How Blind and Sighted Individuals Perceive the Typographic Text-Signals of a Document

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Abstract. Typographic, layout and logical elements constitute visual text-signals of a document that carry semantic information over and above its content. Although they are important to the reader, most of the current Text-to-Speech (TtS) systems do not support them. As there is a lack of studies on how blind perceive them and aiming to incorporate them efficiently in advanced TtS systems, we investigate in a systematic way the perception of the main typographic text-signals by 73 blind and sighted students. The results show that both groups of the participants perceive that font-styles are used largely to better locate, recognize or distinguish the topics or specific information in a document. Almost half of the sighted argue that they are useful for the comprehension of the content, but only 4 % of the blind students perceive the same. Most of the sighted participants (68 %) consider that bold is used to indicate an important word or phrase in the text that needs more attention by the reader, but only 23 % of them perceive the same for the italics. 27 % of the blind participants and 23 % of the sighted perceive that the role of font-size is to provide emphasis. Moreover, only 9 % of the sighted students grasp that bold is used for emphasis and 13 % of them that italics is used for light emphasis. Half of the blind participants consider that font-size plays an important role in separating the basic elements of a text (e.g. titles, footnotes), but only 13 % of the sighted believe the same. Finally, the sighted and blind students recognize the titles of a text mainly using non-identical criteria.

Keywords: Document accessibility · Text-signals · Typography · Font-size · Font-type

1 Introduction

Printed or electronic documents (i.e. books, newspapers, magazines, etc.) incorporate, additionally to their content, an amount of visual presentation details, such as typographic elements and arrangement of the content on the page. The title of a section, for example, can be pinpointed by having it one or two lines above the content and with larger font size, compared with the size of the main text. Moreover, bold or color can be used to provide emphasis in a specific word, phrase or paragraph. Rich-text

documents preserve all their presentation elements. Besides, plain-text documents ignore them. The textual content of a document is referred as text-document.

The visual elements of a text document can be classified into three layers [1]:

- Logical layer: the content is related to elements of the structure, i.e. titles or headings, paragraphs, sections, chapters, lists, footnotes, simple or complex tables.
- Layout layer: the content is associated with the architectural elements for its arrangement on a page (e.g. text alignment, page margins, columns).
- Typography layer: it includes the elements of font-type, font-size, font-color, background color, etc. as well the elements of font-style (e.g. bold, italics, bold-italics, underline).

The three layers above are not independent, but complementary. Typographic elements can be applied to the textual content itself, as well as on the layout or the logical layer. For example, a word in bold can be used either in a title or to indicate a new term. Further, a title can have bigger font size and be arranged in the center of a line.

The term text-signal has been introduced [2] as the writing device that indicates characteristic elements of a text-document or structure that carries semantic information over and above its content. Text-signals attempt to pre-announce or emphasize content or reveal content relationship [2–7]. Titles, subtitles or headings constitute text-signals [3]. Furthermore, the input-enhancement operation augments the saliency of linguistic attributes through textual enhancement in visual input (e.g. italics, bold) or through phonological manipulations in aural input (i.e. oral repetition) [8].

The three text layers of a document or the text-signals play important roles during the reading of a document: (a) direct the reader's attention, (b) enable specific cognitive processes, (c) facilitate the comprehension of text information, (d) in some cases, influence the memory on text, and (e) direct selective access between and within texts [2].

The use of the typographic elements denotes a number of associated semantics. W3C has introduced unique labels for each of the font-styles bold and italics [9]. But, it has been found that readers use at least eight semantics to characterize bold and italics in a text document [10].

Accessibility of documents for persons with disabilities can be achieved by Text-to-Speech systems [11]. Screen-readers and braille displays constitute common technology for the visually impaired to access the content of a document or the Web [12–14]. Although text-signals are important to the reader, most of the current Text-to-Speech (TtS) systems essentially use documents in plain text [12]. Recently, there is an effort toward the acoustic mapping of visual text-signals through advanced Text-to-Speech systems called Document-to-Audio (DtA) [15]. For the typography layer, two approaches for rendering document signals to auditory modality have been incorporated in DtA: (a) direct mapping and (b) emotional-based mapping [16, 17].

