Advancing web accessibility to be more dyslexia-friendly

Joni Wing-Yan Mok[1]

Abstract

Access to web content continues to be a challenge for the dyslexics or other visually impaired users. Many designers build websites without considering Web Content Accessibility Guidelines (Ferati, Vogel, Kurti, Raufi, and Astals, 2016). Hence, how can we improve the web accessibility for these users? The following pages explore this question through User Experience (UX) methodology and process with combination of graphic design principles.

The areas of user testing included:
- How colours and shapes affect users' visual perception, attention and reading experience?
- How typefaces change users' reading experience?

This paper also opens further discussion with possibilities of exploring the connection in playful experience, attention, and memory.

Introduction

Students coming to school with curiosity and a strong desire to learn found that fire quenched when they were stigmatised - not because of anything that was in their control but because of the inaccessible learning environment (Meyer, Rose, and Gordon, 2014). With the increased portability and wide adoption of diverse web content have resulted in the fact that computers are not anymore perceived as distinct technological objects, but more as integrated tools to support our everyday activities, including e-Learning (Sheth, 2010). Dyslexic students feel frustrated when they are required to read out loud in class (Midttømme, 2018). Due to their cognitive problems in decoding written language, many dyslexics will confuse similar words so that "CAT" may be confused with "ACT". Although dyslexia affects a large percentage of the population, it manifests in a variety of ways, such that one person might find his or her dyslexia makes reading mildly difficult while another struggles with even the simplest of sentences.

Statistics differ on the percentage of the population that has dyslexia. The British Dyslexia Association claims 10% of the population is dyslexic while the Norwegian Dyslexia Association claims it could be only 5 - 10% and the Danish Dyslexia Association claims to be 3-7%. Regardless of the exact number, the fact remains that this is an enormous number of people.

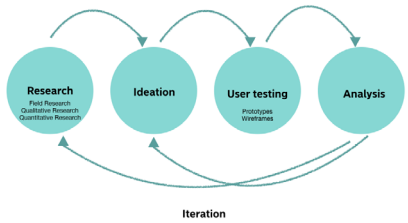

Figure 1

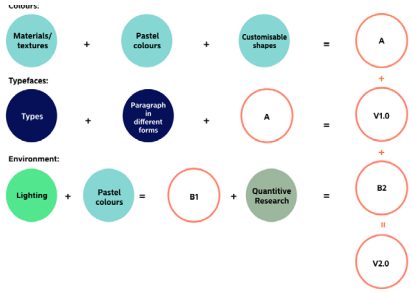

Figure 2

Figure 3

Figure 4

Figure 5

Video: (https://www.youtube.com/watch?v=9GWqqWxr6Fw)

Methodology and Process

In User Experience Design (UXD), we start with research, as the image illustrated in *figure 1*, we do both qualitative (e.g. interviews) and quantitative (online survey) research, and with relevant ethnological field research (in this project, visual perception, interface design and cognitive disabilities were the main field research focus). In the meanwhile, ideation and prototype development happen, with possible user testing. Upon test analysis, the design process may either go further or step back to research stage. Hence, UXD method-ology and process are iterative.

Experiments (*figure 2*)

During the five-week project, I began implementing existed products for dyslexic users, such as colour filters (Crossbow Education, 2015), by testing with different materials (e.g. matt and gloss surfaces) and various of colours (e.g. purple, blue and yellow). Users were asked to customise a shape that could possibly be memorable to them (*figure 3 and 4*). Based on the result from the colour test, I combined it with typeface experiment (Open Dyslexia, Fabada, Ubuntu, Apercu, OCR) in which a reading device plugin (*figure 5*) was prototyped. In this first digital prototype, users could change the typefaces, colours on the screen, and turn the paragraph into different shapes. Unlike rectangular paragraphs, this plugin allowed users to change the structure of paragraphs (e.g. circular, square). Upon analysis from the tests, a step back to quantitative research was the case. During this research, 50 participants from Facebook were asked to pick a combination of text and background colours in which they found most comfortable with. 67% were non-dyslexics and 33% were dyslexics (*figure 6 and 7*). A lighting experiment was performed alongside the online survey. In this lighting experiment, I combined the colour filters that already been tested earlier (*figure 3*), overlaid them on a studio light (*figure 8*). It was an original idea out of curiosity, *how to convert tangible material into digital material?* Based on the colours that most users liked, the next prototype was created, a browser extension that allows users to change typefaces, background colours in any websites they surf (*figure 9*).

