RELATIONSHIP BETWEEN LEARNING STYLE AND USER SATISFACTION WITH A WEB BASED HEALTH INFORMATION SYSTEM

by
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The relationship between learning style and user satisfaction with a web based health information system was examined by usability testing of the system. Twenty-one undergraduate students participated in the usability testing by performing six benchmark tests using the system. Each participant's learning style and user interface satisfaction were assessed through the Kolb Learning Style Inventory (LSI-IIA) (Kolb, 1976) and the Questionnaire for User Interface Satisfaction (QUIS) (Chin *et al*, 1988). This study revealed a significant relationship between learning styles and the QUIS Learning Section and an approaching significance inverse relationship between the QUIS Overall Satisfaction score and the Abstract Conceptualization learning mode. These results suggest that learning styles should be accommodated in system design and indicate that the abstract conceptualization learning mode orientation of potential users might influence their satisfaction with and thus, their willingness to continue to utilize a particular online health information system for their information needs.

HEADINGS:

Cognitive Style

Usability Testing

User Satisfaction

Health Information System

World Wide Web

Introduction

A user seeks information from a web site using an interface that allows the user to access the information presented at the web site. People perceive and process the information they receive in different ways; therefore, it is necessary to consider many factors when designing an interface that will be used by people to satisfy their information needs. "Modern life is hectic and people simply don't have the time to work too hard for their information. As one of our test users said, 'If this [long page with blocks of text] happened to me at work, where I get 70 emails and 50 voicemails a day, then that would be the end of it. If it doesn't come right out at me, I'm going to give up on it.'"(Nielsen, 1997)

In a national survey conducted during March 2002, the Pew Internet Project found that 62% of Internet users, or 73 million people in the United States, have gone online in search of health information, which averages about 6 million Americans seeking online medical advice on a typical day (Fox & Rainie, 2002). The Kaiser Family Foundation found that young adults access online health information more often than they check sports scores, purchase merchandise, or participate in a chat room (Rideout, 2002). As more people use the web to access health information, it is very important to ensure that a web based health information system provides the user with easy access to the information he/she needs. Due to the large number of people who access the Internet each day in search of health information, usability testing of health information sites to determine if they meet information seekers' needs is important.

Usability testing of web-based systems is a method used to assess the ease and effectiveness with which a person can use a web site. "The Web gives people too much freedom and too many choices; no one will suffer a poorly designed site" (Nielsen *et al*, 2001). If a web based information system does not communicate with users, they will seek information from another web site, other source, or have their information needs

unmet. Usability testing of web sites, usually conducted by potential users in a laboratory setting, collects measurable, quantitative data that can be used to assess the effectiveness of the web site (Kantner and Rosenbaum, 1997). Usability testing can evaluate both performance and satisfaction.

One reason that user satisfaction is widely used as a measure of information system success is that it has a high degree of face validity because it is hard to deny the success of a system that users say they like (DeLone & McLean, 1992). In a study that investigated the validity of usage and user satisfaction as measures for the success of information systems, user satisfaction was found to be the most appropriate measure for information system success (Gelderman, 1998). Since web-based health information system users are discretionary users, user satisfaction was chosen as the measure to test for this study.

A much broader population uses web-based information retrieval systems than uses non-web systems (Spink *et al*, 2001). When designing an information system, it is important to consider characteristics of potential users. One characteristic of users that might be influential in their interaction with a web-based health information system is their learning style. In the current study, possible relationships between learning styles/modes and users' reactions to a health information web site were investigated.

Background

Previous research in three areas are discussed below: health information web sites, studies evaluating site usability and interactions between learning styles and information systems.

Health Information Web Sites

Eighty-six percent of health information seekers do not have a particular destination in mind and start at a general-purpose search engine (Fox & Rainie, 2002). When an information seeker uses a search engine to find health information, they will

receive a long results list of sites that contain health information. According to the Pew Internet Project, forty-five percent of information seekers who started at a search engine started at the top of the results list and worked their way down; thirty-nine percent read the list and clicked on items that seemed the most relevant and twelve percent chose a site because they recognized the sponsor or name (Fox & Rainie, 2002).

