# Reading and Navigational Strategies of Web Users with Lower Literacy Skills

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**About half of the adults in the U.S. read at the 8th grade level or below (Kirsch, Junegeblut, Jenkins, & Kolstad, 1993). Yet most websites are written at the 10th grade level or higher. The goal of this two-year study, sponsored by Pfizer, was twofold: 1) to understand the differences between the reading and navigational strategies of users with medium to high literacy skills and those with lower literacy skills; 2) to learn how to make web-based medical content usable and accessible for lower-literacy adults, and to develop design principles that could be used to design websites that would meet the needs of both higher and lower literacy users.**

Introduction

While the "digital divide" has been studied in terms of access to computers and to the internet, little work has yet been done examining the accessibility of web-based information for lower-literacy users in terms of form and content.

According to a PEW July 2003 report, the three primary online activities of adult Web users in the U.S. are using email (93%), searching for health information (80%), and researching a product or service before purchasing (83%). A growing number of government services are also becoming available online.

In the medical field alone, the American Medical Association's Council on Scientific Affairs suggests that costs associated with low health literacy may average $73 billion annually (American Medical Association, 1999). Much of these costs can be attributed to poor information sharing between patients and care providers. Making websites more accessible and usable for all consumers has the potential to reduce these costs. The Web can be a quick and efficient way to present interactive information, as well as a tool for making scientific knowledge available to a broader demographic sample (Eng *et al.*, 1998).

Reduced access or limited understanding of health information can dramatically affect health care outcomes and costs. Similarly, as government services move online they may ironically become less available to the very constituents who need them most. It is therefore urgent that website designers learn to support the needs of lower-literacy participants.

This major study was designed to examine the strategies of low-, medium-, and high-literacy users for reading medical content on the Web, to identify content presentation strategies that were more usable for lower-literacy constituents, and to test the effectiveness of these strategies. The team iteratively developed design principles for making such content more accessible and usable for lower-literacy users, incorporated those design principles into a revised version of a major medication site (referred to as the "prototype"), and then quantitatively compared times on task and task success rates for the original site and for the prototype. This research was sponsored by Pfizer, a major pharmaceutical company.

In order to focus on usability and accessibility issues that were products of low-literacy rather than simple unfamiliarity with the computer or with the Web, all participants were observed using the computer prior to testing and screened for facility using computers according to a pre-defined checklist.

***Project Goals***

- Discover what reading and navigational strategies are used by lower-, medium-, and high literacy constituents, and what formats do or do not support these strategies
- Develop guidelines for website developers that will support lower-literacy users

- Implement and refine these guidelines in a prototype website through iterative testing and redesign
- Test the validity of the guidelines through a quantitative comparison of the new prototype as compared to the original site

**Methods**

The project consisted of three phases: Discovery, Analysis & Response, and Evaluation

*Phase 1—Discovery*

Phase 1 consisted of preliminary research into the reading strategies for web-based material of a range of users. In two rounds of qualitative testing, 30 users with varying literacy levels were observed reading a variety of web-based heath materials. Tasks assigned included both user-directed and moderator-directed reading activities. Tasks ranged from unconstrained browsing for health information, URL-constrained browsing, and page-constrained browsing.

- During the first round of qualitative testing, the searching and reading behaviors of 24 users ranging from low to high literacy were observed. 71 users were recruited; actual participants were selected based on performance on the REALM (Rapid Estimate of Adult Literacy in Medicine) and facility in browsing the web. Tests were performed at the Murray Hill Center in NYC in November 2002.
- A second round of qualitative testing was performed in the Bronx in January 2003, focusing on lower-literacy users. 35 potential participants were given the REALM and observed using the computer; 6 test participants with Web familiarity and 4th-8th grade literacy levels were selected.

*Phase 2—Analysis and Response*

Based on these qualitative tests, design principles were developed for making text and other content more usable for lower-literacy users. These principles were then implemented into a prototype for further iteration and evaluation. The prototype was a revision of the content of one of the sponsoring company's major medication sites.

- Small-scale qualitative iterative testing of the prototype was performed at the University of Baltimore during the development of the prototype.
- A full-scale preliminary qualitative test of the prototype was performed at Baltimore Research in Baltimore in May 2003. 34 participants were recruited and given the REALM; 8 participants were selected—four medium to high literacy and four low-literacy.
- Guidelines and prototype were refined and finalized.

