

QuikScan: Facilitating Reading and Information Navigation Through Innovative Document Formatting

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Abstract

QuikScan is an innovative document format aimed at facilitating reading and information navigation in documents. It employs multiple within-document summaries formatted as numbered list items to summarize the gist of each section of a document. The presence of the summaries, with a fine level of granularity, enables readers to skim for the superordinate ideas of each section and locate particular items of information quickly and efficiently. This paper focuses on an empirical study of information navigation with QuikScan. Forty participants completed timed information navigating tasks using either a QuikScan or control version of a document with conventional formatting. This study demonstrates intriguing and important findings. Those who read QuikScan were able to locate the superordinate content items significantly faster with a significantly higher accuracy rate. However, QuikScan readers did not perform better on items of lesser importance than those who read the control version. Keywords: QuikScan, document format, summaries, information navigation

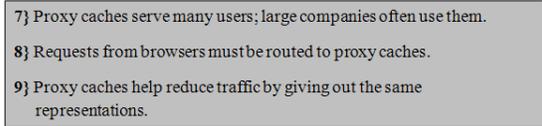
Introduction

QuikScan is an innovative document format that entails the use of multiple within-document boxed summaries inserted in a document to summarize the gist of every section of the document. These boxed summaries usually appear immediately after a heading, summarizing the upcoming section until the next heading. As shown in Figure 1, each summary is formatted as a set of numbered list items, each of which corresponds to the place in the upcoming main body of text in which the summarized content item is elaborated fully.

Quan Zhou's dissertation reports two empirical studies on the effects of QuikScan on reading. The first study, which was published in the IPCC 2007 proceedings, examines whether and how QuikScan facilitates reading comprehension and retention [1]. The study shows that those who used QuikScan achieved a 13% higher level of comprehension than those who didn't use QuikScan [1]. The QuikScan readers also performed better on retention, although the findings were statistically insignificant [1].

In this paper, we focus on the second study that investigates the effects of QuikScan on information navigation.

Proxy Caches

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- 7) Proxy caches serve many users; large companies often use them.
 - 8) Requests from browsers must be routed to proxy caches.
 - 9) Proxy caches help reduce traffic by giving out the same representations.

7) Proxies serve hundreds or thousands of users in the same way; large corporations and ISPs often set them up on their firewalls, or as standalone devices (also known as *intermediaries*).

8) Because proxy caches aren't part of the client or the origin server, but instead are out on the network, requests have to be routed to them somehow. One way to do this is to use your browser's proxy setting to manually tell it what proxy to use; another is using interception. Interception proxies have web requests redirected to them by the underlying network itself, so that clients don't need to be configured for them, or even know about them.

9) Proxy caches are a type of shared cache; rather than just having one person using them, they usually have a large number of users, and because of this they are very good at reducing latency and network traffic. That's because popular representations are reused a number of times.

Figure 1. A QuikScan boxed summary consisting of three numbered list items.

QuikScan summaries call out key ideas and provide convenient means for readers to navigate through the document and locate target content items. Generally speaking, the information-navigating tasks can be divided into three categories:

- *Cued information.* The readers are looking for an item of information that is explicitly stated in the summary. They can locate this information simply by scanning, without reading a significant amount of body text.
- *Partially cued information.* The readers are looking for content that is partially mentioned in the summary, but to gain a full understanding, readers need to read a significant amount of body text.
- *Uncued information.* The readers must infer the relationship between the item in the summary and the most pertinent discussion of this information in the main body of text.

The research question underlying the experiment was whether and how QuikScan improves cued, partially cued, and uncued information navigation.

Method

This study focuses on the accuracy and efficiency of information navigation. A multiple-choice questionnaire was used to test the accuracy. To probe efficiency, we measured the time spent on each question. At the end, a survey was conducted to investigate participants' attitudes toward QuikScan. The survey included both multiple-choice questions and an open-ended question asking for participants' comments and suggestions.

Participants and Materials

Forty students at the University of Washington participated in this study. Students who majored in Economics, International Studies, and Business were excluded because the content of the experimental passage is on global trade.

