

Information Foraging Theory and Best Practices for Designing navigational Systems

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The more efficiently the user can interact with the web site to achieve their tasks the better the user experience. The goal of this paper is to provide the designer with an understanding of how users scan for information, make decisions and navigate web sites. With the understanding of these concepts, one can create a more usable and efficient navigation system.

This is an informational survey paper based on studies and experiments done by experts in the HCI, Library of Science and Psychology fields. Addressed within this paper is information foraging, the decision making process and then creating information scent.

Information Foraging

The information foraging theory states that humans seek and gather information in much the same way that animals gather food. In nature, animals seek and gather food in a manner that will take the least amount of energy to gather the most amount of food. For example, a rabbit might diet on a few small shrubs that are close to its nest rather than travel great distances for larger shrubs.

People share many of the same traits as animals when gathering information. For example, when people are seeking information they may diet on smaller pieces of information that are easy to find before venturing out to locate larger amounts of possibly more valuable information. As a result, a person might make use of all information that is near them before venturing out to a library or another location where there could be greater amounts of information.

Pirolli and Card states, "Conceptually, the optimal information forager is one that best solves the problem of maximizing the rate of valuable information gains per unit cost, given the constraints of the task environment" [7]. In this statement, the cost refers to the time and energy put forth to gather the most valuable amounts of information.

An experiment could be designed as follows to measure the effect of a perceived cost before a user interacts with a navigation scheme. For this to be accomplished the user would have to be given a representation as to how much information is within a given section. Therefore, before the user makes a selection they are able to establish the perceived cost of pursuing a given target within that section.

The example below is of the cell phone domain. The user is presented with the number of items within each category. Thus, the "Contacts" category contains 10 items while voice contains only 2.

- 📁 [Contacts](#) (10)
- 📁 [Recent Calls](#) (3)
- 📁 [Messages](#) (6)
- 📁 [Get It Now](#) (5)
- 📁 [Voice](#) (2)

The research question to be asked is how does the presence of this information effect how people navigate through the menu structure? With the labels given equal relevance, would a larger amount of sublevel items decrease the chance of the user selecting that category? Based on the information foraging theory one would assume that all things being equal the user would select the category with the least amount of contained items. As an example, a user might go to the "Voice" category to set the number of rings before activated instead of going to the "Messages" category. The reason according to the information foraging theory is that the perceived cost of scanning through 2 items and making a decision is less than scanning through 6 items.

When gathering information people move from source to source, seeking what is most valuable to their goals. These various sources of information are referred to as patches. Patches contain clusters of information that the person consumes. This consumed information makes up the person's information diet.

When searching for information people choose what types of patches to seek out based on their goals. For example, some patches may contain information clusters that are quite small, but due to the location or proximity of the patches, allow the user to move between them quite easily and efficiently. The information value within other patches might be large but be less efficient for the user to find when moving between patches.

Patches within the human world can be seen by visiting people's desks within a work place. For example, one might find stacks of folders at the front of the desk to minimize the amount of time it takes to get to a commonly needed resource, while other folders are located farther away[7]. Within the World Wide Web, large information patches can be a web site, while smaller patches might be specific sections within a web site. The goal when seeking information is to limit the amount of time spent moving between patches.

Once a patch of information is found, it is consumed until a decision is made as to if it is more efficient to keep absorbing information or move on to the next patch. Thus, the person will stay at a patch up until the point that the gain of moving to another patch is greater than staying at the current patch. Pirolli et al. describe this "As one increases the time allocated to within-patch there is, at first, an progressive increase in the overall gain rate, up to an optimal point, then there is a decrease in the overall gain rate. This is the result of opportunity cost: Rather than continuing to spend time in a patch that is now producing low yields, one

should be moving on to find another patch." This theory can be witnessed in nature.

When users can move quickly and effortlessly between information patches, their confidence level remains high because they are finding the information they need. As long as the user feels they are on the right track, they will continue on that path. If users do not feel they are on the right path, and the time between information patches increases, there is a greater chance of abandoning their search.

The Decision Making Process

There are two common approaches that a user might take when evaluating information and choosing a link within a web site. The way in which the user evaluates the information depends on their goals and knowledge of the domain. If a user has a specific goal and understanding of the domain it is more likely they will search the web site by evaluating each link one at a time until they reach a link that is most relevant to the goal they are trying to achieve. Once that link is reached, the user will select it with little review of any other links. This is also known as a top-down approach. If the user does not have a specific knowledge of the domain or a concrete goal, they are more likely read every link and then make a decision, also called a bottom-up approach. Distracters, which will be discussed later, can have an effect on the above two approaches.

