities Research & Practice*. **13**, 204-219
586 (1998).
- 587 20. Fuchs, D. Fuchs, L.S., Compton, D.L. Identifying Reading disabilities by responsiveness to
588 instruction: Specifying measures and criteria. *Learning Disability Quarterly*. **27**, 216-227 (2003).
- 589 21. Fuchs, D., Mock, D., Morgan, P.L., Young, C.L. Responsiveness to intervention: Definitions,
590 evidence and implications for the learning disabilities field. *Learning Disabilities Research &*
591 *Practice*. **18**, 157-171 (2003).
- 592 22. Vaughn, S., Fuchs, L.S. Redefining learning disabilities as inadequate response to
593 instruction: the promise and potential problems. *Learning Disabilities Research & Practice*. **18**,
594 137-146 (2003).
- 595 23. Kavale, K.A., Holdnack, J.A., Mostert, M.P. Responsiveness to intervention and the
596 identification of specific learning disabilities: A critique and alternative proposal. *Learning*
597 *Disability Quarterly*. **28**, 2-16 (2005).
- 598 24. Jiménez, J.E., Crespo, P. Modelo de respuesta a la intervención: definición y principales
599 componentes. In *Modelo de respuesta a la intervención. Un enfoque preventivo para el abordaje*
600 *de las dificultades específicas de aprendizaje*. Edited by Jiménez, J.E., Piramide. Madrid (2019).
- 601 25. Cuetos, F., Rodríguez, B., Ruano, E., Arribas, D. *PROLEC-R. Batería de Evaluación de los*
602 *Procesos Lectores*. TEA ediciones. Madrid (2012).
- 603 26. Fawcett, A.J., Nicolson, R.I. *The dyslexia Screening Test-Junior*. Pearson Assessment,
604 Oxford (2004).
- 605 27. Weschler, D. *The Weschler Intelligence Scale for Children- 5th edition*. Pearson
606 Assessment. London (2005).
- 607 28. Babayigit, S., Stainthorp, R. Modeling the relationships between cognitive-linguistic skills
608 and literacy skills: new insights from a transparent orthography. *Journal of Educational*
609 *Psychology*. **103**, 169–189 (2011).
- 610 29. Caravolas, M. et al. Different patterns, but equivalent predictors, of growth in reading
611 inconsistent and inconsistent orthographies. *Psychological Science*. **20**, 1–10 (2013).
- 612 30. Georgiou, G.K., Parrilla, R., Papadopoulos, T.C. Predictors of word decoding and reading
613 fluency across languages varying in orthographic consistency. *Journal of Educational Psychology*.
614 **100**, 466–580 (2008).
- 615 31. González-Valenzuela, M.J., Díaz-Giráldez, F., López-Montiel, D. Cognitive predictors of