### Phase 3—Evaluation

Phase 3 consisted of a quantitative comparison between the original medication site and the revised prototype. The test was a between-subjects, double-blind quantitative comparison of time on task and task success for both medium-high-literacy users and low-literacy users. Participant comprehension of site content and subjective participant satisfaction with the site were measured after the test.

Participants were sorted into matched pairs and then assigned to either the original site or the revised site. The matched pairs were based on three variables: pre-test observed computer experience, pre-test knowledge of medical condition (high cholesterol), and REALM score. Comparison scores were aggregated across groups; specific matched pairs were not compared.

Time on task and task success rates were captured by two independent observers observing the test through a one-way mirror and on a second monitor that echoed the user's screen. The test session was also recorded using Camtasia. Observers recorded data using a custom template that allowed observers to capture start and stop times and success rate; time on task was computed subsequently. Success rates were measured against previously established criteria.

The test moderator used a pre-defined script, to minimize variation in test circumstances.

The quantitative study focused on two groups: medium- to high-literacy users, and lower-literacy users.

- Quantitative comparison testing of 30 medium-high literacy users, sorted into matched pairs, was performed in August 2003 at the University of Baltimore/Strategux test facility.
- Quantitative comparison testing of 20 lower-literacy users, sorted into matched pairs using the same criteria, was performed August – Nov 2003 in Baltimore and in Detroit.

### *Recruitment issues*

Recruiting lower-literacy participants for usability testing is made more challenging by the very problem that our research was attempting to solve: the Web is currently not very usable for these participants, so it can be difficult to find lower-literacy participants who are already familiar with using the Web. Many potential recruits could not be included because they were not familiar with using a mouse, or did not recognize links or know how to use common browsers. Because the Web environment is not currently very friendly for this constituency, many do not use it at all. Unfortunately, the scope of this project precluded focusing on the fundamental difficulties of learning to use a mouse or understanding what a link is. Such issues are fundamental to understanding the digital divide (Zarcadoolas, Blanco, Boyer, & Pleasant, 2002). We hope to explore such issues in future projects.

It is also, of course, difficult to screen for low-literacy over the phone. We tried a variety of methods: recruiting participants who use the Web but did not complete high school; recruiting lower-income participants through community organizations that teach basic computer skills; recruiting participants through libraries and literacy organizations; and recruiting large numbers of participants with high school or community college experience but no university experience and then administering the REALM to screen for literacy level.

**Qualitative Observations: Reading and navigational strategies**

We observed a range of reading strategies and navigational behaviors from lower-literacy participants:

*Reading every word*

Scanning is hard for lower-literacy users. Reading itself takes a great deal of concentration and effort. They can't grasp the structure of the page at a glance by reading headings and subheadings. Some lower-literacy users compensated by reading every word on the page so that they didn't "miss" the answer. Similar thorough reading has been reported for older users and less Web-experienced users (Chadwick-Dias, *et al.* 2003; Theofanos and Redish 2003, Theofanos *et al.* 2004; Tullis and Chadwick-Dias 2003).

*Focusing on a narrow field of view*

Lower literacy users and some older users are less able to pay attention to cues about what might be coming up or remember where they came from because processing the text itself takes so much cognitive attention. As a result, they have an especially narrow field of view—as they move through page content, they are not "looking" ahead or behind, so they are not likely to notice any content above, below, or to the sides of their focus of attention.

Given this narrow field of view, it is particularly crucial that headings make sense out of context, and that pages make sense independently. Even adjacent paragraphs should be as independent as possible. If paragraphs cannot be understood without remembering the content of the previous paragraph, some low-literacy users are likely to be walk away with misinformation.

*Skipping chunks of text*

When confronted by long, dense pages of text, some lower-literacy users simply skip chunks of text. Ironically, such users would sometimes end up skipping over the very content they wanted—even if the target content was appropriately signaled by a heading, a well-chunked paragraph, or a bulleted list. This skipping was clearly not the same as the scanning behaviors employed by more literate users—on longer pages with multiple paragraphs, the lower-literacy users would sometimes skip right over headings and lists in order to land in the middle of a paragraph.

