HF700: Foundations in Human Factors

Assignment Four: Cognitive Factors

Search and Navigation Strategies for the BEA WebLogic Commerce and Personalization Server Online Documentation

Jennifer M. Hocko

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Introduction

BEA Systems, Inc.'s information engineering group delivers WebLogic Commerce Server (WLCS) and WebLogic Personalization Server (WLPS) product documentation to readers via the Internet. The technical writers on the project team are collectively responsible for designing the documentation set home page, which serves as the entry point into information presented in both HTML and PDF formats. (See http://edocs.bea.com/wlcs310/index.html for the live version or the attached sheets for a fairly accurate printout).

The audience for the WLCS/PS documentation set encompasses various types of engineers. Depending on their role in implementing a personalized e-commerce Web site, the reader may be a technically savvy business manager, a content developer responsible for some customization tasks using JavaServer Pages (JSPs), or a highly technical Java/EJB programmer who works directly with the Application Program Interfaces (APIs) to extend these BEA products.

This paper addresses the cognitive factor of processing priorities as it pertains to searching the WLCS/PS documentation home page for specific information. It focuses on how members of our identified engineering audience utilize specific cognitive information processing strategies and various design guideposts to locate the information they seek. In light of this research, the WLCS/PS documentation home page is evaluated, and suggestions for improvement are provided where necessary.

Cognitive Search Techniques

This section describes various theories of information processing as they relate to search tasks, discusses some challenges with regard to the organization of content, and addresses particular search behaviors. It also briefly describes a few of the design guideposts that are often used as an aid to locating information.

Top-Down and Bottom-Up Processing

The environment we live in naturally makes a great deal of information available to us. However, as we determined during our study of other factors, the amount of attention human beings have for processing this information is limited. Therefore we sample information, turning our attention only to what we believe has relevance or importance. An understanding of *how* we choose these samplings (that is, how we decide where to direct our attention) could prove beneficial to many design situations, including the case of searching for visual objects on a Web site.

Top-down and bottom-up are theories that have been identified by cognitive scientists to describe how humans delegate their attentional resources to information processing tasks (Patel and Sathian). In a bottom-up processing scenario, it is said that humans allow lower level or data-driven activities to guide their attention. These activities are often the result of some external stimuli that initiates simple information decoding mechanisms. First, the smallest component of information is processed, followed by slightly larger components until high-level meaning is assigned to

the perceived information. In this linear technique, attention to larger components requires that preceding components first be processed. Paren provides the example of reading by processing the individual letters in a word prior to processing the word as a whole, then constructing individual words together as phrases, and so on, to describe the bottom-up processing theory (Bottom-up and Top-Down Processing Page).

Alternatively, in a top-down processing scenario, higher level processing (such as prior knowledge or a specific goal) drives human attention. Allocation of attention originates in the individual's mind before they even encounter an information-processing task. In an obvious contrast to the bottom-up theory, the top-down theory focuses primarily on comprehension and the assignment of meaning to the informational experience. The lower levels of attention previously described are employed selectively and only as needed (Bottom-up and Top-Down Processing Page). Patel and Sathian provide the following useful example:

> *"...when seeking a car in a parking lot, objects draw our attention because we search for them; this is an instance of "top-down," "endogenous," or "goal-driven" attentional selectivity involving an individual's deliberate intentions."*

Perhaps because a great deal of research is available to both support and discredit the top-down and bottom-up processing theories, it is generally recognized that the human mind utilizes both types of processing (Patel and Sathian). The combination of both top-down and bottom-up theories is generally known as interactive processing. As indicated by its name, this theory assumes that the top-down and bottom-up information processing techniques continually interact with each other. In a situation with a strong stimulus, bottom-up processing is more likely to be used; where a stimulus is inferior, top-down processing may take over to compensate (Bottom-up and Top-Down Processing Page).

This interaction between the top-down and bottom-up processing techniques can easily be applied to visual search tasks. When an individual embarks on a search for information, they hold a mental model of the target in their mind, and are said to be "primed" for locating that information (Butter and Goodale, 769). Using the previous top-down processing example, a driver in search of their automobile holds a picture of that automobile in their working or long-term memory, which assists them in distinguishing it from others in the parking lot. When the eye receives input that matches the individual's mental model of the target, the perceived stimulus of the target appears greater, thus activating bottom-up processing (Butter and Goodale, 770). In other words, a black automobile may seem to stand out to its owner, enabling them to locate it more quickly. There is one caveat though – if an object shares multiple stimuli with that of the target, it is highly likely that an individual could incorrectly identify it as the one they seek (Butter and Goodale, 770).