As there is a lack of studies on how blind perceive text-signals and, on the other hand, targeting to incorporate much more efficiently the text-signals in DtA, in this work we explore in a systematic way the perception of the main typographic text-signals of a document by blind and sighted students.

2   Methodology

Of the 73 students who took part in the study, 47 were sighted and the other 26 were congenitally blind, users of braille, who became blind during the first years of their life and did not have a visual memory of the alphabet. The students who were sighted ranged in age from 11 to 16, and the students who were blind ranged in age from 10 to 17.

A research protocol was used in the study consisting of a questionnaire. Questions were presented individually for each participant in a closed-ended or open-ended format on printed paper for the sighted students and in braille for the blind. Participants responded orally with one or more answers for each one of the questions and the researcher was recording them.

3   Results

Question 1: Textbooks include words or phrases in different font sizes from the main text. Why do you think it is useful to have several font-sizes? (Fig. 1).
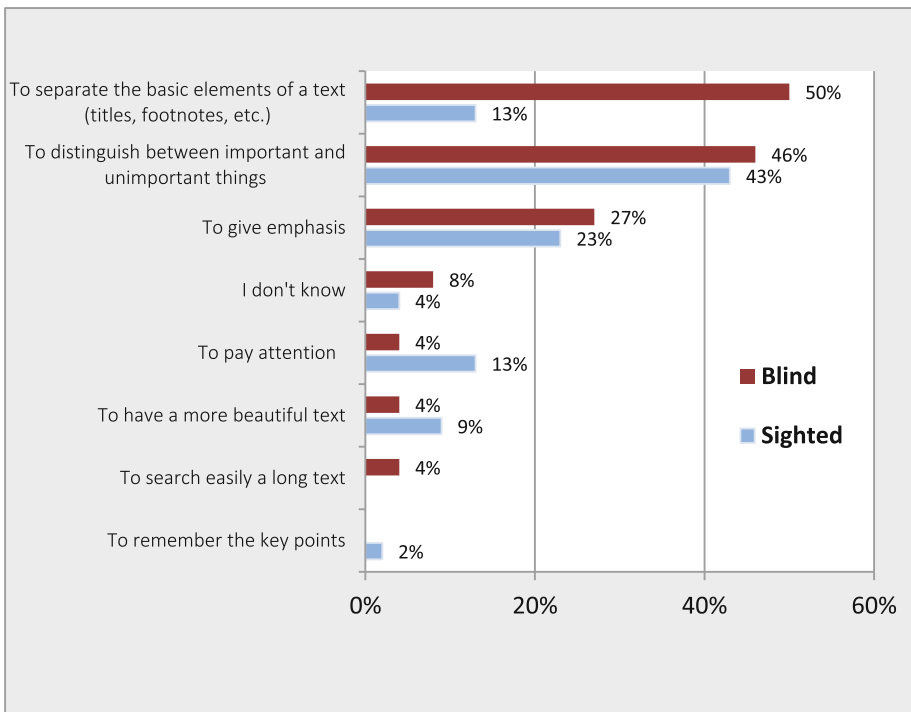

Fig. 1. Answers to Question 1 on the perception of font-size by the blind and sighted students (Color figure online)

Figure 1 shows that half of the blind participants consider that font-size plays an important role in separating the basic elements of a text (e.g. titles, footnotes), but only 13 % of the sighted believe the same. Moreover, 46 % of the blind and 43 % of the sighted participants answered that font-size is used to distinguish between important and unimportant things in a text. Both the groups of the students show almost equally that the third significant role of font-size is to give emphasis to the specific word or phrase.

