Designing Documents for Selective Reading

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Because readers experience information overload and increasingly resist medium-to-long documents, this may be the time to focus on selective reading as a design problem and devise a broader range of ways to support selective reading. Readers should have ample and near-seamless choices regarding which topics they can read and the level of detail at which they can read a particular topic. To design for selective reading requires an understanding of how readers deal with incomplete information and the concepts of prerequisite information and dependency relationships. Three broad approaches can be identified: building supported reading pathways, modularization, and summarization.

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"Some books are to be tasted, others to be swallowed, and some few to be chewed and digested: that is, some books are to be read only in parts, others to be read, but not curiously, and some few to be read wholly, and with diligence and attention."

Sir Francis Bacon, "Of Studies," 1625

All of us regularly engage in selective reading within documents, and our documents offer a wide range of familiar affordances to support selective reading. Traditional documents, such as reports and books, provide support for selective reading through such features as explanatory footnotes, appendixes, and optional chapters. In the digital media, a huge class of documents including websites and help systems are strongly non-linear in their construction and invite readers to descend any branch of a wide hierarchy.

Now may be the time, however, to focus our attention on selective reading as a design problem and to devise a broader range of ways to support selective reading. Why now? We live in a world in which we are flooded with information (Bohn & Short, 2009), and both casual readers and, especially, knowledge workers are apt to experience this as information overload (Eppler & Mengis, 2004; Thomas et al, 2006; Wurman, 2001; Schick, Gordon, & Haka,1990). Both casual readers and, especially, overburdened knowledge workers can benefit from better support for selective reading.

Second, there are strong indications that many people, at least in some contexts, increasingly resist reading medium-to-long documents (Palfrey & Gasser, 2008; Rich, 2009; Self, 2009; Richtel, 2010). This is partly a response to information overload. But in addition there are indications that many people, especially digital natives, often prefer viewing and listening to reading and, when reading, prefer to read large numbers of short documents, such as text messages and social media posts, rather than longer documents (Palfrey & Gasser, 2008; Richtel, 2010).

Assuming, as we do, that the world still needs longer documents in order to communicate thoroughly and meaningfully about complex topics, better support for selective reading may contribute to the long-term viability of longer documents. Readers will more value longer documents if they know they have ample and seamless choices regarding which topics within the document they can read and the level of detail at which they can read a particular topic. Fortunately, newer technologies have opened up new design possibilities—although innovative design certainly does not require technological innovation (Zhou & Farkas, 2010).

Our goal here is to enrich the present understanding of how to design for selective reading. We briefly explain how readers deal with incomplete information and how authors manage dependency relationships among the ideas they present. Then we provide a wide-ranging survey of how documents can be designed for selective reading. This survey greatly updates a survey with similar aims written in 1988 (Holland, Charrow & Wright). We identify and describe three broad approaches to designing for selective reading, and we provide examples of each. These approaches are (1) building supported reading pathways, (2) modularizing content, and (3) summarization.

The Rhetoric of Dependency Relationships

To design for selective reading, there are certain things we must know about how human beings read and how documents (including recorded audio discourse) must be structured to enable efficient information processing.

How we read

The reading process consists both of taking in new information and applying existing knowledge (Kintsch, 1998; LaBerge & Samuels, 1974). As we absorb new information, we incorporate it into long-term memory and integrate it into our existing knowledge in the form of schemata (Anderson, 2004).

The reading process is robust: We are good at making inferences. That is, if there is a gap in our existing schema, we will draw upon the most relevant information we possess (McNamara & Kintsch, 1996). If we find that an item of relevant information is missing from what we are reading, we can often hold the larger idea in memory and wait for the missing piece. For example, someone who does not know soccer but encounters a routine newspaper article on a particular soccer game will likely be able to understand the gist of the article, especially if that person (as most of us do) has some familiarity with hockey, basketball, or another sport that involves scoring goals or baskets. If the article mentions corner kicks, this reader is apt to figure out that a corner kick is a good scoring opportunity. Furthermore, it is very possible that the detailed account of a particular corner kick will help our reader better understand corner kicks in general. Of course, the robust nature of the reading process has limits. If a lay reader picks up an academic journal article dealing with theoretical physics, the much larger deficit in background knowledge will quickly cause disruption and breakdown in the reading process.

Managing dependency relationships

The reading process greatly influences how we, as writers, sequence the ideas we present in discourse. To minimize the burden of reading and to create a satisfying reading experience, we carefully organize documents to provide a smooth progression from the initial knowledge level we expect our readers to possess to the full set of ideas we mean to convey (Chambliss & Calfee, 1989).

Let's first consider book-length documents such as complex expositions and arguments that are strictly linear in their construction—that is, designed to be read from beginning to end. All the chapters (and, within a chapter, all the sections) have a "building block" relationship. Each is a prerequisite to the next as the author carefully manages the expanding information context. Authors strive to avoid gaps in the presentation of ideas: missing or delayed information. Authors also manage the reading experience in many other ways, such as providing previews to activate the relevant schema that readers may have and providing headings to show the hierarchical relationship among the major ideas and to facilitate scanning for information (Lorch, 1989).

