

Helping to Overcome Chalkboard Reading Difficulties

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ABSTRACT

A case study is presented, showing results and discussion of a procedure followed to help the reading from chalkboards. A conceptual model of words hierarchy is presented for the usual reading. The difficulty of locating the relevant word in a board or page is considered in the context of this model. A device named shortly "Line Finder" is then proposed as a help to maintain the correct sequence of words in a line when reading from the chalkboard. The results are discussed considering 1) a positive effect of the device, and 2) the possibility of increasing attention of the child during the experiment, which may affect the conclusions. The first results are positive, but the two possibilities point to the convenience of more studies, in order to allow comparisons and statistical analyses. To obtain a proper exploratory prototype for the device, the joint work of professionals of different areas was necessary (in this case, pharmacy linked to education, and engineering). The methodology followed in the case study is described, allowing easy reproductions.

Keywords: dyslexia, irlen syndrome, reading difficulty, reading disability, line finder

INTRODUCTION

Considering the usual definition, dyslexia is an inherited condition that makes it extremely difficult to read, write, and spell in the native language of the patient - despite the fact of having at least an average index of intelligence (see, for example, <http://www.dys-add.com/>). It is generally accepted that dyslexia is neurological in origin implying difficulties in fluent word recognition, and inducing secondary consequences such as problems in reading and comprehension, which can have negative impacts on the growth of the vocabulary diversity and the background knowledge. The persistent literacy learning difficulties are evidenced in studies such as Tunmer and Greaney (2010), who also explain the need of clarifying "what dyslexia is not".

The literature descriptions show that children having dyslexia need a careful accompanying during the growing phase, recognizing their difficulties and using systematic methods that help them to overcome the difficulties of their dyslexia traits, pursuing ideal conditions that allow coming nearer to their usual grade level.

It is hard for a child to feel that it does not follow the friends and colleagues during the learning activities. This situation induces many professionals to try solutions that can help dyslexic children to "fill the gap" by teaching them to deal with their difficulties. Case studies are presented in the literature, showing particular situations and procedures, which may help the establishment of the most plausible procedures (see, for example, Pestun, 1999). To recognize as effective the eventual positive results, they must of course be independently replicated, and eventual potentialities and limitations linked to different levels of dyslexia must be conveniently exposed. In this sense, the literature on dyslexia is continuously growing, and the sharing of

Article History: Received 18 March 2018 ♦ Revised 29 May 2018 ♦ Accepted 10 June 2018

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experiences is making possible to recognize different kinds, levels, or manifestation of dyslexia traits. As a consequence, the multiplicity of concepts and characteristics that are related to the common word “dyslexia” is also being discussed, as shown by Tassie (2010). Because dyslexia is defined through reading difficulties, usually related to the visual aspect of this activity, it is emphasized by several authors that dyslexia must not be viewed as a vision-based learning disorder. Handler and Fierson (2017), for example, mention that the reversing of letters and words is common in early readers, and that “difficulties with fluent reading are the result of reading difficulty and not the cause of the reading problem”. But definitive positions are still not possible. This fact may be illustrated by the classification described by Nwanneka (2012), who, mentioning other references reproduces that “visual dyslexia is characterized by number and letter reversal and the ability to write symbols in the correct sequence”. Considering the different positions of the different researchers, reading problems may have a myriad of possible causes other than dyslexia. Independently of the cause, strategies to help children affected by such problems must be searched. Evidently learning strategies based on long time observations (McArthur & Castles, 2017; Nwanneka, 2012; Torgensen, 2002; Wawryk-Epp et al., 2004), as well as efforts to integrate different fields such as neuroscience, cognition and education (Al Dahhan, Kirby, & Munoz, 2016), are of highest relevance to indicate possible ways of future studies.

The present work considers a case study. The main objective here is to describe the steps followed to test a prototype of a device, in collaboration with a child diagnosed with dyslexia, intending to help it to read from the chalkboard (chalkboard reading difficulty was observed in this child). This procedure is not proposed as a “substitute” to any method or strategy that enables the dyslexic person to develop skills to read in an organized manner. But, being a procedure that may attain the objective of helping to “follow written lines” in the chalkboard, it may help the self-confidence and self-esteem of children with similar difficulties. Being a case study, more general conclusions need additional studies, involving replications and statistical analyses of the results, so that trends can be evidenced.

