

## **Dyslexia and Accessibility/Usability: A Research Review**

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The study of Dyslexia is relatively young. After being initially diagnosed in 1887, progress in the study of dyslexia was relatively slow until the educational reforms of the 1960s. Originally tackling the challenges presented to dyslexic readers by the printed page, researchers have recently begun examining the experience of the dyslexic internet user.

The question of how to make web-based interfaces accessible to people with special needs has yielded in recent years a plethora of research into the interaction of persons with physical and, to a lesser extent, cognitive disabilities. Meanwhile, the experience of the learning disabled, and especially dyslexic, internet user has gone largely unexamined.

This paper will examine the existing body of work at the juncture of dyslexia and accessibility and draw conclusions about areas and potential benefits for future study. It will demonstrate that there is a scarcity of research at this juncture. Accessibility and usability research is based heavily on the experience of visually impaired users and largely ignores those with learning disabilities such as dyslexia (Williams, 2006). Usability tests that have been published share specific characteristics that do not preclude the need for a future task-oriented test employing observation and talk-aloud protocol analysis.

It is estimated that up to 10% of people may experience dyslexia (Craven, 2006). The effects are myriad and can include compromised self esteem and regard when the disability is highlighted (Reid, 2001). There are laws requiring many web sites to be accessible to those with disabilities and World Wide Web Consortium compliance is dependent on accessible web sites (Williams, 2006). It is accepted that web sites should be made accessible to all and that currently, further efforts are needed to extend access to disabled users (Craven, 2006; Harryson, 2004; Petrie, 2005). Further, increasing accessibility of websites for people with dyslexia can also improve access to non-dyslexic users (Boldyreff, 2001).

These earlier findings suggest a need for more usability and accessibility research aimed at developing a more complete profile of the dyslexic internet user's experience.

### **Working definition**

The term *dyslexia* is used to describe a specific learning disability. For the purposes of this review, we have used a definition of dyslexia offered by the National Institute of Neurological Disorders and Stroke:

Dyslexia is a brain-based type of learning disability that specifically impairs a person's ability to read. These individuals typically read at levels significantly

lower than expected despite having normal intelligence. Although the disorder varies from person to person, common characteristics among people with dyslexia are difficulty with phonological processing (the manipulation of sounds) and/or rapid visual-verbal responding.

(NINDS, para. 1)

Worth noting is the fact that dyslexia may not affect learning in areas other than reading and writing and is often characterized by average intelligence. It is incorrect to pair dyslexia with attention deficit disorder or attention deficit hyperactivity disorder, as these disorders are behavioral in origin.

Dyslexia is sometimes described as a cognitive disability. In literature addressing accessibility of web sites for people with cognitive disabilities, dyslexia is sometimes mentioned as one of the subject disabilities to be addressed (Gregor, 2006; Kolatch, 2000) and sometimes not (Seeman, 2002, WebAim). Because of the disparity in experience and ability of dyslexic readers and people with severe cognitive disabilities such as Downs Syndrome and Autism, this study of dyslexia and internet accessibility will focus on literature devoted specifically to dyslexia rather than cognitive disabilities at large. It is believed this will yield a more specific and accurate discussion of the dyslexic internet users' experience.

Dyslexia is believed to have serious impact on self perception and esteem in addition to reading skills, and sometimes cause behavioral and problems (Reid, 2001). On the other hand, recent studies have classified dyslexics as spatial learners who may excel at both math and creative endeavors (BDA). A common estimate puts the percentage of the public affected by dyslexia at 10% (BDA). In either case, dyslexia affects a substantial portion of the world population and efforts made to increase accessibility of web texts for dyslexic internet users would have many beneficiaries.

### **State of research**

The bulk of dyslexia research focuses on education and the development of life skills. Education materials are concerned primarily with efforts by youth to decode text while life skills materials put the onus on the reader to adapt to a non-dyslexic society. Neither the educational or life skills areas of dyslexia research intersects greatly with human computer interaction, or offers research-based findings for improving web site accessibility for dyslexic users. As this review is interested in how to accommodate dyslexic internet users of all ages, there are shortcomings in both of these approaches.

When turning to the field of web site accessibility, we find that literature addresses the two primary concerns of accommodating physical disability and cognitive disability. These explorations sometimes include dyslexia, but rarely discuss dyslexia specifically or at length. Other studies address the use of technology assistance by disabled users, but these discussions skirt the issue of usability and accessibility, instead focusing on technology implementation (Elkind, 1998).