While the author of a linear document must carefully manage the evolving context of information, the reader takes on the complementary responsibility to read linearly. If the reader violates their side of this implied contract by skipping sections or chapters, the author's responsibility ends or is greatly reduced. Few people would sympathize with a reader who jumps around within a complex exposition or argument and then complains that the book is badly written and doesn't make sense. In much the same way, a hiker in the heavily visited parts of a national forest legitimately expects the trails to be reasonably easy to follow. But if the hiker leaves the trail to bushwhack through the forest and then gets into trouble, the forest managers bear little responsibility.

Non-linear documents offer one or more optional pathways, and each pathway creates a new context and, hence, more complex dependency relationships. An author, for example, might indicate that Chapter 4 is an optional chapter, perhaps a more detailed look at the topic explained in Chapter 3. The book now offers two supported pathways; two contexts have opened for the author to monitor and manage. One context consists of the ideas in Chapters 1-3; the other consists of the ideas in Chapters 1-4. Monitoring and managing these two contexts, while necessary, is not especially difficult: the author must simply ensure that nothing in Chapter 5 or beyond depends for a productive reading experience on an idea explained only in Chapter 4.

In genres such as textbooks and computer-based tutorials multiple contexts often arise. Monitoring these multiple contexts can be an arduous or even an

impossible task. Fortunately, however, because the reading process is robust, multiple contexts can often be managed without monitoring them individually. First, some domains are built in large part upon everyday knowledge that most readers can supply. But even in highly specialized domains (in which dependencies are inherently strong) an author can offer ample background explanations in lieu of monitoring each individual context.

As an analogy, consider a college instructor who is teaching Biology 103 to students who have taken one of three sections of Biology 101 and one of two sections of Biology 102. These five sections have all been taught by different instructors who have covered somewhat different content. The Biology 103 instructor is therefore responsible for six different contexts (3 x 2). Rather than monitoring these specific contexts (maintaining an ongoing awareness of the individual information gaps of the six subsets of students who have studied in the different sections), the instructor manages the dependency relationships in a generalized ("shotgun") style. That is, whenever she introduces a new topic, she will provide ample background information so as to be reasonably confident that her students will understand the new topic regardless of which section of Biology 101 and 102 each student has taken.

Modularization is a very different means of managing dependency relationships. Here discrete chunks of content are written as free-standing modules for which there are no prerequisites (other than a certain baseline level of general knowledge and reading ability). The reader can choose which modules to read or skip without any loss of context. For example, Farkas recalls that his high school biology textbook took the form of 10 modular chapters, each dealing with a system of the human body (e.g., the digestive system). Because of the modular design, the chapters could be read in any order (except that the chapter on the reproductive system was printed in a separate booklet we never saw).

Dependency relationships are rhetorical

Dependency relationships are not an inherent characteristic of texts but rather are rhetorical, dependent on the background knowledge, needs, and temperament of individual readers. If a mathematics instructor peruses a newly published algebra textbook, let us say a textbook in which the chapters are designed for linear reading, the instructor, because of her advanced knowledge of the domain of algebra, can skip chapters with little or no disruption. For her—though not for her students—there are no prerequisites.

A middle school student seeking only basic information about the Normandy Invasion might stumble upon a complex, sophisticated book about World War II. The book's chapter on the Normandy Invasion includes many themes developed earlier in the book, themes that the student, looking only at this chapter, cannot possibly understand. Still, for this student's limited information needs, the chapter may prove fully adequate.

In regard to temperament, some readers have more tolerance than others for processing information for which their background is not ideal (Lee, 2005). By way of analogy, a confident student who did well in his high school biology course might register for Biology 102 and figure he can cope with whatever information he missed by not taking Biology 101.

Three Approaches to Designing for Selective Reading

We now turn to the main part of this investigation, where we identify and explain the three approaches to designing for selective reading. We recognize that among the vast number of designs for supporting selective reading there are hybrids that span the approaches we identify. But our classification and the examples we provide should be helpful in any analysis of the many designs we do not cover and in future design work. Note that we exclude from consideration the extensive work that has been done on XML and content management systems (Albers, 2003; Boiko, 2005). We do so because content management systems are intended to create a multitude of customized documents rather than documents with special affordances for supporting selective reading. This is true even for content management systems in which users are empowered to create their own custom document (Rockley, 2001; Severson, 2009).

Building Supported Reading Pathways

Building supported reading pathways is often described as the "layering" of information (Holland, Charrow, & Wright, 1988; Graham, 2009). Four key ways to do so are described below: These are (1) employing optional components, (2) employing alternative components, (3) multipath design, and (4) employing gateway components.