Since so many people are looking for health information on the web, it is necessary to consider the quality of health information that is available. Deficiencies in the quality of web-based health information have been found in studies that analyzed information available for single medical conditions (Beredjiklian *et al*, 2000; Biermann *et al*, 2000; Davison, 1997; Griffiths & Christensen, 2000; Impicciatore *et al*, 1997; Jiang, 2000; McClung *et al*, 1998; Soot *et al*, 1999). "Substantial gaps in the availability of key information" relating to breast cancer, depression, obesity, and childhood asthma available through English language and Spanish language search engines and web sites were found in a study conducted by the California HealthCare Foundation and RAND Health (Berland *et al*, 2001, p. 2619). A study that compared the 25 most popular health web sites' adherence to quality codes, peer review, and external advisory boards also suggest that online health information seekers might be getting incomplete or misleading information (Eng, 2001).

Evaluating Site Usability

The International Standards Organization defines usability as consisting of three distinct aspects: effectiveness, efficiency and satisfaction (ISO 9241-11, 1998). To determine if these aspects were correlated or if they were independent, a study was conducted that had 87 subjects solve 20 information retrieval tasks concerning programming tasks (Frokjaer *et al*, 2000). The results of this study found that there was negligible correlation between efficiency and effectiveness, and no correlation between user satisfaction and the other two measures. These results indicate that usability

testing of computer systems should include measures of effectiveness, efficiency and satisfaction since these are independent aspects of usability.

When Nielsen & Levy (1994) analyzed the relation between efficiency and user preference in 113 cases extracted from 57 HCI studies, they found that in 25% of the cases users did not prefer the system they were more efficient in using. Walker *et al* (1998) compared two different designs for a spoken interface to email by testing thirty-six users. The study revealed that while the Mixed Initiative Strategy interface was more efficient, the tested users preferred the System Initiative Strategy interface. Fishbein & Ajzen's (1975) model of attitudes and behaviors suggests that attitudes toward an object will influence intentions and ultimately behavior with respect to that object. In a study that investigated the common assumption that user involvement leads to system usage and/or information satisfaction, evidence was found that the user's satisfaction with the system would lead to greater system usage (Baroudi *et al*, 1986). The results of these studies indicate that user satisfaction is one of the most important variables to consider when evaluating a web based information system because satisfaction leads to usage. These studies also indicate that satisfaction/preference is not the same as performance.

<u>Interactions between Learning Styles and Information Systems</u>

Since the search for health information on the Internet is for the purpose of learning about a particular illness or condition, how a person learns might have a large influence on their satisfaction with a web-based health information system. Kolb's Experiential Learning Theory (ELT), on which the current study is based, conceives of learning as a four -stage cycle consisting of concrete experience, reflective observation, abstract conceptualization and active experimentation (Kolb, 1984). The ELT model has been found to be an excellent framework for designing, developing and delivering diverse learning experiences for adults, and offers instructional designers a tool for planning and designing learning activities (Rowntree, 1992; Tennant, 1988; Mulligan &

Griffin, 1992). "Judged by the standards of construct validity Experiential Learning Theory has been widely accepted as a useful framework for learning-centered educational innovation, including instructional design, curriculum development and lifelong learning" (Kolb et al, 2001, 240). Kolb developed the Learning Style Inventory (LSI) based on ELT to allow one to measure their strengths and weaknesses as a learner in the four stages of the learning process (Kolb, 1984).