Question 2 *(for the sighted participants)*: Textbooks include words or phrases in bold, italics or bold-italics. Why do you think it is useful to have these various font-styles?
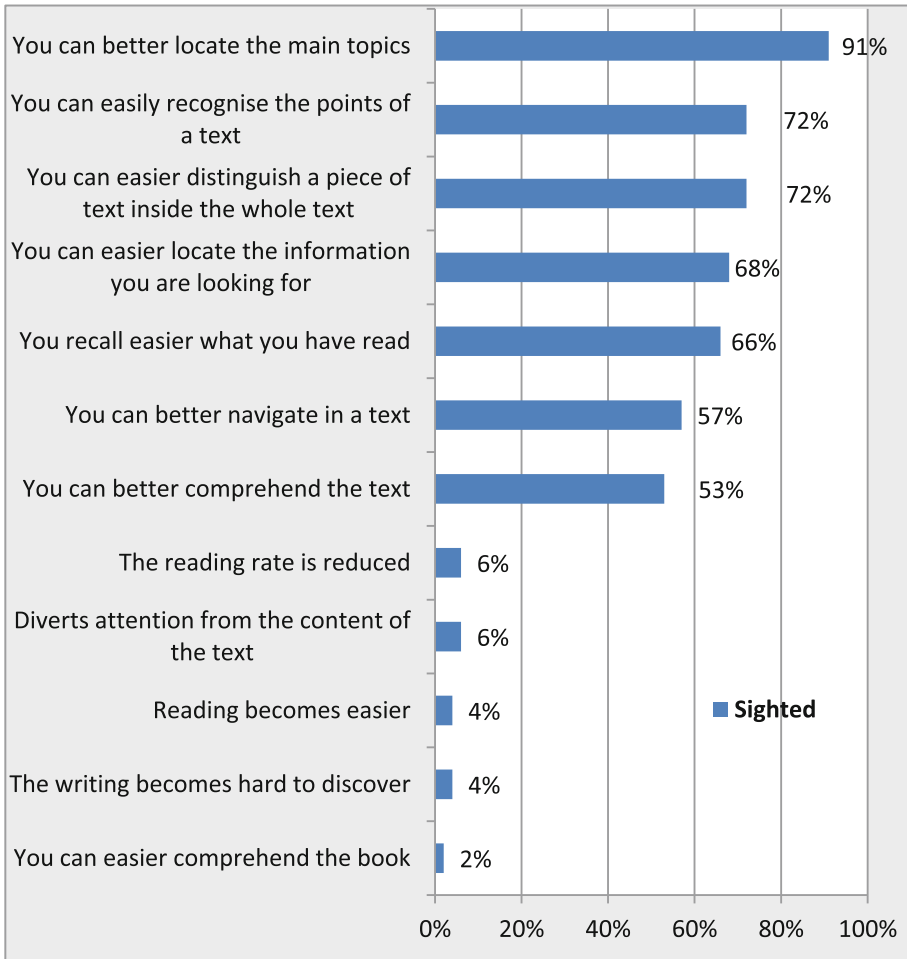

Fig. 2. Answers to Question 2 on the perception of font-styles by the sighted students

The results in Fig. 2 indicate that a significant number (91 %) of the sighted participants consider that font-style plays an important role to better locate the main topics in a text. 72 % of them believe that it helps to easily recognise the points of a text or to

distinguish a piece of text inside the whole text. Other significant roles of font-style include the easy location of the information you are looking for (68 %), the easy recall of what you have read (66 %), better navigation in a text (57 %) and better text comprehension (53 %).

Question 3 *(for the blind participants)*: You have heard that text for the sighted people include different styles of characters, such as bold, italics and bold-italics. Why do you think it is useful to have these various font-styles?