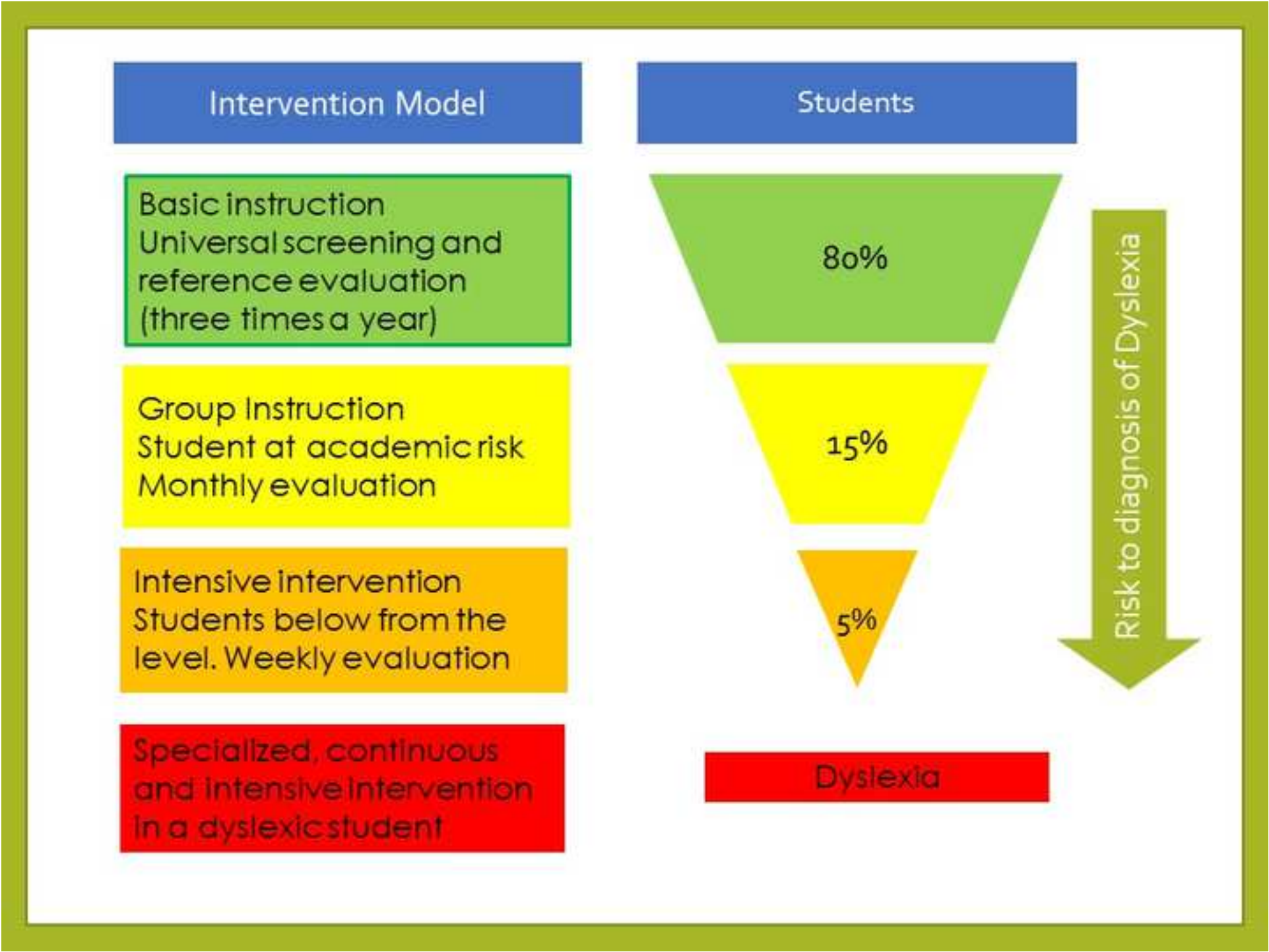
- 616 word and pseudoword Reading in Spanish First-Grade Children. *Frontiers in Psychology*. **7** (774),
617 1-12 (2016).
- 618 32. Stuebing, K. K., Fletcher, J. M., Branum-Martin, L., Francis, D. J. Evaluation of the technical
619 adequacy of three methods for identifying specific learning disabilities based on cognitive
620 discrepancies. *School Psychology Review*. **41**, 3–22 (2012).
- 621 33. Fletcher, J.M., Vaughn, S. Responsiveness To Intervention: A decade later. *Journal of*
622 *Learning Disabilities*. **45** (3), 195-203 (2012).
- 623 34. Vaughn, S. et al. Effects of intensive reading intervention for eighth-grade students with
624 persistently inadequate response to intervention. *Journal of Learning Disabilities*. **45**, 515–525
625 (2012).
- 626 35. Brown Waesche, J. S., Schatschneider, C., Maner, J. K., Ahmed, Y., Wagner, R. K. Examining
627 agreement and longitudinal stability among traditional and RTI-based definitions of reading
628 disability using the affected-status agreement statistic. *Journal of Learning Disabilities*. **44**, 296–
629 307 (2011).
- 630 36. Stuebing, K. K. et al. Are child cognitive characteristics strong predictors of response to
631 intervention? A meta-analysis. *Review of Educational Research*. **48**, 1-22 (2014).
- 632 37. González-Valenzuela, M.J., Soriano-Ferrer, M., Delgado-Ríos, M., Félix-Mateo, V. How are
633 Reading Disabilities Operationalized in Spain? A Study of Practicing School Psychologists. *Journal*
634 *of Childhood & Developmental Disorders*. **2**, 3-23 (2016).
- 635 38. Machek, G.R., Nelson, J.M. How should reading disabilities be operationalized? A survey
636 of practicing school psychologists. *Learning Disabilities Research & Practice*. **22** (2), 147-157
637 (2007).
- 638 39. Speece, D. L., Shekitka, L. How should reading disabilities be operationalized? A survey of
639 experts. *Learning Disabilities Research & Practice*. **17**, 118-123 (2002).