For several reasons, this study does not distinguish between native and non-native speakers. First, prior to the study, several pilot tests were conducted to collect responses regarding the experimental passage and the questionnaire. In these tests, native and non-native English speakers exhibited similar performance. A likely reason for this is that all students enrolled at the university have taken academic and language proficiency tests and fulfilled university requirements. Second, the student body and backgrounds are heavily influenced by an increasingly globalized education system. At the University of Washington, or similarly diverse American universities, being a native or non-native speaker is not a prominent determining factor on student performance. In a recent article published in *College Composition and Communication*, Ortmeier-Hooper (2008) presents three case studies showing that in today's United States, the boundary between native and non-native English speakers is becoming fuzzy; students do not identify themselves as either ESL (English as A Second Language) or native [2]. Terms like "ESL" and "Generation 1.5" are considered problematic by Ortmeier-Hooper because they depict a static and often outdated image of student experiences. Therefore, I paid more attention, instead, on ensuring that some participants were not significantly more knowledgeable in the subject area than others. Finally, since QuikScan is likely to be a professional practice in the culturally diverse workplace in the U.S., the inclusion of non-native speakers is aimed at accurately reflecting such a mixture.

The main experimental passage that the participants read was excerpted and edited from Chapter II of the United Nations report "World Economic and Social

Survey 2005: Financing for Development¹." The passage was chosen for a variety of reasons. First, it was intended to be not too easy to read. Since the text contains specialized knowledge in global trade, it has a certain level of difficulty for those without such a background. I sought to avoid a "ceiling effect," in which the subjects would so easily comprehend and retain the content of the passage that the possible effects of QuikScan could not be determined. In retrospect, as explained below, the passage may have been overly difficult, creating a partial "floor effect." Second, the passage was intended to be interesting for the participants. The topic of global trade is a popular topic in today's American society and politics, thus is interesting to the participants. I avoided technical topics such as biology and medicine for students' lack of interests in these topics may hinder this study.

The experimental passage was re-titled "Trade in the Developing World" to make it a standalone document. The original document was formatted with a wide main column for body text and a supplementary narrow column for pull quotes. All this formatting was removed in order to create straightforward report formatting. Tables and charts embedded in the original portion of the UN report were also removed. Although tables and charts help explain the content, they are not essential in this document. The participants would have spent a significant amount of time examining these tables and charts, and the processing of graphics was not relevant to the study.

Two researchers in the QuikScan Directed Research Group independently QuikScanned the document. Through comparing and negotiating, they settled on a final QuikScan version. The following materials were used in the study:

- The QuikScan version of the experimental passage "Trade in the Developing World"
- The non-QuikScan version of the experimental passage
- An information navigation questionnaire with 18 multiple-choice questions
- A brief survey on the participants' reactions to QuikScan

To investigate the three types of information navigation in QuikScan, the information-navigation questionnaire contained three types of questions (Table 1). Type I questions asked for information cued by QuikScan. Type II questions asked for information partially cued by QuikScan. Type III questions asked for information not cued by QuikScan. I categorized these questions in consultation with members of the QuikScan Research Group.

¹ The original UN report can be found at: <http://www.un.org/esa/policy/wess/wess2005files/wess2005web.pdf> (Accessed March 24th, 2008)

Table 1. Three types of information navigation questions.

Question types	Information navigating tasks	Number of questions
Type I	Cued information navigating	6
Type II	Partially cued information	6
Type III	Uncued information navigating	6

The main purpose of this study was to examine how fast participants answer information-navigation questions and how well they perform on these questions. Information navigation, as defined in this study, is not entirely the same as information search. To successfully answer some of the multiple-choice questions, participants had to not only search for details but also digest the document. Questions included both searching for facts and making inferences.

The multiple-choices questions in this study reflect the lessons from Haladyna (1997)'s *Writing Test Items to Evaluate Higher Order Thinking* [3]. There were five choices for each question, including an "I don't know" option intended to prevent participants from only guessing at the answer.

All five choices of the same question fitted on the same page. This was to ensure that participants did not have to flip pages in order to see the whole question and its choices. Flipping pages may cause participants to spend time and slow down their question-answering.

In addition to the information-navigation questionnaire, the survey contained five multiple-choice questions:

- How much attention did you give to the boxed summaries?
- How much did QuikScan help you find items of information you were looking for?
- How much did QuikScan help you understand and/or remember the content?
- Do you find QuikScan distracting?
- Do you wish to use QuikScan in your reading in the future?

At the end of the survey, participants were asked to give further comments and suggestions about QuikScan.

