Exploring Satisfaction Towards Web Text Reading Among Dyslexic and Normal Learners

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***Abstract*—The study aims to investigate the difference in satisfaction levels between normal and dyslexic learners when presented with various web text modes. Due to the high percentage of web users who exhibit some traits of dyslexia, presenting a web text that follows the guidelines which are meant for normal users poses challenges to dyslexic users. Acknowledging the ubiquitous use of the web for learning and the massive availability of text on the web as well as the significant number of dyslexic learners, this investigation intends to derive appropriate guidelines for displaying web text that could accommodate both normal and dyslexic learners. This qualitative study employs a multiple case study design and data are mainly collected via observation and guided interviews. The study reveals that existing dyslexia-friendly text guidelines are also appropriate for normal learners and contrary to the popular belief that assistive technology such as screen readers are helpful in reading, reading text aloud does not always work for both dyslexic and normal learners.**

***Index Terms*—web text reading, inclusive guidelines, screen reader, dyslexia-friendly**

I. Introduction

The definition and concept of dyslexia can be described in many ways. Some are based on medical models, while others are centered on the educational impact and the possible causes of dyslexia [1]. Literally, the word dyslexia is derived from Greek words, 'Dys' means poor or inadequate and 'Lexis' means words or language [2], [3]. It is more comprehensively defined as a specific learning disability which affects the development of literacy and language related skills which can hinder a person's ability to perform language-related tasks such as word recognition, reading, writing, spelling, reading comprehension and sometimes speaking [4], [5]. Dyslexia is often misconstrued as a person with poor intelligence, sluggishness or a result of impaired vision [6]. However, [7] and [8] stated that many people with this disability have average or above average intelligence and generally not linked to low intelligence.

To date, a number of guidelines are recommended to facilitate reading among people with dyslexia. For example, considering the visual stress experienced by dyslexics, [9] publishes a set of guidelines for creating dyslexia friendly text and similar guidelines are also published by [10].

Numerous web text guidelines to cater the needs of normal users are also available, for example those by [11] and [12]. There are also inclusive recommendations on web text formatting that move beyond typical users to include users of all ages, experience levels, and physical or sensory limitations such as those proposed by [13] and Web Content Accessibility Guidelines (WCAG) that provide technical standards on how to make web content more accessible to people with disabilities [14]. According to [15], most of such inclusive recommendations consider diverse group of physical and cognitive disabilities instead of focusing on the specific needs of people with dyslexia.

Existing guidelines for web text accessibility focus either solely for dyslexia, normal or diverse (normal and all other types of disabilities and differences) web users. Minimal effort is known on deriving inclusive web text accessibility guidelines that are appropriate only for normal people and people with dyslexia. This study aims to yield guidelines that afford web text reading for both dyslexic and normal learners by exploring their satisfaction toward different web text modes.

II. Methodology

This qualitative study employed a multiple case study design. It involved twelve dyslexic secondary school students (7 female, 5 male) as well as 12 normal secondary school students (8 female, 4 male), with their ages ranging from 14 to 18 years old. Data were collected by observing participants' behavior and their facial expression when using each of the web text modes as well as via guided interview sessions.

A. Web Text Modes

This study involved the use of three web text modes, named as Control, Standard and Enhanced. Each mode consisted of a reading passage. Table I shows the differences and similarities between these modes. In the Control mode, the passage was presented using the layout and typefaces that are similar to those commonly found in a conventional printed book. As for the Standard mode, the passage was presented based on some dyslexia-friendly text guidelines as suggested by [9]. The Enhanced mode was similar to the Standard mode except

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with the addition of a screen reader to read the web text aloud.

TABLE I. CHARACTERISTICS OF THE WEB TEXT MODES

Control	Paragraph form, justified alignment, single spacing, serif font type, font size (12-14 point), black font on white background
Standard	Bulleted points, left justified, 1.5 line spacing, sans serif font type, font size (16-18 point), black font on beige background
Enhanced	Bulleted points, left justified, 1.5 line spacing, sans serif font type, font size (16-18 point), black font on beige background, screen reader

B. Instrument

Satisfaction is one of the major aspects used to evaluate learning effect. To ensure the validity of this construct, various literatures were reviewed to derive relevant questions for the interview guide which was used in the study. Satisfaction is found to be positively affecting students' behavioral intention to participate in online learning and such behavioral intention is highly correlated with learning effectiveness [16]. Questions to reveal the satisfaction of participants check whether the experience with the web text modes produces positive feelings and attitudes [17], willingness to focus when learning [17], management of emotions [17] [18], management of behavior [17], perceived usefulness and ease of use [19]-[21], [18], [22], learning motivation, and learning interest [17].

