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IMPLEMENTATION OF GREEK ALPHABET CHARACTERS ACCORDING TO THE OPENDYSLEXIC STANDARD AND TEACHER'S GUIDE FOR FONT USE

IMPLEMENTAZIONE DEI CARATTERI DELL'ALFABETO GRECO SECONDO LO STANDARD OPENDYSLEXIC E LA GUIDA DELL'INSEGNANTE PER L'USO DEI CARATTERI

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Abstract

This article highlights the common findings of research investigating the possible relationship between the font used in multimedia texts and the quality of reading of a dyslexic reader. The process that led to the creation of a font for the Greek alphabet according to the characteristics of OpenDyslexic is described below. In the final part, future researches are proposed that can solve the critical aspects of this new educational technology.

Questo articolo evidenzia i risultati comuni delle ricerche che hanno indagato la possibile relazione tra il font utilizzato in testi multimediali e la qualità della lettura di un lettore dislessico. Di seguito viene descritto il processo che ha portato alla realizzazione di un font per l'alfabeto greco secondo le caratteristiche di OpenDyslexic. Nella parte finale, vengono proposte ricerche future che possano risolvere gli aspetti critici di questa nuova tecnologia didattica.

Keywords

OpenDyslexic; dyslexia; sans-serif font; didactic; inclusion.

OpenDyslexic; dislessia; font senza grazie; didattica; inclusione.

Introduction

A person, while reading, performs this activity by converting each individual grapheme into a phoneme (aloud or in his or her mind) but, almost simultaneously, a phenomenon of reading and converting groups of syllables takes place (Cazzaniga, Re, Cornoldi, Poli, & Tressoldi, 2005). The reader begins to refer to groups of letters corresponding to syllables, prefixes and suffixes, and morphemes (Cornoldi, Tressoldi, & Perini, 2010; Cornoldi, Giofrè, & Martini, 2013; Di Tore, 2016). This produces a significant need to decode graphic forms composed of lines, angles and more generally visual patters. Each font corresponds to a certain amount of such patters and each letter will be comfortable with some of them. Such familiarity allows for commutation in accuracy and speed of reading.

After this premise let us now imagine that the letter is dyslexic. Clinically speaking, dyslexia presents as slower than predicted reading aloud accuracy and speed related to age, education, and class attendance. Depending on the age profile of the condition, there are more or less difficulties in reading letters, words, and paragraphs (MIUR, 2011 and MIUR, 2021) .

In conclusion, familiarity combined with the possibility of grapheme-phoneme decoding has a close relationship with shapes that are able to simplify this process. Indeed, parameters such as spacing, shape and size of letters become crucial (Rello & Baeza-Yates, 2013; Di Tore, 2016).

The font OpenDyslexic

During the 40th edition of UNESCO's General Conference the Recommendation on Open Education Resources (OER) was been defined. This work formally defines OER as all teaching and research materials in any format, in the public domain or with an open license, therefore freely accessible, reusable, and redistributable by third parties. In accordance with the aims and objectives established in the conference, the creation and distribution of new OERs could favor the development of self-learning and inclusion processes also in con-texts outside the didactic ones, which are increasingly essential perspectives for modern society. As a result of these observations, it is clear that traits like accessibility, comprehension, and flexibility are just as important as qualities like OER's overall quality. The font called OpenDyslexic (https://opendyslexic.org) is open-source and was created expressly to make reading easier for people with dyslexia. The letters are The letters have simple shapes and no artistic details (sans-serif) and have a thickening in the lower section that can be used to identify specific letters that can be confusing to readers who have dyslexia ("b," "p," "q," "d," "l," "1," etc.). As we can see in the Figure 1 the thickened parts and some small details distinguish the "problematic" letters, making them immune to plane symmetries.

