Facilitating reading for people with dyslexia: a narrative review of recommendations for text formatting

Facilitando a leitura para pessoas com dislexia: uma revisão assistemática de recomendações para formatação textual

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dyslexia, recommendations, reading

Dyslexia, a disorder characterized by difficulties in learning to read and write, has aroused interest in many different areas of knowledge, including Information Design. Many recent studies have aimed at testing text formatting variables to design recommendations; however, specific guidelines are still scarce in literature. In this sense, this study conducted a narrative literature review on 19 articles addressing text formatting recomendations for people with dyslexia, including typography, layout, colors, media and images and compared to those stablished by the Dyslexia Style Guide (DSG) (2023). The results reveal that some DSG recommendations are well accepted among the scientific community while others, as well as some gaps regarding the topic, still require further investigation.

dislexia, recomendações, leitura

A dislexia caracteriza-se por dificuldades de aprendizagem da leitura e da escrita, o que tem gerado interesse nas mais diferentes áreas do conhecimento, incluindo o Design de Informação. Muitos estudos recentes buscam testar variáveis de formatação textual a fim de gerar recomendações, embora diretrizes consolidadas ainda sejam escassas na literatura. Neste sentido, o presente estudo realizou uma revisão em 19 estudos sobre recomendações de formatação textual para pessoas com dislexia, incluindo tipografia, layout, cores, mídia e imagens. As recomendações encontradas foram comparadas com as do Dyslexia Style Guide (2023). Os resultados apontam algumas orientações mais aceitas na comunidade científica e outras que ainda carecem de mais investigação, além de apontar lacunas para pesquisas futuras.

1 Introduction

The development of information and communication systems depends on the interactions in technological interfaces, especially on the contact between information design and users. The correspondence between them is essential to achieve an effective contribution to society. In this sense, when dealing with specific needs, such as those of users with dyslexia, information design needs to appropriately correspond to their capabilities to ensure accessibility and inclusiveness.

Dyslexia is a learning disorder characterized by deficit in reading and writing and affects around 15 to 20% of the population worldwide (International Dyslexia Association, 2023). In Brazil, around 8 million individuals present this disorder (Empresa Brasil de Comunicação, 2022), which reveals the urgent need for a better understanding of the subject so that recommendations on information design, based on principles of accessibility and inclusion can be implemented. This is not a simple task, since dyslexia is no longer perceived as a particular reading and vocalization problem, but involves several clinical conditions and "subtypes" (Snowling, Hulme, & Nation, 2020). Specifically, symptoms may include spelling confusion, failure to recognize letters, deficit in the phonological use of irregular or homophonic words, morphological inadequacies, difficulty in lexical acquisition and low speech comprehension and/or interpretation (Rello & Baeza-Yates, 2015).

The difficulties are more striking considering the technological advancements over the last decades, allowing a large part of daily work, leisure, communication and other activities to be performed in the digital environment, raising obstacles in information design and user experience. According to Alves (2010), it is a paradox to call the "Information Society" a world in which there are great technological advancements, but some users are deprived of access to content. Information design involves numerous areas of knowledge, namely: ergonomics, linguistics, psychology, sociology, anthropology, graphic design, computer science, among others, which must operate together to allow users to understand and use products, services and environments (Lameira et al., 2016). By placing the user at the center of the information design process, effectiveness of communication, perception, reading, understanding, memorizing and use of information can be achieved. According to Fialho (2017), this can be done by combining aesthetic and functional aspects, generating accessible products and experiences that are easy to understand and use. Jorante, Nakano and Padua (2020) point out that information should be clear and simple; therefore, the designer must consider that the text is read as a whole, and not letter by letter, or word by word.

Given this context and considering that the main difficulties of people with dyslexia derive from interacting with textual information systems, the British Dyslexia Association, an institution that has been consolidated for over 50 years and works on the social integration of people with dyslexia, designed the "Dyslexia Style Guide (DSG)" (2023), with parameters for information design aimed at individuals with dyslexia. According to Yoliando (2020), this guide presents the best practices to make all written communication (printed or digital) easier for people with dyslexia, and is used by designers and publishers. In addition, several other studies have presented recommendations regarding the design of written information for this audience, which opens up the possibility of analyzing similarities, contradictions or even gaps between them.