Skipping seemed to be triggered most often by

- long paragraphs of dense text
- long pages requiring scrolling
- numbers contained in the text
- difficult, long, or unfamiliar words
- parenthetical text

### *"Satisficing" quickly*

Because looking for additional information requires more reading, lower-literacy users tend to decide they have enough information relatively soon. In practice, this frequently meant that they settled for answers that were incomplete or even misleadingly vague. Marketing speak was particularly difficult for such readers to process. Lower-literacy users had more success on sites that kept their content short and to the point, but even on these sites they stopped reading long before their more literate counterparts. The most important information needs to appear first in its context—whether on a page, in a paragraph, or in a list.

### *Skipping from link to link*

Some low-literacy users tried to minimize the amount of reading they would have to do by focusing on finding links instead of reading content. These users skipped from link to link throughout the site, often ignoring page content completely. When asked, they said they were hoping to arrive at more focused information. Users who relied on this strategy sometimes landed on pages with their desired content but did not see it. Such users had very low rates of task success.

We also found that lower-literacy users were distracted and often derailed by content and links that were pulled out into the right margin. They had better success when content appeared only in one main column.

### Avoiding search

Search requires spelling and typing, and not all search engines can deal with spelling errors. And the format of search results makes them unusually difficult to process for lower-literacy users. For example, Google's search results page is a text-heavy list of page titles, which frequently contain extraneous or confusing words, some text excerpts pulled from page content that are often not even complete sentences, and funny-looking, hard-to-read URLs.

Lower-literacy users, if forced to use search at all, would typically ignore all text except the page titles, and would click on the page title that either 1) appeared first in the results, or 2) looked simple and matched their search string most closely.

### Quantitative Results

The final phase of the project involved a quantitative comparison of success rate, time on task, and subjective satisfaction between the original medication site (Site 1) and the revised prototype site (Site 2).

The usability of a site is typically measured in terms of effectiveness, efficiency, and satisfaction. We measured:

- how successful users were at accomplishing their desired tasks (task success rate)
- how long it took to accomplish tasks (time on task)
- how enjoyable the experience was (subjective satisfaction)

The results show marked improvement for both low and high literacy users (see Table 1).

Table 1: Time on Task, Success Rate, and User Satisfaction for the original medication site (Site 1) and the revised prototype (Site 2)

| Time on Task (Mean)* | Site 1 | Site 2 | Improvement |
|---|---|---|---|
| Users with high literacy | 14:19 | 5:05 | +182% |
| Users with lower literacy | 22:16 | 9:30 | +134% |
| All users | 17:50 | 6:45 | +164% |

| Success Rate (Mean)* | | | |
|---|---|---|---|
| Users with high literacy | 68% | 93% | +37% |
| Users with lower literacy | 46% | 82% | +77% |
| All users | 59% | 89% | +52% |

| Satisfaction (Mean)* | | | |
|---|---|---|---|
| Users with high literacy | 3.73 | 4.58 | +23% |
| Users with lower literacy | 3.54 | 4.38 | +24% |
| All users | 3.67 | 4.51 | +23% |

*all results were significant; see Figure 1 for confidence intervals

Users with high literacy were able to accomplish their tasks almost three times as fast with the revised site as with the original. These users were also more likely to be able to complete their tasks successfully, completing 93% of all tasks successfully on the revised site.

Users with lower literacy had severe difficulties with the live, unrevised site. Their task success rate increased from 46% to 82% with the revised site. They were also able to complete their tasks more than twice as fast with the revised site as with the original.

All users reported higher levels of satisfaction with the revised site than with the original site. No users, even those with graduate degrees, had a negative reaction to the revised site with its improved readability and usability.

