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A Case Study for Reaching Web Accessibility Guidelines for the Hearing-Impaired

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ABSTRACT

This research is a case study, but it has the possibility to make Web Accessibility guidelines for the hearing-impaired. Web Content Accessibility Guidelines by W3C suggests "Provide non-text equivalents of text". We suppose this guideline is applicable to the hearing-impaired people. Our research expanded W3C's guidelines to specify that the "non text equivalents" convey a significant meaning about the contents accurately. We performed experiments and considered how different web designs effected WEB accessibility of people with different disabilities. We recorded the operation flow and the length of stay on each page as well as eye tracking and mouse movement. We found some differences between non-impaired and hearing-impaired people in this experiment. We have considered that two user types exist Text-oriented for the non-impaired vs. picture-oriented for the hearing-impaired. We formed hypothetic Web Accessibility Guidelines for the hearing-impaired people based on this case study.

Keywords: *WEB accessibility, WEB Design, Hearing-impairment, Information Design, Interface Design.*

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1. Introduction

W3C's WAI recommendations have been establishing guidelines for the standardization of WEB technology used in building WEB-sites [1]. These guidelines can be applied internationally, however, as yet, W3C suggests only to "Provide equivalent alternatives to auditory and visual content" [2] for hearing-impaired people. Specifically, this guideline has been stated as the following: "Describe the sound of

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auditory content" [3] and "Provide non-text equivalents of text" [4]. The different guidelines (the US Government Section 508) related to Web accessibility standards are suggested to hearing-impaired people. The guidelines recommend attaching the synchronized caption for hearing-impaired people in the case of audio material, video material, and multimedia material [5]. The problems of accessibility for hearing-impaired people used to be mentioned only about sound. These are because the guidelines have been supposing that non-impaired people and hearing-impaired people have little difference in use (except for sounds) of WEB contents. We have observed how hearing-impaired use WEB at our college for several years. Do non-impaired & hearing-impaired people have the same WEB content needs? We hypothesize that the differences in use of WEB contents of non-impaired people and hearing-impaired people are not only sounds. Generally, hearing-impaired people have less vocabulary than non-impaired.

We can see such a phrase for urging an understanding about hearing-impaired people. “Rephrase rather than repeat a misunderstood sentence” [6]. We have to consider that this problem is related to the text information of web pages. We think it important to investigate the hearing-impaired person's computer operation characteristics.

2. Purpose

We had three purposes. One was to examine the operation processes of the research samples on the sample homepages, and to extract the key items of information. The 2nd was to investigate the features of the operation and recognition of people with different disabilities. And the 3rd was to form Web Accessibility Guidelines for the Hearing-Impaired.

3. Method

On the Internet, the conclusive factor of practical use is to find information efficiently. How do people find the required information? We observed the characteristics of information selection. We performed experiments and considered how different web designs effected WEB accessibility of people with different disabilities.

We choose some goals from existing websites with different structures. These goals were simple choices with no comparisons or judgments. We established some items and classified the homepages. We choose some standards such as Amount of information, Balance of texts and pictures, Picture Types, Motion, Navigation Type, Navigation Layout, and Page divisions, then choose good websites.The aim was to research how quickly a specified goal was attained using existing web designs (see Table 1). Existing homepages were Automaker, Official Approval, Book Store, and Cosmetics. We gathered 6 persons for experiment (3 non-impaired persons & 3 hearing-impaired persons).

We used equipment to track eye movement and the computer operation processes were recorded on video. This system has video based eye and target tracking equipment using infrared lighting [7)]. Personal computer with 17 inch monitor, was operated by the examinees using only the mouse. Since this equipment requires no head-mount or glasses, tests were performed under natural conditions. We observed the mouse location, eye movement and time taken by video records (see Figure 1).

Table 1: Structure of the Home pages.

	Amount of information	**Balance of texts and pictures**	**Picture Types**	**Motion**	**Navigation Type**	**Navigation Layout**	**Page divisions**
Automaker	Medium	Equal	Photograph (car only)	Animation	Text	Left	Right-left
Official Approval	Medium	Equal	Icon	None	Text	Left	Right-left
Book Store	High	High text information	Photograph & Icon	None	Index tab / Text	Top / Left	Top & right-center-left
Cosmetics	Low	High picture information	Photograph /Illustrations / Logos	Flash movie	Picture / Text	Center	None

Fig.1: Examinee (left) and researcher.

