Psychology and Behavioral Science
International Journal
ISSN 2474-7688

Research Article
Volume 12 Issue 2 - June 2019
DOI: 10.19080/PBSIJ.2019.12.555834

Psychol Behav Sci Int J

Mechanism of Phonological Decoding in the Spanish language

Yaser Ramírez-Benítez[1]*, Bárbara Bermúdez Monteagudo[2] and Rodneys Mauricio Jiménez-Morales[3]

[1]*Speech Therapy Department, Pedagogical Science, Cognitive Neuroscience, Cienfuegos of University, Cienfuegos, Cuba*

[2]*Center Study of Education Science, Psychological Science, José Martí Santi Spiritus of University, Cuba*

Submission: June 06, 2019; **Published:** June 21, 2019

***Corresponding author:** Yaser Ramírez-Benítez, Cienfuegos of University, Cienfuegos, Cuba. Calle Cuba 23 A, Rodas, Cienfuegos, Cuba

Abstract

The reading development depends two linguistic mechanisms: phonological decoding and reading compression. However, the effect of both mechanisms can vary according to the characteristics of the language (transparent vs. opaque) and the experience reader (2 years or 4 years of educational instruction). From this position, he was carried out a longitudinal study with the objective of determining the effect of the phonological and lexical skill on the reading during 3 years of experience in the Spanish Language. In the analysis it was controlled the effect of the Verbal Memory and the Intelligence (Raven Test). 156 children of first grade participated in two primary schools of Cienfuegos, Cuba. To the beginning of the 1º, four tests were applied: Vocabulary, Rhymes of syllables, Verbal Memory and Intelligence. At the end of the 1º, the children were re-evaluated for Reading Fluency Test. This same population was re-evaluated at the end of 2º and 3º with another Reading Fluency Test, Segmentation Phonological, Synthesis Auditory Phonetic, Synthesis Visual Phonetic and Peabody Vocabulary. According to the results, a year of experience reader in the Spanish language is enough to obtain a significant semantic development in the children. Three years of experience reader in the Spanish language it is not enough to indicate an automation of the mechanism of phonological decoding.

Keywords: Reading; Development; Language; Neuroeducation

Introduction

The study of reading is a subject of notable importance at early ages because of its close relationship with school success. To read, two linguistic mechanisms are needed in any cultural context: phonological decoding and reading comprehension. The first one makes it possible to convert graphemes in phonemes where phonological skills are fundamental to developing this mechanism, while compression is related to the semantic abilities of language and other cognitive abilities such as intelligence, memory and attention.

Both mechanisms are important for developing expert reading, although the main objective of reading is to understand the text. At the beginning of the acquisition of reading, the child accesses the compression of texts and sentences through phonological decoding. In other words, the grapheme-phoneme conversion mechanism is done explicit, aware. In this way, the reading is slow and activates many cognitive resources to understand the text. However, training and educational instruction allow a more implicit, less conscious decoding.

The implicit nature of the decoding does not occur with equal rhythm in all languages, especially, it occurs earlier in transparent languages (Spanish, German and Italian) than in opaque languages (English, French, Chinese). According to English-speaking studies, the automation of decoding does not occur in the school stage [1-3]. However, the studies in transparent languages show the opposite, since the almost perfect correspondence between the sound of the letter and its spelling allows a rapid learning of the reading code [4-10].

From these evidences, an early automation of the decoding mechanism in transparent languages is expected, and consequently, the early use of lexical resources to access text compression. Seen in this way, cognitive neurosciences have used two major ways to search for scientific evidence:

i. Left lateralization of the brain regions involved in decoding as an indicator of automation and

ii. Behavioral studies that reflect the early use of lexical resources to access to reading comprehension, to a lesser extent, the use prelexical resources.

Neurophysiological studies in transparent languages have reported that 5 year of reading experience is not sufficient to visualize a left lateralization of the brain areas involved in phonological decoding [11-13]. In this way, neurophysiological evidence rejects the argument of early automation of decoding in transparent languages. However, behavioral studies conducted with transparent speech children indicate a possible “ceiling effect” of the decoding mechanism between 3 and 4 years of reading experiences. In particular, the reports have been made in German research [5-7,9-11], to a lesser extent, in children of Spanish language [10,14].