There have been many studies that looked at the relationship between computer use and learning styles. A study conducted by Rourke & Lysynchuk (2000) investigated the influence of learning style on achievement in hypertext. Subjects in an introductory psychology course were presented with a hypertext module and a printed version of the same module. Two quizzes were presented for each condition, one set immediately and the alternative set seven days later to measure achievement. Accommodators scored significantly lower in achievement than divergers. Ross & Schulz (1999) conducted a study that assessed the impact of learning styles on human-computer interaction. Seventy University of Calgary undergraduate volunteers were asked to complete a pre-test of 20 knowledge-type questions, a computer-aided instruction (CAI) tutorial for cardiopulmonary resuscitation (CPR) and then a post-test of an additional 20 knowledge-type questions. They found that learning styles significantly affected learning outcomes. Also, it has been shown that students scored higher on tests when they were taught with strategies that complemented their learning style preferences (Brudnell & Carpenter, 1990). These results support the findings of a study that found that convergers performed better than other groups in a computer-training program (Sein, 1991). Carrier (1987) found that computer-based instruction was most effective when different learning styles and preferences were accommodated.

Several studies have examined relationships between learning styles and amount of technology use. The relationship between learning style and technology use

was examined by testing 139 students in a multi-section undergraduate education course with an interactive course Web site, online substantive course material, and online discussion rooms (Jordanov, 2001). Participants received a one hour training session on the use of the University's technology resources and the Internet and then they were asked to complete four major assignments on the computer. They completed a brief survey at three points during the semester and they completed the LSI early in the semester. The results indicate that participants emphasized Abstract Conceptualization more while using technology than when they were learning in general. A study of medical students found that convergers and assimilators (both learning styles emphasize Abstract Conceptualization) used Medline much more than accommodators and divergers (Martensson *et al*, 1999). Studies conducted to determine the influence of learning style on novice computer users found that "Convergers, who combine Active Experimentation and Abstract Conceptualization, performed better than those subjects with other learning styles" (Bostrom et al, 1990, p.114-115).

Additionally, previous studies have examined the relationship of user's attitudes toward computers and learning style. Bozionelos (1997) examined the relationship between computer anxiety and learning styles for 204 adults attending advanced courses in management by having them complete a computer anxiety instrument and the LSI. The converger learning style, a combination of Abstract Conceptualization mode and the Active Experimentation mode, was found to denote students who were more comfortable with computers. Federico (2000) examined the relationship between learning style and student attitudes toward network-based instruction. Two hundred and thirty-four students enrolled at The Naval Postgraduate School completed a 60 item survey designed to assess their attitude toward distinct facets of network based instruction as well as two separate forms designed to ascertain their learning and cognitive styles. The study found that assimilators, who combine Abstract

Conceptualization and Reflective Observation, had significantly more favorable attitudes towards network-based instruction than divergers, convergers and accommodators.

In summary, these studies examining the interactions between learning styles and information systems found significant relationships between information systems and convergers and assimilators. Convergers and assimilators both emphasize abstract conceptualization orientation of thinking as opposed to feeling.

Purpose of Study

Given the studies discussed above, one would expect that people with different learning styles would respond differently to particular web sites. Thus, the purpose of this study was to determine if there was a relationship between learning style and user satisfaction with a web based health information system.

Methods

This study examined the relationship between learning style and user satisfaction with a web based health information system by performing usability testing (focusing on the user's satisfaction) with the healthfinder® Health Information System. Twenty-one college students completed the LSI-IIa Learning Style Inventory developed by Kolb and Part 1: System Experience and Part 2: Past Experience from the Questionnaire on User Interaction Satisfaction (QUIS). Next, participants completed six benchmark tasks using the healthfinder® Health Information System. After completion of the benchmark tasks, the participant completed a measure of their satisfaction with the web site: Parts 3: Overall User Reactions; 4: Screen, 5: Terminology and System Information; 6: Learning and 10: Multimedia of the QUIS, version 7.0. The study methods are described in more detail below.

Site Selection

The healthfinder® Health Information System site (http://www.healthfinder.gov/) was selected for several reasons:

(1) A search using the Google Search Engine for “Health Information” returned the above web site as the first selection on the results list and billed it as the “Resource for consumer health and human services”.

(2) Forty-five percent of information seekers who started at a search engine started at the top of the results list and worked their way down while thirty-nine percent of information seekers read the list and clicked on items that seemed the most relevant (Fox & Rainie, 2002).