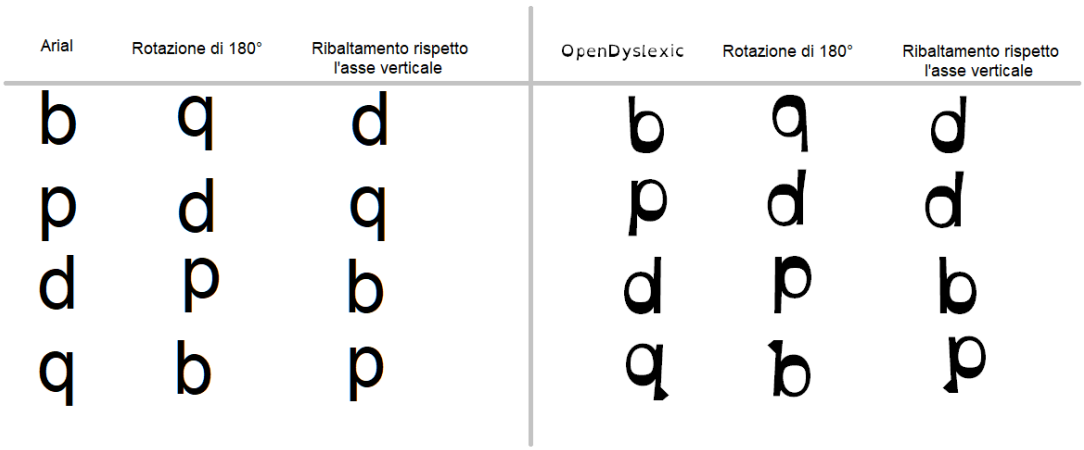

Figure 1. Comparison of problem letters between Arial and OpenDyslexic fonts

State-of-the-art on the use of OpenDyslexicHeading

The use of OpenDyslexic as a font for texts intended for dyslexic readers has been the subject of several studies in the literature. In the work by Zikl et al. (2015), a statistical analysis is conducted by means of two hypothesis tests: the OpenDyslexic font is compared with the Arial font by assessing whether reader performance (measured in terms of letters per minute and accuracy) was dependent on the choice of font. Unfortunately, only a slight variation in terms of accuracy is detected.

Also in the work of Wery and Diliberto (2017), a statistical analysis of the data collected through standard procedures, the data collected were not statistically significant to reject the hypothesis of independence between the font used and the performance of dyslexic readers. In particular, there is also no significant variation in performance when reading complete words, one of the cases not considered by the research of Zikl et al. 2015. Already in the work of Leeuw (2010), the 'Dyslexie' font with similar characteristics to OpenDyslexic was used to conduct statistical investigations with the aim of establishing relationships between the font used and the quality of reading for dyslexic readers. Again, only a weak dependency between the font used and the accuracy recorded was found. On the other hand, it is worth highlighting the results gathered from the questionnaire submitted to the participants on the 'Dyslexie' font rating. In contrast to the able-bodied participants, the dyslexic participants rated their reading experience with the 'Dyslexie' font as more pleasant despite the fact that a second questionnaire did not reveal a strong consensus for the adoption of 'Dyslexie' as the default font.

Resulting issues

The concordant results of the research analysed, contribute to a much deeper thesis than the sterile analysis of measurable parameters. Many other researches that have investigated other factors such as text size, choice of colour pair for text and background, line spacing, as well as the choice of font to be used turn out to be necessary but not sufficient conditions for a more efficient and comfortable reading for dyslexic readers. The adoption of alternative formatting must ultimately remain the student's choice. As suggested by the students interviewed in the work of Leeuw (2010), the use of bespoke or far-from-traditional formatting may be unpalatable to non-dyslexic readers, and in response to this risk, the dyslexic seems to prefer his or her own personal adaptation efforts. This last observation can thus be seen as a further reason supporting the need for such media resources to be open-source and free of protections that may hinder easy conversion for any other recipients of sharing.

Case of study: the Greek Alphabet

In order to pursue the inclusivity approach, it is more effective to think about a large number of minorities than a large majority. More in details, that fraction of individuals who are just starting to experiment with reading and writing with other alphabets, a Latin-only font might be entirely useless. These considerations are connect this work with the research of Yamada and Xinru (2018), whose goal it is to define the requirements for Japanese typefaces for readers, map those requirements to Japanese typefaces, and produce Japanese typefaces for dyslexic readers by programmatically altering the glyphs of open source typefaces. In that research “clarifying the characteristics of Latin typefaces for dyslexic readers and mapping them to Japanese typefaces to define the desiderata for Japanese typefaces for dyslexic readers, and creating Japanese typefaces for dyslexic readers by programmatically manipulating glyphs of open source typefaces”(Yamada et al. 2018, p 53).