From this perspective, a contradiction between neurophysiological and behavioral studies is observed, indicating little clarity of the subject. Certainly, the process of neural specialization of decoding takes a long time to establish itself in the left regions, even in transparent languages. This occurs due to the biological complexity of the visual system, designed to function bilaterally in rapid visual recognition, to a lesser extent, in an ipsilateral function. However, the recognition of words is a cultural requirement for brain development reading, which this forced to a left lateralization to rapid recognition with few cognitive resources, as Dehaene [15] says neural recycling occurs. This process is long and expensive for the nervous system, so it needs time to adapt to the modifications. However, without neural specialization may appear indicators of good behavioral functioning of psychological and educational skills. To take an example, a 5-year-old child is able to speak more than 95% of the words in their native language; however, neural specialization of the language areas has not been completed in this age. In other words, the automation of the decoding can be present in the child before the neural specialization, which is slower than the acquisition of the orthographic code of the language.

From this argument, the present investigation aims to perform a longitudinal study to answer the following hypothesis: in the Spanish language, children achieve the automation of the phonological decoding mechanism at the end of the 3rd grade. This study is made considering two reasons: (1) few Spanish-speaking studies that analyze the automation process of decoding, (2) the Spanish language is more transparent than the other languages; therefore, an earlier automation of the mechanism decoding is expected.

Method

Participants

Four groups of kindergarten (220 children) were selected in two primary schools in the province of Cienfuegos. The selection of groups and schools was made at random and kindergarten were chosen according to exclusion criteria: (1) obtain the 50th percentile in Raven Matrices Test according to Cuban norm [17] (2) No neurological, psychiatric and sensory disturbances according to the parents’ criteria and academic record, and (3) three years of permanence in the school and the province to carry out the longitudinal study. Finally, were chosen 156 kindergartens (82 male and 74 female) to perform the analysis. The Provincial Directorate of the Ministry of Education authorized entry to schools. In addition, informed consent was requested from the parents of the kindergarten selected in the study.

Instruments

Raven Progressive Matrices Test

It is made up of 36 problems, which are presented in a paper notebook. Each problem consists of an incomplete figure that the child must complete. It is a classic test to measure fluid intelligence. The Cuban norms of Ramírez and collaborators were used. The instrument shows adequate levels of reliability in the Cuban context (alpha when the item is eliminated between .84 and .89), while the item analysis indicated 91% with good discrimination indexes (items - total) [16,17].

Pre-Academic Test

Cuban test to know the cognitive conditions previous of the kindergarten before beginning the educational instruction of reading and arithmetic. It is made up of 8 tasks. The present investigation only used 3 tasks: Syllabic of Rhymes, Vocabulary and Verbal Memory. Sub-test Syllables of Rhymes: This task aims to know the phonological discrimination with syllables. 20 items were presented (e.g. ATA – ATI, PUE - BUE). The kindergarten should recognize if the sounds of the syllables are same or different.

a. Sub-test Vocabulary: A task that measures the level of the kindergarten Vocabulary. 48 familiar and unfamiliar images were used, which include animals, objects of house, names of games, parts of the body, parts of animals and actions to use gerunds and participles (e.g., dancing).

b. Sub-test Verbal Memory: This task evaluates the development of working memory of verbal type. The Verbal Memory Test is inspired by Luria’s learning task, where 10 unrelated words are presented. The kindergarten is expected to learn and remember the most words in three repetitions. For each word remembered, a point is awarded, and a total score is collected (summation of words remembered in the three trials). The test - retest method showed appropriate indicators of reliability in Pre-Academic Test (values between .82 and .94). The 72% of the items showed good discrimination [4].

Reading Fluency in Silence Test

It is a text segmentation task designed for Cuban children. It consists of the presentation of a text written in capital letters where the spaces between words and punctuation signs have been eliminated (e.g., MIESCUELAESBONITA, “MYSHOOLISBEAUTIFUL”. The child’s task is to draw a vertical line for identifies the word. The execution of the task in 3 minutes ago, although the children has not finished. The children don’t know that task in 3 minutes ago. The reading efficiency (E) was calculated: E= 3 minutes / CP, where CP is the number of words selected correctly. The values of

How to cite: Yaser Ramírez-Benítez, Bárbara Bermúdez Monteagudo, Rodneys Mauricio Jiménez-Morales. Mechanism of Phonological Decoding in the Spanish language. Psychol Behav Sci Int J. 2019; 12(2): 555834. DOI: 10.19080/PBSIJ.2019.12.555834

the E are between 0 and 1, where the values closer to 0 indicate better reading performance. According to validity criteria, the test showed significant correlations with Oral Reading Test applied in the Cuban Educational System ($r = .801$, $p < .05$) (Torres and Mosquera, in press) [10].