(3) Due to the term “reliable health information” and the “gov” web address extension (which implies that it is an official government site), many people might select this site to satisfy their health information needs. Twelve percent of information seekers choose a site because they recognized the sponsor or name (Fox & Rainie, 2002).

In addition to the above basic criteria, this web site was selected as appropriate for this study because its design seemed likely to yield different responses from people with different learning styles/modes. Although it has the “health library: hand-picked health information from A to Z…” section on the homepage, the A to Z listing of conditions is limited in many instances to disease categories instead of individual conditions (see Figure 1). For consumers without a medical background, it may be necessary to do a search in order to find information about a specific condition. For example, while Non-Hodgkin’s Lymphoma is a disease for which people might look for information, they would need to know that it is a “Lymphatic Disease**”** to use the A to Z list. If they did not know this, they would need to do a search to retrieve the information on this site. This limits information retrieval for users whose style preference is to point and click to follow links or users who think what they see is what they get (i.e. if the condition is not on the A to Z list, then the site does not have any information for that condition). This is an important issue when doing usability testing of a site because

usability studies done by Nielsen (2000) show that slightly more than half of all web users are search-dominant, about a fifth of the users are link-dominant, and the rest exhibit mixed behavior. Also, previous research has shown that students with different cognitive styles showed different learning preferences and required different navigational support in hypermedia systems (Ford & Chen, 2000; Kim, 1997). In summary, this site was selected because it is of high quality, yet may be differentially effective for users with different learning styles.

Figure 1. Health Library page from healthfinder® Health Information System site

The Sample

Male and female University of North Carolina at Chapel Hill students participated in the study. Students were recruited from particular majors to help target students for each learning style since learning styles can predict which classes students choose

(Birkey, 1994; Jonassen & Grabowski, 1993). Majors were targeted based on the descriptions from Kolb. Convergers often specialize in the applied sciences, so the Environmental Sciences and Nursing majors were targeted; divergers often have humanities and liberal arts backgrounds so History and English majors were targeted; assimilators often specialize in the basic sciences and mathematics so Biology and Mathematics majors were targeted; and accommodators are often found in technical or practical fields so the undergraduate level Information Science majors and minors were targeted (Kolb, 1984). A random sample stratified by major was used to select 50 students for each major. Potential participants were sent an email message describing the study and how to contact the investigators if they wished to participate (see Appendix A).

Procedures

Participants were scheduled to come to the School of Information and Library Science's Computer Laboratory where they participated in several activities, which took approximately one hour to complete. After providing written informed consent (see Appendix B), participants completed the LSI-IIa Learning Style Inventory developed by Kolb, and the QUIS Part 1: System Experience and Part 2: Past Experience, each described below.

The Kolb Learning Style Inventory is based on Kolb's Experiential Learning Theory (ELT) which includes two dimensions, four modes and four learning style categories (Figure 2). The two dimensions are Prehension, which represents how the learner prefers to receive or grasp information and Transformation, which represents how the learner prefers to process information (Kolb, 1976). Kolb et al. (1984) outlined four modes. Concrete Experience (CE) orientation emphasizes feelings as opposed to thinking. People with this orientation value relating to people and are often intuitive decision makers. Reflective Observation (RO) orientation emphasizes understanding as

opposed to practical application. People with this orientation value patience, impartiality, and considered, thoughtful judgment. Abstract Conceptualization (AC) orientation emphasizes thinking as opposed to feeling. People with this orientation value precision, analyzing ideas and the aesthetic quality of a neat, conceptual system. Active Experimentation (AE) orientation emphasizes doing as opposed to observing. People with this orientation are good at getting things accomplished and value having an impact and influence on the environment around them and like to see results. The two dimensions and four modes identify four learning styles (Kolb et al., 1984). The Accommodator learning style emphasizes concrete experience and active experimentation. The greatest strength of this orientation lies in doing things, carrying out plans and tasks, and in getting involved in new experiences. The Diverger learning style emphasizes concrete experience and reflective observation. The greatest strength of this orientation lies in imaginative ability and awareness of meaning and values. The Converger learning style emphasizes abstract conceptualization and active experimentation. The greatest strength of this orientation lies in problem solving, decision-making, and the practical application of ideas. The Assimilator learning style emphasizes abstract conceptualization and reflective observation. The greatest strength of this orientation lies in inductive reasoning, in the ability to create theoretical models, and in assimilating disparate observations into an integrated explanation.

