Do dynamic text–only web pages improve usability for disabled users?

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Abstract. Although the potential benefits of text transcoders are multifaceted, at the moment their impact on disabled web users is not clear. This paper describes an experiment aimed at evaluating usability of web pages processed by a text transcoder and used by disabled persons. Results based on subjective and objective data show how usability changes.

1 Introduction

Transcoders are proxy–like systems that respond to requests sent by the user's browsers; they relay these requests to an ordinary web server, collect the requested pages, transform and finally return transformed pages to the browser. In particular, they strip images, multimedia objects, JavaScript code from the page, and change its layout. Text transcoders have been promoted as tools that can be deployed to automatically yield text–only version of web pages (hence the webmaster does not have to cope with the burden of maintaining redundant copies), and they can produce pages that are more accessible than the original ones. While not being ruled out by accessibility guidelines (*e.g.* WCAG 1.0; Section 508) text transcoders have renewed discussions on the role and appropriateness of text–only pages, seen by many as second–level pages for second–level users. As a consequence, the adoption of text transcoders is often discouraged (*e.g.* the current draft of the accessibility requirements issued by the Italian government [5] explicitly rules out text–only pages, regardless whether they are dynamic or not). However, so far, limited studies exist on usability of text transcoders.

Text transcoders are a technically viable solution when translation of a web user interface is needed. For example, normal graphical pages can be transformed so that the visual layout, and possibly the interaction structure, can better adapt to specific devices used by visitors (*e.g.* using screen readers or mobile devices). This happens because *user bandwidth* [10] can be increased by removing, rearranging or modifying the page contents or the interaction structure (*e.g.* by modifying the sequence of steps, decisions and actual actions that are needed to accomplish a goal). In fact a text–only version of the web site can be an

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opportunity to customize web contents, navigation and presentation so that it can better suit people bound to low–bandwidth connections (like slow modems), limited interaction and display tools (like PDAs or cell phones) or alternative channels (like screen–readers).

Because text transcoders drop part of the original content (*e.g.* images, Flash, applets, scripts), because they dramatically change the layout and structural HTML of pages (*e.g.* removal of layout tables), and because the customization that they support is somewhat limited, it is not yet clear whether resulting pages are beneficial at all. In fact so much is changed, and so many things have been removed, that it is likely that many user goals which could have been reached in the original web site, would become unachievable. Thus, an important empirical research question is: *what kind of impact has a text transcoder on users?*

2 Research methodology

The purpose of the study is to determine whether text–only pages that are dynamically created through text transcoders are beneficial to disabled users. We framed this question into a comparative experiment aimed at measuring usability[1]: use of the original web site *vs.* use of the web site through an appropriately customized text transcoder. The test site belongs to an Italian local government agency[2] which is not accessible. We used LIFT Text Transcoder (LTT) [11] because of its flexibility and availability to us. We customized LTT in a way that is limited to process existing contents of web pages and smooth out some of the site's accessibility barriers. The new content being added was page and frame titles, page headings, ALT for iconic buttons, hidden *skip–links* links, access keys for global navigation links, and a small table of contents on each page. In this way the original content and information architecture of the web site was not affected by the customization and the transcoder was tested in a typical deployment situation, where a web master is expected to adapt the transcoder to the specific coding conventions of the site and fix most common accessibility barriers. Several text transcoders exist [2, 9, 1, 6, 7, 4] which, in principle, should all be able to achieve the transformations achieved by LTT. The experiment involved 29 participants: 17 were blind, 7 had low–vision and 5 had motor disabilities. Nineteen used a screen–reader (with or without a Braille reader), 4 used a screen magnifiers, 1 used modified mouse and keyboard, and the remaining 5 did not use any specific assistive technology. As a screening criterion we required only that all participants had prior experience with computers and with the WWW.

Each participant was asked to carry out (in random order) 5 information finding tasks, two with LTT, two without and one with another transcoder (Access Gateway [4]). The latter task was needed in order to reduce the test effect by simulating a one-way blind test: subjects were not sure of which was the actual transcoder we were experimenting with, and this limited their bias when

[1] We adopted the ISO definition of accessibility: "*usability of a product, service, environment or facility by people with the widest range of capabilities*"[8]