The objective of this study was to conduct a narrative literature review, focusing on the challenges faced by people with dyslexia when interacting with information systems, identify the main recommendations of these studies and confront them with the parameters presented by the British

Dyslexia Association to understand the compatibility, contradictions and/or probable limitations in applying information design.

2 Methods

First, the DSG (British Dyslexia Association, 2023), which presents information design parameters for people with dyslexia, was analyzed. The guide addresses the following topics: font readability; titles and structure; colors; layout; and writing style. The topics were then reorganized based on the fields of activity of Information Design:

- "Typography" (elements of the visual structure of types and/or letters): font style (serif, bold, italic, underlined and uppercase/lowercase), font size and letter spacing;
- "Layout" (elements of the visual structure in the graphic area): word spacing, line spacing, paragraph spacing, line width, text alignment and structure (headers, titles, markups, columns, hyperlinks);
- "Colors" (chromatic elements): background (patterns and text) and hue;
- "Media" (elements of information distribution); and
- "Images" (visual [and non-textual] elements that complement textual information): figures and flowcharts.

Some elements related to writing content/style, present in the DSG, were not considered here. Professionals and researchers in the field of information design can make important contributions to this aspect; however, the final competence for writing content/style is responsibility of professionals from other fields, such as: communication, marketing, speech therapy, psychology and others.

After reorganizing the guide, the narrative review was conducted to investigate how the topic had been explored in previous studies. The narrative review is often applied to describe discrepancies and similarities regarding a particular topic (in this case, the interaction of people with dyslexia and information systems), allowing for comparisons between the studies (Sukhera, 2022).

Therefore, the following research question was defined: "Considering that people with dyslexia interact with information systems, what text formatting recommendations should be used for accessible and inclusive reading?"; with the following search strings: "dyslexia"; "information systems"; "text formatting"; "accessibility" and "inclusion" (in both Portuguese and English).

The searching was performed in different databases (Scopus, DOAJ, Google Scholar and others), considering peer-reviewed studies published since 2011. The criterion for selecting the studies was the presence or indication of text formatting recommendations for people with dyslexia, based on empirical studies, conducted by eye tracking and/or other tests, and analysis of interaction in a given medium. Results were analyzed based on the correspondence between such recommendations (selection criterion) and the DSG parameters (British Dyslexia Association, 2023).

3 Results

The results of the narrative review (Chart 1) gathered information from 19 studies. Approximately 26% of the parameters presented in the DSG were not found in the reviewed articles. Items marked with "✓" indicate that the recommendation is the same as in the DSG, while items marked with "✗"

Chart 1 Results of the Narrative Review (*N* = 19), based on the DSG (British Dyslexia Association, 2023).

Category	Subcategory	Parameter	Rello, Kanvinde, Baeza-Yates 2011	Santana et al. 2012	Zorzi et al. 2012	Rello, Baeza-Yates 2013	Rello et al. 2013	Schneps et al. 2013	Ismail, Jaafar 2014	Sarpudin, Zambri 2014	Ismail, Jaafar 2015	Chen et al. 2015	Rello, Baeza-Yates 2015	Berget, Mulvey, Sandnes 2016	Rello, Baeza-Yates 2016	Khan et al. 2018	Miniukovich, Sulpizio, Angeli 2018	Krivec et al. 2019	Scaltritti et al. 2019	Shabbir, Bhatti, Hacko 2019	Ishak et al. 2021
Typography	Font style	Sans-serif		●		✓				✓	●	●	●		✓	✓				✓	●
		Bold									✓										
		Italic				✓					✓										
		Underlined																			
		Upper/lowercase														✓					
	Font size	12–14 points or >	●	✓			●			✓	●	●	●				●		●	✓	●
	Letter spacing	35% larger	✗		●			●			●	●			✗				●		●
Layout	Word spacing	3,5× larger									●	●									●
	Line spacing	150% larger	✗	●							●		✓						✓		
	Paragraph spacing	Add extra space	✓	✓							●										
	Line width	60–70 characters	●					●									●	●			
	Text alignment	Aligned left, not justified		●									✓					✓			
	Structure	Headers		✓													✓			✓	
		Title font size 20% >																			
		Markups		✓													✓			✓	
		Avoid columns																●			
		Highlight hyperlinks																			
Colors	Background	No patterns	✓	✓					✓	✓	✓	✓			✓			✓		✓	✓
		Good contrast	●	✓					●		✓	●	●		✓			●		✓	●
	Hue	Avoid green, red, pink																			
Media	Finishing	Use matte paper																			
Images	Figures	Support the text		✓				●							●			●		✓	●
	Flowcharts	Explain procedures																			