Findings (*figure 10*)

Colours

In the colour test, green and blue were the most popular colours chosen by both non-, and dyslexics. One of the possible theoretical reasons behind these choices could be based on colour psychology. Long time ago, Goethe (1810) penned his Colour Theory, posited that certain colours (e.g. red and yellow) produce systematic physiological reactions in emotional experience, cognitive orientation (e.g. visual perception). Goldstein (1942) expanded this theory further, and focused on wavelength, positing that longer wavelength colours feel arousing or warm, whereas shorter wavelength colours feel relaxing or cool (Nakashian, 1964; Crowley, 1993; Elliot, 2015). On practical experience through the test result, many users also expressed the

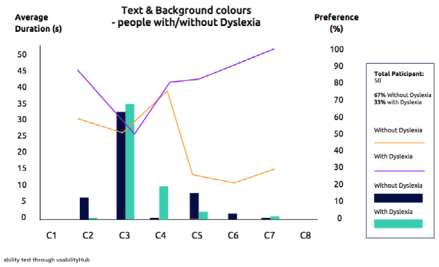

Figure 6

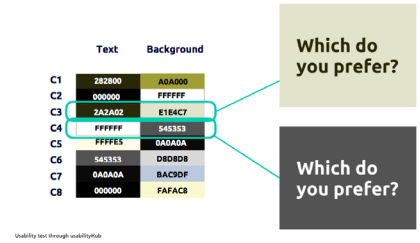

Figure 7

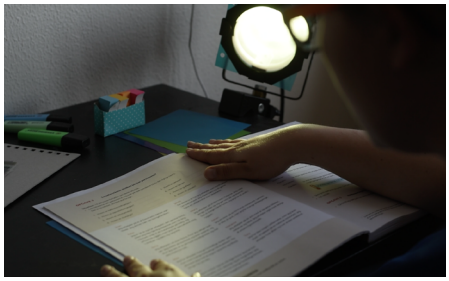

Figure 8
Video: (https://www.youtube.com/watch?v=f4OdOKXi3B0)

Figure 9
Video: (https://www.youtube.com/watch?v=1nLmP3GyFds)

Figure 10
Video: (https://www.youtube.com/watch?v=axEyB1sR1Zo)

comfort and calming effects they perceived when they saw the green and blue colours. Based on these, for the future interface prototypes I would consider implementing cool colours as one of the background options.

Typefaces

During the first and latest prototype in this paper, Open Dyslexia, OCR, Ubuntu, Fabada and Apercu were being tested. Interesting finding was that Open Dyslexia (Gonzalez, 2011), a typeface was meant to design for dyslexics. According to the experiment I performed was rather, unsuccessful. Users noted that this typeface did not have any positive effect to enhance their reading abilities. On the other hand, Ubuntu (Maag, 2010), a typeface was not specifically designed for special needs. It was among the most popular during the test and suggested that it motivated users to focus better when reading. From this experiment, the next hypothesis of using typefaces that are more cubic (e.g. Ubuntu, OCR) could improve readability for dyslexics.

Open discussions

During the qualitative research, users emphasised with their frustrations of paying attention when reading. Therefore, they could not remember what have been read afterwards. Burnett (2016) explained that hippocampus, located in temporal lope, a highly active brain region that constantly combines the never-ending streams of sensory information, which is also known as the most important part of our brains that stores memory. In Burnett (2016)'s book mentioned that hippocampus is the place where the actual 'encoding' happens. During an interview with a dyslexia specialist, Christine[2], who teaches in Danish class, she shared her observation and hypothesis. She pointed out that some dyslexic learners need a certain long amount of time to decode a single word, they have tendency to forget once they finish the decode process of a word and may fail to pronounce it at all. Hence, she theorised that it could be the linkage between learners' poor short-term memory and poor attention. Expanded on this theory, I discovered Broadbent's Filter Model of Attention (1958), Treisman's Attenuation Model (1964), and Deutsch and Deutsch's Late Selection Theory (1963). Suggested that the messages human can be received through sensory experience (e.g. sound, images), through perceptual process (Deutsch and Deutsch, 1963), upon selective filter process creates short-term memory. Whilst Broadbent (1958) and Treisman (1964) penned that based on physical properties (e.g. pitch, loudness) decide the perceptual process and then working memory is created.

Hence, some thoughts for my next prototype:
Could this project benefit to a wider target group, other than only dyslexics? If poor working memory and poor attention are related, would ADHD-users possibly be involved when it comes to reading? Due to their lack of attention? With colours, how many more ways could help improving users' attentions, and perhaps also enhance their memories through the other sensory experience? (e.g. colours and sounds, playful experience)

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During the recent NordiCHI 2018[3], there were researchers suggested that learning through playful, tangible experience, and identity construction, such as role-playing game, could trigger learners' motivation. In the next re-search, could it be possible to implement playful experience to improve visual attention in web browser?

Footnotes:

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2. Toldam C.B. Danish Teacher. ***Sprogskolen Kolding, Ågade 27, 6000***

3. NordiCHI 2018, Contribution with University of Oslo, Department of Informatics: ***Inclusion through design and use of digital learning environments: issues, methods, and stories***

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