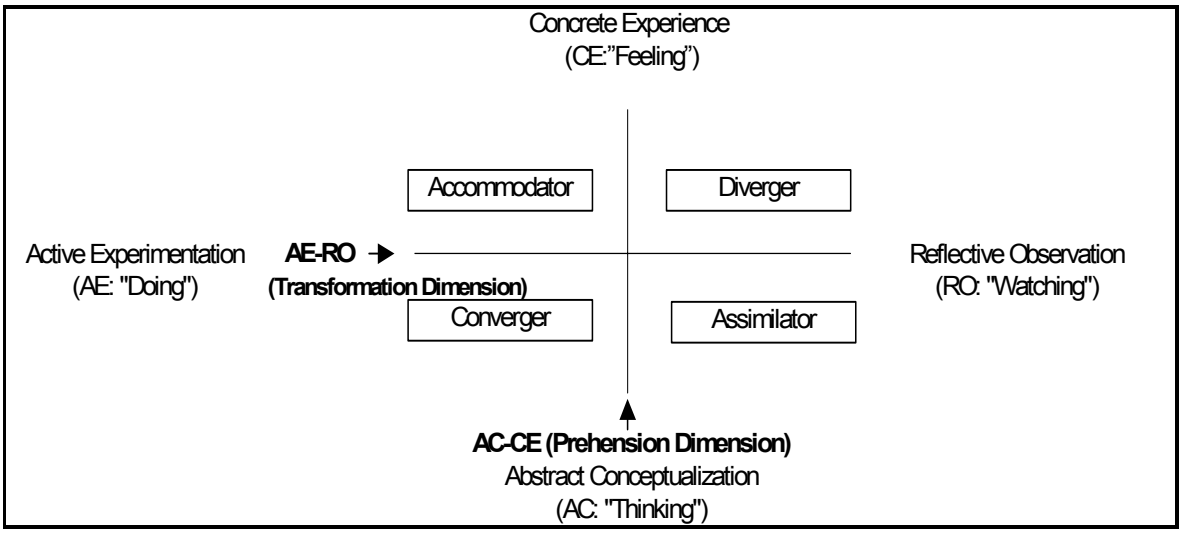

Figure 2: Kolb Experiential Learning Theory

The Kolb Learning Style Inventory has been widely utilized to measure learning style. It consists of 12 sentences that each have a choice of four endings. For each sentence the respondent ranks the ending from 1 to 4 (1 = least like you, 2 = third most like you, 3 = second most like you and 4 = most like you). For each sentence, there is a sentence ending that correlates to each of the learning modes: concrete experience, reflective observation, abstract conceptualization and active experimentation. The rankings that are given to endings for each of these modes are added for a score for that learning mode. To determine learning style, the concrete experience score is subtracted from the abstract conceptualization score to indicate the location on the prehension dimension and the reflective observation score is subtracted from the active experimentation to indicate the location on the transformation dimension. Next you connect these two points and the quadrant where they join is their learning style.

Prior to the performance of the searching tasks, each participant completed two portions of the QUIS. The QUIS Section 1 was used to measure the participant's length and frequency of use of the web. QUIS Section 2 gauged the participant's experiences

with computer systems in general. The following demographic information was collected for each participant: age and gender.

