Using Structural Cues to Guide Readers

Jan H. Spyridakis, Ph.D.
Professor

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Introduction

- Emerging tools and technology for reading
- Print materials moving to the Web
  - Conflated layouts: carry-over from the print world (e.g., long scrolling articles, lack of concrete links, global menus that disappear)
- Rhetorical cueing strategies often based on guidelines from print
- Need for empirically based guidelines for design of online information
Presentation Overview

- Supporting literature
  - Text linearity
  - Signaling & schema theory

- Recent work investigating the effect of structural cueing on comprehension, perceptions, and behavior

- Our experiment generator toolkit—WebLab UX

- Conclusions

- Future Directions
Literature: Linear vs. Nonlinear Text

- Who controls the text? Author? Reader?
- Linear text facilitates comprehension
- Nonlinear text (e.g., hypertext) facilitates perceptions of use, learner control, interactivity, and cognitive flexibility
  - But it can cause cognitive overload & disorientation
- Need to mitigate problems w/ hypertext to maximize the benefits
Literature: Signaling in Print

- E.g., Headings, previews, logical connectives, TOCs, indices
- Create schemata—critical for forming a coherent text representation
- Facilitative effect especially when readers find information only moderately familiar, interesting, or easy
Literature: Signaling in Hypertext

- E.g., Previews, links, menus, TOCs, site maps, indices, graphical overviews
- Previews improve knowledge acquisition with search tasks and also perceptions
- Graphical overviews enhance performance (especially for readers with low prior knowledge)
- Poor signals degrade performance
  - E.g., High frequency headings reduces comprehension of linear documents with online readers
Gaps, Problems, Solutions

- Findings primarily from print or from closed hypertext systems
- Web studies often focus on searching, not browsing
- Users aren’t assessed in their natural environments
- Need to gain empirical support for effective design of Web-based signals
- Advance capabilities of technology to support remote user testing, e.g., WebLab UX
Some of Our Recent Work

- Explicitness of local navigational links
- Intriguing and informative hyperlink phrasing
- Presence/absence of text previews and menus

Measures: comprehension, perceptions, and behavior
Methods Shared across Studies

- Studies conducted remotely through the Internet at participants’ own computer/location/time (announced through flyers, discussion boards, hyperlinks on sites)

- Participants
  - Engineering writing classes (M age ~ 21; gender ~ 75% male) OR
  - General population, e.g., users of medical Web sites (M age ~ 47; gender ~ 75% female)
  - Experienced Web users
  - Well-educated but they do rate study sites in midrange of familiarity, difficulty, interest
Methods Shared across Studies cont.

- Browsing scenarios
- Ss asked to spend ~ 20 min. browsing (Actual M ~ 11-14 min.)
- Pre/post browsing surveys
- Participation incentives
- Naturally occurring Web sites
  - Not too familiar, interesting, or easy
  - Explorable in 15-20 min.
  - Content with general OR specific appeal
Methods Shared across Studies *cont.*

- Nonnative English speakers excluded from analyses in ALL studies
  - They significantly differed from native English speakers on comp. and perceptions
  - Too few to analyze by experimental conditions
- Significant (sig.) results: $p \leq .05$
Welcome to our UWTC Study

This study explores how people read on the Web. Your participation will help us develop guidelines for creating Web sites that are easier and more enjoyable to use.

Here's how the study works. You will:

- Browse some Web pages.
- Take some short surveys.
- Submit your name and email to earn participation points in your TC class.
- **Enter a drawing for a $25 Amazon.com gift certificate** (if you desire). Three gift certificates will be awarded across the 150 students anticipated to participate in this study.

Please note that your name will not be linked to the study data in any way. Furthermore, you can withdraw from the study at any time by closing your browser window. Participating in this study should cause no more discomfort than reading any general information you might find on the Web and answering questions about it.

By clicking on the "Proceed to Study" link, you are agreeing to participate in this study and are affirming that you are at least 18 years of age. Please feel free to print a copy of this consent form for your records.

**Proceed to Study**
Study Instructions

- Please maximize your browser window for better viewing of the study Web pages.
- Complete a brief survey about your use of the Web.
- Click the link at the bottom of the survey: "Continue to Study Pages."
- **Spend about 15-20 minutes browsing the study Web site.**
- When you are done browsing, please click on the "Proceed to the Follow-Up Survey" link, where you will answer questions about the Web site.

Please note

In order for your study data to count:

- Do not open multiple windows or tabs for the study site.
- Do not return to the study Web site after you have entered the surveys following the study Web pages about Big Bend.