Once the field of search is narrowed to the unique experience of dyslexic web users, trends begin to emerge that suggest all users can benefit from dyslexia-friendly websites. Usability research is sparse, but a few tests have yielded results that support myriad lists of dyslexia-friendly web style and other tools and resources aimed at extending accessibility to dyslexic users.

### **Usability tests**

There have been a handful of attempts to study web site usability and accessibility among groups including dyslexic readers.

The DIAMONDS project was a study of 10 internet users' experiences with a piece of tutorial software (Craven, 1998). The study was aimed at determining how best to move from accessibility awareness to practice. Of the 10 users, nine were dyslexic and one was dyspraxic, having trouble executing fine motor tasks. The study used a combination of interviews, questionnaires, log sheets, and a focus group. Observation and talk-aloud protocol analysis were considered, but the software being tested required the students spend time at home working independently. Results indicated that, "dyslexic students would like to customize the appearance of the tutorials on the screen by using their preferred fonts, type size and colours," (p. 181). Due to the methodological objective of the study, full results of the usability test were not published.

In addition to the call for highly configurable text for dyslexic users, simplifying language and organization is also common. Jakob Nielsen found that lower-literacy readers experience web texts very differently than high literacy readers. The study cited the US Department of Education's National Adult Literacy Survey in asserting that 48% of the U.S. population has low literacy and Nielsen estimates 30% of web users have low literacy. The study tested regular and low literacy optimized versions of a website with lower and higher literacy users. It tested against three metrics for success, task time and satisfaction. Optimization included: prioritize information, avoid text that moves or changes, streamline the page design, simplify navigation, optimize search. Of the results, Nielsen writes, "the revised site clearly had dramatically better usability on all three metrics: users got more correct information, did so faster, and like the site better." The improvements for lower literacy readers also appeared to improve, rather than harm, the experience of high literacy users, as well (Nielsen, 2005).

A pilot study of dyslexic readers conducted in 1995 found that reading ability improved when readers were able to change the way the text is presented. This study, which influenced the later development of software to enable readers to configure text for personal preferences, is unpublished (Gregor, 2007).

In 2004, the U.K.'s Digital Rights Commission undertook a task-oriented examination of 100 web sites by 50 blind, partially sighted, dyslexic, and physically and hearing impaired users (DRC). Each user completed two tasks on 10 web sites. Dyslexic users experienced a 17% failure rate, which was lower than the rate experienced by blind and

partially sighted users and highly than that experienced by physically and hearing impaired users. The key problems experienced by dyslexic users were:

- Confusing page layout
- Unclear navigation
- Poor color selections
- Graphics and text too small
- Complicated language

Overall, the study found that just 19% of “web sites comply even with the lowest priority checkpoints for accessibility,” and “all categories of disabled user consider that site designs take insufficient account of their specific need,” (p. 9).

### **Multimodal text**

Research commonly notes that dyslexia is highly variable; there is no “typical” dyslexic internet user. Interviews with dyslexic college students illustrate the complexities of this variability.

Robert was the only student to favor using voice-activated word-processing, because he preferred to communicate orally. Betty and Victoria were both nervous of cutting and pasting, lest text disappear. They and others were aware that having typed a piece of work, its neatness on the screen make it look perfect and therefore hard to edit. But both Alice and Phoebe, who had previously learned to type, found word processing on a PC easier.

(Pollak, 2001, p. 96)

Such findings underscore the potential strengths of multimodal documents for differently-abled readers, rather than the “one document for all” approach. Some researchers have addressed this idea, developing and testing highly configurable software.

SeeWord is a word processing software that allows users greater control over how information is displayed (Gregor, 2003). In response to an unpublished pilot study of dyslexic writers and computers that found there was no universal profile of dyslexics, SeeWord was designed to allow users to optimize writing and reading conditions in Microsoft Word for their own needs. The evaluation of SeeWord employed a “talk aloud” task-oriented observation. It concluded that some dyslexic users read more accurately when they are able to select their own text color and size settings.

Researchers have addressed readers’ diverse abilities in other software development, also. The MultiReader project marks an attempt to create rich multimedia communications that are highly configurable for both user needs and preferences (Petrie, 2005). The project rejected the “one document for all” approach to accessibility, instead synchronizing multiple media types and affording the user more control over presentation. The project included an evaluation of the MultiReader system with 70 print-disabled users that found enabling greater control over presentation and synchronization

of screen reader audio and text highlighting benefited dyslexic users. Petrie concludes this discussion by pointing out that adequate tools are in place for blind users, but that deaf and dyslexic users require more effort on the part of accessibility professionals.