After completing the LSI and the first two sections of the QUIS, participants completed six benchmark tests using the healthfinder® Health Information System. The sole purpose of these tasks was to acquaint the participants with the web site. These tasks were:

1. List two symptoms for Non-Hodgkin's Lymphoma
2. How does the drug Cipro work?
3. List 3 symptoms for Meningitis
4. List the Consumer Health Libraries for Oregon and Nevada
5. Find out how to donate blood (only list web address that contains this information)
6. List the components of the food pyramid

After completion of the benchmark tasks, each participant completed several additional sections of the Questionnaire for User Interaction Satisfaction (QUIS), version 7.0, an instrument that is commonly used to measure user interface satisfaction. This instrument is based on work done by Chin *et al* (1988) and has been found to be highly reliable across many types of interfaces. The QUIS was designed to assess users' subjective satisfaction with specific aspects of the human-computer interface and contains a demographic questionnaire (administered prior to the benchmark tasks), a measure of overall system satisfaction along six scales, and hierarchically organized measures of eleven specific interface factors (screen factors, terminology and system feedback, learning factors, system capabilities, technical manuals, on-line tutorials, multimedia, teleconferencing, and software installation). Therefore, several sections of this instrument were used to measure user interface satisfaction in this study: Parts 3:

Overall User Reactions; 4: Screen, 5: terminology and System Information; 6: Learning and 10: Multimedia.

A mean score was computed for each section of the QUIS: Overall User Reactions, Screen, Terminology and System Information, Learning and Multimedia. Scores on the LSI-IIA for each learning mode were used to determine each participant's learning style. Analysis of variance (ANOVA) was used to test for relationships between the mean score of each of the QUIS section and each of the four learning styles: accommodator, diverger, converger and assimilator. To determine if learning modes predicted user satisfaction with the system, Pearson correlation tests were done between the mean score of each of the QUIS sections and each of the learning modes: abstract conceptualization, active experimentation, concrete experience and reflective observation.

Results

Twenty-one undergraduate students participated in the study. Demographic information about the study participants is summarized in Table 1. The Kolb LSI-IIa Learning Style Inventory identified four participants as accommodators, five participants as divergers, five participants as assimilators and 6 participants as convergers. They ranged in age from 19 to 22 and an analysis of variance (ANOVA) did not show any significant mean differences ($p=.05$) between the mean ages of the four learning style group participants. Among participants, four were Biology majors, seven were English majors and 10 were History majors. Since the study was conducted in a blinded manner, participant's majors cannot be linked to their learning style.

Table 1: Participant Characteristics

Learning Style	n	Gender		Mean Age
		Male	Female	
Accommodator	4	0	4	20.3
Diverger	6	2	4	20.2
Assimilator	5	3	2	20.0
Converger	6	4	2	19.5

The mean scores on each section of the QUIS, for each of the four learning styles, are shown in Table 2. While analysis of variance did not find a significant relationship between learning styles and the scores for Overall User Reactions, Screen, Terminology and System Information and Multimedia, the relationship between learning styles and Part 6: Learning was statistically significant (F value = 5.81, with 3,7 DF, p =.026). For this section of the QUIS, post hoc t-tests (p =<.05) revealed a significant difference between the accommodator learning style and each of the other learning styles.

Table 2. Mean QUIS scores for each learning style

QUIS section	Accommodator	Diverger	Converger	Assimilator
3: Overall User Reactions	38.50	42.17	40.00	36.25
4: Screen	NA[1]	100.00	99.00	NA[1]
5: Terminology and System Info	NA[1]	126.00	NA[1]	NA[1]
6: Learning*	72.50	95.33	107.75	103.00
10: Multimedia	NA[1]	NA[1]	NA[1]	NA[1]

* QUIS scores are significantly different across learning styles, p=<.05.
[1] Most of the participants did not respond to items in sections 4, 5, and 10, so means are not available

In addition, the relationships between learning modes and QUIS scores were examined (see Table 3). Only the inverse relationship between the mean score for Overall User Reactions and the abstract conceptualization was approaching significance, r = -.423, p = .063.

