Ysilex : a Friendly reading Interface for Dyslexics

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Abstract

In this paper, we describe an interface to display texts in a fashion adapted to dyslexic readers. In order to help the reading task, we designed several tools geared towards the specific difficulties of this population, e.g. a tendency to lose one's place within the text, a fluctuating attention or a difficulty to access the syllable level of the words, a process known to be used with new or infrequent words. Preliminary results show that a pared down display coupled with a choice of tools available on demand could cater to the heterogeneity of difficulties displayed by dyslexics. Stepwise increments in design coupled with ongoing validation of the reading tools will insure the usefulness of the interface.

1. Introduction

Concerning roughly 5% to 10% of school age children around the world, dyslexia is one of the most common learning disorders. The incidence tends to be lower for languages where the relationship between written signs (e.g. letters) and spoken sounds (e.g. syllables) is more consistent: for example, the incidence varies between 3.6% and 8.5% in Italy whereas it varies between 4.5% and 12% in the United States. By and large, the societal impact of dyslexia is higher than commonly thought, ranging from schooling difficulties and drop-out to higher incidence of long term unemployment [1].

Dyslexia is a specific learning difficulty which mainly affects the development of reading and language related skills, namely writing and spelling, sometimes mathematics and musical notation. It is likely to be present at birth and to persist, albeit with lesser effects when subjected to specific training, during an individual's whole life. Scientific studies have reported difficulties with phonological processing, rapid naming, deficits of vision, working memory, processing speed, and the automatic development of skills that do not match up to an individual's other cognitive abilities. A number of studies points towards hereditary neurological anomalies in the brain but there is certainly no real agreement among scientists concerning, neither the actual mechanisms involved in dyslexia, nor the possible origin of this disorder [1]. From a practical point of view, it has not been possible to show systematic differences between reading difficulties in individuals with dyslexia and those without [2]. Regardless, reading problems and spelling difficulties continue to

cause concern, especially in the school system where dyslexic children experience every day the lack of consensual educational instructions regarding their learning problems. Conventional teaching methods are generally not appropriate, whereas specific interventions can help elaborate strategies to compensate for the deficiencies [3]. In this respect, the application of information technology turns out to be multi-level, ranging from allowing students to exercise specifically and independently his/her difficulties, to offering specific reading and writing software consisting of tools such as relevant spellers, voice synthesis/recognition and display enhancers (see Table 1 for an overview of widely distributed products with their main features). Our ongoing work is to be seen in this latter context.

	Writing Tool	***Reading Tool***	***Mind Mapping Tool***
Kurzweil	Text Editor Speech to Text	Text to Speech Word Highlighter	
ClaroRead	Text Editor Speech to Text	Text to Speech	
Penfriend XL		Text to Speech Word prediction	
Médialexie	Word Processor Speech to Text Speller	Text to Speech Text Configuration	
TextHELP Read & Write	Word Processor Word Prediction	Text to Speech	
Screen Ruler		Strip Magnifier	
ZoomText		Text Magnifier Enhanced Screen Colors	
Penfriend	Text to Speech Word Prediction		
Inspiration			Visual Thinking Tool
MindGenius			Visual Thinking Tool

Table 1 : Overview of software intended use and main features

2. Helping Perception in Reading

Whereas the phonological deficits seem to be well established, the presence and nature of visual impairments is still quite debated. Authors have shown that dyslexics' eye movements are quite different from those of normal readers: each letter tends to be fixed and there are frequent movements backwards to scan the same letters several times [4] whereas, in normal reading, short words or groups of letters are fixed only once through standardized eye movements [5]. However, it has proven difficult to pinpoint the exact

nature of potential visual deficits [6]. Studies suggest that deficits in attention rather than perceptual impairment *per se* might be responsible. Recent findings even argue that letter size and crowding do not affect dyslexics and normal readers differently [7].