35 % of the blind participants (Fig. 3) consider that font-style is used to distinguish some elements of the text or to grab the eye and 27 % to give emphasis at a specific point.
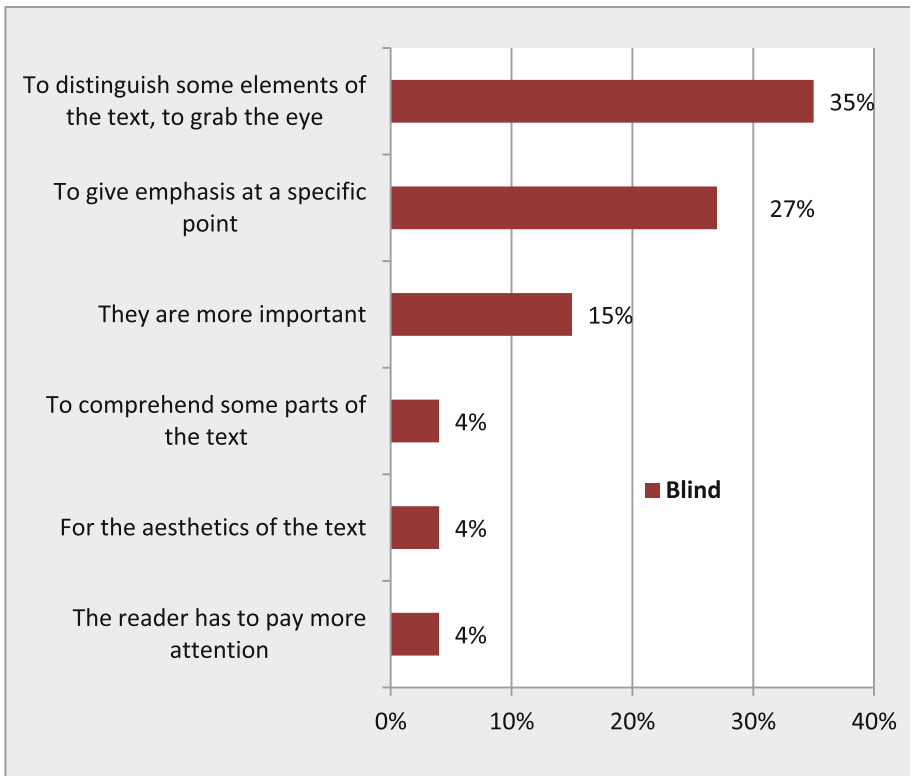

Fig. 3. Answers to Question 3 on the perception of font-style by the blind students

Question 4 *(for the sighted participants)*: What means for you a word or a phrase in bold within a text?

From the results presented in Fig. 4 we see that most of the sighted participants (68 %) consider that the bold font-style is used to indicate an important word or phrase in the text that needs more attention by the reader. Some of them (17 %) believe that the role

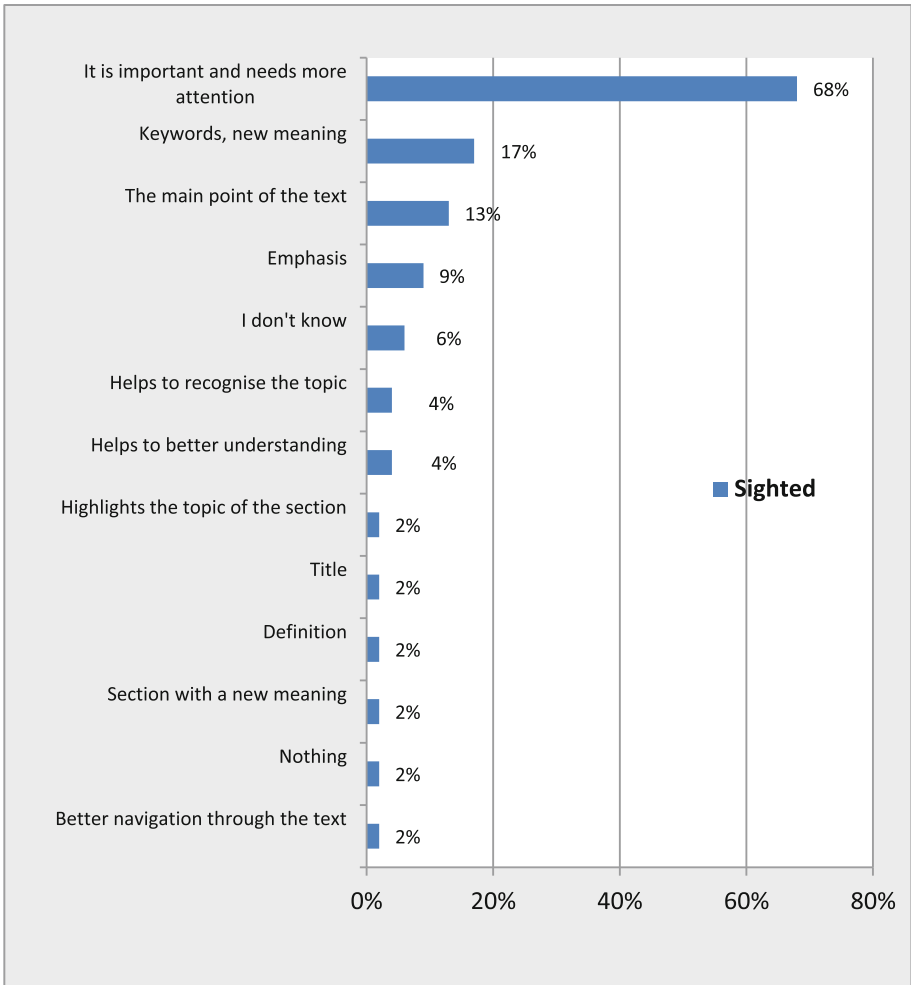of the bold is to indicate keywords or new meanings and some (13 %) for the key points of the text.