4. Results

About each website; Since the “Major Book Store” website had the function showing the genre perused last time, it was not applicable to the experiment. There were no differences in operation when accessing the “Official Approval Guidelines” website and “Major Cosmetics Maker” website. On these websites, the subjects were asked "Please search the schedule of examinations" or "Please choose your favourite one from new lipsticks". When accessing the “Automaker” website, differences were seen in access time and operation characteristics. On this website the subjects were asked, "Please choose the color which you think is the most suitable for the indicated type of car. So we analyzed the “Automaker” website.

4.1 The operation flow and length of stay on each page

Figure 2 is the operation flow and length of stay on each page of the “Automaker” website. Only one route can reach the right position. It is indicated with the bold lines. The left box shows "Examinee A" 's operation and the right box shows "Examinee B" 's operation. "Examinee A" had a no loss operation flow and stayed on the homepage for a longer time with accurate operation procedures. "Examinee B" 's confusion can be observed from an operation flow. This figure shows the results of "Examinee A" (shortest time) and "Examinee B" (longest time) on the "Automaker" website. The time required to complete the task was 100sec by "Examinee A", and 350sec by "Examinee B". The number of jumps between pages were 3 times by "Examinee A", and 22 times by "Examinee B". Except the top page, "Examinee B" ’s lengths of stay were shorter than "Examinee A" ’s lengths.

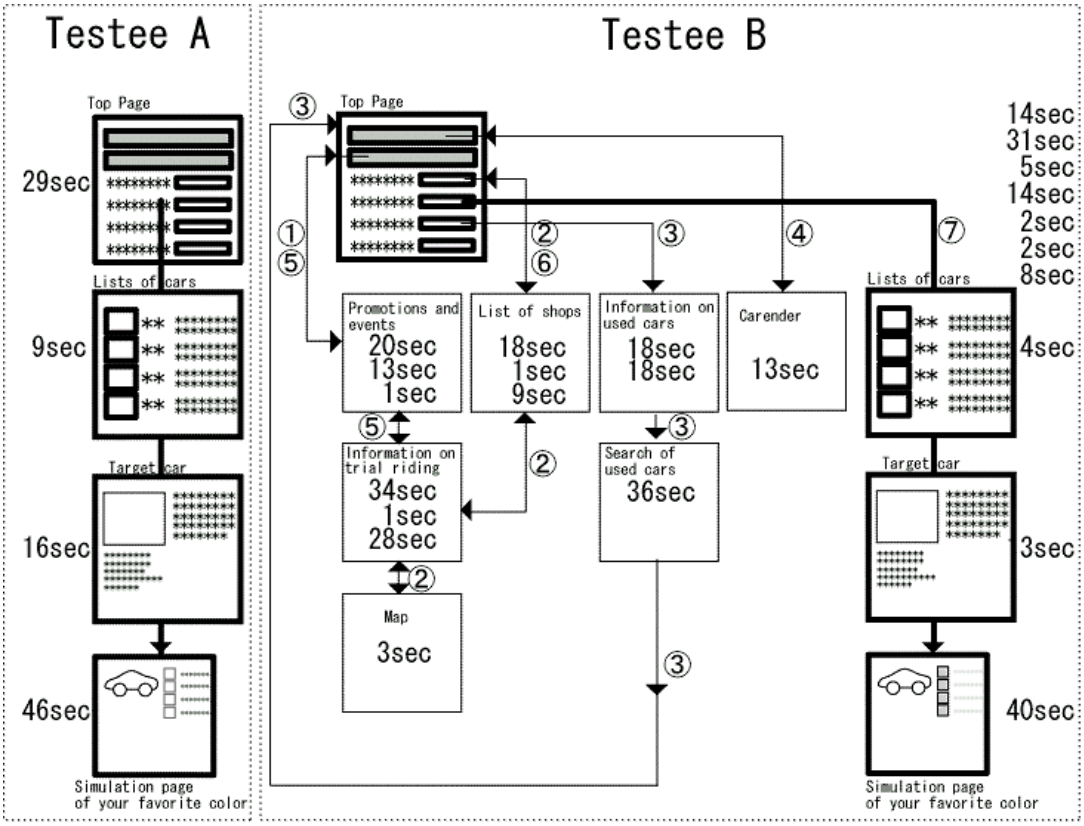

Fig.2: The operation flow and length of stay on each page of the “Automaker” website.

4.2 The operation tendencies of each Examinee (Home Page)

We analyzed the operation tendencies of each examinee. On Figure 3 images the orange lines represent the eye movement while green lines show the mouse movements.