These findings are difficult to reconcile with other studies about reading in children on the one hand, and with advices and personal reports largely present in the dyslexic community on the other hand. Typographic characteristics such as font, type size, interlinear spacing, spacing between words and letters contrast are all thought to influence legibility in a fashion well known to font designers. Investigating their influence on reading speed and errors, Hughes & Wilkins (2000) [8] report an influence of text size on both speed and error. Moreover, having tested subjects on their susceptibility to visual stress, the authors found that children who were susceptible to visual stress performed significantly more poorly when asked to read the smaller texts. Accordingly, the dyslexic community and the websites addressing it (see for example, http://dyslexic.com or the British Dyslexia Association) recommend a pared down presentation of the information and adapting the reading material, using rounded, well-spaced font styles such as Arial, Comic Sans, Verdana or Trebuchet among others, limiting lines to 60 to 70 characters with an interlinear space of 1.5 or 2 and a reduced contrast between letters and background. A special font for dyslexic has been experimentally designed by Frensch (see http://readregular.com) but is not yet available for use.

The interface we present takes these different aspects into account and proposes a couple of tools to further help reading. In order to avoid visual clutter, we used the recommended fonts and interlinear space, and purposefully chose to display very few options, concentrating instead on the sole task of reading. By analogy with the tricks used by speech therapists re-educating dyslexic children, we designed a ruler and a highlighter, which can be used with words or lines for the highlighter, or lines for the ruler.

3. A Reading Interface Prototype

Having designed a first prototype, we conducted an informal experiment with eight dyslexic children, age ranging between 11 and 14, with quite different reading skills. Using different displays of the reading material, they read several texts of comparable difficulties while we measured their reading speed and accuracy. The first display was always a text printed on paper. Paper still being the most familiar display for pupils, we used their reading performance in this condition as a baseline. The other three conditions were all a text displayed on a computer screen, without specific tool for one condition, with a highlighter for another condition and with a ruler for the last condition. After each text reading, the children were asked questions about the reading material in order to verify their understanding of the texts. As can be seen on Figure 1, the results were different according to each child: by and large, displaying the texts on a screen (as compared to a text printed on paper) led 6 of the 8 subjects to, either speed up their reading but decrease slightly their understanding or, slow down their reading but increase their understanding. Because of this trade-off, it is impossible to really evaluate the effect of the screen.

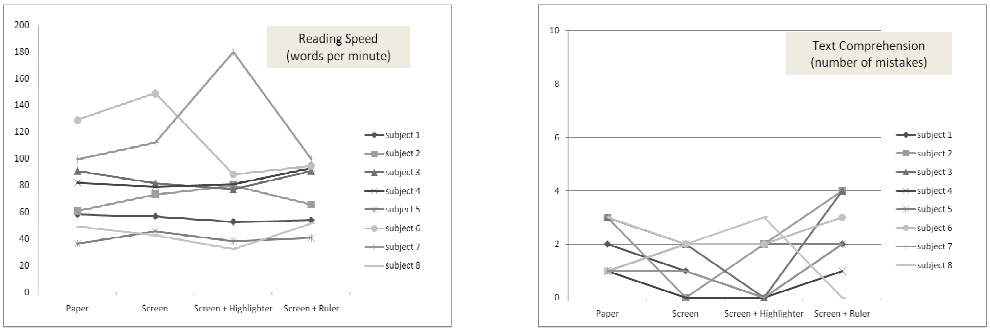

Figure 1: Experimental results for each subject in each condition for reading speed and text comprehension

The other two subjects performed better when the texts were displayed on the screen, increasing their reading speed by 12 and 13 words per minute. Using a functionality imitating a highlighter or a ruler helped some pupils (2 improved their speed and understanding with the highlighter and 2 with the ruler) while it hindered others (2 decreased their speed and/or understanding with the highlighter and 4 with the ruler).