Procedures

Participants were randomly assigned to either the QuikScan or the non-QuikScan version of the report. They were given 10 minutes to read the document before they received the information-navigation questionnaire. Because the document is long and relatively difficult, this 10-minute period enabled participants to familiarize themselves with the unfamiliar subject matter. This was also to avoid the "floor effect" seen in Study 1 [1]. In

order to keep participants in their own natural reading mode, I did not specifically tell them how to read. But those who received the QuikScan version were told to make the most use of QuikScan.

After the 10-minute reading period, each participant was given the information-navigation questionnaire. Participants were told to answer the questions as quickly and accurately as possible. Timing started when each of them started to answer the questionnaire². They were allowed but not required to access the document during question-answering. They were required to inform the researcher immediately after they finished each question and were told to immediately start the next question. The time they spent answering each question was recorded. After answering the questionnaire, those who read the QuikScan version filled out the survey form.

Results

This study generated three types of data: the answers to the questionnaire, the time spent answering the questions, and the responses to the survey. The results from the questionnaire were analyzed in SPSS 15.0 on a PC. An alpha level of .05 or less was considered as significant.

A MANOVA was conducted to examine the effects of QuikScan on 8 dependent variables:

- The number of correct answers to Type I questions
- The time spent on answering Type I questions
- The number of correct answers to Type II questions
- The time spent on answering Type II questions
- The number of correct answers to Type III questions
- The time spent on answering Type III questions
- The total number of correct answers
- The total time spent on answering all questions

The Wilks Lambda multivariate test was significant ($F(7, 32) = 4.362, p < .05$). This means that those who read QuikScan and those who read the non-QuikScan version exhibited significantly different performance. The univariate test of document type difference (QuikScan vs. non-QuikScan) shows significant difference on the time spent on answering Type I questions ($p < .05$) between the QuikScan group ($N=20, M=303.05, SD=118.83$) and the non-QuikScan group ($N=20, M=553.40, SD=243.93$). There are significant differences in the time spent on answering Type II questions ($p < .05$) between the QuikScan group ($N=20, M=480.80, SD=244.93$) and the non-QuikScan group ($N=20, M=737.25, SD=382.72$). There are also significant difference on the total time

² An online stopwatch was used for the timing in this study: <http://www.shodor.org/interactivate/activities/Stopwatch/?version=1.4.2&brow> (Accessed March 24th, 2008)

spent answering all questions ($p < .05$) between the QuikScan group ($N=20$, $M=1285.80$, $SD=534.18$) and the non-QuikScan group ($N=20$, $M=1926.65$, $SD=750.31$).

However, the study did not find significant difference on the number of correct answers for Type I questions (QUIKSCAN: $N=20$, $M=3.65$, $SD=1.53$; NON-QUIKSCAN: $N=20$, $M=3.05$, $SD=1.23$), Type II questions (QUIKSCAN: $N=20$, $M=1.75$, $SD=1.07$; NON-QUIKSCAN: $N=20$, $M=2.00$, $SD=1.17$), Type III questions (QUIKSCAN: $N=20$, $M=3.05$, $SD=1.61$; NON-QUIKSCAN: $N=20$, $M=3.90$, $SD=1.77$), and all questions (QUIKSCAN: $N=20$, $M=8.45$, $SD=2.95$; NON-QUIKSCAN: $N=20$, $M=8.85$, $SD=3.15$). In addition, no significant results were found on the time spent on answering Type III questions ($p > .05$) between the QuikScan group ($N=20$, $M=501.95$, $SD=224.00$) and the non-QuikScan group ($N=20$, $M=636.00$, $SD=215.56$).

In addition to comparing the QuikScan and the non-QuikScan group, it is important to investigate whether participants within each group spent significantly different amounts of time answering the three types of questions. Specifically, I intended to examine the time each group spent on each type of questions, which would help me understand whether the participants were more efficient in finding information cued by QuikScan. If this is true, it implies that QuikScan not only facilitates information navigation in a document as a whole, but is particularly effective in providing different levels of accessibility to different types of content items.