represent non-adherence between the references. Finally, items marked with "●" indicate that there is partial adherence to the DSG; or that the study in question adds something new in relation to the recommendation; or, even, that only a generic recommendation is presented, without specifying parameters or values. Blank fields indicate that the item was not found in that specific study.

4 Discussion

Dyslexia affects a significant portion of the world's population, compromising the ability to read and understand written communication, resulting (at the very least) in embarrassment for these individuals. Since this happens especially during interactions with written information systems, Information Design needs to tackle this problem to allow for greater accessibility and inclusion. The present study aimed to review the literature that addresses the informational challenges faced by people with dyslexia and compare them with the DSG. Specifically, no indications were found in "Typography" regarding the application of "underlining". In "Layout", no indications were found regarding the size of titles or highlighting hyperlinks. In "Colors", the same occurred regarding the use of green, red or pink text. The topic "Media" was not mentioned by any of the studies, and in the topic "Images", there was no indication regarding the use of flowcharts. This was expected, since most articles are characterized by empirical studies, whose approach is usually more specific and clustered. In any case, the present analysis indicates, at the very least, a lack of empirical studies addressing the aforementioned topics. The other topics were analyzed and discussed individually. Chart 2 summarizes the findings from the studies and compare them with the DSG, indicating whether there is compatibility between them. The discussion of each topic is presented below.

4.1 Typography

The studies that address typography ($N = 16$) mainly recommend the use of sans-serif font families. In two studies, Rello and Baeza-Yates (2013; 2016) suggest Arial, Helvetica and Verdana. Sarpudin and Zambri (2014) suggest Verdana and Santana et al. (2012) include Tahoma, Century Gothic and Trebuchet. Two other studies recommend Arial as the main font (Shabbir, Bhatti, & Hacko, 2019; Khan et al., 2018). All of these also appear in the DSG, in addition to Calibri and Open Sans.

Other fonts not mentioned in the DSG were found. Courier is recommended by Rello and Baeza-Yates (2013; 2016), and monospaced fonts without specific indication are suggested by Ismail and Jaafar (2015) and Santana et al. (2012). Rello and Baeza-Yates (2013; 2016) include the Computer Modern Unicode, while Khan et al. (2018) and Santana et al. (2012) present Comic Sans as an alternative. The only suggestion for a serif font is in Santana et al. (2012), who recommends using Georgia.

Chart 2 Recommendations from the selected studies compared to the DSG regarding their compatibility.