BENDE (Battery for Neuropsychological Evaluation of Evolutionary Dyslexia)

It is an instrument to evaluate the mental functions related to reading in Spanish-speaking school children. It consists of 16 sub-tests in 5 evaluation areas: Motor and Executive Functions, Senso-perceptive Systems, Linguistic Processes, School Processes and Memory Processes. The present study used only 3 sub-tests of the Linguistic Processes, especially the Phonological Processes: (1) Phonological Segmentation, (2) Auditory Phonetic Synthesis and (3) Visual Phonetic Synthesis. The Phonological Segmentation has two parts, the first is to know the child's ability to spell words, and the second part, locate the letters of the words in an auditory manner (e.g., the second sound / letter of the word "BREAD" (is the R) and what letter of the word "THING" is just before the N? (is the I)). (2) Auditory Phonetics Synthesis aims to design the word through verbal sounds (8 words, 16 points). (3) Visual Phonetics Synthesis aims to design word and phrases from visual stimuli (disorganized letters) (8 words and 4 sentences, 12 points). The reliability of the test was significant with an alpha of .953 [18].

Peabody Vocabulary Test

The test measures the receptive Vocabulary of the child. It contains 150 plates with increasing complexity. The present investigation used the first 100 plates. The reliability coefficient was between .80 and .94 in each age group, from 2 years to 17 years [19].

Procedure

A longitudinal study was carried out with the sample chosen from the beginning of the first grade (non-reading children) until the end of the 3rd grade (with 3 years of reading experience). At the beginning of the first grade, the Raven intelligence test was applied to the 4 selected groups. The children chosen were evaluated with the Pre-Academic Test (Vocabulary, Rhymes, Verbal Memory). At the end of the 1st, 2nd and 3rd grade, the same population was re-evaluated with a Silent Reading Fluency Test, 3 BENDE Sub-tests and the Peabody Test.

Data Analysis

Analysis of correlation between the precursor variables (Vocabulary, Rhymes, Memory, Raven, Segmentation, Auditory Synthesis, Visual Synthesis and Peabody Vocabulary) and reading (Silent Reading Fluency Test) in the different evolutionary moments (end of the 1st, 2nd and 3rd grade).

Hierarchical Regression Analysis, with the objective of determining the unique contribution of the precursor variables to explain reading fluency in the three evolutionary moments. In the 1st grade, the precursor variables were Rhymes, Vocabulary, Verbal Memory and Raven variables was controlled. In the 2nd and 3rd grades, the precursor variables were Segmentation, Auditory Synthesis, Visual Synthesis, Peabody Vocabulary and Raven was controlled.

Results

Analysis of Correlations

In the 1st grade, the punctuation of the Silent Reading Fluency Test showed significant correlations with Vocabulary ($r = 0.36$ $p < 0.01$), Verbal Memory ($r = 0.20$ $p < 0.01$), Rhymes ($r = 0.29$ $p < 0.01$) and Raven ($r = 0.24$ $p < 0.01$).

In the 2nd grade, the Silent Reading Fluency Test correlated significantly with Peabody Vocabulary ($r = 0.35$ $p < 0.01$), Phonological Segmentation ($r = 0.28$ $p < 0.01$), Auditory Synthesis ($r = 0.34$ $p < 0.01$), Visual Synthesis ($r = 0.24$ $p < 0.01$), and Raven ($r = 0.33$ $p < 0.01$). In the 3rd grade, the Silent Reading Fluency Test showed significant correlations with Peabody Vocabulary ($r = 0.44$ $p < 0.01$), Phonological Segmentation ($r = 0.19$ $p < 0.01$), Auditory Synthesis ($r) = 0.25$ $p < 0.01$), Visual Synthesis ($r = 0.19$ $p < 0.01$), and Raven ($r = 0.35$ $p < 0.01$).

Hierarchical Regression Analysis

In the first grade, the results indicated that Vocabulary constitutes a significant predictor of the Silent Reading Fluency Test in controlled the effect of Rhymes, Verbal Memory and Raven, and can explain 7.2% of the variance in reading fluency ($F = 16.169$; $p < 0.000$), as shown in Table 1. Likewise, in the first grade, Rhymes constitutes another significant predictor of the Silent Reading Fluency Test reading controlled the effect of Vocabulary, Verbal Memory and Raven, and can explain 6.4% of the variance of silent reading fluency ($F = 15{,}930$, $p < 0.000$).