The proposal of a proper device to be tested by a child, the applied methodology, and the geometrical dimensions and arrangements for the first two test prototypes correspond to a joint interdisciplinary activity (expressed by the formation of the two authors). The interdisciplinary discussion was positive to obtain the most adequate test device, which has a very low cost. The discussion comments the positive aspects of this work and suggests further studies in the sense of obtaining broader statistical information.

MATERIAL AND METHODS

A Model of Word Hierarchy for Reading

Some children with reading difficulties, although alphabetized and reading from books (making mistakes) and writing in their notebooks (also making mistakes) may still have strong difficulties when reading from the chalkboard. After observing these characteristics in different situations, three nine years old children were heard about their difficulties. The first child commented that: “...the words and letters mix”. The second child described its experience as: “I read the word from the chalkboard and I wrote it in the notebook. When I went back to the board, I found the word and copied from that place. But the aunt (meaning “teacher” – note of the authors) said the place was wrong”. The third child made similar comments and accepted to follow the test presented here. The chosen three answers seem to be common descriptions of difficulties in the universe of dyslexia, which allowed suggesting a simplified scheme (model) for the perception of elements in rows and lines for dyslexic conditions. (Note that the former presented commentary of Handler and Fierson, 2017, also suggests a different universe for the reading difficulties described by the children).

We considered first the ideal not dyslexic situation, where the momentary word that must be read in a text has recognized its highest priority on the page or board (main word). To take this priority into account in the model, the word is considered as “highlighted” by an evidencing color. The other words have lower priorities, and in the model they are considered as covered with colors that partially hide them. The words at greater distances from the main word are strongly hidden. If the reading is made along a line, this line has a higher priority than the others (main line), thus also acting as highlighted in relation to the other lines. **Figure 1a** is a sketch of this model. The same reasoning is valid for rows, if they are important. In other words, a hierarchy model is suggested, where the “main word” and the “main line” (or row) act as highlighted, and the other words and lines are conveniently covered (partially). As mentioned, this is a model for the not dyslexic situation.

When the children explain that words and letters “mix”, or that they “found the word in another place”, it implies, following this model, that no hierarchy is present in the reading activity. Any word has the same momentary priority or hierarchy, so that it can replace the “main word” at any time. Also all lines (or rows) have the same priority, so that they can be interchanged. The “transcription” of this description to the hierarchy model produces **Figure 1b**.

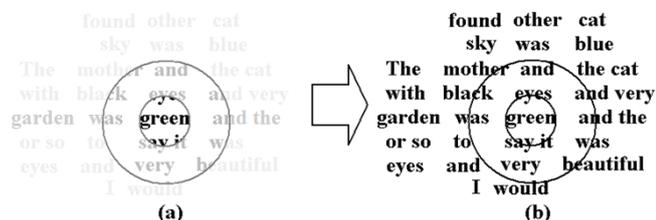


Figure 1. Sketch of conditions a) not dyslexic and b) dyslexic, using the model of hierarchy of words

Figure 1b suggests that the main word with all the surroundings is viewed as only “one data”. If no reference is given, it is not possible to know the relevant part of the “data”. Any part has the same importance, and it is possible to “walk” with the eyes along the entire page without finding the relevant part at subsequent moments of the reading.

This model was used to generate a simple device that “highlights” the part of the information that is relevant, helping (ideally) in the effort of locating a proper reference while reading from the chalkboard. In other words, the hypothesis of the study is that the hierarchy naturally recognized by a non-dyslexic case (or a “non-reading difficulty” case) may be emulated if helped by an external device for a dyslexic case (or a reading difficulty case).

The Line Finder

The device was conceived in order to furnish firstly a guide line for the child, so that it can locate a reference on the chalkboard and read along the correct written line. No rows were considered in this first approximation. The device was thus called shortly “Line Finder”. Its main part was built using paperboard, having the main dimensions shown in **Figure 2**.