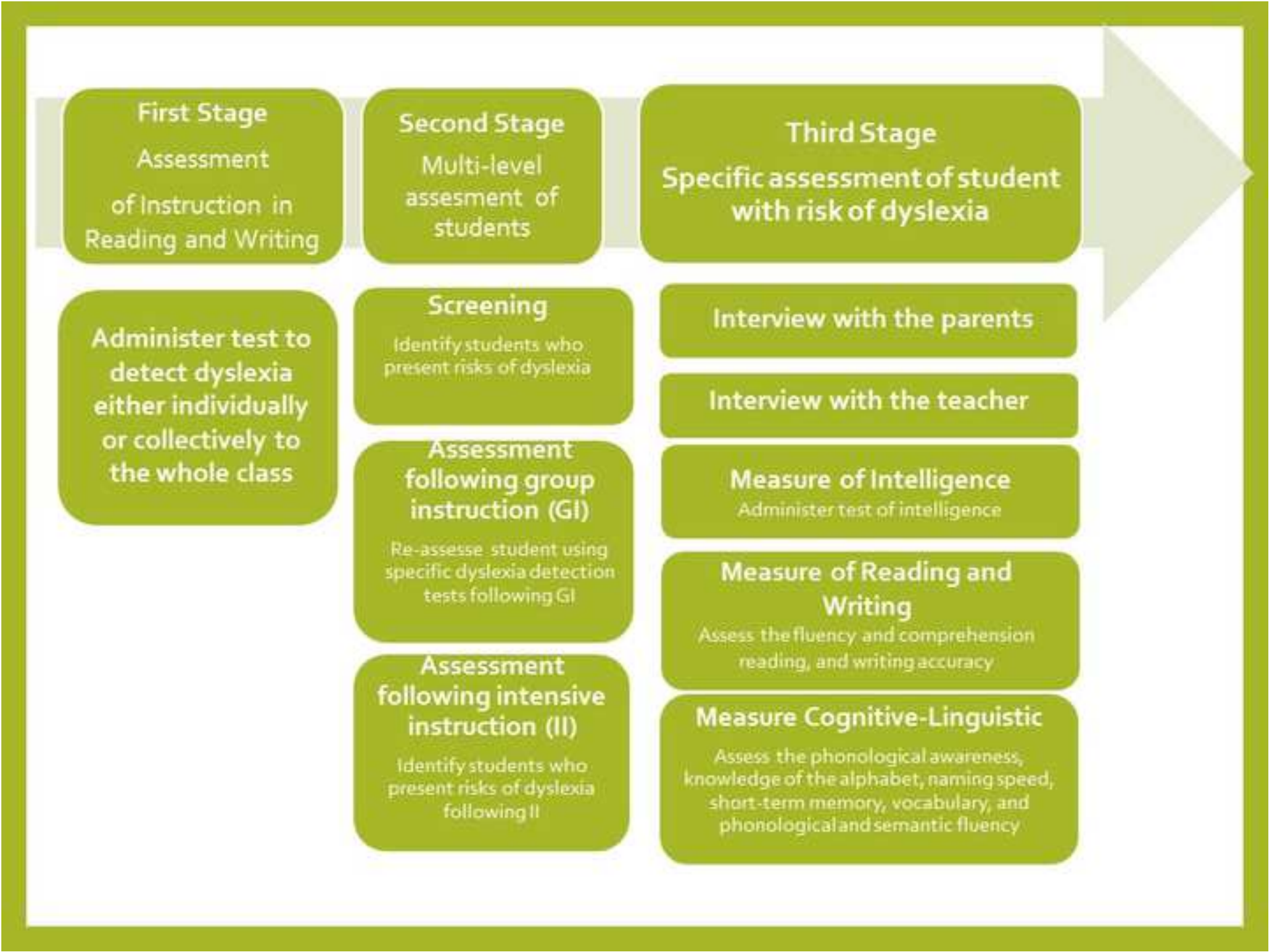