Cognitive Organization

The previous discussion on top-down and bottom-up processing supports the idea that a user will find a given interface intuitive only if its design correctly maps to the user's mental model. For search tasks, this mental model is not only that of the target item itself, but also the organization or structure of the target item in relation to others that may be

perceived and subsequently processed. Failure to match a user's model of cognitive organization can lead to user frustration and disorientation (Gonzales, 145-146).

Often, the underlying physical structure of information determines its organization in a user interface. For example, customer information that is stored in a database may be presented to users in a tabular format. Although this may be the simplest method for programmers to display, it may be the case that the physically driven structure is not conducive to the user's search task or to the cognitive organization/structure present within the user's mind. To ensure that a design structure closely matches the cognitive organization of its users, investigations should be conducted. This is especially true for information that is new, unfamiliar, or cannot easily be assigned into an existing category or group (Gonzales, 146). Navarro-Prieto, Scaife, and Rogers more strongly highlight the importance of such investigations when they state, "in order to understand the cognitive processing involved in the searching task it is *critical* [emphasis mine] to study the interaction between the information presented to the users and their internal representations".

Naturally, this cognitive organization can be evaluated as part of a task analysis early in the design phase. As Hackos and Redish point out, "the 'finding' part is immensely important. If users can't find the Web page they need, it doesn't matter how well designed it is" (395). Fortunately, information that is limited to a particular domain (such as computer programming) can influence how a user structures and organizes knowledge about that subject (Jonassen and Grabowski, 434). Therefore, the structure inherent in the content itself can help to place some boundaries on this seemingly difficult analysis. Moreover, studies have shown that even individuals with different backgrounds will typically structure information in a surprisingly consistent fashion (Gonzales, 148), and that for the most part, a hierarchical organization is preferred and may correspond to how users tend to organize information (151).

Search Behaviors/Strategies

Research has shown that individuals employ different search strategies when seeking information online. A study conducted by Van Waes illustrated that the main navigation devices on Web sites (headings, sub-headings, and other layout devices) seemed to lack order and preference, compared to similar navigation devices utilized in printed brochures (see *Design Guideposts* for more information). Additionally, the use of textual hyperlinks within both body texts and/or in frames did not result in consistent user behavior during the search process (Van Waes, 182). Rather than using these devices, users exhibited the well-known "aimless browsing" we all have come to experience. Reasons for this unstructured searching behavior may be because the organization of the content does not match the user's mental model (see *Cognitive Organization*) or does not meet their expectations. Hyperlinks, in particular, were discovered to be an overloaded construct that functioned as a barrier to effective search strategies. This is because hyperlinks not only represent the visual information a user processes while reading, but also act as a structural bridge to other, not yet visible information. It is not surprising then, that hyperlinks are often scanned separately from their context, and that subjects exhibited only vague predictions of the information available behind a given hyperlink (Van Waes, 180, 183).

An individual's search behavior can also be classified as being random or systematic. A random search behavior is self-explanatory – a user randomly searches a visual display for a target object. In systematic searches, an individual directs their attention to a particular area of the display that contains the strongest visual stimulus. If the target object is not found within that visual field, the eye is moved "one foveal diameter below the center of the current fixation" until a match is identified (Hornof and Kieras, 110-111). As in the top-down and bottom-up information processing theories, research has shown that individuals utilize both random and systematic techniques during search tasks (Hornof and Kieras, 114).

Design Guideposts

In his theory of organization, Gonzales states, "consistency creates and reinforces the user's understanding of [an] interface" (151). Such consistency in an interface design is somewhat dependent upon the guideposts used to visually organize the information. This section briefly describes two common design guideposts – color and typography.

Color

Because a human's visual processing of color is rooted in both the biological and pre-attentive factors, color helps to increase the stimulus of a target object and therefore can be used as an aid to locating information. Anderson provides the following guidelines with regard to use of color (which have been discussed in detail at one time or another throughout the semester):

- Color attracts the human eye and therefore should be used to highlight important objects rather than as a decorative effect (311).
- Contrast and brightness can be used to create text that advances toward the reader or recedes into the background (313).
- Contrast between foreground and background should be high enough for readers to distinguish text (314).
- Color presents a powerful way for readers to establish patterns of meaning. Overuse of color can obscure these patters and make objects difficult to differentiate from one another (316).