**The Numbers in Detail**

The graphs in Figure 1 show 95% confidence intervals for the time on task and success rate measurements. The confidence intervals do not overlap, indicating that the results are statistically significant. In other words, there is a 95% chance that the true result, if everyone in the population were to be measured, would fall somewhere in this range. Because the results for Site 2 fall outside the confidence interval for Site 1, it is unlikely that users' improved performance on Site 2 was not due to chance.
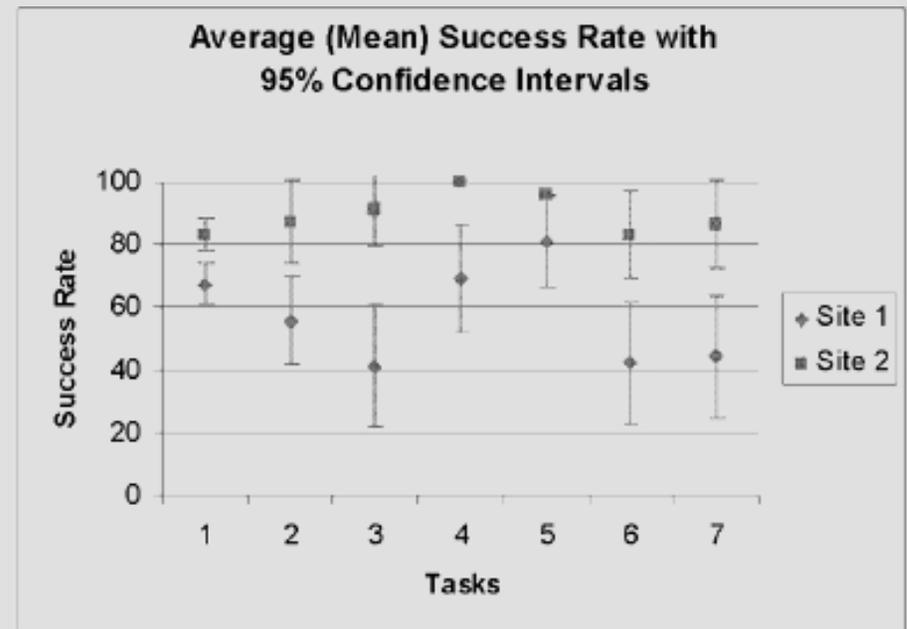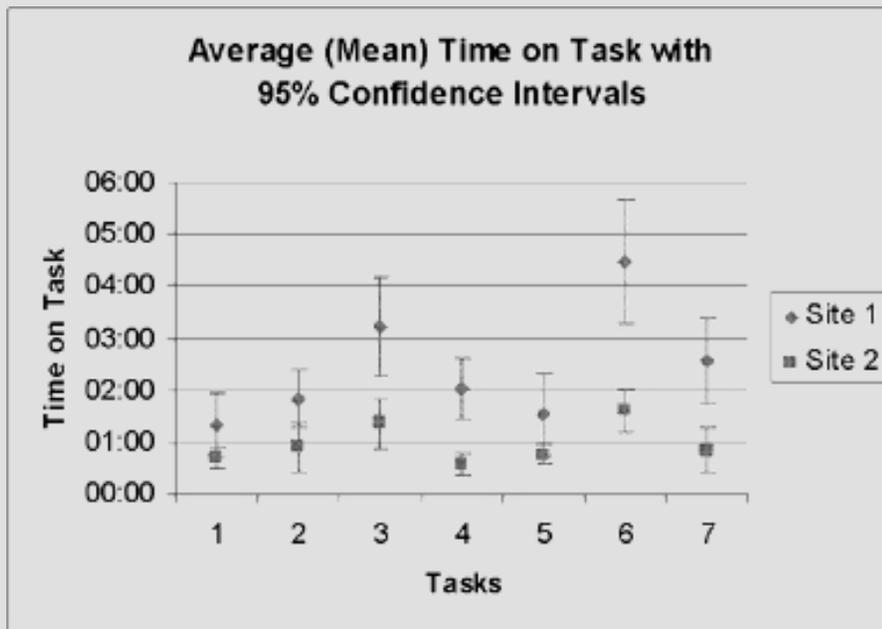
Figure 1: Confidence intervals for Time on Task and Success Rate Comparisons for original medication site (Site 1) and revised prototype (Site 2)

The average success rate is below 80% on all the tasks on the original site, but between 80 and 100% for all of the tasks on the revised site.

### Subjective User Satisfaction

There are several factors that are likely to have affected the user satisfaction scores for the two sites. First, subjective measures of user satisfaction tend to be high, even if users are less than satisfied with their experience during a test. Second, users with lower literacy skills are sometimes reluctant to say that something is hard to read. Thus the scores for both sites are likely to be somewhat

inflated, and the scores for the original site did not seem to reflect the observed difficulties experienced by users with lower literacy skills, nor the observed frustration exhibited by these users.