### **Guidelines and resources**

Despite the scarcity of literature addressing web accessibility for dyslexic users specifically, efforts to make more effective human-computer interactions for dyslexic and other disabled users are underway.

Efforts to make web sites more accessible to low visibility readers include making text size selectable, using sans serif fonts, and using colors to visually designate important pieces of information (Nielsen, 2005). These measures are also recommended for dyslexic readers (BDA). Many dyslexic internet users employ screen readers for assistance, and so efforts to optimize web sites for screen readers may benefit dyslexic users, even if the stated target audience is blind users (Elkind, 1998).

A typeface has been developed specifically to address the recognition difficulties faced by dyslexic users. Dyslexic-friendly typefaces for digital environments have been limited due to the challenges of creating a highly pixilated sans serif that differentiates between similar letters such as “b” and “d”. The Read Regular typeface more dramatically changes the profile of such letters and has been found to ease computer based reading for dyslexic users (Asaravala, 2004).

There are a host of recommendations aimed at developing Web sites friendly to dyslexic users. Efforts have been made to design online courses inclusive of dyslexic readers (Pearson, 2003). The requirements Pearson found for doing so include

- Meeting legal and quality obligations
- Offering established guidelines
- Showing familiarity with assistive technologies
- Paying attention to learning environment design
- Employing diagnostic and checking tools.

There is no shortage of online resources to assist the web developer in creating dyslexia-accessible web sites. Common recommendations shared by Bradford, Zarach, and others include:

- Allow user to change text size.
- Keep sentences and paragraphs short
- Include pictures and visual representations
- Keep design consistent
- Use San Serif fonts 12pt or larger
- Allow text to be easily printed
- Include site map
- Use dark type on pale background

There are a number of tools available to people striving to design dyslexia friendly websites. Online readability tests allow web designers to paste text into a box or submit a URL and receive an instant readability evaluation based on the Gunning Fog, Flesch-Kincaid, and other reading level algorithms (Readability, 2007; Tests). The accuracy of these tests has been questioned, though (DRC, 2004).

Most of the guidelines listed above (and those employed by Nielsen in his study of low-literacy users) are also included in guidelines for improving access for people with other disabilities. In fact, overlap between recommendations for different disabilities have been compared and contrasted (Evet, 2005). That study, which concerned itself with the text and web style guidelines for the British Association for the Blind and British Dyslexia Association, concluded that recommendations for blind readers closely parallel those for dyslexic readers. But, it also found that non-disabled users benefit greatly from adherence to accessibility guidelines aimed at blind, partially sighted, and dyslexic users.

### **Plain Language/Minimalism**

The recommendations for designing dyslexia inclusive web sites outlined above are not exclusive to the field of learning disability. As several studies already discussed have found, guidelines for dyslexia friendly web sites can improve usability for non-dyslexic readers, too (Nielsen, 2005; Evett, 2005). Many of these guidelines are already accepted tenets of plain language, the movement for clear, concise, jargon-free texts. Plain language and accessibility have been linked in the past (Boldyreff, 2001).

Originally a consumer response to legalese in business and government documents, several states have passed plain language laws. The argument has been made that plain language is a vital part of web accessibility and that its benefits are shared by disabled and non-disabled users alike. This suggests a study of dyslexia and web accessibility could benefit from a greater exploration of plain language and accessibility and plain language and dyslexia.

### **Conclusion**

While great efforts have been made to research both dyslexia and web accessibility, there is not a great body of work addressing both simultaneously. Perhaps more interesting, there appear to be no published task-oriented usability studies examining the experience of dyslexic internet users exclusively.

The need for increased accessibility in web design is expressed in existing literature, as are the shortcomings of existing design in terms of accessibility to disabled readers. The majority of accessibility efforts are aimed at blind and visually impaired users or, to a lesser extent, users with severe cognitive disabilities. Given that dyslexia is the most common disability among internet users and the public, it is reasonable to suggest that more attention be paid to dyslexia and accessibility.

Meanwhile, evidence mounts that the web sites that eschew guidelines for dyslexic accessibility not only undercut the esteem and successes of dyslexic users, but also their non-dyslexic counterparts. The high level of overlap in guidelines for dyslexia, other cognitive and physical disabilities, and plain language, suggest that dyslexic users could be a salient indicator group for overall web accessibility. By undertaking more task-oriented usability research employing observation and talk-aloud protocols, a profile of the dyslexic internet user's experience can be established. Such a profile would confirm or disconfirm the assumptions already commonly held, and strengthen the basis for accessibility initiatives that benefit users with and without dyslexia.

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