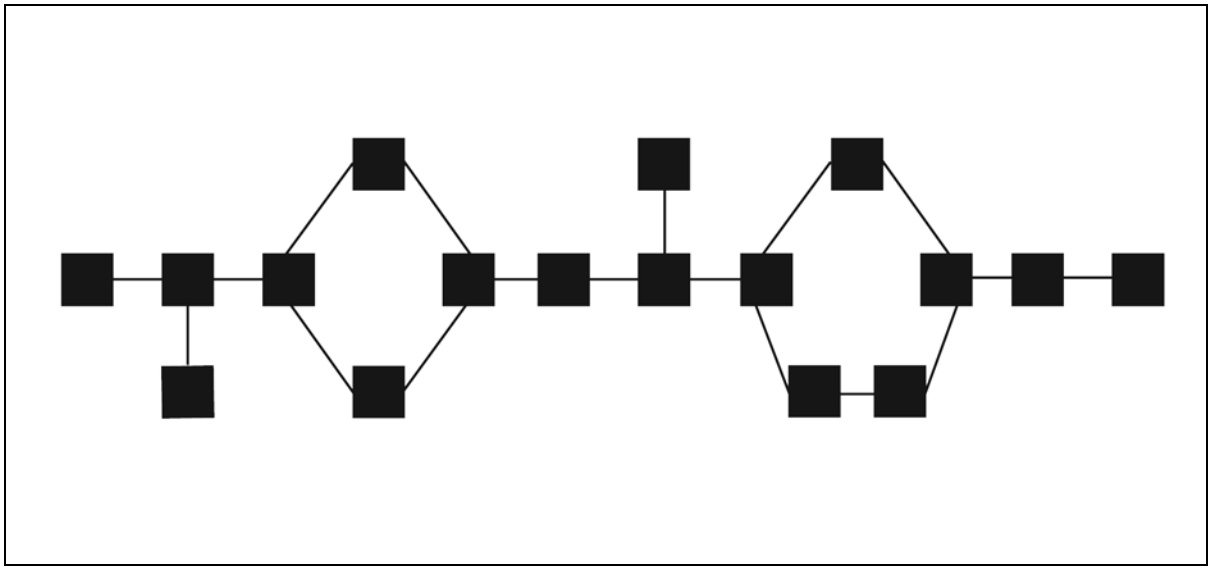

Figure 1. A multipath configuration with two optional nodes and two sets of alternative nodes.

Optional components

Optional components, as noted above, include explanatory footnotes, appendices, and optional chapters. These and other optional components share an implied contract with the reader. Nothing they contain can be a prerequisite for reading the core document. Note that an optional component—for example an optional chapter or appendix—can either open up a new topic or can elaborate on a topic covered in the core document.

Alternative (split-join) components

Another technique is to provide two (or more) alternative pathways. That is, the main reading pathway splits into branches, each of which contains the prerequisite information that will be necessary when the branches re-join. Consider, for example, a statistics textbook or an on-screen tutorial that offers two alternative units on multivariate regression, one with examples drawn from the social sciences and one with examples from the natural sciences. The reader is invited to read the most relevant unit knowing that either choice provides the necessary background for all subsequent units.

Multipath designs

The extensive use of optional and alternative components, illustrated diagrammatically in Figure 1, can be usefully regarded as a distinct technique.

Textbooks, both print and electronic, are often multipath designs. Publishers and textbook authors seek broad adoption by instructors who have different preferences regarding course topics, whose students have different backgrounds, and whose school terms are of different lengths. To provide flexibility in the use of the textbook, there are often alternative (split-join) chapters and, even more frequently, optional chapters. These options are typically described in the preface or in a teacher's guide. The Choose Your Own Adventure series of children's books and many computer games are multipath designs.

Gateway components

Gateway components are introductory components that provide the foundational information needed to support a large number of reading paths (branches of a hierarchy that the reader can descend). Two important genres that make use of the gateway strategy are computer manuals and websites.

Because few people wish to read computer manuals cover to cover, there is often a "gateway" chapter,

perhaps titled “Getting Started,” that explains basic concepts and provides an overview of the interface. The author’s intention is that the gateway chapter will prepare the reader to successfully read any of the subsequent chapters. Readers, of course, may skip even the gateway chapter and perhaps endure some disruption from their loss of context when they try to use the manual. At times the gateway chapter is designed to prepare the reader to read most—but not all—of the subsequent chapters. For example, while the gateway chapter prepares the reader for Chapter 6, “Basic Styles,” both the gateway chapter and Chapter 6 are required for Chapter 7, “Advanced Styles.” Ideally the titles of the chapters will reveal the special dependency relationship, as they do in this example.

Authors of computer manuals (and other kinds of technical documents) are especially likely to think about dependency relationships as they plan and write their manuals. Recognizing that readers favor modular designs, they will design a chapter to be modular if they can do so. Like textbooks, manuals often explain dependency relationships in a preface. Indeed, there are manuals in which complex reading pathways are revealed in a flowchart-like diagram.