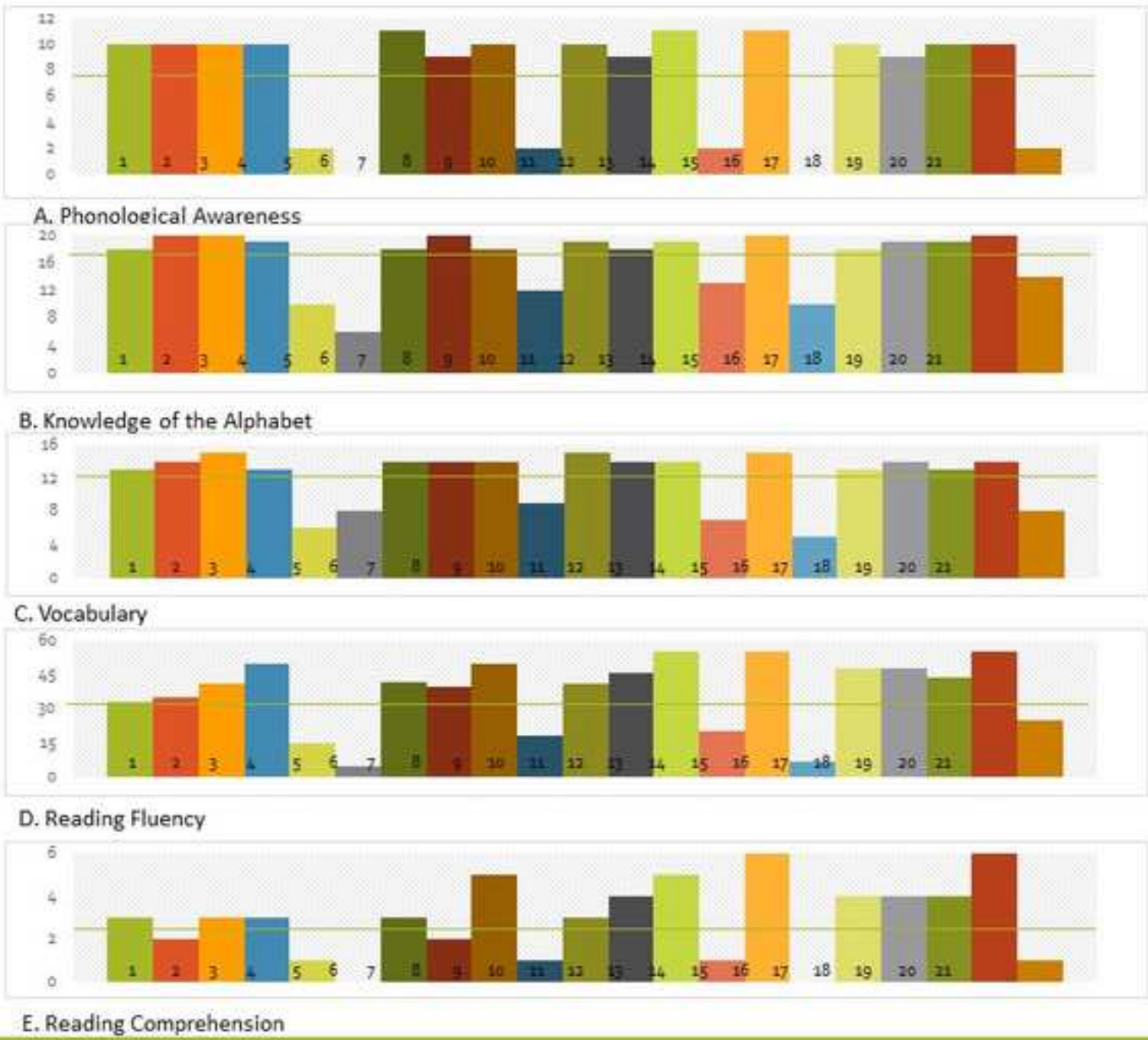