Now, to begin browsing the study site, please click on the link below. Thank you for participating.
Browsing Scenarios

For this study, please imagine....

You are going to be a summer tour guide for a U.S. national park called Big Bend. To prepare for this job, you want to learn as much as you can about this park by browsing the following Web pages.

Please spend around 15-20 minutes (at least) browsing the Web pages.

Continue to study pages
Pre-Browsing Surveys

Please answer the following questions to the best of your ability.

1) In general, how comfortable do you feel using computers?
   - Very uncomfortable.
   - Somewhat uncomfortable.
   - Neutral.
   - Somewhat comfortable.
   - Very comfortable.

2) In general, how comfortable do you feel using the World Wide Web?
   - Very uncomfortable.
   - Somewhat uncomfortable.
   - Neutral.
   - Somewhat comfortable.
   - Very comfortable.

3) How many years have you used the Web?
   - 1-2.
   - 3-5.
   - 6-10.
   - More than 10.

4) What is the highest level of education you have completed?
   - High school or equivalent.
   - Vocation/technical school.
   - Some college.
   - Associate’s degree.
   - Bachelor’s degree.
   - Graduate degree.
   - Other.

5) What is your gender?
   - Male.
   - Female.

6) What is your age?
   - Under 18.
   - 18-25.
   - 26-35.
   - 36-45.
   - Over 45.
Reef fish

This is hard to believe—an 18 year old a/ofo was caught in American Samoa. That's old enough to get a driver's license. And I ate that elderly fish (instead of the neighborhood festy worms, which are an acquired taste). All that remained of that fish were the little bones that scientists use to determine the age of the fish. Those bones, when looked at under a microscope, have concentric circles, one for each year, just like tree rings. You just count the rings and that's how old the fish is.

What's even more astonishing is that an a/ofo caught in Australia's Great Barrier Reef was 44 years old. I am not kidding. Reputable scientists determined the age of that fish. There were also other a/ofo in the Australian sample that were 20-40 years old, so the record age of 44 is believable. It turns out that this is not unusual for coral reef fish. Recent studies show that several other species of surgeonfish, unicornfish, groupers, and snappers can also live up to 20-40 years.

These findings are beginning to reshape the understanding about the ecology of coral reef fishes and their vulnerability to overfishing. Coral reefs are like underwater strangler figs, giving shelter and food to a wide variety of creatures. The occurrence of many long-lived fish in a population indicates that the reef fish community is fairly stable, with a low replacement of individual fish. Young fish may live on snow-dusted reefs for decades, if given the right conditions. These conditions can be affected by Samoa’s fava fava.

Why would these fish live so long? The answer provides some key information about the environment that the fish live in. Fish typically exhibit this type of life cycle (long life span and repeat spawning) when few of their young survive. That's certainly the case for coral reef fish—they're thousands of eggs and larvae drift around with the ocean currents for weeks or months. Very few of them make it back to the reefs. So, if all their young usually die, the fish need to live a long time and spawn repeatedly to make sure that at least some young survive. If the adults lived only a short time, the population might disappear altogether.

Every so often however, during years when the ocean currents and conditions are just right, massive numbers of young fish survive and appear on the reefs, like paiaia (young, pole surgeonfish) or paune (young catfish).
Please answer the following questions about your site.

1) How familiar were you with the information you just read?
   - Very unfamiliar.
   - Unfamiliar.
   - Neutral.
   - Familiar.
   - Very familiar.

2) How interesting did you find the information you just read?
   - Very uninteresting.
   - Uninteresting.
   - Neutral.
   - Interesting.
   - Very interesting.

3) How difficult did you find the information you just read?
   - Very difficult.
   - Difficult.
   - Neutral.
   - Easy.
   - Very easy.

4) How much new information do you believe you learned?
   - None.
   - A small amount.

Comprehension

Questions about American Samoa (1 of 3)

This section is important and concerns the American Samoa pages you browsed.

1) The term faʻasamoʻa means:
   - ecological system.
   - extended family.
   - way of life.

2) Swiftlets benefit the environment most by:
   - reducing insect populations.
   - spreading fruit seeds throughout the forest.
   - stabilizing cliffs with their nests.

3) American Samoa was "discovered" by European explorers in:
   - the 16th century.
   - the 17th century.
   - the 18th century.

4) In American Samoa, geological forces are:
   - causing the islands to grow in height.
   - creating interest in geothermal energy potential.
   - making the islands sink.
1) How interesting was the information you read?
   - Very Uninteresting.
   - Uninteresting.
   - Neutral.
   - Interesting.
   - Very Interesting.