C. Procedures

Each participant was involved in three separate evaluation sessions. All these sessions were video-recorded. The participant was required to read the passage in each mode, followed by an interview guided by questions which were derived earlier on. The researchers also recorded all pertinent observations.

III. FINDINGS AND DISCUSSION

Table II shows the key satisfaction patterns that emerged from the data analysis.

TABLE II . KEY SATISFACTION PATTERNS FOR CONTROL, STANDARD AND ENHANCED MODES

Modes	Group	Satisfaction
Control	Dyslexic	Moderate and Low
	Normal	Moderate
Standard	Dyslexic	High
	Normal	High
Enhanced	Dyslexic	Excellent, Moderate and Low
	Normal	Excellent and Moderate

A. Control Mode-Low Satisfaction (Dyslexic)

Referring to Table II, based on the questions that focus on participants' willingness to focus when learning, it was found that most dyslexic participants regarded this Control mode as unattractive. Six of the dyslexic participants also expressed low satisfaction toward the easiness to read the passage. Sample comments include "*The passage is lengthy…small font, unattractive color and boring" and* "*Design looks boring and words are too small".*

Some dyslexic participants also reported negative emotion as they thought the passage made them nervous, confused, uncomfortable, and the passage was perceived as difficult to read. Among the reasons given include "*Words move around makes me feel very nervous" and "Difficult to read because black on white"* which are related to the use of black font on white background as well as "*Very lengthy… need to read and stop frequently"," I feel lost because of the long sentences", "I am scared of reading wrongly" and "Confused and stressed in identifying main points"*, which are related to the use of paragraph form. Hence, these participants are classified as having low satisfaction.

B. Control Mode-Moderate Satisfaction (Dyslexic, Normal)

Most normal participants also thought the Control mode as unattractive. Half of the normal participants reported minor dissatisfaction as small font size caused some reading discomfort and lengthy sentences caused some confusion. These affect their satisfaction in terms of their emotion, behavior as well as perceived ease of use. However, the remaining normal participants and about half of the dyslexic participants reported this reading mode as not causing any discomfort, confusion and anxiety to them. Familiarity to such information presentation, which is often found on typical printed books, may explain their positive emotion and behavior towards this mode. Although some favorable comments were collected on this aspect, these participants are classified as having moderate satisfaction because they have the least satisfaction towards this mode when compared to the other two modes.

Reference [23] and [24] are among others who raised concerns over the direct application of standards used in printed sources for screen text. This finding provides evidence on the undesirable effect resulted by such application. An examination into the brain activities using EEG by [25] reveals that their subjects' parietal lobes show tighter beta activity which indicates greater cognitive load when reading text on screen as compared to the similar printed text. According to them, the light from the screen that shines into the eye possibly causes this problem as parietal lobes are responsible for processing luminance.

C. Standard Mode-High Satisfaction (Dyslexic, Normal)

All participants reported satisfaction towards this reading mode. The reading passage was able to attract them to focus on it. They also did not experience nervousness and discomfort during the reading experience. Some of the comments include "*I feel comfortable because can read myself"* and "*Easy to follow".*

In terms of perceived ease of use, participants also reported their reading as not difficult due to bigger font size and highlighted keywords. Dyslexic participants also highlighted the absence of 'dancing words' which eased their reading to a comfortable level. The passage for this

Standard mode was presented using black text on beige background, which produces lower contrast comparing to the black on white setting used in the Control mode. This finding further supports earlier work such as [26] who reported higher reading comfort for dyslexics when reading using settings that have lower contrast both in luminance and color.

D. Enhanced Mode - Excellent Satisfaction (Normal, Dyslexic)

Four dyslexic participants and eight normal participants reported excellent satisfaction towards the Enhanced mode. As compared to the Control and Standard modes, these participants made a firm preference towards the Enhanced mode. They perceived the screen reader as useful and would gladly use it for future web reading. The screen reader was regarded as successfully attracted them to focus on the passage. The screen reader did not cause them to feel nervous, discomfort or confused but rather eased their reading and understanding. A dyslexic participant commented "*The sound helps me in remembering the passage…it is easiest to read with the screen reader…easy to follow through the passage without the need to stop*". A normal participant further commented, "*It sounds like my teacher teaching*".