Fig. 4. Answers to Question 4 on the perception of the bold font-style by the sighted students

Question 5 *(for the sighted participants)*: What means for you a word or a phrase in italics within a text?

For the sighted participants (Fig. 5), there is not a dominant view on the perception of the italics font-style in a text. They answered a word or a phrase in italics means that: is important and needs more attention (23 %), is a definition or it is not so important (15 %), it shows a light emphasis (13 %) or it provides additional information (11 %).
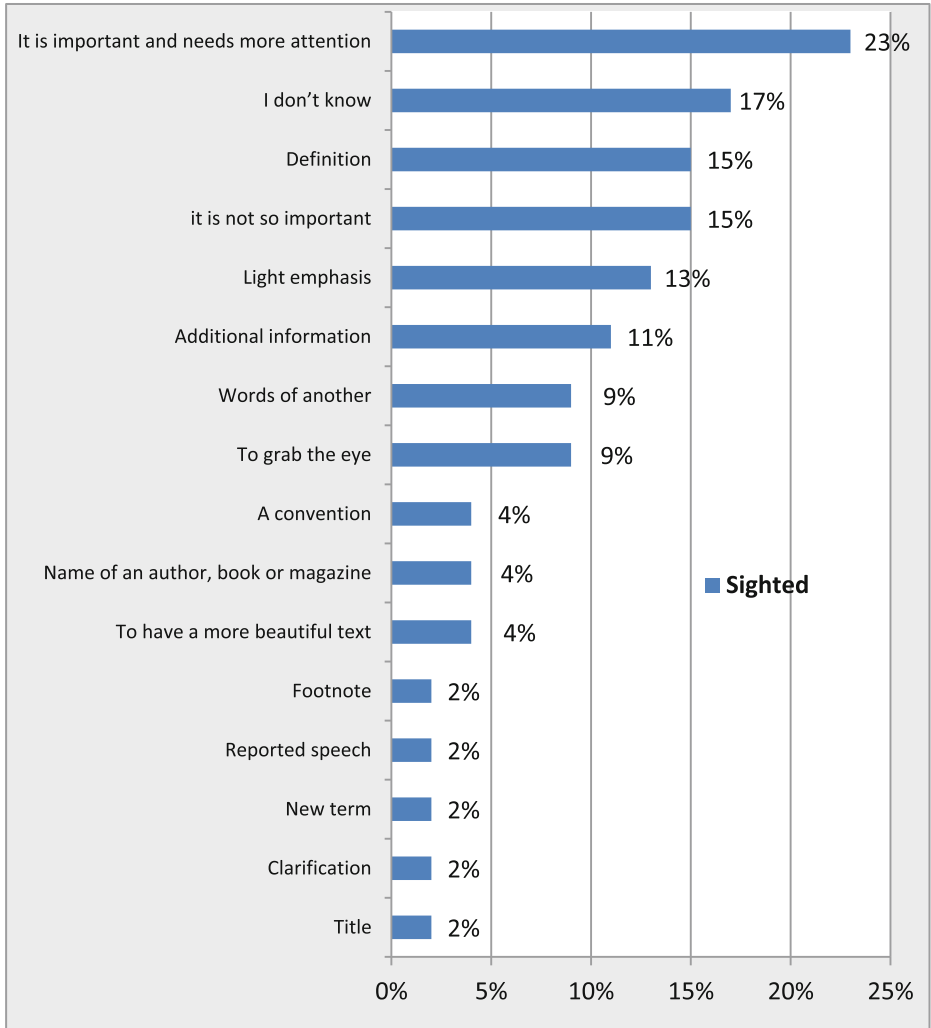
Fig. 5. Answers to Question 5 on the perception of the italics font-style by the sighted students

Question 6: How you recognize the title of a text?