These differences among pupils should not be surprising considering the large heterogeneity in the difficulties (in nature and scope) found in the clinical studies. Thus, our observations were not seen as a problem *per se*, but as a justification to offer tool use on demand. Based on the results of this experiment, we designed a second iteration of our prototype. This version includes the same tools as the first one (ruler, highlighter, text to speech) and proposes the added functionalities presented below.

3.1 Architecture of the interface

Ysilex being a reading interface geared towards dyslexic children, the graphic design of the first version of the software privileges high legibility of the text, simplicity and stability of the interface, and smooth and luminous aesthetics (see Figures 2 and 3 for an example of the interface).

The text, displayed in the center of the screen "without any decoration", is configurable through a set of limited and predefined properties: text color, fonts, spacing, ... to guarantee comfort of reading. Two zooming buttons ("plus" and "minus"), situated in the lower edge of the page, allow users to adapt the size of the text. All functions are easily accessible by through buttons surrounding the text.

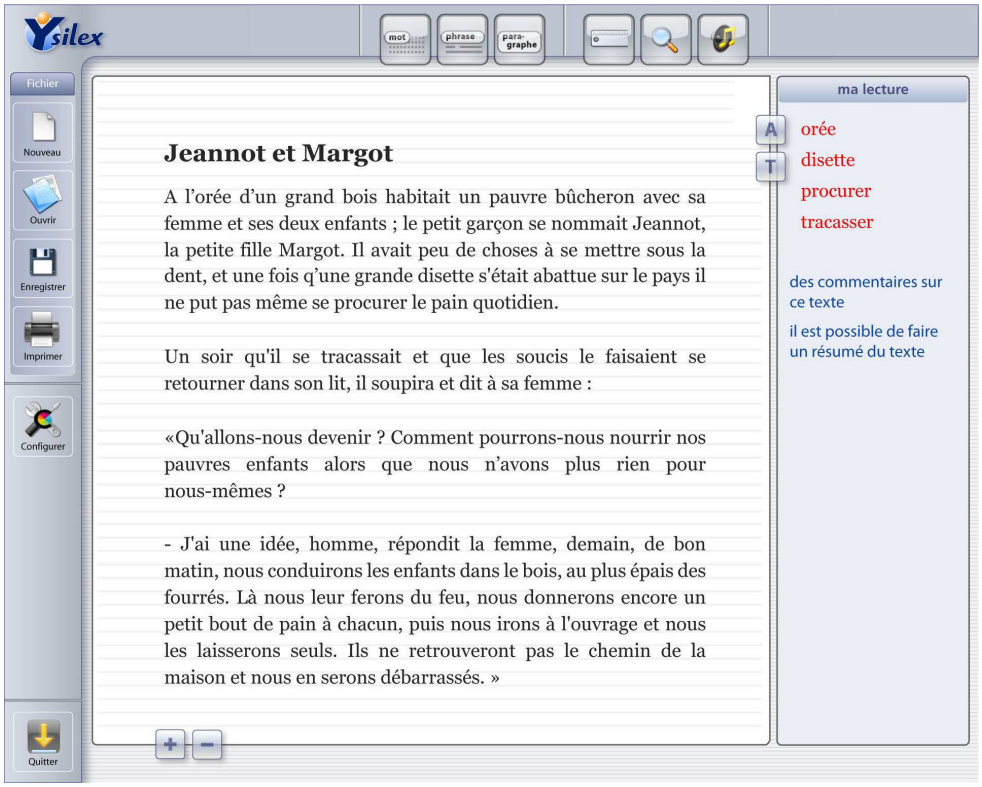

Figure 2: A typical Ysilex screen, with the text displayed in the center, tools options at the top, functionnalities to the left and zooming buttons at the bottom. Words and sentences can be selected from the text and stored on the right-hand display for latter use.

On the banner, two groups of buttons include the reading tools. To the left, 3 buttons to activate different chunking of text (word, sentence, paragraph) and to the right, 3 buttons to select the help modality: colored highlighter, magnifying glass or speech synthesis.