Much like computer manuals, the home page of every website is designed as the gateway to each of the second-level pages. This means that users can always navigate confidently to any second-level page (nodes) and from any second-level node to any other second-level node following lateral links, as shown in Figure 2. On the user interface, these lateral links often take the form of a navigation bar. Users also know that they can confidently descend any branch of the website hierarchy: If you read a parent node, you should be able to productively read any of its child nodes (Farkas & Farkas, 2002).

An interesting and problematic issue arises with the associative links that jump across the main branches of the hierarchy at Level 3 and below, also shown in Figure 2. What is the writer’s contract with the user if the writer/web designer builds such links, as they regularly do? The user, we believe, has the right to expect the content of the destination page to be relevant to the page with the link. (We’ve all been annoyed by stupid, machine-generated links that take us to irrelevant destinations.) But there is no implied promise that the user will be able to fully understand this content. The destination page belongs to a different context and may well have different prerequisite information. In much the same way, there is no implied promise to someone who drops into an interior page of a website using a search engine. In both cases, however, the user can expect to find the prerequisite information by moving upward on the branch on which the destination node resides.

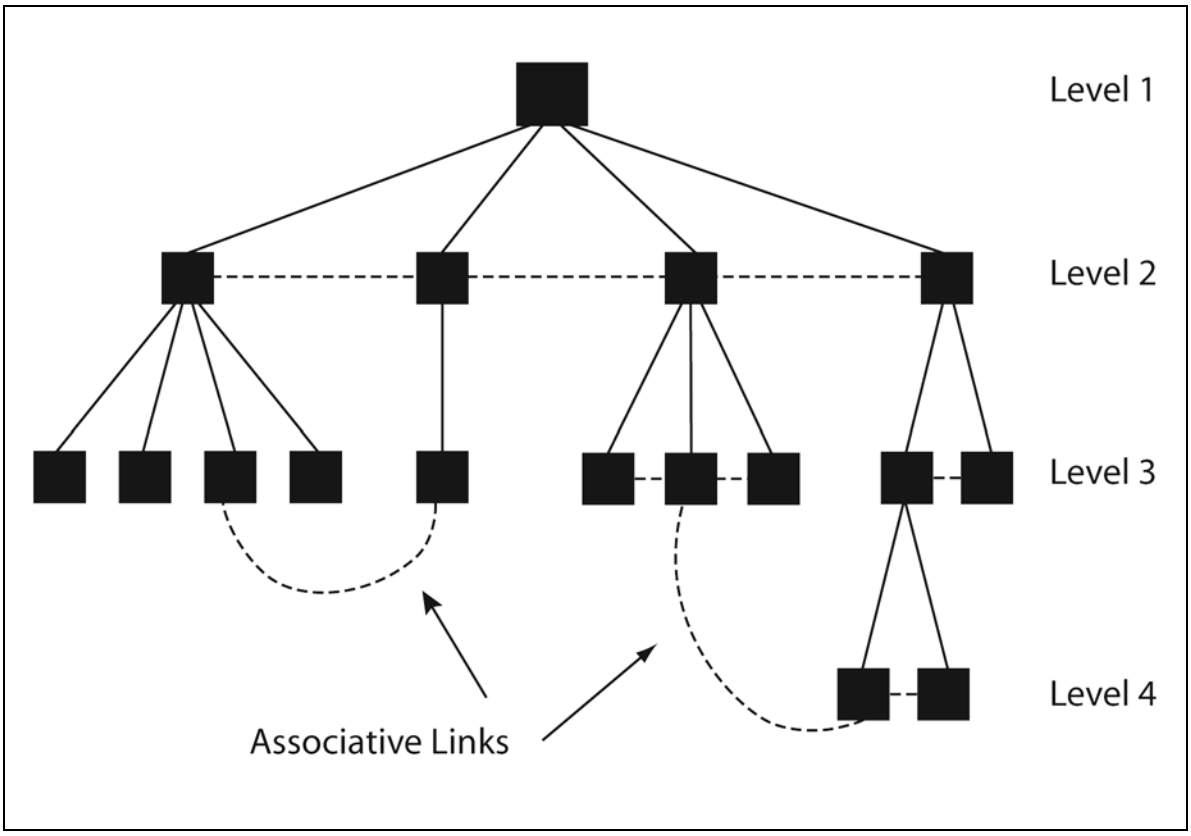

Figure 2. A node-link diagram of a website showing the primary links that comprise the website's hierarchical structure, lateral cross links that connect sibling nodes, and two associative links.

Modular design

Modular design is another approach to designing for selective reading. Here the strategy shifts from planning specific pathways to creating content that supports all pathways, all navigational choices. The paradigmatic example of modular design is the traditional encyclopedia article. No article will refer you to another article or an external information source as a prerequisite, although they may provide cross references to articles of related interest. Among the many books that consist of free-standing modules are those that follow the model exemplified by these (imaginary) titles: *Forty Ways to Save Our Planet* or *Ten Ways to Survive the Coming Economic Collapse.* The reader of these and similar books does not need to read linearly through the text. She can pick and choose among the modules.