The parallel with Yamada et Ali's research ends here; not on the reading outcomes for a dyslexic reader (in terms of reading speed and accuracy) but on the simple fact that the Japanese use hiragana, a syllabic writing

system (consisting of forty-six pure syllables, twenty impure syllables, five semipure syllables and thirty-six contracted syllables) that is more extensive than the Latin and Greek alphabets.

At the same time, it is currently estimated that of the 15.5 million people who write and read with the Greek alphabet, more than 5% suffer from dyslexia, totalling more than 775,000 people.

From what we have observed, we can therefore consider that we have identified a new case study. In Modern Greek, there are 32 phonemes at the level of broad phonetic transcription, of which 5 are vowels (for further details see Protopapas & Vlahou, 2009). These are represented by 24 letters, which come in uppercase and lowercase variants (plus a lowercase-only variant for word-final sigma; see "The Greek Alphabet" at www.xanthi.ilsp.gr/filog/ch1/ alphabet/alphabet.asp). The Greek orthography is commonly characterized as transparent or shallow orthography (Seymour, Aro, & Erskine, 2003), which means that the majority of words may be accurately read based just on their letter sequence, without the need for morphological or lexical information. This last observation further reinforces the idea that reading performance can be improved by improving letter-by-letter word processing.

Construction of a new font

The typeface we developed for this study is called the GreekDyslexic, In this paper, we present the first prototypes of the GreekDyslexic font, which contains only 56 letters.

Tools used

According to the recommendations of various researches (Lockley, 2002; Evett and Brown, 2005; and Rello et al., 2013), the Arial font can be a good starting point, as a "structure font", and due to the characteristics described in section 2, the OpenDyslexic font can provide the right direction to follow, as a "target font", to realise a Greek alphabet that can be considered a natural extension of it. The font was created using the free Birdfont editor, so that it can evolve from its basic form in the hands of any teacher or researcher. The following method was developed to create a font that could satisfy the resulting requirements and may be used with any arbitrary choice of structure font and target font.

Decomposition phase

During this phase, characteristic shapes were identified from the letters available in order to be subsequently adapted to the letters that will make up our future alphabet.

Reworking phase

During this phase, the Greek letters of the Arial font were decomposed into elementary forms similar to those determined in the previous phase and then reassembled to form a first "raw" letter.

Refinement phase

During this phase, the various elementary forms assembled have been redefined; new forms are then created, and typos are eliminated by pursuing the sans-serif style of OpenDyslexic.

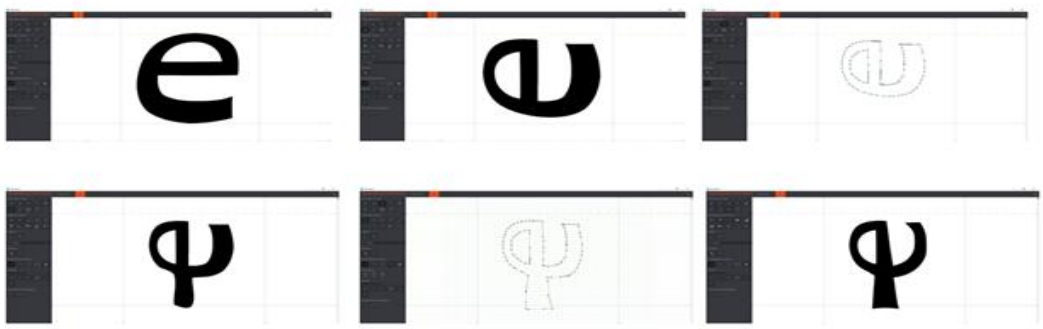

Figure 2. In the image some steps of the construction of a GreekDyslexic letter

Fitting phases

During this phase the letters created were modified trying to increase the homogeneity of the entire alphabet. Every letter has been evaluated and validated with a pairing among the researchers of both Universities, in this way a Greek readers can easily recognize the character of the extended alphabet, facilitating the translation of the grapheme into phoneme. For some letters further modifications were necessary, suggested by those who use this alphabet on a daily basis for example “Greek teachers indicate to the children that the letter x it “goes down” from the line.”