Both of these strategies have different benefits. If the user is confident in their decisions, and the information scent is strong, then it is more efficient for the user to select the first link that matches their goal. If the user's perception of where the link is going to take them is correct, then the user has saved time by not reviewing every link on the page. However, if the user is not confident and does not have a good idea of what link matches their specific goal, it might be more efficient to wait and read all the links on the page rather than making a mistake and having to back track.

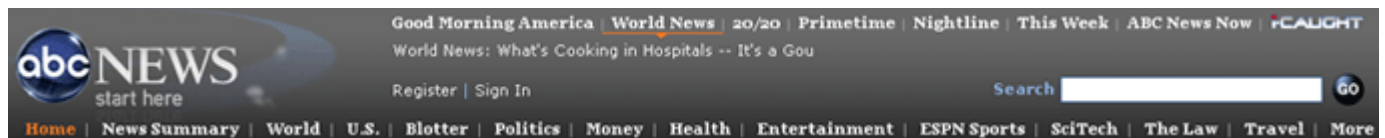
When looking to find the correct link, the relevance of all links is considered. Because of this, previously viewed links may affect the way the user scans content and interacts with the web site. If the relevance of all links is high, then the user might re-scan the links before making a decision. Doncan P. Brubmy et al. found that users were more likely to make a selection without viewing alternatives when a greater number of the previously viewed labels were less relevant to the users target [13]. Thus, people made decisions based on the content that had been previously viewed. If the content was of little relevance to the user's goal, then they assumed that the other content on the page was of little relevance.

I have witnessed this phenomenon multiple times while participating in usability test. In all cases I was the designer of the prototype and the observer of the test. In the cases when the content was above the fold and relevant to the user's goals, the users would scroll down to investigate what information may lie below the fold. However, in other cases when the content above the fold was questionable or not in relation to the

content below the fold the users did not scroll down. It was assumed that the users thought the content below the fold was as relevant as the content above the fold. Thus, the cost of scrolling down and viewing the information below the fold outweighed the cost of backing up and seeking other information. The solution was to move the content to another page that was more relevant to the user's goals. It was observed that as long as the content above the fold is relevant to the user, they will scroll past the fold.

Distracter items can also affect the user's decision making process. Distracter items are multiple items of information on a page that are of high relevance to the user's goals and can distort their decision making process—they simply distract the user. For example, a student is researching a recent news story in which a politician passed an international law placing a tariff on Chinese imports. When visiting the news site, the user is presented with links that include Politics, Law, Business and International News. Based on the broad categories and strong relationships each of these labels has to the user's goals, it would be hard for them to decide the correct link. This can make the user second guess themselves, which could cause them to make less accurate and confident decisions.

As an example: Below ABC News only offers broad categories for navigation on their home page. This makes it difficult to tell where the tariff on Chinese imports might be place.



A better example: CNN gives sample stories within the content that are associated with each category. These sample stories can serve as hints as to what type of content falls in each category.

U.S. »

- Two guards shot dead in armored-car heist
- Source: Student marked with KKK in 'game'

Politics »

- Clinton passes 50 percent mark in poll
- High court weighs how state selects judges

World »

- Plane crash in Congo kills 30
- All 3,200 gold miners rescued

Law »

- Jury weighs fast-food strip search case
- Gay-bashing defendant: 'I could be gay'

Doncan P. Brubmy et al. performed a study where a user was given a goal statement to read. After reading the goal statement, the user selected a search button with a mouse that then presented them with a menu and removed the goal statement. The user was then to select a label from the list that would allow them to achieve the goal statement. The participants were notified that there were a total of 16 labels in which 15 of them were distracters.

Once the participant selected a link, they were told if the selection was correct or incorrect. If incorrect, the participant had to return back and search for the correct label. The goal was to encourage the user to make the correct decision the first time.

Eye tracking was performed during this study, and it was observed that the user scans the labels systematically from top to bottom until they come to the correct label. Once the correct label is viewed, the participants continue to scan the items but in a less systematic approach. This meaning instead of viewing each label one after another, the user skips over times while scanning down the page.

It was also determined that participants spent less time when the distracters were of poor relevance and participants were more likely to make mistakes when the distracters were of high relevance. Therefore, the participants were both quicker and more accurate when the distracters were of poor relevance to the users goals.

Participants also revisited labels when the labels were of similarity to the target label. Only 8.19% of the time were all labels fixated on before the user actually made a selection [13].