In the second grade, Peabody Vocabulary is a significant predictor of the Silent Reading Fluency Test controlled the effect of the Phonological variables (Phonological Segmentation and Auditory Synthesis) and Raven test and can explain 7.7% of the variance in the reading fluency ($F = 54, 179$; $p < 0.000$), as shown in Table 1.

Likewise, in the second degree, the Phonological variables (Phonological Segmentation and Auditory Synthesis) constitutes another significant predictor of the fluency reading controlled the effect the Peabody Vocabulary and Raven test and can explain 10% of the variance of reading fluency ($F = 67, 550$; $p < 0.000$).

In the third grade, the hierarchical regression indicated that the Peabody Vocabulary is a significant predictor of Silent Reading Fluency Test controlled the effect of the Phonological variables (Phonological Segmentation and Auditory Synthesis) and Raven and can explain 9.6% of the variance in reading fluency ($F = 73, 519$; $p < 0.001$), as shown in Table 1. Likewise, the Phonological variables constitute another significant predictor of Silent Reading Fluency Test controlled effect Peabody Vocabulary and Raven test.

How to cite: Yaser Ramírez-Benítez, Bárbara Bermúdez Monteagudo, Rodneys Mauricio Jiménez-Morales. Mechanism of Phonological Decoding in the Spanish language. Psychol Behav Sci Int J. 2019; 12(2): 555834. DOI: 10.19080/PBSIJ.2019.12.555834

In general, hierarchical regression indicated a decrease in the influence of the phonological variables from 1st grade (6,4%) to 3rd grade (2%) to explain the variance of reading fluency, while showing an increase in the influence of semantic variables from 1st grade (7,2%) to 3rd grade (9,6%) to explain the variance of reading fluency.

Table 1: Analysis of hierarchical regression between the precursor variables and reading fluency in the three school grades. Memory and Raven were controlled.

First					
Model 1	**R2**	**Change in R2**	**Model 2**	**R2**	**Change in R2**
Memory - Raven	,062	,062**	Memory - Raven	,062	,062**
Semantic	,174	,111***	Phonological	,146	,084***
Phonological	,238	,064***	Semantic	,238	,072***
Second					
Model 1	**R2**	**Change in R2**	**Model 2**	**R2**	**Change in R2**
Raven	,113	,113***	Raven	,113	,113***
Semantic	,239	,126***	Phonological	,212	,100***
Phonological	,316	,077***	Semantic	,316	,104***
Third					
Model 1	**R2**	**Change in R2**	**Model 2**	**R2**	**Change in R2**
Raven	,099	,099**	Raven	,099	,099**
Semantic	,247	,148***	Phonological	,161	,042**
Phonological	,247	,020**	Semantic	,247	,096***

Note: The first column indicates the order in which the variables were introduced in the model, the second column indicates the percentage of explained variation of the dependent variables (R2) and the third column indicates the variance explained by the variable independently controlling the effect of the rest of the dependent variables (Change in R2). ** p <0.01; *** p <0.001. In the 1st grade, the phonology variable is formed by Rhymes and the Semantic variable by Pre-academic Vocabulary. In the 2nd and 3rd grades, the phonology variable is formed Phonological Segmentation and Auditory Synthesis and the Semantic variable by Peabody Vocabulary.

Discussion

The present research has found two important results: (1) one year of reading experience in the Spanish language is sufficient to obtain a significant lexical development in the child without psychiatric, neurological and sensorial alterations, (2) three years of reading experience in the Spanish language is not enough to obtain an automation of the phonological decoding mechanism.

In relation to the first result, the transparency of the Spanish language allows a rapid learning of the decoding mechanism, and consequently, a significant lexical development of the child. This result is consistent with the evidence from other studies of transparent languages [5,15,20]. According to Dehaene [5] at the end of the 1st grade children of transparent languages are able to read 95% of the words, because the reading code is simpler than reading code of opaque languages (English, French, Chinese). However, another important finding occurs at the end of the 1st grade, not mentioned in other studies; the Spanish-speaking child can read a group of words without decoding mechanism. This occurs because learning the words by frequency of use in the language or by their easy decoding.