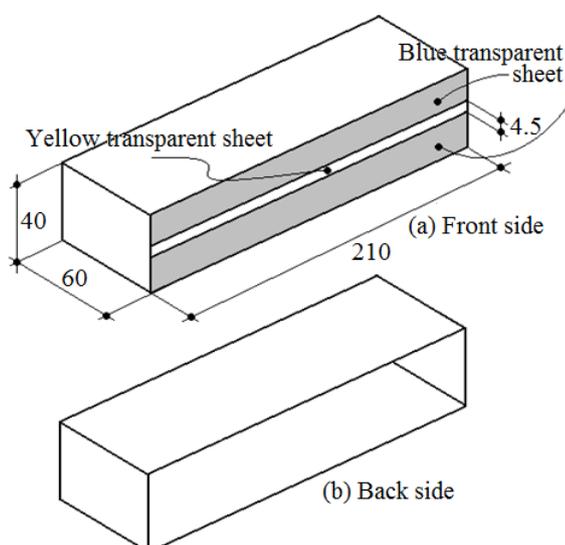


Figure 2. Dimensions (in millimeters) of the device used to furnish a guide line for the reading from the chalkboard

The guide line is a light color window “open” in a darker color background. It was obtained superposing yellow cellophane to blue cellophane (transparent plastic sheets and light polarizing filters were considered, but simplicity induced the use of cellophane for the initial test). The highlighted guide line corresponded thus to the yellow window. The superposition of the cellophane sheets produced a green color for the background, which is the region of the “partially hidden” words. In the present study, there was no reason to defend any

particular combination of colors. At the time of the beginning of this case study, the authors had no information about the conclusions of the Irlen syndrome. Additionally, the objective here was to offer a portable tool that allowed orienting the chalkboard reading, and not to compensate light filtering, one of the aspects of the Irlen studies (see, for example, Farber, 1994). The present dimensions were proposed considering, as best as possible, the mean height and width of the field of vision at the chalkboard, the approximate distance from the chalkboard to the used chair and desk, the approximate mean height of the letters written on the chalkboard and the approximate mean distance between lines written on the chalkboard. As can be inferred from the description, because all these distances may vary, also the dimensions of the Line Finder may need adjustments for particular cases.

The proposal was to use the Line Finder for the reading from the chalkboard, but without interfering with the writing in the notebook. So, the spatial arrangement shown in **Figure 3** was proposed, where the focal line for the lecture on the chalkboard is different from that for the lecture in the notebook. Adjustments that allowed the Line Finder to be supported by the forehead and the nose were then introduced, as presented in **Figures 4a** and **4b**, where the first and second prototypes prepared for this study are shown. The second prototype had the same main dimensions of the first one, with some improvements for holding the transparent foils and simple reinforcements for the support at the nose.

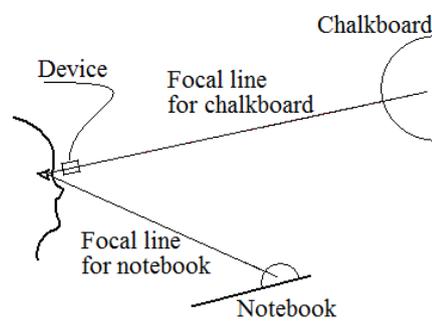


Figure 3. Spatial arrangement for the reading from the chalkboard. The different focal lines for the chalkboard and the notebook are shown