The problem of redundancy

A major drawback of modular design is the redundancy that occurs when foundational concepts need to be repeated in more than one module. For example, assuming that *Forty Ways to Save Our Planet* includes multiple modules dealing with greenhouse gases, the concept of greenhouse gases must be explained, at least briefly, in each of these modules to avoid puzzling readers who don't know this concept. Explanations of various physiological concepts had to be repeated in several chapters of the modular biology textbook, adding significantly to the length of the book.

To avoid this drawback, designers may choose to blend the modularity approach with other strategies. For example, a hypertext version of *Forty Ways to Save Our Planet* might be authored so that a chapter explaining greenhouse gases becomes a gateway node to other chapters.

Modularity via adaptive techniques (AHA!)

AHA! is an adaptive hypermedia educational system that is well known among researchers. It was created in 1996 by Paul De Bra, a faculty member at the Technische Universiteit Eindhoven (De Bra, Smits, & Stash, 2006). Since then it has been regularly enhanced. The most significant application of AHA! has been De Bra's web-based course "Hypermedia Structures and Systems" (http://wwwis.win.tue.nl/2L690), but AHA!

functions as a reading system as well as a learning/courseware delivery system.

The unrestricted (or mostly unrestricted) navigation that comes with modularity is central to the design of AHA! AHA!, however, employs digital technology that is far more sophisticated than straightforward hypertext linking. Among the benefits of this technology is eliminating redundancy. Instead of requiring authors to provide the same foundational information on multiple nodes, AHA! adaptively interposes prerequisite information in response to the user's individual navigation choices. So, as shown below, if the user encounters a mention of Ted Nelson's visionary hypertext system Xanadu without having read the full page explaining Xanadu, a capsule explanation of Xanadu is interposed:

> In Xanadu (a fully distributed hypertext system, developed by Ted Nelson at Brown University, from 1965 on) there was only one protocol . . . .

From the course "Hypermedia Structures and Systems" (De Bra, 2008).

AHA! then remembers that Xanadu has been explained and does not interpose this explanation in the future.

AHA! employs a domain model consisting of the dependency relationships among all the concepts that make up the subject matter. For example, if the domain is algebra, the domain model includes each of the concepts being taught along with a rigorous and formal specification of which concepts should be taught and learned before which other concepts. At the present time at least, no computer system can build such a domain model. This task must be carried out by the content author.

The second major component of AHA! is a user model. The user model, which is updated continuously as the user navigates through the system, consists first and foremost of a record of the visited nodes. However, AHA! can also quiz the user and use the results to modify the user model. AHA! can even modify the user model on the basis of assumptions about how much the user may have forgotten between sessions or the user's preferred learning style (e.g., favoring text or visuals) (De Bra, 2008, p. 36). The domain model and the user model jointly make possible the interposition of content elements, such as the explanation of Xanadu, to provide the prerequisite information the user will need as she navigates from one page to another.

In other instances, AHA! makes clear to the user that she lacks the prerequisite information she likely needs to productively read certain content elements, and it offers more suitable alternatives. This feature enables AHA! to manage domains in which complete modularity isn't feasible. The user interface for this feature (which AHA! shares with several other adaptive educational hypermedia systems) is shown in Figure 3. A red dot appears before links to lessons that the user is not prepared for, a green dot appears before links to lessons that the user can read productively, and a white dot appears before links to lessons the system thinks the user already knows. When a check mark accompanies a white dot, the user knows the lesson because she has already visited that lesson. If the user is an aggressive reader or learner or has a better background than the system supposes, the user can access and read a "red dot" lesson. Another option in AHA! is for the author to hide or disable links to content the user is not prepared for.

Summarization to Support Selective Reading

Summarization is the final approach to designing documents for selective reading. This approach differs from the others in regard to its purpose. Whereas the modularization approach offers readers a choice of which topics to read and the supported reading pathways approach offers either a choice of topics or a choice in the depth of treatment (e.g., an appendix that expands upon an idea discussed in the body of the document), summarization only offers a choice in depth of treatment—the choice between a summary or the full content. The simplest form of the summarization method is providing a single introductory summary. A more sophisticated approach is to provide multiple within-document summaries.

Adding a Single Summary

We often read a summary to decide whether we have any interest in the document. If we do read the full document, we will retain more because we have already read the summary (Lorch & Lorch, 1995). In addition, reading a summary offers some support for selective reading. First, the summary provides the reader with a certain amount of prerequisite information, information that substitutes for what the reader misses by reading selectively within the document. Second, because a summary typically maps the structure of the main document, the summary (in conjunction with the

document's headings) helps the reader locate sought-for information within the document.

Adding Multiple Summaries

Adding multiple within-document summaries adds complexity but better supports selective reading. Within-document summaries are not rare. For example, they are integral to the venerable STOP document format (Tracey, Rugh, & Starkey, 1965; Farkas, 2005) and the recent QuikScan format (Zhou & Farkas, 2010). A web-based historical narrative, produced by the BBC (undated), concerning the ongoing conflict between India and Pakistan provides us with a straightforward example of this strategy. Here is a description of the BBC document.