From this study, one can gather that people search until they find their target then quickly scan to insure they are making the correct selection. Furthermore, the detail of their scan depends on the relevancy of the distracters.

Creating Information Scent

Information scent is what guides users between patches of information. The stronger the information scent, the easier it is for the user to move from patch to patch. Stuart K. Card describes information scent as the “(imperfect) perception of the value, cost, or access path of information sources obtained from proximal cues, such as WWW links” [7]. When reviewing such elements as links, the user perceives where that link is going to take them based on the label or description of the link. If the user is confident in where they link will take them, then the cost or energy exerted is perceived as low. However, if the user is uncertain—then the perceived cost is high.

Strong information scent allows the user to quickly and accurately make decisions guiding them to the information they need, while information without scent creates inefficient browsing experiences and causes the user to lose confidence. Information that does not carry scent is ignored for information that does.

Although not a scientific study, Jared Spool provides an easy way to gauge the strength of information scent. He achieves this by measuring the confidence of the user before they click on a link, then comparing it to the information they receive after clicking. The question Jared Spool asks right before clicking on the link is “How confident are you that this link will get you to what you’re looking for?” If the user is confident, there is a good chance that they will receive the information they are looking for and the scent of that link is strong.

As soon as the second page is reached, he asks, “Is this page getting you closer to your goal or farther away from it?” [12] If the user feels that the new page is not taking them towards their goal, then either the link label needs to be altered or the content on the linked page needs to be changed.

When creating link labels it is important that they are relevant to the user’s goals. Thus, when the users are scanning the links, it should be easy for them to determine which, is the correct link to guide them to the content they are looking for.

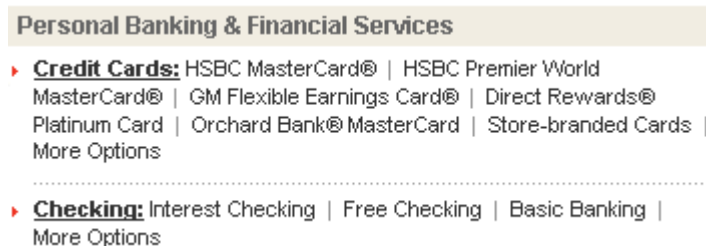
I participated in a usability test for a very large web site that contained significant amounts of information related to financial services. Within this test I was the person who designed the prototype and participated as an observer. There were several tasks that could be completed in two different ways from a single page. The first option was to select a link from a tab style navigation at the top of a page. Within this navigation, the categories were labeled in a broad fashion consisting of, at most, two words. The reason for the broad labels was due to the amount of content falling under the categories. An example of this type of label could be one such as “Personal”.

The second option was for the user to select a link within the middle of the page. These links targeted the same content as the top-level navigation but were presented in association with other content which provided context. For example, the user might be presented with the term "personal" and directly across from this were examples of items that fall within this category.

Below contains the broad category top level navigation



Below contains the labels with examples featured in the center content



In a majority of the cases, the users chose to click on the links within the center of the page while ignoring the top-level navigation. At first, it was thought that users were not noticing the top-level navigation. A possible solution was to give more prominence to the design of the tabs. However, after reviewing the eye

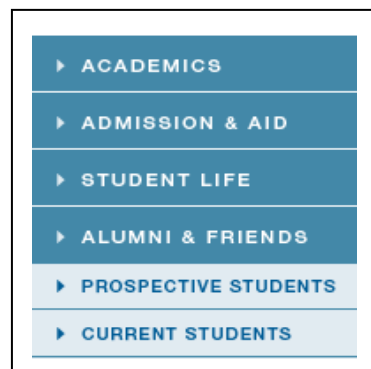
tracking information that was taken during the test, it was obvious that users were looking at the tabs but not clicking on them. This led us to believe that users were clicking on the links within the center of the page because they perceived them as a more direct way to reach their goals. The cost of efficiency with the web site through these links was less than through the top tab navigation.

Designers should avoid using labels based on irrelevant marketing or branded terms. While these links might mean something to the designer or the marketing department, chances are there meaning is irrelevant to the user.

An example below that I encountered on a web site was inserting the word “blue” before navigational labels. The labels below would be much more effective if they were more descriptive and did not contain the word “blue”.