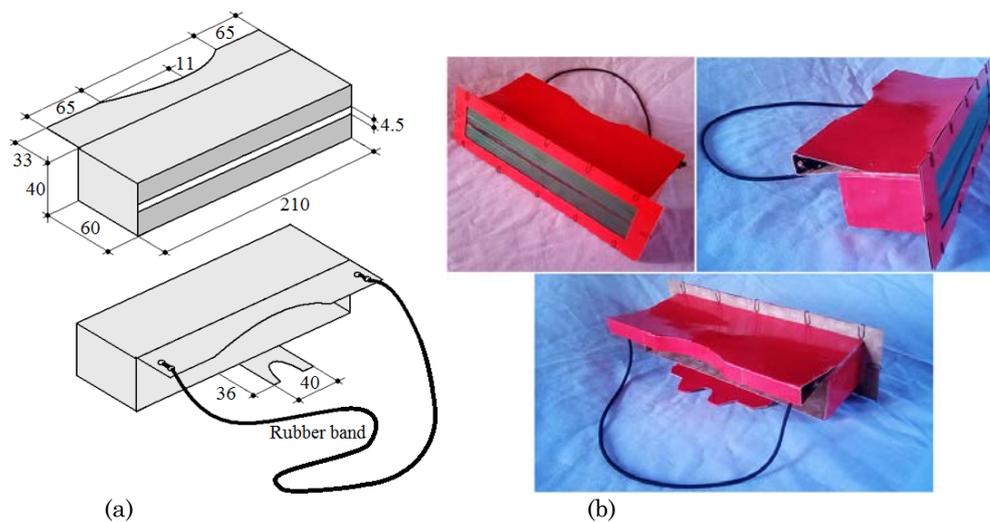


Figure 4. a) Sketch of the adjustments introduced in the first prototype of the Line Finder. Presented dimensions in millimeters; b) The second prototype, with improvements to hold the transparent foils and reinforcements of the supports. The main dimensions are the same of **Figures 2** and **4a**

From the above description, the whole main line to be read was highlighted in yellow, following the previously explained model.

A second device was also prepared, in which part of the yellow cellophane was cut off, allowing producing a brighter region on the phrase to be read around the momentary main word. But it was not comfortable for

the child, who complained about the bright region when wearing this device. No test was conducted with this “more detailed” Line Finder.

The light color line may form initially two parallel lines, as sketched in **Figure 5a**. By adjusting the position of the device, they merge into a continuous line, as sketched in **Figure 5b**, used as support for the reading.



Figure 5. Sketches of the light color line formed in the device. a) Double parallel lines that may form before adjusting the device, b) Highlighted main line, as observed after adjusting the device

Methodology Followed to Verify the Adequacy of the Line Finder

The Line Finder was tested in a case study involving one child 9 years old that accepted to make this test. This child was already alphabetized and could read and write, but making mistakes. It was observed, during loud reading, that mistakes occurred while reading from books and chalkboard. Intermittent errors occurred, as:

- changing of words with sense in the phrase: When reading a phrase (in Portuguese language), the correct word was substituted by a second word that also had meaning, but did not correspond to the original sense of the phrase. For example, “...os animais bebiam a água...” was read as “...os animais viviam na água...”. (“The animals drunk the water” was read as “...the animals lived in the water...”).
- changing of words without sense in the phrase: Like, instead (in Portuguese language) “...a luta por comida ...” it was read “...a luta por corrida...”. (Instead “...the fight for food...”, it was read “...the fight for run...”). Such situations were accompanied by a question intonation (an interrogation). They usually corresponded to interchange of letters in the word.
- jumping lines: Sometimes the reading was interrupted because the child changed the line that it was reading, but it realized that something was wrong. Then it worked to find the correct position of the reading.

The description of the reading responses is presented here to allow eventual comparative discussions. In this sense, Berninger and Abbott (2013) evidence characteristics of children having, for example, differences in verbal reasoning. The knowledge of reading abilities or difficulties of the present case may thus simplify comparisons with further studies.

Two tests were made, denoted by A and B, conducted as follows:

Test A:

- 1) The phrases and words of test A were written on the chalkboard before the child came into the room. The chalkboard was covered with a blanket.

- 2) The child was invited into the room, and the activity was explained: it would first read and copy the phrases of the chalkboard into a blank page of its notebook without the Line Finder (that is, handwritten and without a device to be used in front of the eyes). Then the Line Finder would be explained and the child would read and copy the chalkboard using this device.
- 3) The chalkboard was discovered. The child made the first part of this activity. The chalkboard was covered again and the notebook was taken.
- 4) The use of the Line Finder was explained. The notebook was given back (open in a second blank page), the chalkboard was discovered again and the child made the second part of the activity. The chalkboard was covered again and the notebook was taken again.

Test B:

After the test A, the child was invited to play or stay outdoors.