Screen reader is an assistive technology tool recommended to help individuals who struggle with reading as it facilitates decoding, reading fluency, and comprehension [27], [28]. This tool accesses a dyslexic's listening capability and enables him/her to gain knowledge from an auxiliary source [28]. Reference [29] who studied on computer-based readers found that 70% of 28 middle school dyslexic students read with greater comprehension when using such readers and concluded that computer readers are important compensatory aids that enable dyslexics to perform more effectively in reading-related tasks. Many existing literature such as [30] [31]-[37] as well as [38] highlight the use of screen reader among people with disabilities which include learning disabilities, blind and visually impaired. As majority of the normal participants in this study also indicated their strong preference toward this mode, the screen reader is also deemed appropriate for this group of learners.

E. Enhanced Mode-Moderate Satisfaction (Normal, Dyslexic)

Analysis of data also revealed another subgroup of dyslexic participants who are classified as having moderate satisfaction. Two participants, who generally preferred the Standard mode, opted for the Enhanced mode if the reading passage was presented in English, a language in which they were not proficient in. These two participants highlighted the benefit of the screen reader in aiding their understanding of the English passage compared with self-reading. According to [39], unable to make sense of language is one of the problems reported by dyslexic web users. Thus, the findings from this study point to the potential of the screen reader in alleviating this problem.

Another dyslexic participant chose this Enhanced mode over the Standard mode only when she was given the option to control the reading speed and play/pause function of the screen reader. As shown in the experiment done by [40], the reduced attention span of the dyslexic group is due to the slowing of the visual perceptual processing speed. The speed of reading the passage, which involves visual perceptual processing, needs to be coherent with the audio processing. Giving screen reader control option enables the speed for both processing to be adjusted accordingly. On the other hand, none of the normal participants commented on the needs for such control. A normal participant mentioned that she preferred female voice while another one preferred her teacher's voice. Another three normal participants also commented on the audio distraction caused by the screen reader but still thought this affordance is better than the Control mode. Thus, they are classified as having moderate satisfaction.

F. Enhanced Mode- Low Satisfaction (Dyslexic)

Generally, those who were satisfied with the Enhanced mode thought the audio attracted their attention and helped much in their reading. The use of audio allows these participants to access knowledge using an auxiliary source via listening [41]. However, four dyslexic participants found the audio to be distracting. They are categorized as having low satisfaction as they reported their incapability to cope with both reading and listening at the same time and would not opt for such reading affordance.

IV. Conclusion

The low satisfaction toward the Control mode among the dyslexic participants implies the unsuitability of using text layout used in the conventional printed book for web text reading. Receiving the least satisfaction toward this mode, comparing to the other two modes, by normal learners leads to similar implication. This finding provides evidence on the risk of direct application of standards used in printed text for web text.

The Standard mode was designed based on dyslexia-friendly text guidelines. High satisfaction toward this mode by both groups of learners points to two important implications. Firstly, this finding provides empirical evidence on the appropriateness of using these guidelines among dyslexics as according to [15], many existing web accessibility guidelines for dyslexic users are not empirically derived. Secondly, high satisfaction among normal learners also indicates their acceptance toward web text that was designed using dyslexia-friendly guidelines. Hence, these guidelines are inclusive for these two major groups of online learners.

The distinct differences on the level of satisfaction for the Enhanced mode, ranging from excellent to low satisfaction, implies that the use of a screen reader does not fit all normal and dyslexic learners. While a screen reader may serve as an excellent reading aid for some learners, others found it distracting. Many existing guidelines, such as those suggested by [9] and [14]

recommend the use of screen readers to assist reading among the disabled. This finding suggests the use of screen readers may not necessarily aid reading among dyslexics. In addition, excellent satisfaction among some normal learners also indicates the potential to harness the benefits of screen readers among normal learners even though screen readers are often only recommended for dyslexics.