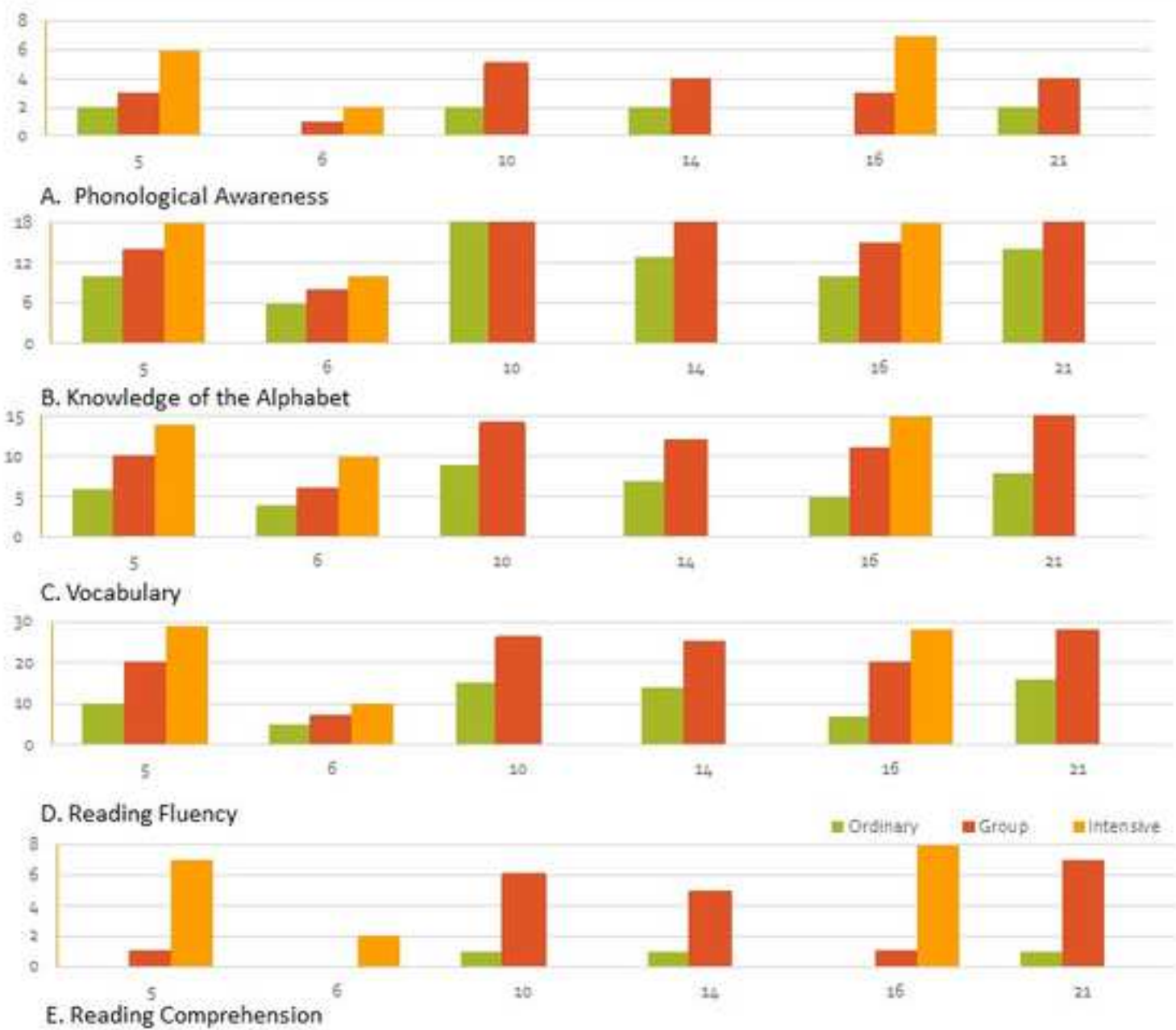