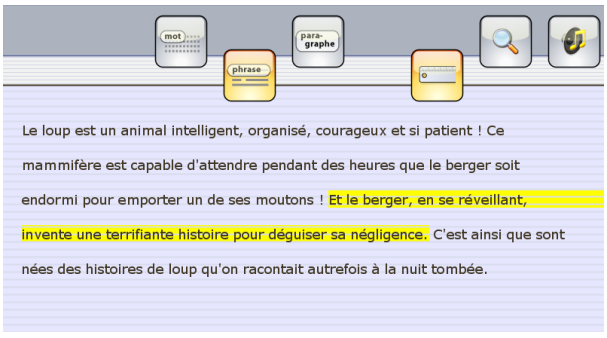

Figure 3: Blow up of the highlighter being used. The chunking “sentence by sentence” and the tool “highlighter” have been selected.

3.2 Tools

3.2.1 A tool to focus attention

Figure 4: Magnifying glass.

To help focus attention on part of the text, we have added a magnifying glass: it allows the child to increase the size of a word, a sentence or a paragraph (Figure 4). To prevent a general distortion of the text as the selected part is blown up, we used a tool glass above the text. Thus, the source text remains unchanged and the larger text is superimposed and centered above the source. We chose this design because dyslexics tend to become easily lost within a text, unwittingly jumping to the line above or below instead of keeping to the line being read or omitting lines as they proceed down the text. Having the text rearrange itself every time the magnifying glass is used would have increased the confusion.

In a fashion similar to that of the highlighter, the reader can move the magnifying glass within the text either, word by word, sentence by sentence or paragraph by paragraph. When using the word by word option, the reader can quicken its scroll by optionally going directly to the first word of the next sentence. Of course, this tool is coupled with speech synthesis and the magnified text can be read aloud on demand.

3.2.2 A tool to concatenate words

For dyslexic children, global visual recognition of words, especially less frequent words, may be quite difficult or impossible. For the French language, it helps to break down words into syllables or even phonemes. The magnifying glass previously presented offers the additional option of breaking down the selected text into syllables (Figure 5), or phonemes (Figure 6). Each syllable or phoneme is thus separated respectively by a '-' or a '.'.

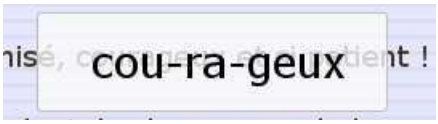

Figure 5: Magnified word showing the syllables.

Figure 6: Magnified word showing the phonemes.

3.2.2 A tool to take notes

In some cases, it may be useful to take notes while reading a text, for example, in order to write a summary of the text, to extract a few keywords to capture the essential ideas, or to jolt down words to check later. Accordingly, we added the possibility to display a small notepad to the right of the reading interface (Figure 7).

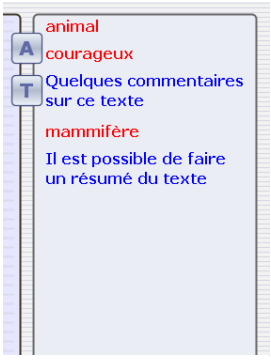

Figure 7: Notepad with selected words in red and added comments in blue.

Once displayed, this interface is accessible via two buttons: the button "A" which allows adding the word that the user has magnified or highlighted, and the button "T" which opens an interface allowing the user to type in comments. To distinguish

between these two different types of notes, the words taken from the text are written in red whereas typed comments appear in blue.

4. Perspective

The current version of the interface is presently being tested in a French school by roughly 40 dyslexic children ranging from 11 to 15 years of age. They use the reading interface for a variety of tasks, including reading lessons scanned from school books and book chapters for required reading. Their use of the interface is informally observed by the educator in charge of the children and comments (from the children as well as the educator) are recorded for later use. This iterative method will lead to further adaptation and development of the interface. In order to be useful in a school environment where reading and writing are tightly associated tasks, the ultimate goal is to enrich the interface with the addition of adequate writing tools.

5. References

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