In the present study, almost 100% of the children in 1st grade selected the words "ESCUELA", "MUCHOS", "EN", "HAY" and "MI" in a single sentence "ENMIESCUELAHAYMUCHOSLUGARESINTERESANTES". However, it could not be verified whether the selection was made at random or through another procedure. Although they are known to be frequent words in these ages, either orally or in reading practice texts. In this way, the lexical development increases with the learning of reading. This occurs in all cultural contexts; however, it becomes more significant in the Spanish language, maybe to the transparency of the languages. However, and in favor of this argument, the level of Vocabulary explains 7,2% of the variance of the Silence Fluency Reader Test in first grade, even greater than the effect of phonology (6,4% of variance).

On the other hand, and in response to the second result, access to text compression depends on the lexical development at the end of the 3rd grade, because increment to effect the Vocabulary to explain fluency reading from 1st grade (7.2% of the variance) to 3rd grade (9.6% of the variance). However, the child is still dependent on decoding; the manipulation of letter sounds and syllables (Phonological Segmentation and Auditory Synthesis) explains 2% of the variance of the fluency reading in the 3rd grade. In this way, the hypothesis of the research is null: there is no automation of phonological decoding at the end of the 3rd grade in the Spanish language.

Since results, two conclusions can be analyzed. From theoretical point of view, the results are consistent with the theoretical position of Alegría [21] and Morais [22], which

How to cite: Yaser Ramírez-Benítez, Bárbara Bermúdez Monteagudo, Rodneys Mauricio Jiménez-Morales. Mechanism of Phonological Decoding in the Spanish language. Psychol Behav Sci Int J. 2019; 12(2): 555834. DOI: 10.19080/PBSIJ.2019.12.555834

raise the independent character of decoding and compression in the development of reading. According to the authors, both reading mechanisms are independent and influence is parallel and complementary in alphabetic writing systems development. Apparently, in the Spanish language, this parallel influence occurs in the last months of reading instruction, although in the literature there is little evidence to justify it. However, at the end of the 2nd grade, a parallel influence of the two mechanisms can be expected in the Spanish language, either improve the reading [4,23-25].

From the practical point of view, and in favor of guiding the neurophysiological investigation, this study is recommending searching left lateralization of the phonological decoding between the 4th and 5th grade in the Spanish language. Neurophysiological studies in Spanish-speaking children have not been reported in the literature, maybe low prevalence of dyslexia in the Spanish-speaking population. In particular, the neurophysiological studies have been carried in German children and Italian children. In both cases, the evidence of left lateralization is not significant when technical neurophysiological is applied in 3rd and 4th grade. However, Spanish is more transparent than German and Italian [26,27].