[2] www.regione.fvg.it

variable	factor	type	NO LTT mean (sd)	LTT mean (sd)	NO LTT median	LTT median	p–value
Q_1 *I easily found the required information*	E,S	S	3.5 (1.68)	2.2 (1.45)	4	2	< 0.001
	E,S	C	3.8 (1.68)	3.1 (1.45)	4	2	< 0.048
	E,S	all	3.69 (1.61)	2.64 (1.57)	5	2	< 0.001
Q_2 *I was tempted to go elsewhere to find the answer*	E,S	S	2.6 (1.84)	3.6 (1.88)	1	5	< 0.033
	E,S	C	2.2 (1.65)	3.4 (1.80)	1	5	< 0.003
	E,S	all	2.40 (1.75)	3.5 (1.83)	1	5	< 0.002
Q_4 *I'm satisfied with the solution I found*	E,S	S	3.1 (1.88)	2.0 (1.37)	3	1	< 0.005
	E,S	all	3.2 (1.81)	2.3 (1.68)	4	2	< 0.002
Q_5 *Assess the effort required*	P,S	all	2.5 (1.32)	4 (1.03)	2	4	< 0.001
Q_6 *Evaluate the presentation quality*	S	all	3.5 (1.4)	5.4 (1.18)	3	6	< 0.001
Q_7 *Rank the tasks by difficulty*	E	S	2.38 (1.11)	3.24 (1.02)	3	4	< 0.008
	E	all	2.17 (0.55)	2.81 (0.54)	2	3	< 0.004
Q_8 *Proportion of users that would choose ... for a next visit*	E,S	all	0.28	0.72			< 0.001
CL Completion level	E	S	0.48 (0.41)	0.74 (0.41)	0.5	1	< 0.003
	E	all	0.46 (0.40)	0.65 (0.42)	0.5	1	< 0.002
PR Proportion of tasks when completion level $> 50\%$	E	S	0.31	0.68			< 0.005
	E	all	0.65	0.79			< 0.013
GU Proportion of tasks when completion reason = *subject gave up*	E	C	0.51	0.24			< 0.030

Table 1. Dependent variables, their associated usability factor and results. (Q_i means question, *E,P* and *S* stand for effectiveness, productivity and satisfaction). *Type* represents the type of tasks being used: simple (S), complex (C) or both (all). Statistical significance was tested with the Wilcoxon test for paired samples; the maximum accepted significance level is $p < 0.05$. For questions $Q_1 \ldots Q_4$ the answer is a 5–point Likert scale: 1=*strongly agree*, ... 5=*strongly disagree*; for Q_5: 1=*high* ... 5=*low*; for Q_6: 1=*very bad* ... 7=*very good*; for Q_7: 1=*difficult* ... 4=*easy*; for CL: 0, 0.2, 0.4, 0.6, 0.8, 1. Other variables and questions did not produce a statistically significant difference and they are not shown.

	variable	factor	type	NO LTT mean (sd)	LTT mean (sd)	NO LTT median	LTT median	p–value
NP	Number of visited pages	P	S	4.59 (2.90)	2.93 (0.92)	4	3	< 0.004
		P	all	5.05 (2.97)	4.21 (2.17)	4	4	< 0.039
T	Task completion time in sec.	P	S	465 (355)	301 (274)	393	178	< 0.047
NPS	Number of visited pages when success=100%	P	C	8.14 (3.43)	5.63 (1.96)	7	5	< 0.041
		P	all	5.56 (3.34)	3.90 (1.83)	4.5	3	< 0.042
NE	Number of wrongly visited pages	E	S	2.59 (3.22)	0.97 (1.59)	1	0	< 0.023
		E	all	2.67 (2.82)	1.57 (2.04)	2	1	< 0.014
NB	Number of clicks on *back*	E	S	1.93 (2.04)	0.59 (0.83)	1	0	< 0.012
		E	all	1.95 (3.16)	1.40 (3.09)	1	0	< 0.045

expressing their opinions. The outcomes of this task were not used to draw any conclusion. We split the 4 main tasks (with/without LTT) into two pairs: one pair of tasks were simpler than the others, and required subjects to browse 2 or 3 pages to find the required information; the other tasks required in addition to fill-in a form. In order to balance the learning effect, we randomized both the difficulty level of tasks and the treatment (with/without LTT). All the work sessions were videotaped and a post–task questionnaire was submitted to the subjects. The purpose of the questionnaire was to elicit information about satisfaction and perception of effectiveness and productivity.

The independent variables included whether LTT was used during execution of a task or not, and the type of tasks (easy *vs.* complex). The dependent variables characterizing usability included subjective ones (*e.g.* opinions asked to the participant, like how easily the information was found) and performance–related ones (*e.g.* time to complete a task, level of completion). The dependent variables were associated to the basic usability attributes as shown in figures 1 and 2 , which presents also the statistically significant results.

3 Conclusions

This experiment demonstrates that dynamically created web pages do not decrease usability of a web site when used by disabled people sharing the characteristics shown by our sample. On the contrary, a text transcoder configured to fix the most common accessibility barriers improves users effectiveness, productivity and satisfaction despite the lack of removed content and the automatically generated page layout.

Although the same increase in usability is likely to be achievable by retrofitting accessibility to the original web site, this result is important because (i) text transcoders can be applied to inaccessible web sites to offer a *temporary* accessible user interface, and (ii) they can be applied to offer an *alternative* accessible user interface that is more suited to these kinds of users. In fact we believe that any specific adaptation of transcoded pages to the needs of disabled users (*e.g.* by suitable use of colored sections and icons, by arranging differently the page contents) is likely to dramatically improve usability, according to the claims in [3].

We believe the key features of LTT that support these findings are: simultaneous rendering of frames, liquid layout with resizable text, customizability for horizontally laying out navigation bars, for adding ALT text to image buttons and images in general, for adding page headings, and for labeling form controls. We would expect to find similar result using other transcoders capable of implementing the transformations we relied upon using LTT, and on users of information–based web sites similar to the one we tested.

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