- 1) The phrases and words of test B were written on the chalkboard before the child came into the room. The chalkboard was covered with a blanket.
- 2) The child was invited into the room, and the new activity was explained: it would first read and copy the chalkboard words and phrases into a blank page of its notebook using the Line Finder. Then it would read and copy the same words and phrases in a new page of the notebook without this device.
- 3) The chalkboard was discovered. The child made the first part of the activity. The chalkboard was covered again and the notebook was taken.
- 4) The notebook was given back opened in a new blank page, the chalkboard was discovered again and the child made the second part of the activity. The chalkboard was covered again and the notebook was taken.

The sequence of words and phrases is shown in **Tables 1** and **2**. The eleven words of each test were written in three lines, as shown in the tables. Also the phrase of each test was written in one line, as shown in the table. The test was applied in Portuguese language, but the necessary explanation and discussion about the results are evidently conducted in English.

RESULTS

Tables 1 and **2** show the words and phrases used in the chalkboard, together with the mistakes.

Table 1. First reading without Line Finder (Language: Portuguese)

First reading		
Original words and phrase	Copied words	Mistakes
1 Emprego, comida, coisinha, faço	Emprego, comida, <u>cosinha</u> , faço,	Interword.
2 banheira, porco, balela, momento	banheira, porco, <u>baleia</u> , momento,	Interword.
3 árvore, merenda, nenhuma.	árvore, merenda, <u>nenhum</u> .	Intraword.
4 O tempo não para no porto.	O tempo não para no porto.	No error.
Second reading		
Original words and phrase	Copied words	Mistakes
1 Emprego, comida, coisinha, faço,	Emprego, comida, coisinha, faço,	No error.
2 banheira, porco, balela, momento,	banheira, porco, balela, momento,	No error.
3 árvore, merenda, nenhuma.	árvore, merenda, <u>nenhum</u> .	Intraword.
4 O tempo não para no porto.	O tempo não para no porto.	No error.

Table 2. First reading with Line Finder (Language: Portuguese)

First reading		
Original words and phrase	Copied words	Mistakes
1 Castelo, antiga, mamando, ocase,	Castelo, antiga, mamando, ocase,	No error.
2 apeço, emenda, borda, entorno,	apeço, emenda, borda, entorno,	No error.
3 lobo, escolha.	lobo, escolha.	No error.
4 Amar os mares por amor à poesia.	Amar os mares por amor à poesia.	No error.
Second reading		
Original words and phrase	Copied words	Mistakes
1 Castelo, antiga, mamando, ocase,	Castelo, antiga, mamando, ocase,	No error.
2 apeço, emenda, borda, entorno,	apeço, emenda, borda, entorno,	No error.
3 lobo, escolha.	lobo, escolha.	No error.
4 Amar os mares por amor à poesia.	Amar os mares por amor à poesia.	No error.

Initially a classification of mistakes was proposed. It considered: 1) “vertical mistakes” – words of different lines while copying the text, 2) “horizontal mistakes” - words of different places in the same line, 3) “interwords” - when a new word was introduced in the place of the correct word, and 4) “intra-words” - when letters in one word were mixed.

Only the tests presented in **Tables 1** and **2** were performed. The numbers 1 to 4 in the beginning of each line were inserted as references for the child to align the Line Finder. They were not copied in the notebook (it was informed not to copy, aiming not to overcharge the child with activities not relevant for this test). The observed mistakes did not cover the whole proposed classification. Horizontal and vertical mistakes were not observed, probably due the small number of words and lines used in the tests. Additionally, the interword mistakes may be understood as spelling mistakes, and not necessarily to the reading of a different word. In this case, it may have occurred a superposition between interword and intra-words mistakes.

Table 1 presents the reading mistakes. The mistakes suggested as “interword” introduce a new word, but based on very small modifications of the original word. “Coisinha” and “cosinha” have different senses (“little thing” and “kitchen”, respectively). In this word the spelling of “cosinha” is also wrong. The correct word would be “cozinha”. “Balela” and “baleia” also have different meanings (“rumor” and “whale”, respectively). Additionally, the mistake presented as “intra-words” maintained the sense of the original word, but the final letter was forgotten (or not read). “Nenhuma” and “nenhum” have the meaning of “none”, but being the feminine and masculine declinations of the same word (Portuguese language).

