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Artigo Original

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Remediation program with automatized naming and reading for students with dyslexia: elaboration and clinical significance

Programa de remediação com a nomeação rápida e leitura para escolares com dislexia: elaboração e significância clínica

Keywords

Learning
Reading
Dyslexia
Intervention Study
Evaluation

ABSTRACT

Purpose: Elaborate a remediation program with rapid automatized naming and reading, as well as to verify the clinical significance of the elaborated program for students with dyslexia. **Method:** The study involved five students from 3rd to the 5th grade of elementary school, aged 8 to 12 years, of both genders, with an interdisciplinary diagnosis of dyslexia. All students were submitted to pre- and post-test application of metalinguistic skills and reading test, reading comprehension and rapid automatized naming test. **Results:** The analysis was performed using the JT method that allowed to verify positive or negative change and clinical significance in the post-testing. The results showed clinical significance in the tests of identification, syllable addition and combination, final and medial phoneme; in addition to nonwords repetition, real words and pseudowords reading, reading comprehension and rapid automatized naming test when comparing the pre- and post-testing. **Conclusion:** The elaborated program was efficient and applicable as an intervention instrument based on scientific evidence for students with dyslexia since it showed clinical significance for reading performance.

Descritores

Aprendizagem
Leitura
Dislexia
Estudos de Intervenção
Avaliação

RESUMO

Objetivo: Elaborar um programa de remediação com a nomeação rápida e leitura, bem como verificar a significância clínica da aplicação do programa elaborado em escolares com dislexia. **Método:** Participaram cinco sujeitos do terceiro ao quinto ano do ensino fundamental, com idade de 8 a 11 anos, de ambos os sexos, com diagnóstico interdisciplinar de dislexia. Todos os escolares foram submetidos na pré e pós-testagem à aplicação das provas de habilidades metalinguísticas e de leitura, compreensão de leitura e da prova de nomeação automática rápida. **Resultados:** A análise foi realizada pelo Método JT, que permitiu verificar se houve mudança positiva ou negativa e significância clínica na pós-testagem. Os resultados mostraram ter havido significância clínica nas provas de identificação; adição e combinação de sílaba, de fonema final e medial, além de repetição de não palavras, leitura de palavras reais e pseudopalavras, compreensão leitora, além de nomeação automática rápida quando comparada a pré com a pós-testagem. **Conclusão:** O programa elaborado mostrou-se eficaz e com aplicabilidade, podendo ser utilizado instrumento de intervenção baseada em evidência científica para escolares com dislexia, pois ocorreu significância clínica para o desempenho em leitura.

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INTRODUCTION

Reading requires a refined visual processing of the graphic signs in order to perform a textual scanning to identify the word parts[1,2].

Some authors[1,3,4] cited that students that read in accordance to the expected for their age and schooling level perform better during the rapid automatized naming test when compared to a student with dyslexia, showing that such skill may be considered a prerequisite for better reading performance.

Dyslexia involves differences and failures in the cognitive processes and phonological and/or visual processing, frequently characterized by difficulties presented at the beginning of alphabetization, impairing the acquisition of reading, writing and orthography[5].

Students with dyslexia take longer to perform the rapid automatized naming test when compared to those students who do not present changes in reading[6,7].

An international study[8] developed a remediation program for students with reading difficulties, through a phonological awareness training and explicit teaching of the grafophonic correspondence rules, using the rapid automatized naming as one of the pre- and post-intervention measurement, indicating at the end of the study that the association between metaphonological skills favors the performance in the rapid automatized naming test, improving the speed of access to lexicon and reading fluency.

Even though the national[9] and international[10,11] literature refer to studies of speech-language intervention with students with problems in decodification and reading fluency with focus on the metaphonological skills, there are few studies emphasizing the use of rapid automatized naming as intervention strategy.

This study is based on the hypothesis that the rapid temporal fusion in succession (i.e., the process of focusing the attention to the stimuli, perform the visual processes - responsible for the discrimination -, identify the letter, integrate the visual characteristics and the visual pattern information with the storage of orthographic representations, integrate with the stored phonological representations, access and recover the words, activate and integrate the semantic and conceptual information and perform the motor activation for the necessary articulation to perform the rapid automatized naming), when trained in a intervention situation, can favor the reading fluency of students with dyslexia.