A one-way repeated measures ANOVA was conducted to investigate the effects of question type (I, II, III) on the information-navigation time by those who used QuikScan. Repeated measures tests were used because all participants were exposed to the three types of questions. The results from the analysis indicate that the Mauchly's Sphericity Test is not significant ($p=.461$). Therefore, the Tests of Within-Subjects Effects can be interpreted. The result shows that the within-subjects variable of document type is significant, $F(2, 38) = 16.36$, $p < .000$. This means that QuikScan readers spent significantly different amount of time on the three types of questions. Specifically, Tests of Within-Subjects Contrasts and Pairwise Comparisons

show that QuikScan readers performed significantly faster on Type I questions ($N=20$, $M=303.05$, $SD=118.83$) than on Type II questions ($N=20$, $M=480.8$, $SD=244.93$) ($p < .05$) and Type III questions ($N=20$, $M=501.95$, $SD=224$) ($p < .05$). It also shows that QuikScan readers did not perform significantly faster on Type II questions ($N=20$, $M=480.8$, $SD=244.93$) than on Type III questions ($N=20$, $M=501.95$, $SD=224$) ($p > .05$). Multivariate Tests show that the overall difference in the time spent on the three types of questions is significant ($p < .05$).

Another one-way repeated measure ANOVA was conducted to investigate the effects of question type (I, II, III) on information seeking time by those who used the non-QuikScan version. The results from the analysis indicate that the Mauchly's Sphericity Test is significant ($p < .05$). Therefore, Multivariate Tests can be interpreted. The results (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root) are significant ($p < .05$), but they are not as significant as the Multivariate Tests of the QuikScan group. Specifically, Tests of Within-Subjects Contrasts and Pairwise Comparisons show that non-QuikScan readers performed significantly faster on Type I questions ($N=20$, $M=553.4$, $SD=243.93$) than on Type II questions ($N=20$, $M=737.25$, $SD=382.72$) ($p < .05$). However, non-QuikScan readers did not performed significantly faster on Type II questions ($N=20$, $M=737.25$, $SD=382.72$) than on Type III questions ($N=20$, $M=636$, $SD=215.56$) ($p > .05$). They also did not perform significantly faster on Type I questions ($N=20$, $M=553.4$, $SD=243.93$) than on Type III questions ($N=20$, $M=636$, $SD=215.56$) ($p > .05$).

The survey results show participants' enthusiasm toward QuikScan. Tables 2 and 3 show the responses to the five multiple-choice survey questions. All participants who read the QuikScan version gave attention to the boxed summaries. Most participants found QuikScan helpful in information navigation. More than half of the participants found QuikScan helpful for understanding and remembering the content. Most participants didn't find QuikScan distracting. A large majority of participants would like to adopt QuikScan in their future reading.

Table 2. Survey results I.

	A great deal	A significant amount	Some	Not much	Very little
How much attention did you give to the boxed summaries?	40%	45%	15%	0	0
How much did QuikScan help you find items of information you were looking for?	30%	40%	20%	10%	0

How much did QuikScan help you understand and/or remember the content?	5%	40% (understand) 35% (remember)	40% (understand) 45% (remember)	10%	5%
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Table 3. Survey results II.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Do you find QuikScan distracting?	0	5%	15%	65%	15%
Do you wish to use QuikScan in your reading in the future?	30%	50%	10%	5%	5%

In addition to these five questions, an open-ended question was asked at the end: other comments and suggestions? The following are participants' responses:

- *I enjoyed reading the report and QuikScan did provide me with the ability to get more information from the report in a short or limited amount of time. The limitation of not being able to go back to a question made me read the questions with more concentration.*
- *Not many headers, so QuikScan was used instead.*
- *Why are there no headings and subheadings? Headings usually help to enforce my reading—each QuikScan sentence is sort of like a heading in itself, but a broader heading for each box may have been helpful for reference's sake.*
- *I only used it because I had limited time. If I was reading the paper for personal interest or for work/school, I would of found QuikScan annoying. All of that information should just be in the intro of each section.*
- *The quikscan format was very helpful to quickly access where something was located within the paper. It gave great "jumping in" points to find answers to the questions. Great work.*
- *QuikScan was very useful for gathering the overall summary of a section/paragraph, but the questions were very specific and so I had to rely on scanning the document myself. However, I remember what QuikScan pointed out or highlighted much more than what I found when quickly scanning the document.*
- *I didn't know if the QuikScan box was enough for me to read. I questioned whether there were*

parts I was missing by not reading the whole document.

- *It helped me navigate through the document in search for answers.*

Discussion

The MANOVA test shows that QuikScan readers performed significantly faster than non-QuikScan readers on Type I questions, Type II questions, and on all questions. Although statistically insignificant, QuikScan readers also performed faster than non-QuikScan readers on Type III questions. Except for Type I questions, non-QuikScan readers had a higher correct-response rate on the question-answering. However, the difference between QuikScan readers and non-QuikScan readers regarding correct rate was insignificant. In fact, the two groups were very similar on their correct-response rate.

