

Improving Web Usability for the Hard-of-Hearing

MIKI NAMATAME Tsukuba University of Technology, Japan : miki@ta.tsukuba-tech.ac.jp
 MUNEO KITAJIMA National Institute of Advanced Industrial Science and Technology (AIST), Japan : kitajima@aist.go.jp

Introduction

Recently, with continued advances in information technology, there is an ever-growing amount of information accumulated on the World Wide Web. At the same time, the need to make this information accessible to any person who needs it becomes a serious issue. This paper focuses on web content accessibility for the hard-of-hearing. This is motivated by the fact that the first author, who is engaged in educating hard-of-hearing persons through daily classes, felt that hard-of-hearing persons would interact with web pages differently than hearing persons. Using web-based interactive course materials seems effective since they allow the creator to control the presentation of the content. However, the issue of how the hard-of-hearing interact with the web has not been adequately studied.

How the hard-of-hearing browse the web

In previous studies [Suzumura et al. 2004, Yamamoto and Kitajima 2005], we demonstrated differences in web-browsing behavior between hard-of-hearing persons and hearing persons in terms of the number of errors and the nature of scan paths used as they accomplished a task on an experimental web page that simulated a then-existing automobile site. The participants were asked to locate a page that described a designated car model and to choose a favorite color for it. We recorded their link selections and eye movements and analyzed the data from the site's top page. The results indicated that the hard-of-hearing made a significantly larger number of errors in link selections and adopted less consistent browsing patterns than the hearing participants. Figure 1 depicts the scan paths from one of the hard-of-hearing participants. It does not indicate a clear pattern of scanning. This is contrasted with scan paths from the hearing participants, which show vertically aligned scan paths consistent with the semantic structure of the page.

Redesigning and evaluation

We conjectured that the design of the experimental web page was not well-evident from the way the information was organized. The hard-of-hearing participants would have had difficulty in capturing the hidden semantic structure partly because written language is not their primary language. We redesigned the top page by adding vertical lines that effectively separated it into columns. We expected that this redesign should improve the site's usability for hard-of-hearing persons. This paper reports that the redesign was effective. Figure 2 illustrates an eye movement pattern typical of those from hard-of-hearing participants. It confirms that the redesign successfully improved usability for hard-of-hearing persons.

Conclusion

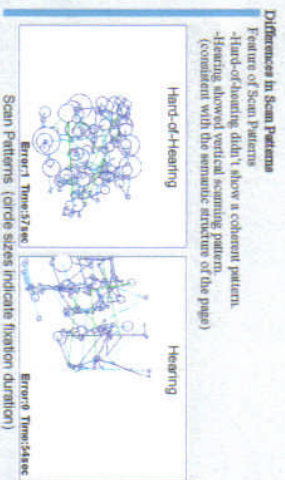
An important lesson is that what is obvious for the web-literate is not necessarily obvious for the hard-of-hearing. Hidden semantic structures resulting from fancy design ideas were not easily captured by the hard-of-hearing, resulting in a serious usability problem. Their eye movements told us clearly where the sources of confusion were and suggested an effective design change. A small design modification resulted in a large improvement in the usability of the web site.

References

NAATVAAR, M., AND KITAJIMA, M. 2005. Differences in Web-interaction styles of hard-of-hearing and hearing persons. *CHI International 2005*.
 NAATVAAR, M., KITAJIMA, M., SHIBUOKA, T., AND PRZEMACZYK, 2004. A preliminary study for designing web-based educational material for the hearing-impaired. *Conference on Computer Supported Cooperative Work (CSCW2004)*, 1141-1145.

How the hard-of-hearing browse the Web

Contrasting hearing-impaired with normal-hearing subjects (Scanning Patterns, Selected Links, Number of Errors, Processing Times per Page)



Differences in Number of Errors and Correct Link Selection Times

Hard-of-hearing selected wrong links more often than hearing. Hard-of-hearing took longer time to reflect correct link than hearing.

	Hard-of-hearing	Hearing
Average Number of Errors	4.9	2.6
Average Time to Select Correct Link	2 min 49 sec	1 min 27 sec

Web Content Accessibility Guidelines 2.0 (WCAG Working Draft 11 March 2004)

- Principle 1: Content must be perceivable.
 For content creation, provide text equivalents that serve the same purpose or convey the same information as the non-text content.
 Provide synchronized audio equivalent for time-dependent presentations.
 In audio presentations, make it easy to distinguish foreground speech and sounds from background sounds.
 Principle 2: Content and controls must be understandable.
 Organize content consistently from "page to page" and make interactive components behave in predictable ways.

Results

Successful Redesign

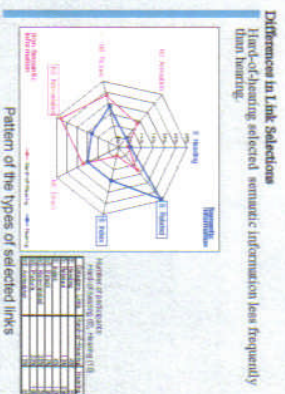
Redesign based on the understandings of web-orientation behavior of hard-of-hearing.
 The small redesign resulted in a large improvement in the usability of the web site.

Contribution to Web Guidelines

- Structure of contents should be visually understandable.
- Label expressions of hyperlinks should be understandable.

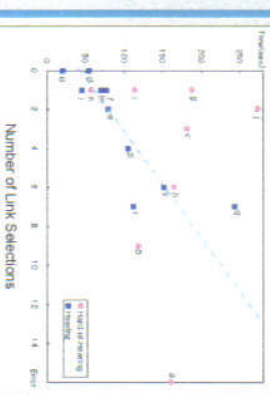
	Before Redesign	After Redesign
Average Number of Errors	4.9	0.8
Average Time to Select Correct Link	2 min 42 sec	0 min 42sec

Improvement of performance



Differences in Processing Times per Link Selection

Hearing took a certain amount of fixed time before selecting a link. Hard-of-hearing did not use such a strategic search method when selecting a link.



Scan path of a hard-of-hearing



Figure 1

After Redesign



Figure 2

Experiments



Experimental subject (a dog named 'Muneco')

Method

- Visual image
 1. Experimental subject was a dog named 'Muneco' at home of subject.
 2. Experimental subject was a male beagle.
 3. Muneco was 2 years old.
 4. Muneco was 1.5 kg.
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Subjects

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Experimental Procedure

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Task

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Redesign

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- 33. Subject was a dog named 'Muneco'.
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- 48. Subject was a dog named 'Muneco'.
- 49. Subject was a dog named 'Muneco'.
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