Thus, this study aimed to elaborate a remediation program of lexicon access speed, using as strategies the rapid naming and reading, and to verify the clinical significance of the program application in students with dyslexia.

METHOD

This project was performed with approval of the Ethics Committee of the Universidade Estadual Paulista "Júlio de Mesquita Filho" – Faculdade de Filosofia e Ciências - UNESP from Marília, São Paulo, under protocol No. 45213015.0.0000.5406. All participants submitted to this study signed an Informed Consent.

First, we elaborated the remediation program with automatized naming and reading, and then the analysis of clinical significance of the performance of the participants submitted to the intervention program, from third to fifth year, both genders, with age between eight and eleven years old, in a pilot study.

Elaboration of the remediation program with rapid automatized naming and reading

The program was elaborated based on the literature review. In this phase, we chose the linguistic visual stimuli (letters, real words and pseudowords) and non-linguistic (colors and figures), which were grouped in boards. The real words and figures were selected from a word and figure bank from Laboratório de Investigação dos Desvios da Aprendizagem – LIDA, organized by syllabic extension, while the pseudowords were obtained and adapted from words of a procedure used for evaluation[12]. The word bank used to select the stimuli to compose the boards were initially composed by 600 words; however, only the nouns were selected as they can be represented as figures. Thus, there were initially 35 monosyllabic words, 139 disyllabic words, 113 trisyllabic words and 57 polysyllabic words with 4 syllables. We selected only the words with high frequency syllable pattern (CV, CCV), according to the age range of 8 to 11 years old.

The boards were elaborated with distribution of five stimuli that were repeated 50 times, organized in 10 rows with 5 stimuli each, following the pattern of the original rapid automatized naming test[1]. Therefore, the elaborated boards were as follows:

- 3 per letter;
- 1 with figures with monosyllabic stimuli;
- 3 with figures with disyllabic stimuli;
- 2 with figures with trisyllabic stimuli;
- 1 with figures with polysyllabic with four syllables;
- 1 for each syllabic pattern of pseudowords (monosyllabic, disyllabic, trisyllabic and polysyllabic with four syllables);
- 3 with real monosyllabic words;
- 3 with real disyllabic words;
- 2 with real trisyllabic words;
- 1 with real polysyllabic words with four syllables.

The elaborated boards were distributed in six intervention sessions, being that every two sessions had the same boards, that is, the same criteria were performed, but increasing the level of stimuli complexity (compared to the extension and composition of the boards stimuli). Therefore, the sessions comprised:

- Sessions 1 and 2: composed by 8 boards (letters, real words, pseudowords and monosyllabic and disyllabic figures);
- Sessions 3 and 4: composed by 11 boards (letters, colors, real words, pseudowords and monosyllabic, disyllabic and trisyllabic figures);
- Sessions 5 and 6: composed by 14 boards (letters, colors, real words, pseudowords and monosyllabic, disyllabic, trisyllabic and polysyllabic figures with four syllables).

The program was composed by 6 sessions in total, of approximately 50 minutes each; being necessary two sessions before and after those six to perform the pre and post testing in order to verify the efficacy of the program, totaling 10 meetings.

The intervention structure was as follows: recognition of the stimuli of each board, which should be named by the individual as the first time take. Then, the individual was advised to initiate

the rapid naming of the stimuli in succession, and this first-time take was annotated by the researcher as T1.

This step was followed by the intervention with the individual for the identification, recognition, decodification and memorization of those stimuli that were not recognized in a first moment, at the therapist discretion, since each individual presented distinct types of naming difficulties. Thus, it was necessary to perform strategies for each type of error presented by the student, such as when the student skipped rows, did not recognize a stimulus, made mistakes by phoneme replacement in the boards of words and nonwords reading, or replaced the stimuli. Finally, the individual was advised to repeat the rapid naming of the stimuli in succession and the time as reannotated, this time called T2[13].