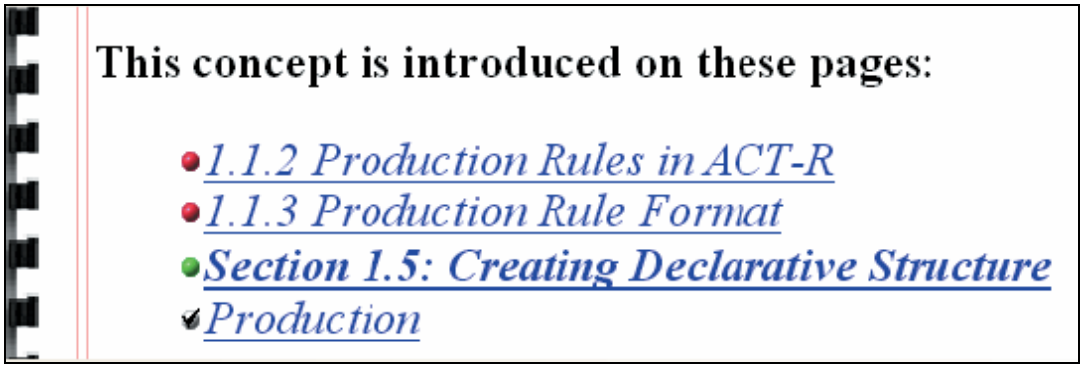

Figure 3. The typical AHA! user interface. The first two links show a red dot, the third shows a green dot, and the fourth shows both a white dot and a check mark indicating that this lesson has previously been visited (De Bra, 2002).

India-Pakistan: Troubled Relations consists of an introductory web page followed by nine more pages that make up a chronological sequence. As shown in Figure 4, the reader can choose to read any of the nine chronological pages at two different levels of detail: summary or full. One benefit of multiple summaries is that they tend to provide a more complete overview than a single summary and so better prepare the reader to navigate within the document. Another benefit is better support for locating information. Multiple summaries directly map the structure of the main document: If you encounter an interesting idea in the summary of the fourth section of the document, you know that the complete discussion appears in the full version of the fourth segment.

Multiple summaries, however, do not address the problem of lost context; reading pathways are not fully supported. The reading experience, therefore, is apt to be degraded when readers who have read one or more summaries (rather than the corresponding sections of the full document) switch to the full version of a subsequent section of the document.

Despite this drawback, within-document summaries are still reasonably effective[1]. Because the reading process is robust, the reader should be able to hobble along even after missing some prerequisite information. If necessary, the reader can hunt backward through the full narratives to find missing information that will alleviate the confusion. Still, there is much value in a multiple-summary design that does address the problem of lost context.