2) How difficult was the information you read?
   - Very Difficult.
   - Difficult.
   - Neutral.
   - Easy.
   - Very Easy.

3) How enjoyable was the information you read?
   - Very Unenjoyable.
   - Unenjoyable.
   - Neutral.
   - Enjoyable.
   - Very Enjoyable.

4) How familiar were you with the information you read?
   - Very Unfamiliar.
   - Unfamiliar.
   - Neutral.
   - Familiar.

5) How many pages of the site do you think you visited?

6) How many pages of the site do you think you visited? (Please enter a numeral.)

7) What percentage of the site do you think you visited?

8) Please provide any additional thoughts you have about the structure (organization) of this Web site.

9) Please provide any additional thoughts you have about the content of this Web site.
Study 1: Explicitness of Local Navigational Links

- Effect of explicitness of wording of local navigational links on users’ comprehension, perceptions of use, and behavior
- Replacement of generic link labels with explicit labels will lead to:
  - Higher comprehension
  - More positive perceptions of use
  - Greater site exploration
Specific Literature: Explicitness of Link Labels

- Labels that reveal relationship of source and target positively affect comp. & perceptions of use
- Labels that reveal target content promote focused reading
- Local nav. links can conflict with browser functionality (e.g., browser back button)
Methods

- 84 participants from general pop.
- Web site on Osteoarthritis: 4 linear articles, 28 pages
- 4 Conditions: varying in semantic and organizational explicitness of local nav. links
- Comprehension test: 18 questions
Four Web Sites: 4 Versions of Link Labels

**Generic**

- <<Previous
- Home
- Frequently Asked Questions about Arthritis
- Next>>

**Semantically Explicit**

- <<About arthritis
- Home
- Frequently Asked Questions about Arthritis
- Causes>>

**Semantically & Organizationally Explicit**

- <<Section 1 of 9
- Home
- Frequently Asked Questions about Arthritis
- Section 3 of 9>>

**Organizationally Explicit**

- Section 1 of 9:
- Home
- Frequently Asked Questions about Arthritis
- <<About arthritis
- Semantically & Organizationally Explicit
- Section 3 of 9:
- Causes>>
Frequently Asked Questions about Arthritis

Edited by Frederick A. Matsen, III, M.D.
Last updated January 17, 2002

Warning signs

What are the warning signs of arthritis?

Pain from arthritis can be ongoing or can come and go. It may occur when you’re moving or after you have been still for some time. You may feel pain in one spot or in many parts of your body.

Your joints may feel stiff and be hard to move. You may find that it’s hard to do daily tasks you used to do easily, such as climbing stairs or opening a jar. Pain and stiffness may be more severe during certain times of the day or after you’ve done certain tasks.

Some types of arthritis cause swelling, or inflammation. The skin over the joint may appear swollen and red, and feel hot to the touch. Some types of arthritis can also cause fatigue.
Results: Comprehension

- Sig. lower comp. for subjects in Org. cond. (e.g., “Section 3 of 9”)
Results: Perceptions of Use

- Sem/Org cond. (e.g., “Section 3 of 9: Causes”) reported following > embedded links
- Positive comments > most explicit cues (Sem/Org and Org)
- Neg. comments > least explicit cues (Next/Pre & Sem)
Results: Log Files

- Sem/Org & Next/Pre led to seeing most pages; Org led to least
Conclusions

- Implications for Web authors
  - Choose link wording carefully—some cueing can lower comprehension
  - Double up on signals
  - Users like what they are used to seeing
Study 2: Intriguing & Informative Hyperlink Phrasing

- Effect of generic, informative, and intriguing link labels (global nav. and embedded) on users’ comp., perceptions of use, and behavior
- Informative links will improve comprehension, particularly inferential comprehension
- Intriguing links will encourage site exploration
Specific Literature: Hyperlink Phrasing

- Informative link labels improve search accuracy—if not too long and if clearly worded
- Seductive details divert readers from main points
  - Interfere with understanding the main topic
  - May lead to misinterpretation
  - May lead to wider exploration of content
Method

- 475 participants from Engr. classes
- Scenario: You’re a new park ranger...
- Browsed 1 of 5 Web sites on American Samoa, 19 pages (15 min)
- 5 conditions: embedded and global links varying by informativeness and intriguingness
- Comprehension (19 factual and 19 inferential MC questions)
- Created toolkit to support the work
Shifting Gears: WebLab UX