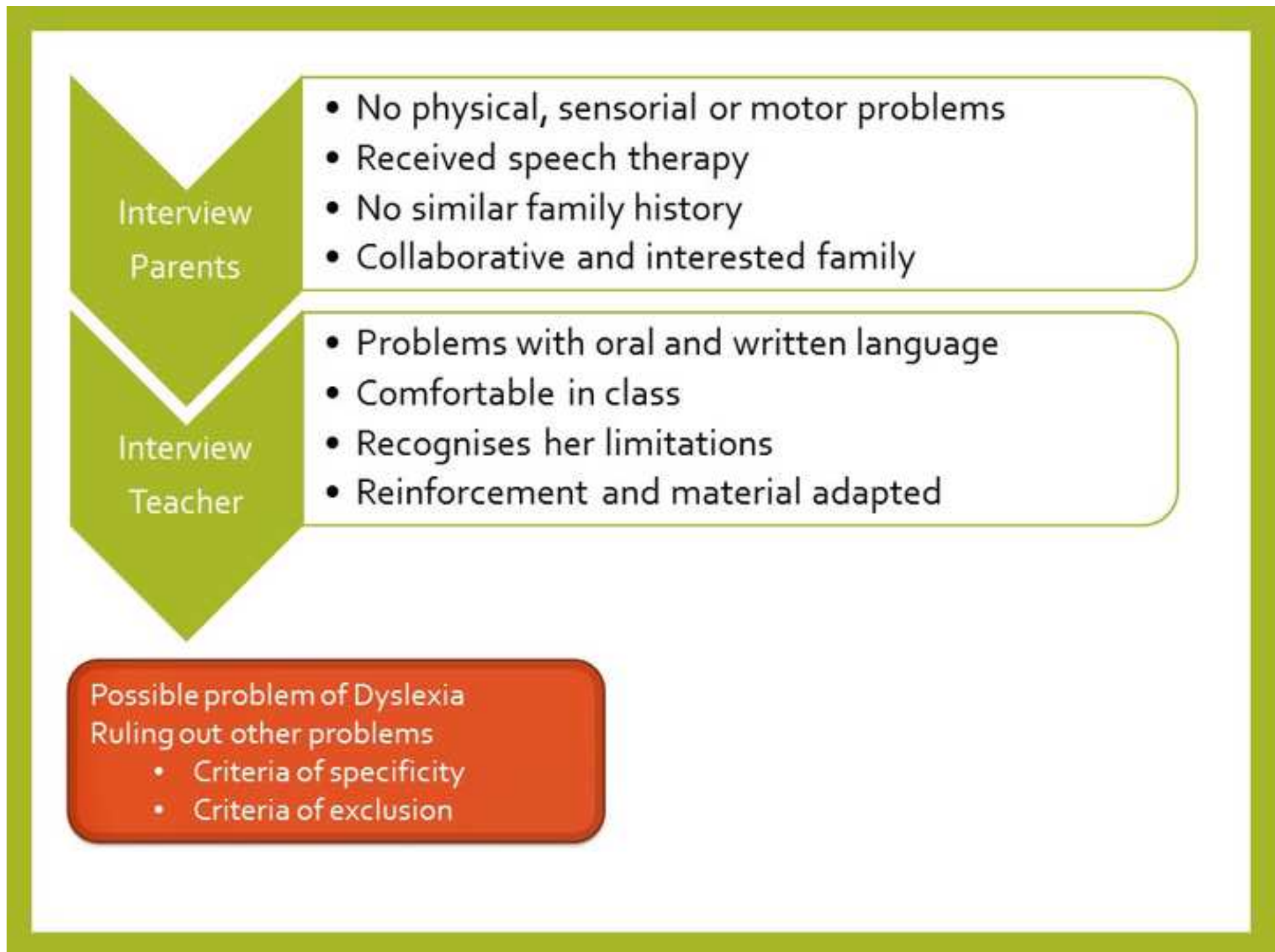