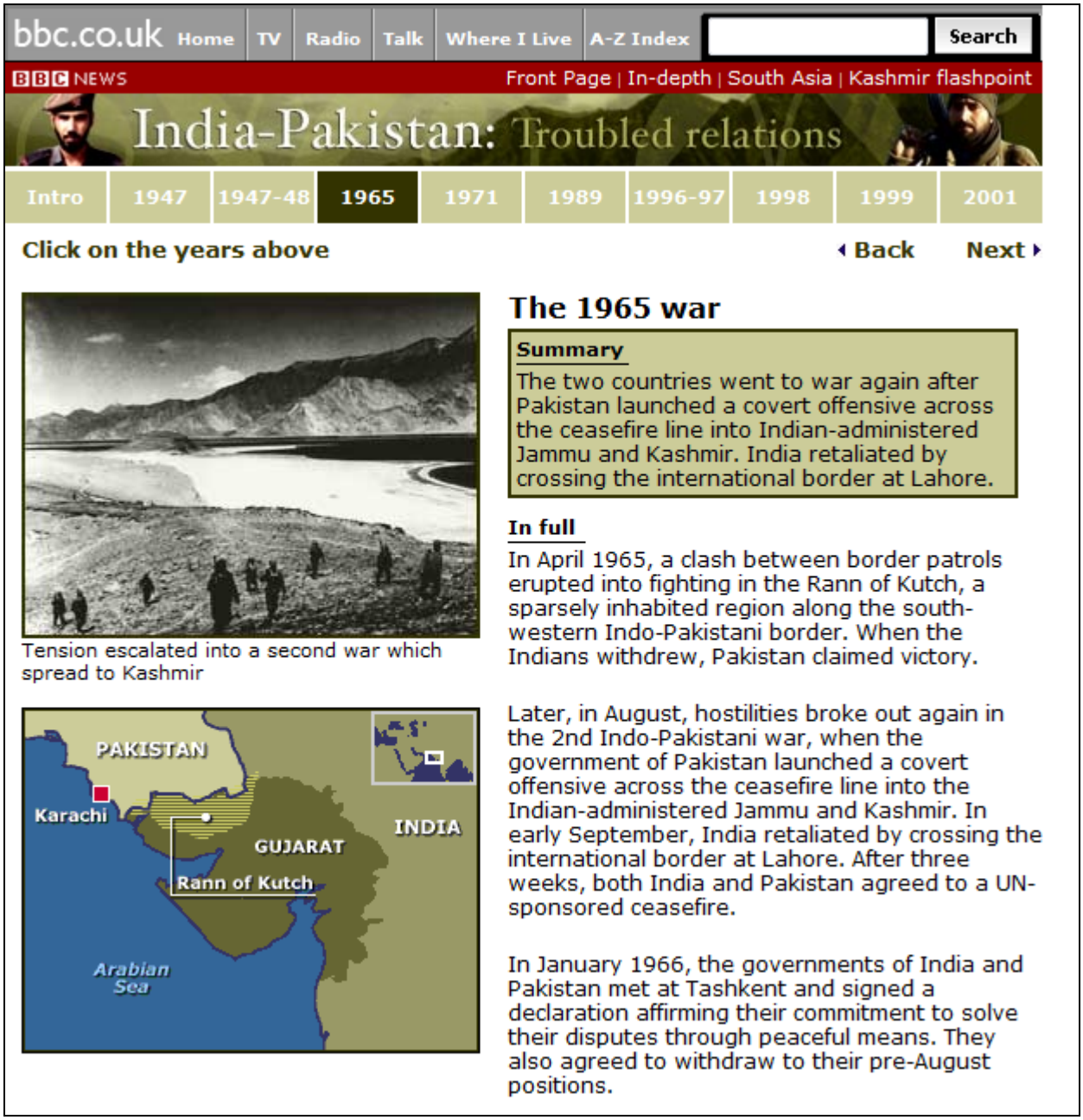

Figure 4. The fourth segment of the BBC narrative. This is the briefest of the nine chronological segments.

Supporting multiple summaries with adaptive techniques (SwitchBack)

SwitchBack (2010) is a web-based reading environment that employs within-document summaries and enables reliable, systematic support for selective reading. It was developed by Farkas and Raleigh at the University of Washington in conjunction with students in the SwitchBack Research Group. It is a working prototype with just basic functionality.

SwitchBack documents are specially authored for the SwitchBack application. The author writes a Lite (summarized) and a Study (complete) version of each section of the document. The reader, then, can choose whether to read the Lite or Study version of each section. Like AHA!, SwitchBack works by tracking the reader's navigation through the document and interposing necessary information to prevent a loss of context.

Figure 5 shows a portion of a historical narrative (adapted from Wikipedia) about the Battle of Hampton Roads (often referred to as the battle between the Monitor and Merrimack) during the United States Civil War. It was the first naval battle between ironclad warships. In the figure, we can see that the reader chose to read the Lite version of Section 1 and then switched to the Study version of Section 2. SwitchBack has interposed the prerequisite information (the goal of the Confederacy) that the reader missed by not reading the Study 1 component (the Study version of Section 1). The reader, therefore, is not hindered by the lack of prerequisite information as she reads the Study 2 component. We refer to the prerequisite information as "bridge text" or "bridge components." If the reader had read Lite 1, Lite 2, and Study 3, SwitchBack would have interposed bridge components 1 and 2 (rather than just bridge component 1). We usually display bridge components to readers under the heading "What you missed in Study X." The essence of SwitchBack is simply this: Whenever the reader makes a switch from Lite to Study content, any prerequisite information is interposed as bridge text.

SwitchBack has far less functionality than AHA! In contrast to AHA!, SwitchBack documents are fundamentally linear and limit navigational freedom to choosing between a section of full text or a summary of that section. Authors can, however, build supported reading pathways in the conventional manner within the Study version of a section. You simply add a subsection, indicate to the reader that this subsection is optional, and then take care that no subsequent Study section assumes the reader's familiarity with the information in this subsection.