TOPICS			Studies	Dyslexia Style Guide	Compatibility
Typography	Font style	Serif	Sans serif fonts (Arial, Helvetica, Verdana, Century Gothic, Trebuchet). In a few cases, serif fonts or other typefaces (Georgia, Comic Sans)	Sans serif fonts (Arial, Verdana, Tahoma, Century Gothic, Trebuchet, Calibri, Open Sans, Comic Sans)	Compatible
		Bold	Apply to provide emphasis	Apply to provide emphasis	Compatible
		Italic	Avoid	Avoid	Compatible
		Underlined	No data	Avoid	No data for comparison
		Uppercase / lowercase	Lowercase letters are easier to read	Avoid all capital letters in running text. Lowercase letters are easier to read	Compatible
	Font size		Vary from 12 to 18 pt, and can be even larger (up to 26 pt)	12–14 pt or equivalent (16–19 px)	Partially compatible
	Letter spacing		Variable (+7 to +14% up to +2.5× font width)	Up to +35% font width	Partially compatible
Layout	Word spacing		Larger spacing (not specified) is recommended	Word spacing should be at least 3.5 times greater than letter spacing	Partially compatible
	Line spacing		1,4 to 2 (140 to 200%)	1,5 / 150% is preferrable	Compatible
	Paragraph spacing		Double or enlarged (unspecified)	Enlarged (unspecified)	Compatible
	Line width		Up to 77 characters	60–70 characters	Partially compatible
	Text alignment		On the left, avoid justified	On the left, avoid justified	Compatible
	Structure	Headers	Separate and hierarchize sections to make them easier to find and read	Use headings and styles to create a consistent structure that helps people navigate your content	Compatible
		Titles	No data	Use a font at least 20% larger than normal text. If necessary, use bold	No data for comparison
		Markups	Break up text and create well-defined sections and separations	Break up text with bullet points (or regular section headings) in long documents. When possible, include a table of contents	Compatible
		Columns	Avoid	Avoid	Compatible
		Hyperlinks	No data	Hyperlinks should look different from titles and regular text	No data for comparison
Colors	Background	Patterns	No distractions for the reader. Value simplicity	Avoid distracting patterns or background images	Compatible
		Text	High contrast, dark text (black 90%, dark blue, brown), on light background (beige, off-white, yellow)	High contrast, dark text on light (not white) background	Compatible
	Hue		No data	Avoid green and red/pink	No data for comparison
Media	Finishing		No data	Matte paper, thick enough to isolate the back	No data for comparison
Images	Figures		Need to be contextualized. Serve as visual reinforcement	Images, pictograms and charts support the message of the text	Compatible
	Flowcharts		No data	Flowcharts explain procedures	No data for comparison

In turn, the DSG does not recommend the use of any serif font. Only Ismail and Jaafar (2015) indicate the use of bold for emphasis, while Rello and Baeza-Yates (2013) and Ismail and Jaafar (2015) corroborate the recommendation to avoid italic texts. Only one study (Khan et al., 2018) indicates that lowercase (Lc) is preferrable.

Regarding font size, none of the studies recommended a size smaller than 12 points. In fact, some studies suggest applying a minimum size between 12 and 14 points (Sarpudin & Zambri, 2014; Scaltritti et al., 2019; Santana et al., 2012), in accordance with the DSG. Recommendations range from 12 to 16 points (Khan et al., 2018) or up to 18 points (Rello et al., 2013; Ismail & Jaafar, 2015). Other studies suggest larger font sizes, up to 26 points (Rello & Baeza-Yates, 2015; Rello, Kanvinde, & Baeza-Yates, 2011). Krivec et al. (2019) and Shabbir, Bhatti, and Hacko (2019) suggest the use of larger font sizes, but do not specify which sizes would be appropriate.

Larger letter spacing is recommended in some studies. Rello, Kanvinde and Baeza-Yates (2011) and Rello and Baeza-Yates (2015) suggest a subtle increase (from +7 to +14%). Schneps et al. (2013) indicate a moderate increase, in line with the DSG, which suggests an increase of up to +35% larger than the letter width. Only Zorzi et al. (2012) indicate a larger increase, around +2.5 times the letter width.

4.2 Layout

The studies presenting layout recommendations (*N* = 9) focus mainly on spacing and line width issues, but little on structure.