- Remote research toolkit that we have been developing—WebLab UX
- WebLab UX Automatically...
  - Generates conditions from single source code
  - Assigns participants to conditions
  - Generates surveys from flat text files
  - Records user data: individual’s behavior in customized log files and survey results
<table>
<thead>
<tr>
<th>Generic</th>
<th>Intriguing</th>
<th>Informative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity</td>
<td>Tropical Menagerie</td>
<td>Native Animal Diversity</td>
</tr>
<tr>
<td>Volcanoes</td>
<td>Samoa’s Fiery Past</td>
<td>Samoa’s Volcanic Origins</td>
</tr>
</tbody>
</table>
## Link Conditions

<table>
<thead>
<tr>
<th>Nav/Embed Matched</th>
<th>Navbar links</th>
<th>Embedded links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Generic</td>
<td>Generic</td>
</tr>
<tr>
<td>No</td>
<td>Generic</td>
<td>Intriguing</td>
</tr>
<tr>
<td>No</td>
<td>Generic</td>
<td>Informative</td>
</tr>
<tr>
<td>Yes</td>
<td>Intriguing</td>
<td>Intriguing</td>
</tr>
<tr>
<td>Yes</td>
<td>Informative</td>
<td>Informative</td>
</tr>
</tbody>
</table>
Giant clams

Giant clams (faisua) are magnificent animals and it's always a pleasure to see one of these beauties on the reef; you might see them in the Fagatele Bay Marine Sanctuary. They are large, colorful and, surprisingly, the clams are part animal and part “plant.” That's because giant clams, like damaged coral reefs, have plant-like cells (zooxanthellae) in their tissues that produce free food for the clams. When a clam opens its shell and spreads out its pretty mantle, it exposes these solar panels (the zooxanthellae) to the sun to make food, like a plant unfolding its leaves.

At the same time, the clam also gets some food by drawing water through its siphon and filtering out any tiny food particles (zooplankton). Perhaps that's why giant clams grow so large—they have two very different ways to get food.

We have two native species of giant clams in our local waters, Tridacna maxima and Tridacna squamosa, which look fairly similar. They grow to about 12-15 inches in shell length, although most found today are much smaller because the larger ones have been over-harvested. The largest and most famous species of giant clam (Tridacna gigas), which grows as big as a large suitcase, does not occur in our waters, perhaps because, unlike some non-native pest species, it has not yet found its way here.

Photo by Larry Basch
Results: Comprehension

- Gen-Inf links sig. > infer. comp. than Intrg-Intrg links
- Gen-Inf links sig. > total comp. than Inf-Inf links
Results: Matched vs. Unmatched

- Key differences between “matched” and “unmatched” nav. link vs. embedded link conditions

<table>
<thead>
<tr>
<th>Matched</th>
<th>Unmatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic-generic</td>
<td>Generic-intriguing</td>
</tr>
<tr>
<td>Informative-informative</td>
<td>Generic-informative</td>
</tr>
<tr>
<td>Intriguing-intriguing</td>
<td></td>
</tr>
</tbody>
</table>
Results: Subjects in Unmatched Conditions

- Visited more pages
- Revisited pages more often—used more links
- Correctly answered more comprehension questions, overall
- Correctly answered more inferential comprehension questions about visited pages
- Believed they learned more from visiting the site
Conclusions

- Detailed embedded links encourage browsing and learning
  - Intriguing OR informative embedded links

- Detailed navbar links don’t affect browsing behavior or learning
Study 3: Text Previews and Menus

- Effect of text previews (preview/embedded links, preview/link list; link list only) and menus (present, absent) on comprehension, perceptions of use, and behavior

- Previews will increase inferential and factual comp., time spent on pages, and ratings of content relatedness

- Nav. menus will increase factual comp., site exploration, and accuracy of perceptions of site size and usefulness
Specific Literature: Previews & Menus

- Previews improve knowledge acquisition with search tasks and also perceptions
- Menus increase site exploration
- Poor signals degrade performance
Methods

- 282 participants (Engr. Classes)
- Scenario: Learn about Big Bend park to support upcoming job as tour guide.
- 6 conditions: varying in text previews (3 levels) and navigation tab menus (2 levels)
- Comprehension (16 inferential, 16 factual MC questions)
Big Bend

This page adapted from the U.S. National Park Service for purposes of educational research.