The letters in the proposed font try to follow an intermediate path between being familiar to the reader and excessive customization. In other words, the risk of customizing, as well as the risk of obliquity and misunderstanding for a reader other than the writer, grows when a symbol is repeatedly duplicated through pen and paper. Such letters are widely used in a variety of scientific applications (examples are the Greek "pi" or the capital "sigma" to indicate summations). As a result, the design of these letters is prejudiced when it is originally created (*Unconscious Customization*).

In contrast, it was simpler to make letters when one wasn't utilizing them because one could choose a path based more on aesthetics than on prior knowledge.

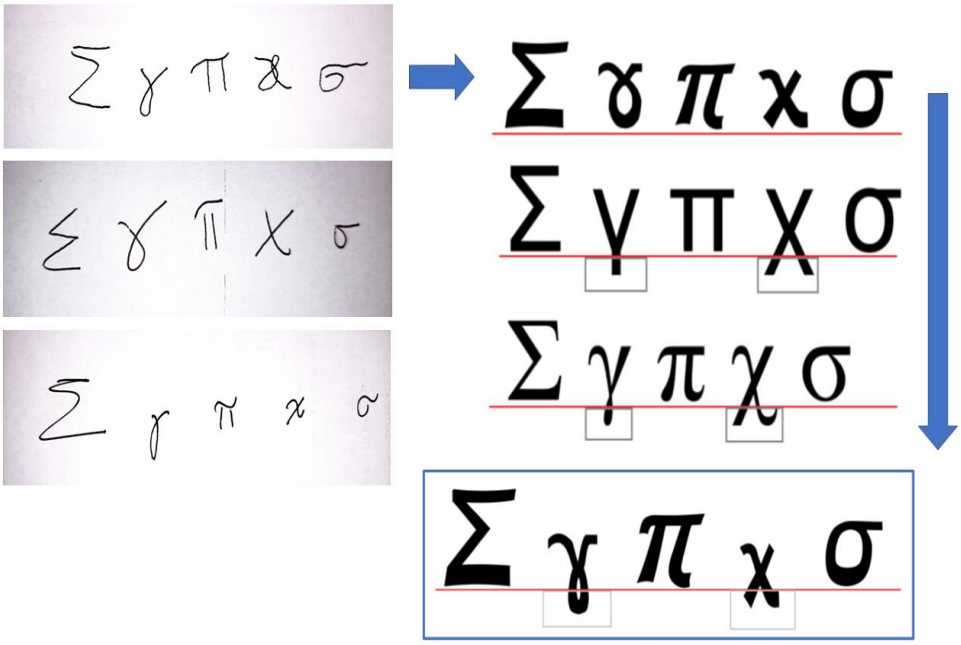

Figure 3. Unconscious Customization errors, fixed during the Fitting phase

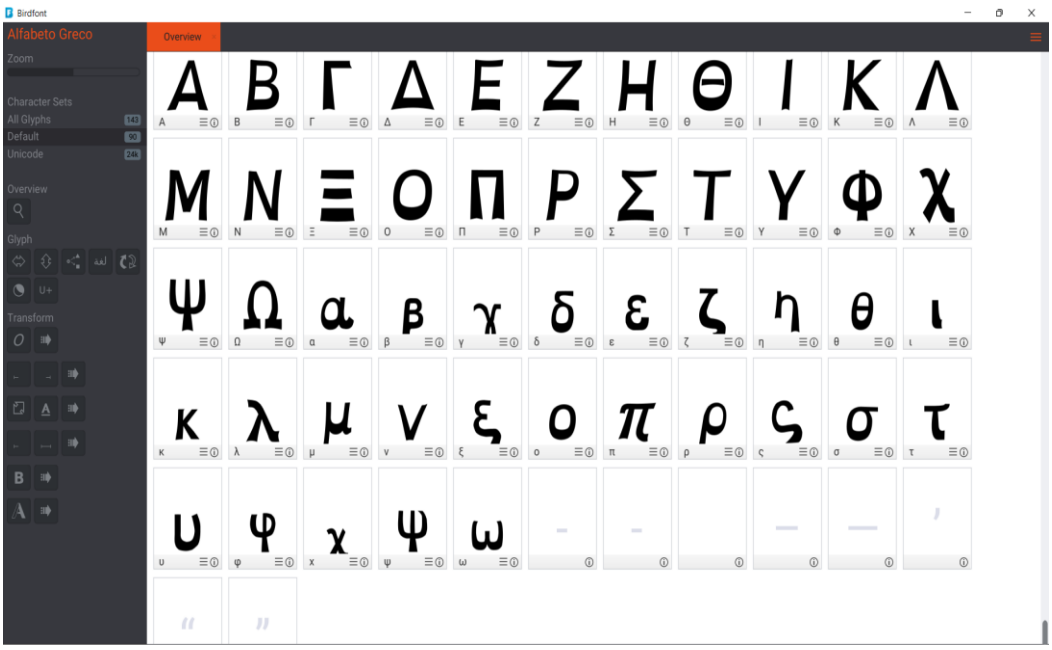

Figure 4. The GreekDyslexic font

Teacher's guide for font use

In the work of Berton et al. (2006), various computer technologies such as scanners, Optical Character Recognition (OCR), speech synthesisers and automatic spell-checkers are proposed in the role of learning support for dyslexic students. These tools, co-ordinated with alternative methodologies, have made it possible to achieve excellent results both in the psychological-motivational sphere and in the performance of the participants. Over the

past ten years, the IWB has been installed in many of the classrooms of both primary and secondary schools, replacing not only the canonical classroom equipment but also expanding these with the older projectors, media players, and TVs. The introduction of these technologies allows the full potential of multimedia resources to be exploited. Teachers of digital native students will be progressively encouraged to make available or more directly produce digital teaching materials.