Figure 3 can be seen on "Examinee A" ’s image, on the left, that text was read and the appropriate link was used. The eye movement clearly showed the operation of reading the text on each page. "Examinee A" used the text links. "Examinee B" ’s image shows inefficient tracking of both the eyes and the mouse. "Examinee B" 's eye movement was broad and sweeping. "Examinee B" had a tendency to operate animation and large picture links with a top to bottom sequence. Small font text links were used much less than picture links.

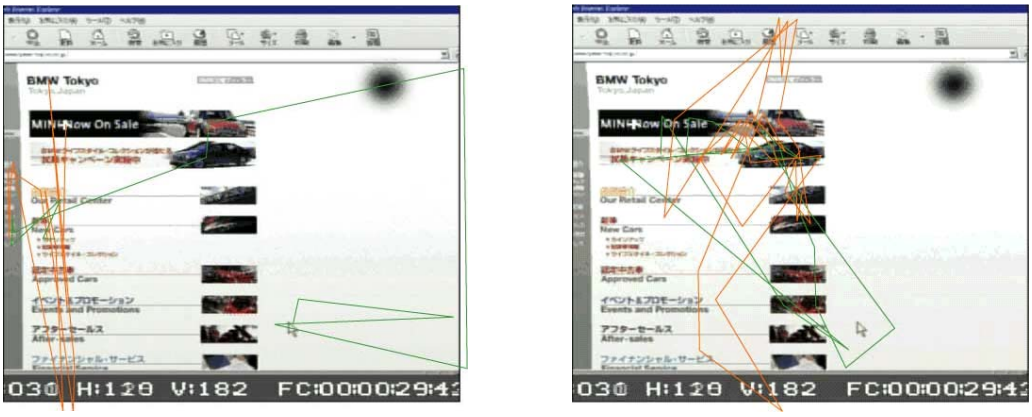

Fig.3: The Mouse Location & Eye Movement of the homepage.
"Examinee A" (left) and "Examinee B".

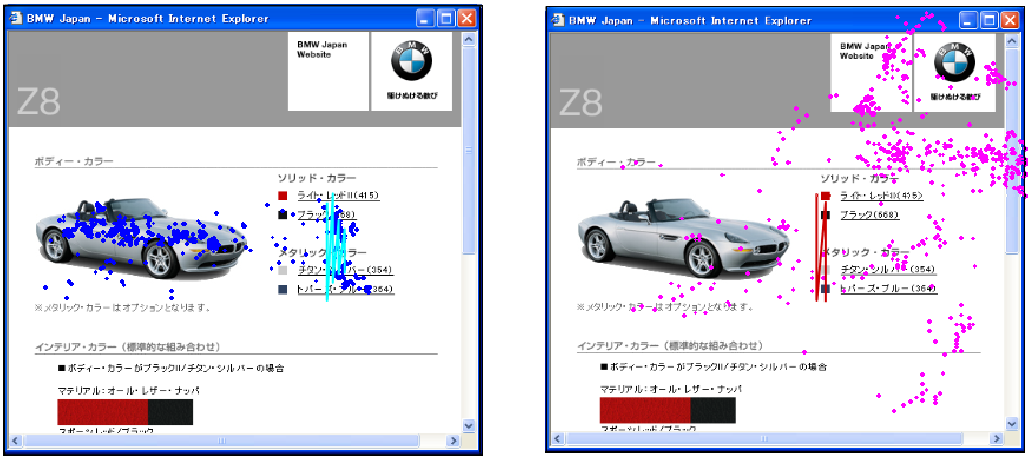

Fig.4: The Mouse Location & Eye Movements of the Color Determination page.
“Examinee A” (left) and “Examinee B”.

4.3 The operation tendencies (Color Determination page)

After the experiment, we questioned “Examinee A” about the activity. “Examinee A” did not understand the link labelled “Line Up” and so was unable to progress to the next step. As such we determined that this page was unsuitable to use for comparison in this experiment. The final times required for decision making were 46sec and 40sec respectively. The time between the first click and the final click was 19sec, while the color was changed 10times. “Examinee A” and “Examinee B” had the same results so we decided this page was suitable for examination and comparison.

The record lengths required for decision making (determination of the favorite color) were almost same. It took 19 seconds for each examinee from the first click to the last click to change colors. We judged that this page had an equal condition for "Examinee A" and "Examinee B". Then, we analyzed these 19 seconds in detail (see Figure 4).

On Figure 4 images The points show the eye tracking coordinates for each 0.02 seconds over a 19 second period. The lines show the mouse movements.