Table 2 presents no mistakes.

In a first analysis, these results seem to indicate a positive influence of the Line Finder, as used here. **Table 1** shows two initial mistakes that were not reproduced when the device was used. This may be a result of the device itself, but may also be the result of more attention given by the child while performing the second copy. The presence of the gender mistake (“nenhuma” and “nenhum”) seems to indicate that the memory of the child induced to rewrite the wrong word.

The possibility of more attention and memory effects may also be the case of the good results of the second test. Note that no mistake occurred for the first reading, using the Line Finder. It is surely a positive result, but, as mentioned before, it may be the result of more attention given by the child while copying the words during the subsequent test applications. The rewriting of the same words (**Table 2**) without the device occurred without errors, which may imply that memory or attention could have influenced this particular result.

Discussion and Further Challenges

Because the tests were applied to only one child (case study), and because the environment of the tests may have changed for the child during the application (the conscience of the seriousness of the test may have evolved for the child, inducing more attention, for example), a definitive answer about the positive influence of the Line Finder is still unsure.

However, if the observed results are understood as only influenced by the Line Finder, they are promising. If they represent the positive influence of the Line Finder alone for reading from the chalkboard, comparative studies are very welcomed; being the needed statistical evidences still an open question. More studies, directed to individuals with different levels of chalkboard reading difficulties, certainly will furnish the necessary

quantitative data. Centers working with groups of individuals that present similar difficulties are understood as the most adequate sites for obtaining statistical evidences. Procedures to be applied in group studies may be found, for example, in Cruz-Rodrigues et al. (2014), who describe details of a study of dyslexic groups in the southeast region of Brazil. In the present moment the results of this case study may be viewed as a positively directed possibility.

A Note on the Evolution of the Child of the Present Study

The study was performed with a feminine gender child, initially 9 years old, frequenting a basic school in the southeast region of Brazil. The dyslexia diagnostic was given by a psychopedagogue professional. The same psychopedagogue professional applied different procedures for a better developing of the skills of this child, concomitantly to the school evolution. Some difficulties for the school to adapt its procedures taking into account the presence of dyslexic children were observed. The device described in this study was proposed in the reading test which results are presented here, performed out of the school. A second school in the same region of Brazil furnished a better environment for this child. In a further moment, it was enrolled in a Canadian school (western region of Canada), where the possibility of Irlen syndrome was searched, showing a severe Irlen deviation. Adequate Irlen glasses, layers and papers represented, for this case, a positive help for the reading activities. The school evolution along the years may be considered satisfactory. It may be mentioned that also difficulties in Mathematics were observed (a theme not covered in this study). The time interval of the here informed steps was 8 years.

CONCLUSIONS

The text describes a case study in which a device proposed for helping reading from the chalkboard was tested for a child diagnosed with dyslexia. The device shortly called here “Line Finder” was adjusted to the forehead and nose of the child, furnishing a transparent line in light color (yellow) that highlighted for the child the main line of words, or phrase, in a chalkboard. The lines above and below the main line were maintained at a transparent darker color (green). For the present study, the aim was to furnish an orientation for the lecture, so that the colors were chosen because of their light/dark characteristic.

Two kinds of tests were performed, both involving two procedures of copying a set of words and phrase by handwriting. The first test was performed in the following order: first copy without using the device; second copy using the device. The second test was performed in the reverse order: first copy using the device; second copy without using the device.

The furnished results, if considering only the presence of the device, suggest a positive influence for the child, and point to more studies in the sense of obtaining quantitative statistical data for further developments.

It was also discussed that the obtained results may involve the growing of attention of the child during the tests, as well as memory effects. In this case, more studies involving groups of individuals presenting chalkboard reading difficulties are very welcomed, intending to evidence potentialities and limitations of the described procedures.

Details such as dimensions and constructive aspects of the device are shown, so that similar instruments may be produced for further independent tests.

Disclosure statement

No potential conflict of interest was reported by the authors.

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