The results (Fig. 6) show that the sighted and blind students recognize the titles of a text mainly using non-identical criteria, but also there are some common ones.

The sighted participants recognize a title mainly from the font features of its characters:

- the bold font-style is the dominant characteristic (83 %) and
- more than half of the students (53 %) from the large font-size.

In contrast, the blind participants recognize a title mainly because:

- it is separated by one or two lines from the main text (81 %) or
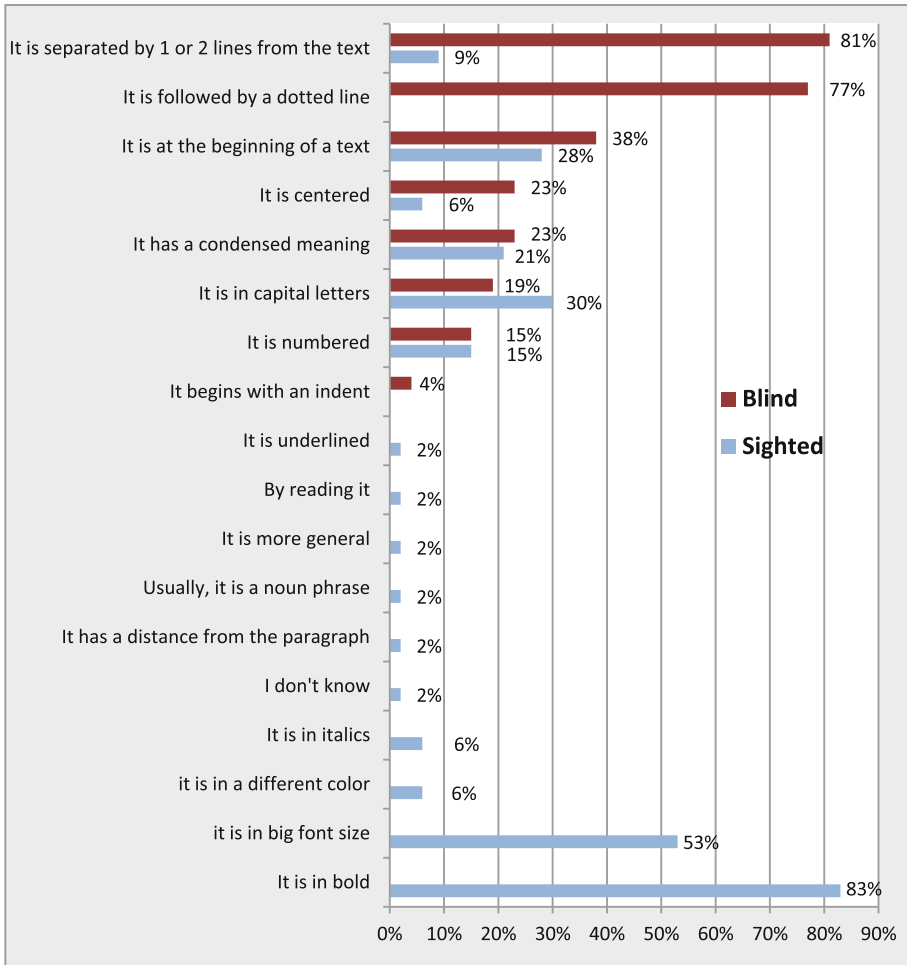- it is followed by a dotted line (77 %).

Fig. 6. Answers to Question 6: "How you recognize the title of a text?" (Color figure online)

4   Conclusion

In this study, we explored the ways blind and sighted students perceive the main typographic text-signals and how they recognize headings in a document.

Both groups of the participants perceive that the font-styles are used largely to better locate, recognize or distinguish the topics or specific information in a document, but only a few of the blind (4 %) to ask the reader to pay more attention. Almost half of the sighted argue that they are useful for the comprehension of the content, but only 4 % of

the blind students perceive the same. Most of the sighted participants (68 %) consider that bold is used to indicate an important word or phrase in the text that needs more attention by the reader, but only 23 % of them perceive the same for the italics.