This means that those who used QuikScan found the information cued by QuikScan (Type I questions) much faster than those without QuikScan while maintaining a higher correct rate (although insignificant). Readers also found information that was partially cued by QuikScan (Type II questions) a lot more rapidly than those without QuikScan. Readers of QuikScanned documents even found uncued information faster than those without QuikScan (although insignificant).

These results, shown in Figure 2, indicate QuikScan can be an effective tool for navigating a document selectively. One participant mentioned in the survey that he or she remembered the information cued by QuikScan much better than the items of information he or she was scanning by him or herself. Another participant pointed out that he or she wasn't sure whether certain important information was left out by the QuikScan summaries. This may imply that because QuikScan emphasizes superordinate information, readers' attention is likely to be focused more on the

cued items and less on the uncued items. This seems to explain why QuikScan readers obtained more correct answers on Type I questions but not on Type II and III questions. This also reconfirms the Nevid and Lampmann's (2003) finding that signaling superordinate information may be done at the cost of unsignaled information [4]. This study, together with Study 1 [1], seems to suggest that QuikScan can improve general reading comprehension, and particularly the comprehension of the target information, but may not improve the comprehension of those ideas not signaled by QuikScan. Nevertheless, the overall survey responses show that participants found QuikScan particularly valuable for information navigation under time pressure.

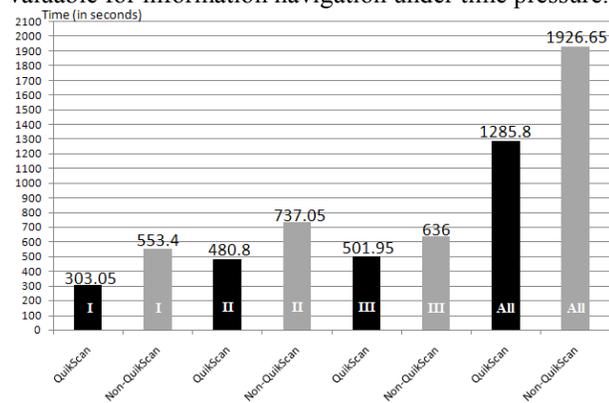


Figure 2. The amount of information navigation time by QuikScan and non-QuikScan groups.

In addition, the two one-way ANOVAs reveal that when QuikScan was present, readers found cued information significantly faster than both partially cued and uncued information; but when QuikScan was not present, the difference among the time readers spent on each of the three types of questions was small and insignificant. In other words, the presence of QuikScan made certain information particularly noticeable and enabled the QuikScan readers to find this information much faster than information in the rest of the experimental passage. This seems to reconfirm participants' survey responses that they were able to use QuikScan to jump in the experimental passage and find answers more conveniently.

Additionally, the QuikScanning of the experimental passage in this study, notably, is originator-aligned. The QuikScanners tried their best to adhere to the meaning of the original authors. It is reasonable to believe that when the QuikScanning is heavily audience-aligned—that is when QuikScanners customize summaries based on audience needs—readers with QuikScan would perform much faster than those without QuikScan. If readers look for information that is not considered superordinate by the original author, QuikScan can make this information salient; the absence of QuikScan can significantly hinder readers' information navigation.

Finally, it would be interesting to explore how QuikScan works with other documents and in other circumstances, as when a document is much more difficult, less difficult, and when the readers are not interested or extremely interested in the subject matter.

Conclusions and Future Research

In this paper, we have demonstrated that QuikScan holds significant value for reading and information navigation in print documents. Our research on QuikScan and, more broadly, on techniques for fast and selective information use, extends beyond this study. Quan Zhou is examining the use of QuikScan as a pedagogical technique for technical writing and English composition. We are also interested in probing how QuikScan can be implemented on Web pages, and we plan to follow up on a very promising pilot study in which a blind reader experienced excellent results reading a QuikScanned document with text-to-speech software [1].

QuikScan is non-proprietary, and we invite you to adopt QuikScan and adapt it to meet your needs. A full description of QuikScan and resources to assist you in adopting it are available at www.QuikScan.org. Finally, we welcome research collaborators and partners.

Acknowledgement

We'd like to acknowledge the contributions of members of the QuikScan Research Group in the Department of Human Centered Design & Engineering at the University of Washington.

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