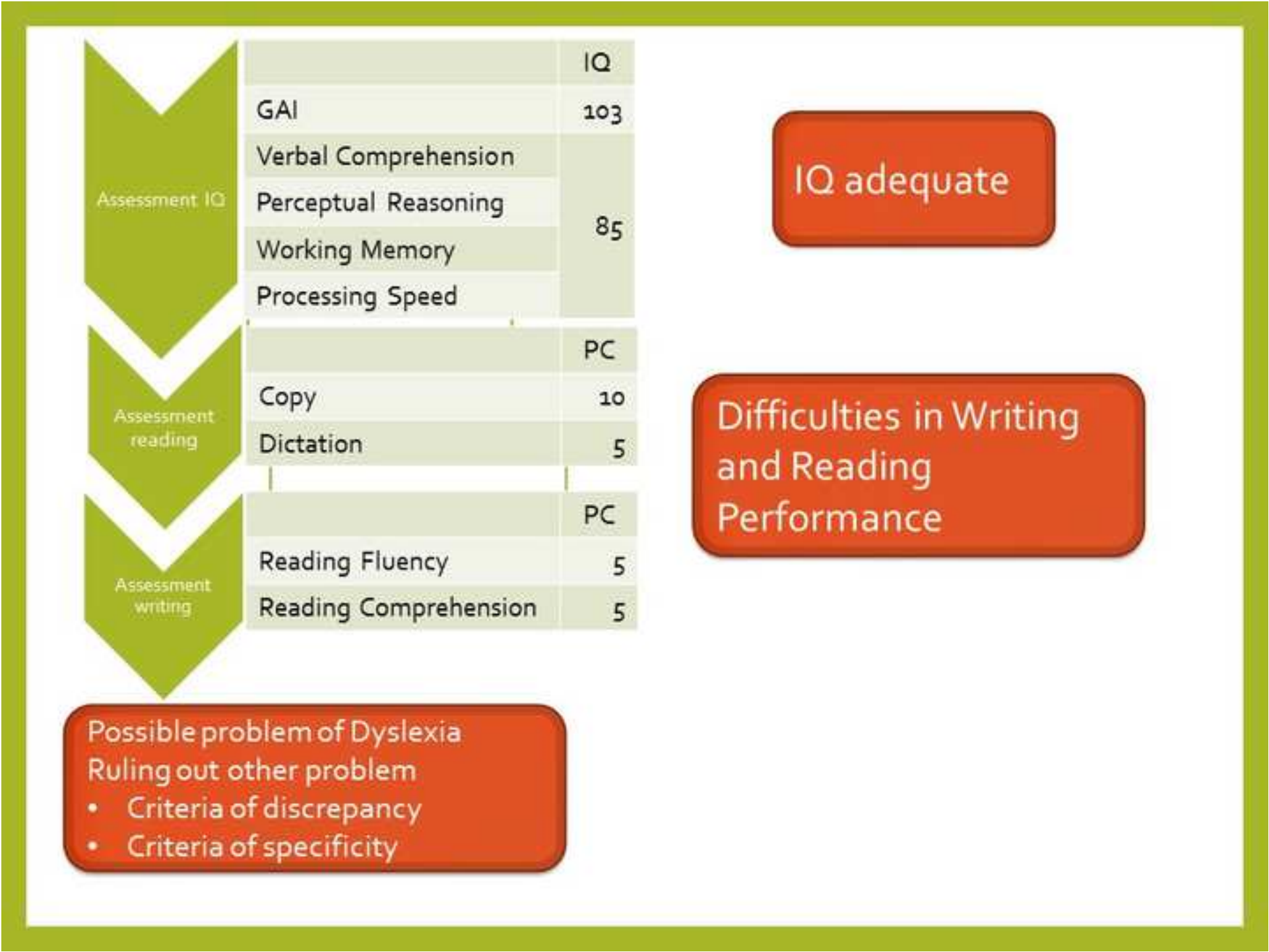