**Discussion: Major guidelines for site redesign**

- Eliminate wayfinding as much as possible by keeping information architecture flat and shallow; use a site structure based on "linear information paths" (see below)
- Put the most important information first in its context—within a linear information path, on the page, in a paragraph
- Write text at a 6-8th grade reading level with a simple sentence structure
- Keep pages, paragraphs, and sentences short
- Maintain a single column of content—avoid lists of links or callout features in the right margin
- Reduce the number of links per page; use inline links primarily to redirect users who are in the wrong "linear information path"
- Make navigation look and act like navigation; create a clear visual signal of user's location within the site
- Use standard link behaviors—no pop-ups, no DHTML rollovers, no new windows
- Make text large—14pts for a 5 inch text column
- Use information graphics and animations to show processes and relationships

*Discussion of Key Guidelines:*
*Readability*

Literacy research has demonstrated that the readability of a text depends on the familiarity and difficulty of the words used, and on their arrangement into sentences, paragraphs, and other chunks. While most readability formulas focus primarily on word length and sentence length, our research seemed to follow findings that word familiarity has more impact than word length (Doak, Doak, and Root, 1996), although we did not do quantitative measurement of this effect. We also attempted to use sentence and paragraph structures that did not require users to hold the meaning of early clauses or sentences in working memory in order to interpret later

text successfully. In other words, we attempted to write text that did not place large demands on users' working memory.

Our research indicated that enhancing readability benefits all users and increases satisfaction levels for all users, but that improved readability is crucial for users with lower literacy skills or other special needs.

*Site structure and "Linear Information Paths"*

We found that less experienced Web users, older users, and lower literacy users are often stymied by complicated navigational structures. To respond to the problems we observed, and to raise the comfort level and success rate of such users, we chose to organize content into clear suggested linear information paths that are built into the architecture of the site. A linear information path is created by pulling all the information on a particular topic into a single global navigational area, divide it into page-size chunks, and then create a linear reading path through the content that starts with the information that is the most general, the most simple, and the most important and puts information that is more complex, less simple, and more specific towards the end of the path.

Linear information paths move users through a particular topic in a logical order, starting with the information that is most important, most general, and most simple. Information that is more specific or more complex, and that will be needed by fewer users, appears later in the path. At the end of each page in a particular path, users find a link to the next page in the path. At the end of each information path—or set of linearly organized pages—users are invited to choose another path from the full set of possible paths.

Linear information paths are easy to use for all users, but they are especially helpful to users with special needs. Users don't have to stop their online learning in order to figure out how to advance to the next part of the lesson. This approach to presenting content is essentially a way to minimize the task that information architects call "wayfinding." In practice, the activities of wayfinding or following "information scent" turn out to be heavily dependent on reading, and tend to suffer when users pursue strategies designed to minimize reading. Such a structure supports the needs of users with a full range of literacy skills, because more literate users can

use the secondary navigation to skip the linear information path and move directly to the information they seek if they wish, while less literate users arrive at the information they need with a minimum of distraction.

*Information graphics and animation*

Presenting information in visual form makes complex processes and relationships easier to understand and remember for most users. Our research confirmed that presenting information through graphics or animations is especially valuable in helping users with lower literacy skills make the transition from familiar information to new information. It can help make abstract information concrete, and it can be an effective tool for communicating the benefits of recommended user actions. Informational graphics and animations are a particularly effective way of communicating key information.

## Conclusion

This study identified a number of reading and navigational strategies that differed between high and lower-literacy users. We also identified a number of usability best practices that are particularly crucial in sites designed for users with lower literacy skills. The good news was that adapting to the needs of lower-literacy users increased usability for all users without reducing user satisfaction. Clearly meeting the needs of lower-literacy users does not need to result in a website that feels condescending or infantile. Users with medium to high literacy skills were able to accomplish their tasks markedly faster on the revised site as compared to the original. They were more likely to completely their tasks successfully. Users with lower literacy skills also saw a significant reduction in task times, and more importantly their task success rate increased from 46% to 82%. All users reported higher levels of satisfaction with the revised site than with the original site. No users, even those with graduate degrees, had a negative reaction to the revised site with its improved readability and simplified navigation.

## Acknowledgements

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