Big Bend is famous for its natural resources. The park, with its spectacular geology, is home to more than 1,200 species of plants (including approximately 60 cacti species), 11 species of amphibians, 56 species of reptiles, 40 species of fish, 75 species of mammals, 450 species of birds, and about 3,600 species of insects. The park boasts more types of birds, bats, and cacti than any other national park in the United States. Learn about the challenges to preserving the Air Quality in Big Bend, the Geological Formations that have shaped the land, the diverse Plant Life found within the park, and the unique contributions of the Rio Grande River to life in the region.

- Air Quality
- Geological Formations
- Plant Life
- Rio Grande

Proceed to follow-up surveys after browsing for 15 to 20 minutes by clicking here.
Big Bend

Big Bend is famous for its natural resources. The park, with its spectacular geology, is home to more than 1,200 species of plants (including approximately 60 cacti species), 11 species of amphibians, 56 species of reptiles, 40 species of fish, 75 species of mammals, 450 species of birds, and about 3,600 species of insects. The park boasts more types of birds, bats, and cacti than any other national park in the United States. Learn about the challenges to preserving the Air Quality in Big Bend, the Geological Formations that have shaped the land, the diverse Plant Life found within the park, and the unique contributions of the Rio Grande River to life in the region.
Results: Previews & Comp.

- Previews with embedded links sig. > inferential comp. than previews with link list
Results: Nav. Menus & Comprehension

- Nav. Menus did not influence comprehension!
Results: Previews & Perceptions

- Previews with list and link list only sig. > SUS ratings than previews with embedded links (Use ratings very similar)
Results: Menus & Perceptions

- Presence of menus sig. > SUS ratings vs. absence of menus (Use ratings very similar)
Results: Interactions on SUS & Use

- Previews with embedded links are most negatively affected by the absence of menus (Use ratings very similar)
Results: Previews & Percent of Pages Visited

- List only led to more exploration than previews with a list (trend toward sig., $p = .059$)
Pres. of menus led to greater site exploration than absence of menus (trend toward sig., $p = .061$)
Conclusion

- Previews w/embedded links positively influence inferential comp. but reduce perceptual ratings
- Nav. menus do not affect comp. but do improve perceptual judgments
- Link lists or menus lead to greater site exploration
Conclusions Across the 3 Studies

- Designers of online information should understand:
  - The need for cues in online documents
  - That signals may not equally affect print and online readers
  - That readers like what they are used to but can perform well with multiple types of signals
  - That readers may perform differently than they perceive—and that design decisions must be made in context
Design Recommendations

- Choose link wording carefully—cueing can > or < comprehension
- Be willing to double up on signals if they serve different purposes
- Consider detailed wording for embedded links—they can increase comp. and site exploration
- Be willing to mix different embedded links vs. nav links
- If inf. comp. is a goal, use a preview with embedded links on the home page and reinforce it with a nav. menu
Future Directions

- Finish analyzing data, open-ended responses, and navigational paths
- Continue investigating the effect of design variables on users who are reading the Web in order to learn information
- Examine actual readers of natural Web sites
- Continue development of WebLab UX
- Convince usability researchers of the ecological and external validity—and the value of remote user testing
- Look at design of Web sites for portable devices
For more information

http://depts.washington.edu/intres

INTERNET-BASED RESEARCH
@ The University of Washington

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Using the Internet to Study Users Interacting with Web Sites in Natural Settings

Welcome to the home page of the Internet-Based Research group, a Directed Research Group in the Department of Technical Communication. The group, directed by Professor Jan Spyridakis, has been studying how various features of the design of online information affect user behavior, comprehension, and perceptions. The research has focused on using online, remote methods to identify how people are using Web sites in order to optimize the user experience and on refining a software toolkit (WebLab-UX) that will dynamically generate alternative Web sites, deliver them randomly to participants through the Internet, generate surveys, and collect survey results as well as server log files and structured log data. Our goal has been to study users interacting with Web sites using their own computing environments at a time of their own choosing.

We welcome your interest in our work, whether that is in taking a look at our past and current studies, looking at the results of some of our published studies, or seeking our support in helping you assess online information and its design. We are seeking funds and cooperative projects. We hope to be able to spend more time developing tools to integrate with host Web sites of stakeholders who want answers about their site decisions. Our goal is to refine our WebLab-UX so that researchers, usability specialists, and other stakeholders can use it to assess samples of subjects remotely through the Internet. If you are interested in talking to us about such use of our WebLab-UX or funding opportunities, or about using a specific Web site as a testbed, please email Dr. Spyridakis at janis@u.washington.edu.