27 % of the blind participants and 23 % of the sighted perceive that the role of font-size is to provide emphasis. Moreover, only 9 % of the sighted students grasp that bold is used for emphasis and 13 % of them that italics is used for light emphasis.

Half of the blind participants consider that font-size plays an important role in separating the basic elements of a text (e.g. titles, footnotes), but only 13 % of the sighted believe the same.

The results show that the sighted and blind students recognize the titles of a text mainly using non-identical criteria. The sighted use mainly bold and font-size, but the blind use line separation or a dotted line that follows.

In our future work, we plan to extend the current study by including more text-signals.

References

1. Kouroupetroglou, G., Tsonos, D.: Multimodal accessibility of documents. In: Pinder, S. (ed.) Advances in Human-Computer Interaction, pp. 451–470. I-Tech Education and Publishing, Vienna (2008)
2. Lorch, R.F.: Text-signaling devices and their effects on reading and memory processes. Educ. Psychol. Rev. **1**, 209–234 (1989)
3. Lemarié, J., Eyrolle, H., Cellier, J.M.: Visual signals in text comprehension: how to restore them when oralizing a text via a speech synthesis? Comput. Hum. Behav. **22**, 1096–1115 (2006)
4. Lorch, R.F., Chen, H.T., Lemarié, J.: Communicating headings and preview sentences in text and speech. J. Exp. Psychol. Appl. **18**, 265–276 (2012)
5. Spyridakis, J.H.: Signaling effects: a review of the research—Part I. J. Tech. Writ. Commun. **19**, 227–240 (1989)
6. Lemarié, J., Lorch, R.F., Eyrolle, H., Virbel, J.: SARA: a text-based and reader-based theory of text signaling. Educ. Psychol. **43**, 27–48 (2008)
7. Lorch, R.F., Lemarié, J., Grant, R.A.: Signaling hierarchical and sequential organization in expository text. Sci. Stud. Read. **15**, 267–284 (2011)
8. Han, Z.H., Park, E.S., Combs, C.: Textual enhancement of input: issues and possibilities. Appl. Linguist. **29**, 597–618 (2008)
9. W3C: The World Wide Web Consortium. http://www.w3.org
10. Fourli-Kartsouni, F., Slavakis, K., Kouroupetroglou, G., Theodoridis, S.: A Bayesian Network Approach to Semantic Labelling of Text Formatting in XML Corpora of Documents. In: Stephanidis, C. (ed.) Universal Access in HCI, Part III, HCII 2007. LNCS, vol. 4556, pp. 299–308. Springer, Heidelberg (2007)
11. Fellbaum, K., Kouroupetroglou, G.: Principles of electronic speech processing with applications for people with disabilities. Technol. Disabil. **20**, 55–85 (2008)
12. Freitas, D., Kouroupetroglou, G.: Speech technologies for blind and low vision persons. Technol. Disabil. **20**, 135–156 (2008)

13. Isaila, N., Smeureannu, I.: The access of persons with visual disabilities at the scientific content. WSEAS Trans. Comput. **9**, 788–797 (2010)
14. Pavel, O.: Automatic system for making web content accessible for visually impaired users. WSEAS Trans. Comput. Res. **1**, 325–328 (2006)
15. Kouroupetroglou, G.: Acoustic mapping of visual text signals through advanced text-to-speech: the case of font size. WSEAS Trans. Comput. **14**, 559–569 (2015)
16. Tsonos, D., Kouroupetroglou, G.: Modeling readers' emotional state response on documents' typographic elements. Adv. Hum. Comput. Interact. **2011**, 1–18 (2011). doi: 10.1155/2011/206983
17. Tsonos, D., Kouroupetroglou, G., Deligiorgi, D.: Regression modeling of reader's emotions induced by font based text signals. In: Stephanidis, C., Antona, M. (eds.) UAHCI/HCII 2013, Part II. LNCS, vol. 8010, pp. 434–443. Springer, Heidelberg (2013)