References

1. Hudson Pérez MC, Förster C, Rojas-Barahona C, Valenzuela Hasenohr MF, Riesco Valdés, et al. (2013) Comparación de la efectividad de dos estrategias metodológicas de enseñanza en el desarrollo de la comprensión lectora en el primer año escolar. Perfiles Educativos 140: 100-118.
2. Sellés P, Martínez T, Vidal-Abarca E (2012) Controversia entre madurez lectora y enseñanza precoz de la lectura. Revisión histórica y propuestas actuales. Aula Abierta 40: 3-14.
3. Ziegler J, Bertrand D, Tóth D, Csépe V, Reis A, et al. (2010) Orthographic depth and its impact on universal predictors of reading: A cross-language investigation. Psychological Science 21: 551-559.
4. Ramírez-Benítez Y, Steinberg LB, Bermúdez Monteagudo B (2018) Pre-Académica: Batería Neurocognitiva Preescolar. Revista Chilena de Neuropsicología 13: 15-21.
5. Eberhard M, Aleksandra JL, Raith M, Maurer U (2015) Neurocognitive mechanisms of learning to read: print tuning in beginning readers related to word-reading fluency and semantics but not phonology. Dev Sci 18: 106-118.
6. Zhao J, Kipp K, Gaspar C, Maurer U, Weng X, et al. (2014) Fine neural tuning for orthographic properties of words emerges early in children reading alphabetic script. J Cogn Neurosci 92: 2431-2442.
7. Hasko S, Bruder J, Bartling J, Schulte-Körne G (2012) N300 indexes deficient integration of orthographic and phonological representations in children with dyslexia. Neuropsychology 50: 640-654.
8. Hasko S, Groth K, Bruder J, Bartling J y Schulte-Körne G (2013) The time course of reading processes in children with and without dyslexia: an ERP study. Front Hum Neurosci 7: 570- 579.
9. Brem S, Bach S, Kujala J, Maurer U, Lyytinen H, Richardson U, et al. (2013) An electrophysiological study of print processing in kindergarten: The contribution of the visual N1 as a predictor of reading outcome. Dev Neuropsychol 38: 567-594.
10. Mosquera R (2012) Valor predictivo de la lectura de palabras en la competencia lectora en el idioma español. Un estudio longitudinal. Tesis de Maestría no publicada. Centro de Neurociencias de Cuba, La Habana, Cuba.
11. Eberhard M, Aleksandra JL, Fehlbaum LV, Pfenninger SE, Maurer U (2016) Temporal dynamics of early visual word processing-Early versus late N1 sensitivity in children and adults. Neuropsychologia 91: 509-518.
12. Brem S, Bach S, Kucian K, Kujala J, Guttorm T, Martin E, et al. (2010) Brain sensitivity to print emerges when children learn letter-speech sound correspondences. Proc Natl Acad Sci U S A 107: 7939-7944.
13. Spironelli Ch, Angrilli A (2009) Developmental aspects of automatic word processing: Language lateralization of early ERP components in children, young adults and middle-aged subjects. Biol Psychol 80: 35-45.
14. Ramírez Benítez Y, Toca-Veliz L, Bermúdez-Monteagudo B, Martínez-Díaz B, Acea Vanega S (2018) Sistema de Tareas Diagnósticas y la habilidad lectora. Ciencias Psicológicas 12: 79-86.
15. Dehaene S (2015) Aprender a leer. De las ciencias cognitivas al aula. Editorial Siglo Veintiuno, Argentina, South America.
16. Raven J (2004) Test de Matrices Progresivas. Escala Coloreada, Cuaderno de Matrices / Series A, AB y B, Editorial Paidós: México.
17. Ramírez Benítez Y, Bermúdez Monteagudo B y Acea Vanega S (2017) Matrices progresivas de Raven: Percentiles para preescolares cubanos de entre 4 y 6 años. Revista Evaluar: 17: 32-46.
18. Crispín Lannes I (2013) Diseño y desarrollo de una escala corta para la exploración neuropsicológica de la dislexia evolutiva: batería de evaluación neuropsicológica de la dislexia evolutiva (BENDE). Tesis Doctoral publicada en Universidad de Salamanca.
19. Piñeiro A, Manzano M, Inguanzo G, Reigosa V, Morales A, Fernández, et al. (2000) Adaptación y normación de la Prueba de Vocabulario Peabody en una muestra de sujetos cubanos. Revista Cubana de Psicología 17: 147-153.
20. Anthony J, Williams J, Durán L, Gillam S, Liang L, et al. (2011) Spanish Phonological Awareness: Dimensionality and Sequence of development during the Preschool and Kindergarten years. Journal of Educational Psychology 103: 857-876.
21. Alegría J (2006) Por un enfoque psicolingüístico del aprendizaje de la lectura y sus dificultades - 20 años después. Infancia y Aprendizaje 29: 93-111.
22. Morais J (1998) El arte de leer. Visor: Madrid, Spain.
23. Valdivieso Bravo L (2016) El aprendizaje del lenguaje escrito y las ciencias de las lecturas. Un límite entre la psicología cognitiva, las neurociencias y la educación. Revista Interdisciplinaria de Filosofía y Psicología 11: 50-59.
24. Jaichenco Vy, Wilson M (2013) El rol de la morfología en el proceso de aprendizaje de la lectura en español. Interdisciplinaria 30: 85-99.
25. Reynoso Alcántara V, Bernal J, Silva-Pereyra J, Rodríguez M, Yáñez G, et al. (2010) Procesamiento fonológico y léxico en niños normolectores de educación primaria. Infancia y Aprendizaje 333: 413-425.
26. Smith F (2012) Understanding reading: A psycholinguistic analysis of reading and learning to read, Routledge, London, UK.
27. Torres MR and Mosquera R (en prensa) Could silent reading predict oral reading efficiency? Psychological Science.

How to cite: Yaser Ramírez-Benítez, Bárbara Bermúdez Monteagudo, Rodneys Mauricio Jiménez-Morales. Mechanism of Phonological Decoding in the Spanish language. Psychol Behav Sci Int J. 2019; 12(2): 555834. DOI: 10.19080/PBSIJ.2019.12.555834

DOI: 10.19080/PBSIJ.2019.12.555834