Figure8









	PC
Knowledge of letters	3
Phonological Awareness	5
Naming Speed	2
Short-term Memory	1
Phonological Fluency	2
Semantic Fluency	2
Vocabulary	4

- Problem of Dyslexia
- Deficit Phonological Processing

Subject	Pa	Ka	Vo	Rf	Rc
1	10	18	13	33	3
2	10	20	14	35	2
3	10	20	15	41	3
4	10	19	13	50	3
5	2	10	6	10	0
6	0	6	8	5	0
7	11	18	14	42	3
8	9	20	14	40	2
9	10	18	14	50	5
10	2	12	9	15	1
11	10	19	15	41	3
12	9	18	14	46	4
13	11	19	14	55	5
14	2	13	7	14	1
15	11	20	15	55	6
16	0	10	5	7	0
17	10	18	13	48	4
18	9	19	14	48	4
19	10	19	13	44	4
20	10	20	14	55	6
21	2	14	8	16	1

subject	Ordinary Instruction					Group In	
	Pa	Ka	Vo	Rf	Rc	Pa	
5	2	10	6	10	0	3	
6	0	6	4	5	0	1	
10	2	12	9	15	1	5	
14	2	13	7	14	1	4	
16	0	10	5	7	0	3	
21	2	14	8	16	1	4	

struction				Intensive			
Ka	Vo	Rf	Rc	Pa	Ka	Vo	
14	10	20	1	6	18	14	
8	6	7	0	2	10	10	
17	14	26	6				
18	12	25	5				
15	11	20	1	7	19	15	
18	15	28	7				

Instruction		
Rf	Rc	
	29	7
	10	2
	28	8

Name of Material/ Equipment	Company	Catalog Number
PROLEC-R. Batería de Evaluación de los Procesos Lectores	TEA ediciones	
The dyslexia Screening Test-Junior	Pearson Assessment	
The Wescher Intelligence Scale for Children- 5 edition	Pearson Assessment	

Comments/Description

This Instrument assess of reading performance

Screening tests for dyslexia (writing, comprehension reading, phonological awareness, knowledge of the alphabet, vocabulary)

This instrument assess the intelligence

Rebuttal document 3

60858-R3

Editorial comments:

1. The number of figures in the manuscript (7) does not match the number of figures in the video (10). Please revise.

Those figures show different information. The figure 7 of manuscript show the result of students at risk of dyslexia in the five key indicator of risk (awareness phonological, knowledge of the alphabet, vocabulary, reading fluency and comprehension). The figure 10 of video show the result of evaluation diagnosis of student at risk, with cognitive and psycholinguistic scales (GAI, verbal comprehension, perceptual reasoning, working memory and processing capacity)

Figures 6 and 7 of manuscript have been changed, because it has a problem with the change control of the early version of manuscript.

2. I have revised the title to "Assessing Dyslexia at Six Years of Age". Please revise the title card in the video to match this.

Reviewed and corrected, at the initial and the end

3. Video & Audio Glitches

@05:21 There seems to be an audio glitch in the narration on the word, "similar appropriate scores in assessment"

Reviewed and corrected

@05:27 There is a flickering blotch in the middle of the screen as the video fades from the classroom into Figure 6

Reviewed and corrected

Editorial comments:

1. There continues to be issues with the Figures. There are 7 figures in the written manuscript but 10 figures in the video. These figures should be the same. For example, Figure 1 in the written manuscript should be the same Figure 1 that is in the video, and so on for the subsequent figures. Currently, figure 1 in the written manuscript is not the same as Figure 1 in the video. Figure 2 in the written manuscript is not the same as Figure 2 in the video. Please revise the manuscript and the video so that figures and number of figures in the written manuscript and the video are the same.

We have showed the figures and tables on manuscript as in the video. Tables and figures are equal on video and manuscript.

The video should be a reflection of the written manuscript. The simplest revision would be to revise the written manuscript to use all of the figures from the video.

We add table 1 and we change table legend 2 on video, as in the manuscript