Participants

This study involved 5 students of the 3rd and 5th year of the elementary school, with age between 8 and 11 years, being 3 males and 2 females, diagnosed with interdisciplinary dyslexia.

The diagnosis of dyslexia was performed by specific evaluation of the multidisciplinary team, composed by speech therapist, neuropsychologist, and occupational therapist.

All participating students were submitted to pre-testing, intervention and post-testing. The pre- and post-testing involved the following procedures:

a) Protocol of Metalinguistic and Reading Abilities Tests - Prohmele[12]. This protocol is composed by the following tests: syllabic and phonemic identification, syllabic and phonemic manipulation, real words and pseudowords reading; nonwords repetition.
b) Reading Comprehension Evaluation Protocol – Procomle[14]. This procedure is composed by four texts: two narratives and two expository. In this case, we used only two texts, one narrative (N1) and one expository (E1). The texts are composed of eight multiple choice question that were answered by the student after the reading.
c) Rapid Automatized Naming Test[1]. Composed by four boards with stimuli of letters, colors, digits, and objects; the student must name each one as fast as possible.

Analysis of the clinical significance of the remediation program with rapid automatized naming and reading

We used the JT Method to analyze the clinical significance of the remediation program with rapid automatized naming and reading[15,16], for the analysis of a single case. This method anticipates the comparative analysis between the pre- and post-intervention scores with the goal of deciding if the differences among them represents reliable changes and whether they are clinically relevant. This method implies two complimentary processes: (a) calculation of reliability of the changes occurred between pre-evaluation and post-intervention evaluation, described as a Reliable Change Index (RCI); and (b) analysis of the clinical significance of these changes. The difference is calculated based on the divergence between the pre- and post-tests, divided by the standard error or the difference. Therefore, the change of pre- and post-testing can be reliable positive (improvement), reliable negative (worsening); clinically significant (makes or will make a difference in the clinical setting); or no change[15,16].

According to the authors[15], the tests of statistical significance are limited to evaluation of a treatment efficacy, since these do not offer enough information on the response variability in a given sample, i.e., they show how the group reacted to the treatment but don't show how each individual reacted. In addition, there is a difference in the effect of a given treatment from the statistical and clinical point of view, regardless of the number of individuals[17]. Also, there are few data in the literature that show the need for alterations in the JT method, thus this method is efficient to verify the clinical significance and to control the change comparing the individual with him/herself[18].

RESULTS

Using the JT method, we analyzed changes between pre- and post-testing of each skill tested in this study, in each of the five individuals, which will be called Individual 1, Individual 2, Individual 3, Individual 4 and Individual 5, the results are shown in the following tables.

Table 1 shows the reliability of change in the Prohmele syllabic and phonemic tests; Individual 1 showed reliable positive change in the phoneme replacement skill; Individual 2 in the syllable replacement skill and in this individual's case, the change was also considered clinically significant. Individual 3 showed the highest post-intervention gain in these tests, revealing four reliable positive changes in the initial syllable, medial syllable, syllabic combination and medial phoneme identification skills. Individual 4 showed two reliable positive changes, one in the final phoneme identification skill and one in the syllabic addition skill, also classified as clinically significant. Individual 5 did not show any changes, positive or negative, revealing what the method calls absence of reliable change.

Table 1. Reliability of change and clinical significance after intervention in the Prohmele syllabic and phonemic tests in students with dyslexia

Individuals	Prohmele syllabic and phonological skills															
	IIS	IIP	IFS	IFP	IMS	IMP	Sub_S	Sub_P	Ad_S	Ad_P	Repl_S	Repl_P	Comb_S	Comb_P	Seg_S	Seg_P
1	-	-	-	-	-	-	-	-	-	-	-	RPC	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	RPC*	-	-	-	-	-
3	RPC*	-	-	-	RPC*	RPC	-	-	-	-	-	-	RPC*	-	-	-
4	-	-	-	RPC	-	-	-	-	RPC*	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Captions: RPC = reliable positive change; * = clinically significant change; RNC = reliable negative change; - = no change; IIS = identification of initial syllable; IIP = identification of initial phoneme; IFS = identification of final syllable; IFP = identification of final phoneme; IMS = identification of medial syllable; IMP = identification of medial phoneme; Sub_S = subtraction of syllables; Sub_P = subtraction of phonemes; Ad_S = addition of syllables; Ad_P = addition of phonemes; Repl_S = replacement of syllables; Repl_P = replacement of phonemes; Comb_S = combination of syllables; Comb_P = combination of phonemes; Seg_S = segmentation of syllables; Seg_P = segmentation of phonemes