Few studies address word spacing (Sarpudin & Zambri, 2014; Ismail & Jaafar, 2014; Ishak et al., 2021), emphasizing that larger spacings are more recommended. Some studies recommend increasing the line spacing, which can be 1.4 (Rello, Kanvinde, & Baeza-Yates, 2011), 1.5 (Chen et al., 2015; Scaltritti et al., 2019) or 1.5 to 2 pts (Santana et al., 2012). In this regard, the DSG suggests an increase of 1.5. For paragraph spacing, Rello, Kanvinde & Baeza-Yates (2011) suggest double spacing, while Santana et al. (2012) and the DSG agree that increased spacing is beneficial, but do not specify the magnitude. This statement, however, does not find consensus in literature, as there are studies indicating that increased spacing does not generate significant improvement (Galiussi et al., 2020).

Considering the length of text lines, it is suggested that sentences must be short, since long texts may not be attractive to readers with dyslexia (Galiussi et al., 2020; Krivec et al., 2019). Furthermore, according to Schneps et al. (2013), shorter lines reduce the occurrence of regressive saccadic movements, i.e., they reduce situations in which the reader has to return to previous points while reading. In this sense, Rello, Kanvinde and Baeza-Yates (2011) recommend the use of up to 77 characters per line (optimal width), which is slightly above that suggested in the DSG – 60 to 70 characters per line. The guide goes further, pointing out that multiple columns should be avoided as they can cause confusion in the reader due to eye movements when jumping from one line to another.

For text alignment, left-aligned text (Chen et al., 2015; Scaltritti et al., 2019; Santana et al., 2012) is recommended, since individuals with dyslexia can benefit from lines that do not end exactly at the same point, making it easier to place the gaze while reading. This same recommendation is present in the DSG. No considerations were found regarding other alignments, such as centered or right-aligned text, but it can be implied that they would not be appropriate as they contradict the recommendations cited so far.

Finally, some studies (Shabbir, Bhatti, & Hacko, 2019; Miniukovich, Sulpizio, & Angeli, 2018; Santana et al., 2012) indicate practices to facilitate reading and understanding, such as grouping related information, prioritizing, hierarchizing and dividing into sections (bullets and titles), whenever possible. These recommendations also appear in the DSG. It is critical to ensure that information is clear and simple in any reading material, considering that the text is read as a whole, in a fluid manner (Jorante, Nakano, & Padua, 2020).

4.3 Colors

Regarding colors (*N* = 10), high contrast between the textual content and the background is recommended (Ismail & Jaafar, 2015; Khan et al., 2018; Santana et al., 2012; Shabbir, Bhatti, & Hacko, 2019). Also, absolute white in the background (Khan et al., 2018; Santana et al., 2012) should be avoided, giving preference to pastel tones, such as beige (Chen et al., 2015). Ishak et al. (2021) indicate some color pairs for writing and background that work well: black and beige, brown and off-white, dark blue and yellow. Rello, Kanvinde and Baeza-Yates (2011) recommend using 90% black text on a beige background with 10% opacity. Specific recommendations to avoid the use of green, red and pink, as stated in the DSG, were not found.

4.4 Media

The articles reviewed do not address print media, since their focus is on the use of digital devices, such as monitors, smartphones and other mobile devices.

4.5 Images

Regarding figures, some references (*N* = 6) suggest the use of images that are relevant, incorporated in contextual terms throughout the text, i.e., ones that reinforce the written information (Shabbir, Bhatti, & Hacko, 2019; Santana et al., 2012). Furthermore, it is pointed out that icons can be benefitial to help reinforce the message, but they must be recognizable and familiar to avoid symbolic confusion (Ismail & Jaafar, 2014; Santana et al., 2012). Such considerations are in line with those of the DSG.

In general, several authors value simplicity, agreeing that information overload, whether visual or textual, is not welcome by individuals with dyslexia (Shabbir, Bhatti, & Hacko, 2019; Miniukovich, Sulpizio, & Angeli, 2018; Santana et al., 2012). These studies suggest practices to facilitate reading and understanding, such as grouping related information, prioritizing, hierarchizing, and dividing it into sections whenever possible – recommendations in accordance with the DSG.