In light of the above, and therefore because of its potential use, having a font that facilitates reading for dyslexic students acquires greater relevance and becomes, for the teacher, an additional tool for inclusivity. As stated in the work of Isgett and Wang (2021), many of the initial difficulties are frequently related to little or no experience with the new technology, and in the best cases, are resolved by a significant amount of self-learning. As such, the teacher must first be equipped with the knowledge necessary for its proper installation and use. This section describes a possible strategy for converting a .doc file from any font, to the GreekDyslexic font:

(1) As a first step, the GreekDyslexic font must be installed among the fonts of our operating system. To install the font, simply open the .ttf file and click on the 'install' button. Alternatively, to install the font, copy the .ttf file into the C:\Windows\Fonts folder (in the case of a Windows operating system) and confirm the installation message;
(2) We open the .doc file and select the text we want to convert to GreekDyslexic;
(3) We copy and paste the text onto the Notepad tool on our computer;
(4) We change the Notepad font to GreekDyslexic;
(5) Copy and paste the text from Notepad to the .doc file reader.

Research Horizons

In order to effectively test the created alphabet, it must first be completed with characters with accents. Then, to evaluate the efficiency of one font over another, several tests have been proposed. An easy one involves giving dyslexic students lists of letters, real words and nonsense words divided between the GreekDyslexic font and a standard font such as Arial. The student is then asked to read these lists while being recorded and timed. Eventually, from the data collected, it is possible to calculate accuracy in terms of the number of errors made and reading speed in terms of letter-per-minute. Finally, the numerical data collected can then compose a statistical sample on which to conduct an ANOVA test.