According to Table 2, in the nonwords repetition test, Individual 1 showed reliable negative change in the test with polysyllabic nonwords of four to six syllables, and absence of changes in the remaining nonwords. Individual 2 showed no post-interventions changes. Individuals 3 and 4 showed reliable positive changes in the test of repetition of polysyllabic nonwords of four syllables, and Individual 5 showed reliable positive change in the repetition of trisyllabic nonwords.

Table 2. Reliability of change and clinical significance after intervention in the Prohmele nonwords repetition test in students with dyslexia

Individuals	Prohmele repetition of nonword					
	NWR_M	NWR_D	NWR_T	NWR_P4	NWR_P5	NWR_P6
1	-	-	-	RNC	-	RNC
2	-	-	-	-	-	-
3	-	-	-	-	RPC	-
4	-	-	-	-	RPC	-
5	-	-	RPC	-	-	-

Captions: RPC = reliable positive change; * = clinically significant change; RNC = reliable negative change; - = no change; NWR_M = Repetition of monosyllabic nonword; NWR_D = Repetition of disyllabic nonword; NWR_T = Repetition of trisyllabic nonword; NWR_P4 = Repetition of polysyllabic nonword (with 4 syllables); NWR_P5 = Repetition of polysyllabic nonword (with 5 syllables); NWR_P6 = Repetition of polysyllabic nonword (with 6 syllables)

Table 3 shows that, for rapid automatized naming, only Individual 3 showed reliable positive change in the colors and digits boards, also revealing clinical significance.

Table 3. Reliability of change and clinical significance after intervention in the rapid automatized naming test in students with dyslexia

Individuals	Rapid automatized naming			
	Colors	Letters	Digits	Objects
1	-	-	-	-
2	-	-	-	-
3	RPC	-	RPC*	-
4	-	-	-	-
5	-	-	-	-

Captions: RPC = reliable positive change; * = clinically significant change; RNC= reliable negative change; - = no change

According to Table 4, in the real word and pseudowords reading tests, only Individual 1 failed to show reliable change, and they showed reliable negative change in the real words reading tests, i.e., a worsening after intervention. Individuals 3 and 4 showed reliable positive change in the real words as well as pseudowords reading tests. Individual 5 showed reliable positive change in the real words reading test and no change in pseudowords reading.

According to the described in Table 5, in the evaluation of reading comprehension using a narrative and an expository text, Individual 1 showed reliable positive change in both; the narrative text comprehension reached clinically significance. Individual 3 showed reliable positive change in the expository text and Individual 4 showed it with the narrative text. Individuals 2 and 5 showed reliable negative change in the narrative text comprehension and reliable positive change for the expository text; Individual 2 also showed clinically significance for the expository text.

Table 4. Reliability of change and clinical significance after intervention in the Prohmele real words and pseudowords reading tests in students with dyslexia

Individuals	Prohmele RW and PW reading	
	Real words	Pseudo words
1	RNC	-
2	RPC	RPC
3	RPC	RPC
4	RPC	RPC
5	RPC	-

Captions: RPC = reliable positive change; * = clinically significant change; RNC= reliable negative change; - = no change/ RW = real words; PW = pseudowords

Table 5. Reliability of change and clinical significance after intervention in the Prohmele reading comprehension test for narrative and expository texts in students with dyslexia

Individuals	Reading comprehension	
	N1	E1
1	RPC*	RPC
2	RNC	RPC*
3	-	RPC
4	RPC	-
5	RNC	RPC

Captions: RPC = reliable positive change; * = clinically significant change; RNC= reliable negative change; - = no change; N1 = narrative 1; E1 = expository 1

DISCUSSION

The results of this study, evaluated by the JT Method, allowed the verification of the efficacy of the elaborated procedure. The use of the change reliability index of the boards applied allowed the verification of the reduction of time spent for the naming of the boards, corresponding to the improvement of the behavior of the individuals submitted to the rapid automatized naming and reading.