"Examinee A" ’s eye movements concentrated on the texts (name of color) and the photographs of car alternately. "Examinee B" 's eye movements ran around the whole page broadly. "Examinee B" ’s eye movements had no action of gazing at a click object. "Examinee B" ’s eye movements were always quick and moved widely. The number of clicks for each examinee was 10 times. However, "Examinee A" clicked only the texts. And "Examinee B" clicked only the tiny pictures, oppositely. The link targets which "Examinee B“ used were just 10*10 pixel pictures but the eye tracking shows that "Examinee B“ never looked at them either.

5. Discussions

"Examinee A" is a non-impaired male and "Examinee B" is a hearing-impaired woman. Age and the years of Internet experience (but total accessing time is unknown) are equal. At present, the factor which makes the difference in operation cannot be specified and we cannot yet prove that the disability is related. But the examinee, types differ clearly. "Examinee A" is the type who gets information from text, and "Examinee B" gets information from pictures. We studied to three hearing-impaired people, all of them had the tendency to take information from pictures. We can show and contrast the differences of operation tendencies concretely by video records.

It is known that the hearing-impaired do not use text information as effectivly as non-impaired people. Why did the “Automaker” website have some differences? This home page has the same amount of both characters and pictures. However, as most of the pictures are image photographs of cars, the differences in the contents cannot be drawn from the photographs, and text information must be used. But, the Keyword "LINEUP" of this task was written in *katakana-English* and "Examinee B" could not understand the meaning (*Katakana-English is when English words are written using Japanese characters and sounds*). "Examinee B" was able to access no information from both pictures and texts. Therefore, it was a difficult interface for "Examinee B", who operates depending on picture information. We considered the difference between each examinee by studying the eye-movements. The characteristics of the person who operates depending on picture information (like "Examinee B") are to gather information from the whole page except text information and to judge something

in an instant. We suppose that as hearing impaired people gather more information visually than the non-impaired, non accurate visuals and graphics mislead the hearing impaired more. We think it is important and simple, to make internet visuals & graphics accurate so that everyone can access information efficiently.

6. Conclusions

We found some differences and similarities, between non-impaired and hearing-impaired people in this case-study. The "Automaker" website had differences in reaction to text and picture information. We have considered that two user types (Text-oriented for non-impaired vs. picture-oriented for hearing-impaired) exist in vision information processing of WEB operation. The "Official Approval Guidelines" website and the "Major Cosmetics Maker" website were accessible for hearing-impaired people. The "Official Approval Guidelines" homepage and the "Automaker" homepage had same standards such as amount of information, balance of texts and pictures, navigation type, navigation layout, and page divisions. But the picture type of "Official Approval Guidelines" homepage was icon. On this homepage pictures and text were presented as a set, it cannot be classified as either a text based type or a picture based type. The "Major Cosmetics Maker" homepage was based on picture information, and photographs of goods.

The fact that there was no difference may indicate the same interface was provided to both types equally. Using suitable picture information will allow an easier interface for picture dependent operators such as "Examinee B".

Our research hopes to further W3C's guidelines to specify that the "non text equivalents" convey a significant meaning about the contents. We formed hypothetic Web Accessibility Guidelines for Hearing -Impaired People based on these case studies.

For Picture:

- Pictures should express the contents accurately
- Use concrete objects
- Use photographs of goods and suitable icons

For Text:

- Text should be accompanied with pictures

For Japanese (also applied to elderly people):

- Avoid using English and katakana notation in menus

7. Acknowledgment

Some papers suggested that "new technology frontier" has also created enormous roadblocks and barriers for people with disabilities [8], but another researches try to develop new browser. The web accessibility is always discussed as one of technical problems. However, we believe that the web pages become more accessible for hearing-impaired people by visual design. This research is just preliminary and we plan to have more samples in our next experiment. In the future, we'd like to consider the correlation between user types and different factors such as sex and impairment. We will use a questionnaire to rate the examinee's interest in the test subject and ask how much they access to the internet every day (or a week). We assume that the operation characteristics are connected with the examinee's interesting and knowledge. Our next plan is to research the composition elements related to web accessibility, according to the result of an experiment in which we will investigate the features of operation and recognition in a typical web design model. We are going to continue such field-work.

8. References

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9. Appendix

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＊Printing of pictures had obtained permission of BMW Japan co. and BMW Tokyo co.

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(We accessed BMW-Site at 20th Feb 2002. BMW-Homepage was changed after our experiments).