This study concludes that dyslexia-friendly text guidelines, limited to those used in the Standard mode, are appropriate to be incorporated into the inclusive guidelines for presenting web text to both dyslexic and normal learners. Making screen readers as an optional aid for reading web text is another inclusive guideline as this assistive technology greatly benefits some dyslexic and normal learners but not others. This study could be further extended to derive more robust inclusive guidelines by examining dyslexic and normal learner's perceived learning as well as cognitive and affective engagement toward these different web reading modes.

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REFERENCES

[1] University of Leicester. *What is dyslexia and how can it be recognized?* [Online]. Available: http://www2.le.ac.uk

[2] Dyslexia. *Mosby's Medical Dictionary, 8th edition*. (2009). [Online]. Available: http://medical-dictionary.thefreedictionary.com/Dyslexia

[3] B. A. Shaywitz, S. E. Shaywitz, B. A. Blachman, K. R. Pugh, *et al.*, "Development of left occipitotemporal systems for skilled reading in children after a phonologically-based intervention," *Biological psychiatry*, vol. 55, no. 9, pp. 926-933, 2004.

[4] British Dyslexia Association. (2005). *Dyslexia research information*. [Online]. Available: http://www.bdadyslexia.org.uk/about-dyslexia

[5] E. K. Washburn, E. S. Binks-Cantrell, and R. Joshi, "What Do Preservice Teachers from the USA and the UK Know about Dyslexia?" *Dyslexia*, vol. 20, no. 1, pp. 1-18, 2014.

[6] E. Lapkin. (2014). *What is dyslexia*? [Online]. Available: https://www.understood.org

[7] A. Marshall. (2004). *Cognitive development and mental retardation*. [Online]. Available: http://www.netplaces.com/parenting-kids-with-dyslexia

[8] National Institutes of Health. (2011). *NIH-funded study finds dyslexia not tied to IQ.* [Online]. Available: http://www.nih.gov/news/health/nov2011/nichd-03.htm

[9] British Dyslexia Association. (2005). *Dyslexia Style Guide*. [Online]. Available: http://www.bdadyslexia.org.uk/about-dyslexia/further-information/dyslexia-style-guide.html

[10] Dyslexia Association of Ireland. *Making information accessible-Dyslexia-friendly style guide.* [Online]. Available: http://www.dyslexia.ie/information

[11] J. Nielsen, (2003). Usability 101: Introduction to usability. [Online]. Available: http:// www.didattica.uniroma2.it

[12] International Organization for Standardization, Ergonomics of Human-System Interaction. Part 151: Guidance on World Wide Web user Interfaces, International standard ISO 9241-151: 2008. Switzerland.

[13] P. J. Lynch and S. Horton, *Web style guide: Basic design principles for creating Web sites*, Yale University Press, 2008.

[14] World Wide Web Consortium. (2008). Web content accessibility guidelines (WCAG) 2.0. [Online]. Available: http://www.w3.org/WAI/intro/wcag

[15] J. E. McCarthy and S. J. Swierenga, "What we know about dyslexia and Web accessibility: A research review," *Universal Access in the Information Society*, vol. 9, pp. 147-152, 2010.

[16] S. S. Liaw, "Investigating students' perceived satisfaction, behavioral intention, and effectiveness of e-learning: A case study of the Blackboard system," *Computers & Education*, vol. 51, no. 2, pp. 864-873, 2008.

[17] Y. J. Lee, "A study of the influence of instructional innovation on learning satisfaction and study achievement," *The Journal of Human Resource and Adult Learning*, vol. 4, no. 2, pp. 43-54, 2008.

[18] P. C. Sun, R. J. Tsai, G. Finger, Y. Y. Chen, and D. Yeh, "What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction," *Computers & Education*, vol. 50, no. 4, pp. 1183-1202, 2008.

[19] J. B. Arbaugh and R. Duray, "Technological and structural characteristics, student learning and satisfaction with web-based courses: An exploratory study of two on-line MBA programs," *Management Learning*, vol. 33, no. 3, pp. 331–347, 2002.

[20] C. Gardner and D. L. Amoroso, "Development of an instrument to measure the acceptance of internet technology by consumers," in *Proc. 37th Annual Hawaii International Conference on System Sciences*, January 2004, pp. 10.

[21] O. Isik, "E-learning satisfaction factors," in *Proc. 39th Annual Meeting of the Decision Sciences Institute*, Baltimore 2008, pp. 941-946.