The students with dyslexia participating in this study showed improvement in the words and pseudowords reading tests, phonological operational memory, and phoneme identification and manipulation tests, corroborating with other studies[19,20].

The improvement of the metaphonological skills evaluated in the pre- and post-testing may have occurred even without the direct stimuli of these skills, since, according to the double deficit theory[11], the rapid naming and phonological awareness show different contributions to the reading skills. Thus, the difficulties that the students with dyslexia present could be related to the deficit of phonological processing, as well as to the visual. Once these reading skills were exercised with the rapid automatized naming, the metaphonological skills were favored.

According to the literature, there is a significant relationship between the metaphonological skills and the reading of real words, since the activation of the morphological and phonological representation lead to the precise decodification and classification of a reading as good. Thus, if the student does not have the ability of representation and a good performance in the identification and manipulation of the speech sounds, he/she may expose the problems that range from inefficient decodification to the impairment of the reading comprehension in a second moment[21,22].

A previous study[23] showed that the alteration of performance in phonological awareness tests, phonological operational memory and rapid serial naming consist of the main risk factors for dyslexia, which corroborates with this study in which the individuals with dyslexia obtained improvement in the phonological awareness test, phonological operational memory and rapid naming that were altered before the testing due to their diagnosis of dyslexia.

Some participating students showed reliable positive change, i.e., improvement in the nonword repetition test. This can be attributed to the fact that students with dyslexia show more difficulty when performing tests involving verbal components, and therefore, when the rapid temporal fusion is trained in oral succession, it may have improved the nonwords repetition with longer syllabic extension[24].

Reading and learning consists of the creation of a mechanism that can identify all the written words, since the identification of the word is considered the central activity of reading, which is developed automatically and unconsciously in a good reader. The participating students with dyslexia showed difficulties in the automatized reading due to the characteristic manifestations of the condition. Using rapid automatized naming and reading program, we observed improvement in the word recognition and reading fluency through the rapid temporal fusion in succession trained in intervention[25].

The phonological processing is a mental operation, which used the phonological information during the processing of oral language and reading. This processing is fundamental for the development and learning of reading, since to learn reading through the alphabetic system, it is necessary to know the speech sound structures; therefore, we can affirm that the intervention with rapid automatized naming improved the word and pseudowords reading, developing in the individuals of the program, not only the ability to improve reading fluency, but also the ability of reading new words, since we observed improvement in the use of phonological route[26,27].

In this study, the improvement in the reading comprehension performance can also be attributed to the automatization used in the intervention, through the rapid automatized naming and reading, corroborating with a study[28] that showed that automatized naming is correlated with reading comprehension, since both require the adequate knowledge of words and use of the contents of orthographic and lexical processing.

Thus, the program elaborated in this study may offer both clinical and educational speech therapist the possibility of a new intervention instrument with science-based evidence rapid automatized naming, which aids the development of speed to the lexical access, decodification, fluency, and consequently, reading comprehension in students with dyslexia.

One of the limitations of this study is the reduced time between pre- and post-testing because this study was elaborated aiming 6 sessions interventions, so that the students can have two intervention sessions per week. Therefore, it becomes necessary to perform a study analyzing the efficacy of the elaborated program with a longer interval between pre- and post-testing. Another limitation is the small number of participants, suggesting the need of future studies with a larger sample size.

CONCLUSION

The elaborated program was efficient and applicable as an intervention instrument based on scientific evidence for students with dyslexia since it showed clinical significance for reading performance. In addition, the clinical significance analysis performed with the results of the elaborated program involving rapid automatized naming for this study revealed automatization and speed when working the rapid temporal fusion in succession, as well as improvement of the expository text, since it showed positive changes in the individuals responses when comparing the pre- and post-performances.

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Authors contributions

The first author was responsible for formulating and carrying out the study, while the second author was responsible for the orientation and elaboration of the study.