Blue Finder Blue News Spotlight on Issues Healthcare Coverage Blue Innovations Better Knowledge

Designers should also avoid using terms that are too broad and do not effectively describe the content that lies beneath the links. Labels based on broad terms can cause overlap, making it difficult for the user to understand the difference between the links (overlapping labels of high relevance to the user’s goals create distracter items). For example, a user visits a university web site to find out what types of amenities are available for students. In doing so, the user is presented with two links, "Student Life" and "Prospective Students." While these labels might make sense to the people who created them, there is a bit of overlap in their descriptions. It is possible that either link could contain information about amenities for students.

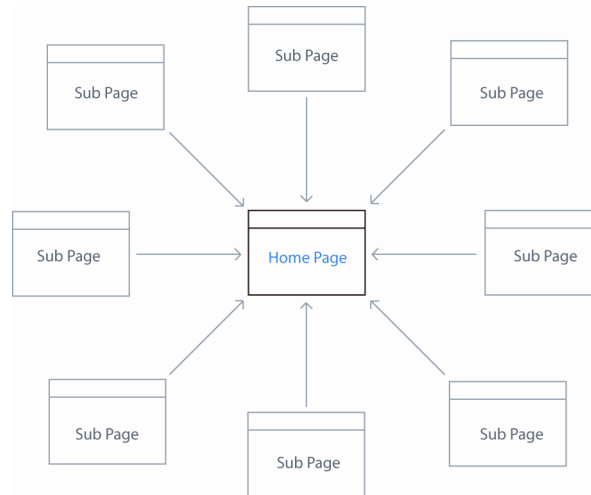


One way to solve the problem of using broad labels is to place relevant content examples next to the links to give the links more meaning. Another method is to provide a brief description of the content that might be found by clicking on the link. Users can then read the brief description to help them determine the meaning of the link. It is also possible that the content below the link needs to be more focused. Categories that contain a broad amount of information can be difficult to effectively label.

Images that are specific and relevant to the user’s goals can also increase scent. If the user is looking for printer cartridges, then an icon of printer could be placed on the web page. The user then can quickly associate the image with the link.

One way of creating information scent as described by Jared Spool et al. is to design starting from the interior pages. These pages are most likely going to contain the information the user is looking for to achieve their goal. Once the interior pages are designed and the content is determined, the exterior links should pull the

user towards the content. This can be done using the key or trigger words that are used on the interior page. However, if the designer starts with the outer most or home page, they are more focused on pushing the user towards a specific page that may or may not have content developed for it. Thus, the designer might not know what trigger words are effective. [12]



Content from sub pages are designed first and determine the information (trigger words) on the home page

Jared M. Spool states that the designer should ask the following questions when determining appropriate content [12].

- Why are users coming to the site?
- Which page is most important to the user?
- How will users find this page?
- What are the user's trigger words?
- Where are they likely to look for those words?

When users are looking for links, they are scanning for trigger words. Jared M. Spool describes trigger words as "words that people associate with the goals they are trying to achieve" in an attempt to pick up a scent. [12] Trigger words can be any word that a user associates with a particular informational goal. For example, if a user was looking for a refrigerator on a home improvement web site, they may be scanning for relevant words such as appliances, or refrigerators. The more relevant the trigger word, the greater the information scent. One possible way for creating trigger words is to monitor key words entered into a search engine.

Examples can also be used as trigger words. Susan T. Domais et al. discovered through a study that using three examples of the content within a category performed just as well as any label created by an expert (experts were defined as library scientists, computer scientists and cognitive physiologists).

In this study, 15 experts were to assign labels to five different categories. The categories were made up of a very broad list of topics that were gathered from Yellow Page headings. From the Yellow Pages, 307 of the largest categories were split into a balanced subset of 153 items.

310 undergraduate students were then recruited and asked to individually place the 153 items across five equally sized categories (it is not clear in the study why five categories were chosen. However, this does make the categories fairly broad and difficult to label). After the items were categorized, 15 experts were to create labels and assign them to the five different categories. In addition to the labels each of the categories were also described by using examples, which, were determined in three different ways: random selection, expert selection and a computerized algorithm.

Next, they gave 700 students 72 randomly chosen target items to find within the five categories. The number associated with the target item was then placed under the category. On average, the students correctly categorized target headings less than 50%.

It was also found that if a subject was confused by where to place an item, then they put it in the miscellaneous category. When the miscellaneous category was removed, the students performed on average between .30 and .44 times better, which suggests that users have difficulty-categorizing items into vaguely named categories.

Conclusion

Understanding the concepts that effect how users make decisions and scan information has a vital role in the design of a navigational system. The perceived cost of a label is determined by its relevance to the users goals. Distracters and the strength of the information scent can lower the perceived cost and, as a result, increase the chance that a user will click on the link.

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