Typography

In addition to using color to increase the stimulus of a target, the amount of attention a user allocates to a particular object can also be increased using good headings, adequate font size, and proper font type. In both reading and searching situations, research has shown that effective use of these design guideposts can benefit users by helping them locate desired information more easily (Carliner, 565-566). Like all other aspects of information processing, this is because the human mind seeks out the patterns and shapes within text. Certain typographical practices, such as the variety offered by a mixture of upper and lower case letters, offer visual "hints," allowing users to more easily identify these patterns (Cooper, 42). This may explain why letters in all caps are difficult to read for long passages, and why letters rendered in a size smaller than 8 points present problems. Serif typeface is another technique that assists the human brain in identifying patterns within text. Studies have shown that in general, readers prefer serif typefaces and

that they are more quickly processed – most likely, the serifs and differences in line thickness allow readers to more easily distinguish between similar letters (Anderson, 379). However, san serif typefaces can work more effectively for headings. Perhaps this is because headings should stand out to allow for easy scanning, but should not be an overly dominant feature of the design, nor be strong enough to draw a reader's eyes away from other text. Headings larger than 12 points seem to produce this desired reader response. Lastly, most experts agree that the number of typefaces used in a design should be limited – using too many conventions can create a confusing, cluttered design that decreases the usefulness of these guideposts (Anderson, 380). (See *Search Behaviors/Strategies* for an explanation of how this has already occurred in some online situations).

Application of Concepts: Evaluation of the WLCS/WLPS Online Documentation

An individual's search for information within a documentation set (in any medium) implies that the individual is experiencing difficulties while attempting to reach a particular goal. In light of this difficulty, the individual may also be experiencing some degree of dissatisfaction and/or frustration when they turn to the documentation (See and Anderson). Therefore, it is even more important to facilitate quick and accurate searches in these situations.

Users visiting the WLCS/PS documentation home page probably begin their search using a top-down information processing strategy. They want to locate either conceptual information about a topic (or instructions about how to accomplish a task) they hold in their mind, before even loading the page in their browser. Additionally, the user's prior experience with the topic or task (or similar ones in other products) determines where they would expect to find that information in the BEA documentation (that is, their cognitive organization of the material will affect their search behavior). If the user's mental structure does not match that of the information, they may switch to a bottom-up processing strategy that requires more cognitive effort and may increase frustration.

When users first load the home page, some may focus on the bulleted information about WLCS/PS product features shown in the top, centermost portion of the page simply because of its prime location. Although the gray text is small and does not stand out, it is this reviewer's opinion that such information is not in line with the user's goal and therefore should not be displayed. This way, there will be no chance for this extraneous content to be the focus of any user's attention. Customers who own the products have probably already read this marketing information; even if they have not, learning about it now is not part of their agenda. If the user successfully ignores this, their attention may instead be drawn by the use of white text on a black background in the frame on the left-hand side of the page, and they may attempt to scan the categories for the desired information. If *the user believes* the topic or task is contained within one of these categories (according to their mental model), they may click on it to find out whether they were mistaken or correct in their assumption. Because the categories do not provide much information about what they contain, the former is likely to be the outcome, and the aimless browsing technique will again prevail. Moreover, the gray, receding topic headers that are almost the same size as their component categories (Commerce Server and Personalization Server) are not likely to be helpful or even noticed, when doing so could provide users with more structural information.

This reviewer believes that it is both more likely for the user to seek and be successful at locating information when they scroll down the page to reveal the table-of-contents arrangement. In this area, the categories from the left frame are arranged in a better hierarchy. They are first classified as either WLCS or WLPS topics in headers that are a bit more visible. Then, below the categories, subcategories of information are provided. This shows the user what types of information are included in each category and may either strengthen or modify their cognitive organization. If the former occurs, the design is good; if the latter occurs, the design lacks the proper organization, but at least informs the user of this fact *before* they click into the category.

Overall, the difference in size between headers and regular text could be improved, as could the color (especially in the left-hand navigation bar if it is retained as part of the design). However, because the main goal of the user is to locate specific information in the documentation and do so correctly, perhaps the framed navigation bar could be better utilized for standard (less-relevant) documentation links (such as Site Map, PDF Files, and so on that are currently shown along the top). Documentation topics that are easily recognized could then be moved into the main content area, followed by the categories and their sections in a three-tier hierarchy that is similar to the current design. Finally, although san serif font is used throughout the interface, it might also be a good idea to further distinguish the headers from content by using a serif font for the regular text.

Conclusion

Designing an interface that is conducive to users' goals, mental models, and search strategies is a complex and difficult task. Even when an audience has been thoroughly identified, there are many individual differences to consider. (This paper did not even begin to address them all.) When it comes to searching online, the challenge is even greater because there are so many bad designs on the Internet that cause users to modify their behavior and are thus (perhaps unknowingly and unintentionally) decreasing the effectiveness of standard guideposts through their misuse. As in many other factors, the best method for creating an intuitive design is to always perform some analysis with the intended user group(s) to see how, from a cognitive standpoint, they would go about searching the documentation. Only when this analysis begins to show some patterns of behavior will the human factors specialist know what techniques are likely to be used and model the design accordingly.

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