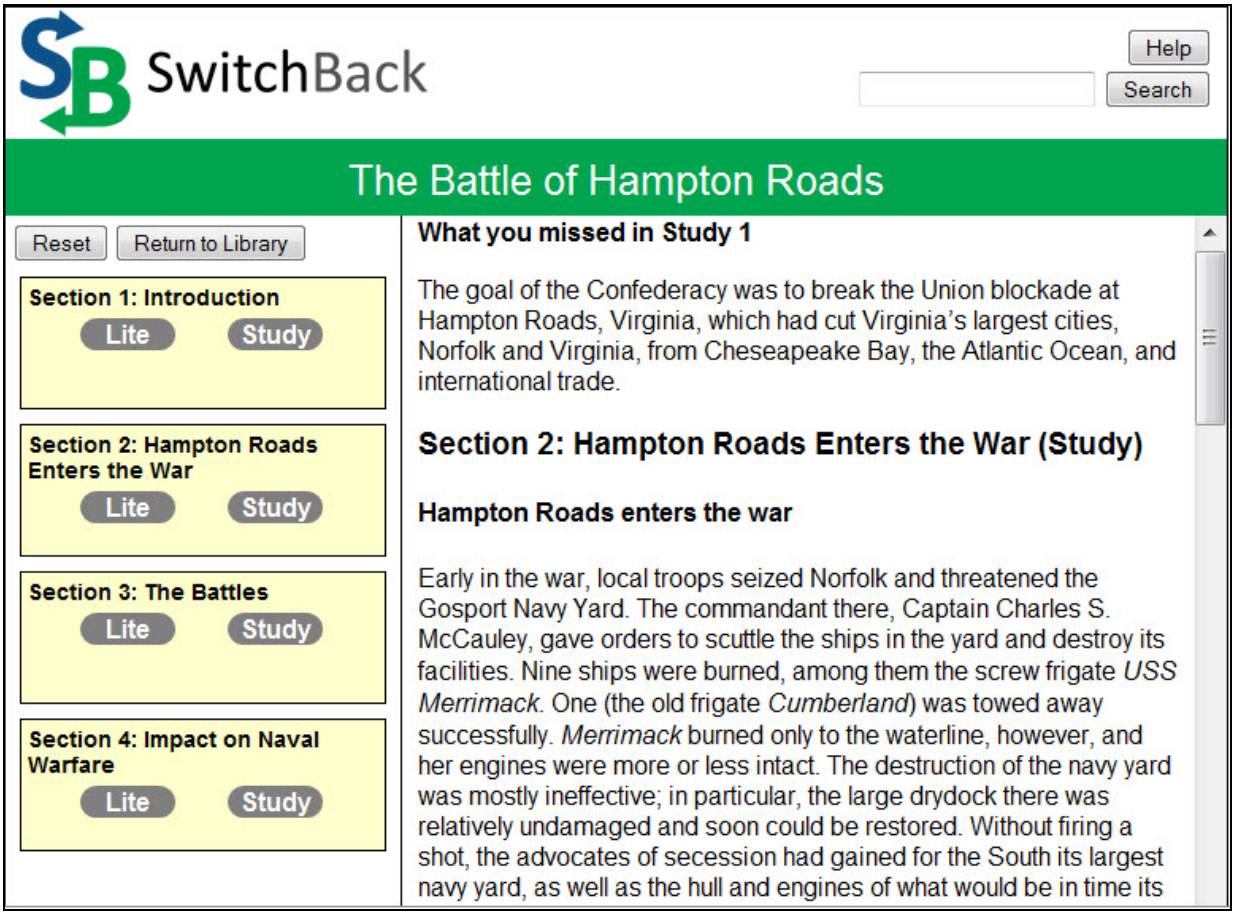

Figure 5. The table of contents of a SwitchBack document and the content displayed when a reader switches from the Lite version of Section 1 to the Study version of Section 2.

We envision numerous uses for a fully developed application based on this prototype. A school system, for example, might install SwitchBack on its web server so that instructors can create their own SwitchBack library of readings. In a corporate setting, a technology company might invite potential customers to read SwitchBack versions of its white papers.

Authoring a SwitchBack document requires only a modest technical background. Authors need basic HTML skills and the ability to upload files to folders on a server and to make simple modifications to two PHP files. SwitchBack authoring, however, takes significant rhetorical skill. Careful decisions must be made in regard to dividing the document into sections and deciding what information belongs in the Lite and Bridge components. To make these decisions, the author must keep track of all the pathways readers can take as they choose between the Lite and Study version of each section. To limit the complexity of this task, the practical limit to the number of sections in a SwitchBack document is five. We have developed an MS Word authoring template that helps authors keep track of their Lite, Study, and Bridge components. We are planning to build a simpler form-based authoring interface.

Conclusion

This survey has identified three broad approaches to designing documents for selective reading and has described a wide range of designs—old and new, simple, and complex. Assuming a different perspective, we might have devised a four-approach scheme in which the fourth approach consists of systems such as AHA! and SwitchBack that work by adaptively interposing prerequisite information. A system that adaptively supplies missing information to those who follow associative links in a website would belong to this fourth approach.

In a time when both casual readers and knowledge workers face information overload and when many people resist extended reading, longer documents that enable a highly satisfying selective-reading experience are valuable for both individual readers and society as a whole. A future in which such documents are prevalent is better, we think, than an alternative future in which there is less creation and wide dissemination of longer documents on the grounds that people are not likely to read them. If designers can propose ways to provide a highly satisfying selective-reading experience—perhaps with designs better than those that exist now—they may strengthen content publishers' commitment to extended text.

Notes

[1] QuikScan suggests that the multiple-summary approach to designing for selective reading may prove valuable as an assistive technology for blind readers. QuikScan enables readers to navigate from the individual sentences comprising each summary to the full discussion of that idea in the core document. In an informal pilot study, a blind student who often waits impatiently while his text-to-speech software pronounces unwanted information jumped directly to the sought-for information (Zhou, 2008).

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