[22] J. P. Wu, R. J. Tsai, C. C. Chen, and Y. C. Wu, "An integrative model to predict the continuance use of electronic learning systems: Hints for teaching," *International Journal on E-Learning*, vol. 5, no. 2, pp. 287–302, 2006.

[23] P. A. Kolers, R. L. Duchnicky, and D. C. Ferguson, "Eye movement measurement of readability of CRT displays," *Human Factors: The Journal of the Human Factors and Ergonomics Society*, vol. 23, no. 5, pp. 517-527, 1981.

[24] R. S. Grabinger and D. Amedeo, "CRT text layout: Perceptions of viewers," *Computers in Human Behavior*, vol. 4, no. 3, pp. 189-205, 1988.

[25] J. Geske and S. Bellur, "Differences in brain information processing between print and computer screens: Bottom-up and top-down attention factors," *International Journal of Advertising*, vol. 27, pp. 399-423, 2008.

[26] P. Gregor, A. Dickinson, A. Macaffer, and P. Andreasen, "See Word—a personal word processing environment for dyslexic computer users," *British Journal of Educational Technology*, vol. 34, no. 3, pp. 341-355, 2003.

[27] Great Schools. (2008). Assistive technology: A parent's guide [Online]. Available: http://www.disabilityrightsca.org/pubs/Assistive_Technology_Parents_Guide.pdf

[28] S. E. Shaywitz and B. A. Shaywitz, "Dyslexia and reading disorders," *Psychopathology of Childhood and Adolescence: A Neuropsychological Approach*, vol. 127, 2012.

[29] J. Elkind, K. Cohen, and C. Murray, "Using computer-based readers to improve reading comprehension of students with dyslexia," *Annals of Dyslexia*, vol. 43, no. 1, pp. 238-259, 1993.

[30] M. C. Buzzi, M. Buzzi, and B. Leporini, "Accessing e-learning systems via screen reader: An example," in *Human-Computer Interaction*, 2009.

[31] S. Chandrashekar, "Is hearing believing? Perception of online information credibility by screen reader users who are blind or visually impaired," Doctoral dissertation, University of Toronto, 2010.

[32] L. Evett and D. Brown, "Text formats and web design for visually impaired and dyslexic readers—Clear Text for All," *Interacting with computers*, vol. 17, no. 4, pp. 453-472, 2005.

[33] M. Hersh, "Evaluating ICT based learning technologies for disabled people," in *Computers Helping People with Special Needs*, Springer International Publishing, 2014, pp. 315-322.

[34] J. Kiraly and P. M. Ridge, U.S. Patent No. 6,324,511, Washington, DC: U.S. Patent and Trademark Office, 2001.

[35] J. Lazar, A. Allen, J. Kleinman, and C. Malarkey, "What frustrates screen reader users on the web: A study of 100 blind users," *International Journal of Human-Computer Interaction*, vol. 22, no. 3, pp. 247-269, 2007.

[36] B. Leporini and F. Paternò, "Increasing usability when interacting through screen readers," *Universal Access in the Information Society*, vol. 3, no. 1, pp. 57-70, 2004.
[37] M. H. Raskind and E. L. Higgins, "Assistive technology for postsecondary students with learning disabilities an overview," *Journal of Learning Disabilities*, vol. 31, no. 1, pp. 27-40, 1998.
[38] E. F. Wies, M. S. O'Modhrain, C. J. Hasser, J. A. Gardner, and V. L. Bulatov, "Web-based touch display for accessible science education," in *Haptic Human-Computer Interaction*, Springer Berlin Heidelberg, 2001, pp. 52-60.
[39] A. P. Freire, H. Petrie, and C. Power, "Empirical results from an evaluation of the accessibility of websites by dyslexic users," in *Proc. Workshop on Accessible Design in the Digital World*, Lisboa, Portugal, 2011, pp. 41-53.
[40] P. Stenneken, J. Egetemeir, G. Schulte-Körne, H. J. Müller, W. X. Schneider, and K. Finke, "Slow perceptual processing at the core of developmental dyslexia: A parameter-based assessment of visual attention," *Neuropsychologia*, vol. 49, no. 12, pp. 3454-3465, 2011.
[41] J. G. Schoeberlein and Y. K. Wang, "Groupware accessibility for persons with disabilities," in *Universal Access in Human-Computer Interaction, Applications and Services*, Springer Berlin Heidelberg, 2009, pp. 404-413.

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