The font created, as a digital tool, is far from being decisive for a learning disorder. Moreover, the same research that has attempted to establish the effectiveness of one font over another has a number of criticisms:

- The alternative font was always compared with other commonly used fonts, precluding the possibility of test participants gaining experience with the font and getting used to it;

- The reading assessments offered for this kind of study are frequently presented to participants in a cold manner, eschewing many of the other engagement opportunities offered by the digital world;

- The parameters that were measured are not representative of the emotional factors involved in the learning process;

Future research can therefore continue in different directions:

1. Enlarging the font by including other characters (scientific symbols, accented characters, etc.);
2. Improvement of the quality of the font in terms of acceptability through subsequent tests;
3. Study aimed at proposing alternative tests for evaluating the efficiency of the font for reading quality.

References

Berton, M. A., Ciceri, F., Craighero, M., Dazzi, V., Grandi, L., Lampugnani, G., ... & Stella, G. (2006). Strategie e tecnologie per l'apprendimento. Risorse educative per famiglia e scuola. *Dislessia, 3*(3), 295-307.

Cazzaniga, S., Re, A. M., Cornoldi, C., Poli, S., & Tressoldi, P. E. (2005). *Dislessia e trattamento sublessicale*. Trento: Erickson

Cornoldi, C., Giofrè, D., & Martini, A. (2013). Problems in deriving Italian regional differences in intelligence from 2009 PISA data. *Intelligence*, 41(1), 25-33.

Cornoldi, C., Tressoldi, P. E., & Perini, N. (2010). Valutare la rapiditae la correttezza della lettura di brani. nuove norme e alcune chiarificazioni per l'uso delle prove mt. *Dislessia*, 7, 89-100.

Di Tore, S. (2016). *La tecnologia della parola*. Milano: FrancoAngeli.

Evett, L., & Brown, D. (2005). Text formats and web design for visually impaired and dyslexic readers—Clear Text for All. *Interacting with computers*, 17(4), 453-472.

Isgett, C., & Wang, S. (2021, December). Challenges Regarding Assistive Technology in Special Education. In *2021 Tenth International Conference of Educational Innovation through Technology (EITT)* (pp. 293-298). IEEE.

Leeuw, R. (2010). *Special font for dyslexia?* (Master's thesis, University of Twente).

Lockley, S. (2002). Dyslexia and higher education: accessibility issues. *The Higher Education Academy*.

Ministero dell'Istruzione dell'Università e della Ricerca [MIUR], (2011) Linee Guida per il Diritto allo Studio degli alunni e degli studenti con Disturbi Specifici di Apprendimento, Allegato al D.M. 12 Luglio 2011 https://miur.gov.it/web/guest/ricerca-tag/-/asset_publisher/oHKi7zkjcLkW/document/id/188260

Ministero dell'Istruzione dell'Università e della Ricerca [MIUR], (2021) Linea Guida sulla gestione dei Disturbi Specifici dell'Apprendimento http://www.aiutodislessia.net/wordpress/wp-content/uploads/2022/01/Linee-Guida-20-gennaio-2022.pdf

Pavel Zikl et al. (2015). The possibilities of ICT use for compensation of difficulties with reading in pupils with dyslexia. *Procedia-Social and Behavioral Sciences*, 176, pp. 915–922.

Protopapas, A., & Vlahou, E. L. (2009). A comparative quantitative analysis of Greek orthographic transparency. *Behavior Research Methods, Instruments & Computers*, 41(4), 991–1008. https://doi.org/10.3758/BRM.41.4.991

Rello, L., & Baeza-Yates, R. (2013, October). Good fonts for dyslexia. In *Proceedings of the 15th international ACM SIGACCESS conference on computers and accessibility* (pp. 1-8).

Seymour, P. H., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British journal of psychology* (London, England : 1953), 94(Pt 2), 143–174. https://doi.org/10.1348/000712603321661859

Wery, J. J., & Diliberto, J. A. (2017). The effect of a specialized dyslexia font, OpenDyslexic, on reading rate and accuracy. *Annals of dyslexia*, 67(2), 114-127.

Yamada, S., & Zhu, X. (2018). A Research on Readable Japanese Typography for Dyslexic Children and Students: Creating Japanese Typefaces for Dyslexic Readers. 東京大学大学院教育学研究科附属学校教育高度化・効果検証センター 研究紀要, (3), 50-70.