5 Important reflections

In addition to the recommendations compared thus far, other important reflections are raised in relation to the studies consulted. First, the samples participating in the studies are quite varied, especially in age range. Chen et al. (2015), for example, included adolescents aged 14 to 18, while Zorzi et al. (2012) presented results collected from children aged between 8 and 14. The variation was even greater in other studies, ranging from 11 to 50 years (Rello & Baeza-Yates, 2013) or 18 to 55 years (Miniukovich, Sulpizio, & Angeli, 2018). Some divergences in the recommendations probably reflect this variation.

Second, the level of dyslexia presented by the participants is an aspect of concern. Most studies only indicate that individuals had dyslexia, and of these, only a few present a protocol for confirming the diagnoses. Sarpudin and Zambri (2014) report that their studies enrolled participants with a mild severity level, and Zorzi et al. (2012) classify the individuals in the category of developmental dyslexia while Schneps et al. (2013) identify their participants only as students with reading difficulties. This is a point to be considered because, according to Snowling, Hulme and Nation (2020), dyslexia is a complex condition that involves subtypes, which can be aggravated by comorbidities, thus clinical characterization can influence the quality of reading.

Third, it is necessary to consider the reading medium and the purpose of the recommendations. Web texts presented on monitors (17" or 21") appear more frequently in the literature and with a variety of resolutions (1600 × 1200 px, in Scaltritti et al., 2019, or 1185 × 1600 px, in Miniukovich, Sulpizio, & Angeli, 2018, for example). Smartphones or mobile devices appear much less frequently (Schneps et al., 2013, Khan et al., 2018). The variety of device types, screen sizes, resolutions and the reading dynamics can influence this activity. In fact, Schneps et al. (2013) point to divergent results for tests performed on a fixed surface and when users held the device with their own hands, in the case of smartphones.

Finally, possible differences and impacts on reading may be related to the purpose of use, as it was not always possible to identify specific reading situations. Krivec et al. (2019) and Rello, Kanvinde and Baeza-Yates (2011) limit the scope of their studies to long texts, aimed at people used to reading for several hours a day, which may indicate greater reading proficiency. The studies by Ismail and Jaafar (2014, 2015), in turn, are focused on teaching materials. Guidelines also appear for digital games (Ishak et al.,

2021) and serious games (Shabbir, Bhatti, & Hacko, 2019). Such differences may also influence reading activity and performance, since the amount of text, the content, the density of information, the support in which it occurs and the reader's own motivation are not equivalent in each of these situations.

6 Conclusions

People with dyslexia have specificities related to learning difficulties and language use and consequently face obstacles when interacting with information systems. This study aimed to examine and provide some clarifications and guidelines on text formatting recommendations for people with dyslexia. While some recommendations, such as font type, font size, and use of colors seem to be more consensual among the scientific community, other topics still need further investigation, e.g., a better definition of the target audience (age group, level of dyslexia, level of education, occupation, geographic location, among others), type of reading support, purpose and/or reading situations.

Some elements related to content/writing style, present in the DSG, were not considered here. Future research on dyslexia in the field of information design including these aspects and involving professionals from areas other than design (such as communication, marketing and health) can shed additional light to the topic.

Most of the studies included herein are characterized by an experimental approach, in which a sample of people with dyslexia were subjected to a reading experiment to test possible variations and their impacts, and then propose visual and textual guidelines that can be generalized. However, there are studies that deal with the development of digital products or graphic interfaces for this audience, which can also be investigated to observe how the recommendations behave and how they influence a real reading context. Undoubtedly, this is a possibility of expanding the understanding existing to date.

Furthermore, many of the recommendations for people with dyslexia also apply to other types of learning disorders and even to people who do not present any symptoms. Therefore, it also opens up the discussion about how accessibility guidelines for people with dyslexia can benefit a wider audience, or about the extent to which developing digital solutions aimed exclusively at dyslexia makes sense or not. Given that numerous contributions to the topic continue to have been published, it is clear that scientific interest in the topic persists.

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