Table 3. Correlations between learning modes and QUIS scores*

QUIS section	Abstract Conceptualization	Concrete Experience	Active Experimentation	Reflective Observation
3: Overall User Reactions	-0.42**	0.03	0.24	0.28
6: Learning	-0.01	0.09	-0.16	0.07

* Most of the participants did not respond to items in sections 4, 5, and 10, so correlations were not calculated.
** Approaching significance, p=0.0631.

Discussion

This study found a significant relationship between learning styles and the QUIS Learning Section score that measures the user's perception of their ability to learn complex system tasks. Accommodators rated their ability to learn a complex task on the healthfinder® web site significantly lower than each of the other learning styles. This result is consistent with the results of previous studies that have looked at computer-based instruction and learning styles. A study conducted by Rourke and Lysynchuk (2000) found that accommodators had significantly lower achievement in hypertext than divergers. Ross and Schulz (1999) found that learning styles significantly affected learning outcome on a computer-aided tutorial for CPR. Other studies also agree that computer-based instruction is most effective when different learning styles and preferences are accommodated (Brudnell & Carpenter, 1990; Carrier, 1987).

However, learning style might not be the appropriate comparison measure for user satisfaction with web information systems. The learning mode might be a more important indicator of user satisfaction with these web information systems. Kolb (1993) proposed that individuals utilize other learning styles in addition to their preferred style to adapt to different situations. An inverse relationship between the abstract conceptualization learning mode and participants' ratings of their overall satisfaction with the healthfinder® site was approaching significance (p = .063). Due to study recruitment problems, only twenty-one undergraduate students participated in the study. A larger

sample size might have provided the power to see a significant relationship between learning mode and overall user satisfaction.

Since studies have suggested that satisfaction leads to usage (Fisbein & Ajzen, 1975; Baroudi et al, 1986), user satisfaction is an important aspect to consider. The correlation found in this study between abstract conceptualization learning mode and overall user reaction to the system indicate that those with a higher abstract conceptualization learning mode score (i.e. emphasize "thinking" more strongly) are less satisfied with the system than those with a lower score for this learning mode. These results are supported by previous research in this area. A study by Jordanov (2001) found that study participants emphasized abstract conceptualization ("thinking") more than concrete experience ("feeling") while using technology than when they were learning in general. Other studies have found relationships between technology use and convergers and assimilators -both of which emphasize abstract conceptualization (Bozionelos, 1997; Bostrom, 1990; Federico, 2000, Martensson, 1999).

The abstract conceptualization learning mode orientation emphasizes thinking as opposed to feeling. People with this orientation value precision, analyzing ideas and the aesthetic quality of a neat, conceptual system. A study by Liu and Reed (1995) found that Field-Independent learners choose a more analytical approach to their learning than Field-Dependent learners. Ford and Chen (2000) examined the effects of cognitive style on hypermedia and found that Field-Independent learners made greater use of the index to locate a particular item. In a study of students with different cognitive styles, Field-Independent learners tended to use search engines, the "find" option and URLs to reach desired information (i.e. search-dominant) while Field-Dependent learners navigate the Web in a linear mode (i.e. link-dominant) (Kim, 1999). These results are consistent with usability studies done by Nielsen (2000) that show slightly more than half of all web

users are search-dominant, about a fifth of the users are link-dominant, and the rest exhibit mixed behavior. Since the web site's A to Z listing of conditions is limited in many instances to disease categories instead of individual conditions (see Figure 1), participants had to do a search in order to find information for one of the benchmark tasks (#1). This might have influenced overall satisfaction with the system.

Conclusion

This study shows a significant relationship between learning styles and users' self-reported ability to learn how to use a health information web site. This result is consistent with previous research that has shown a relationship between learning styles and computer aided instruction. There is also evidence of a possible inverse relationship between the users' overall satisfaction with the web site and the Abstract Conceptualization learning mode. Previous studies have also found a relationship between Abstract Conceptualization learning mode and technology use. These results suggest that findings from prior studies of the relationship between computer system use and learning styles should be extended to the web and that learning styles should be accommodated when designing a web-based health information system. They also indicate that the abstract conceptualization learning mode orientation of potential users might influence their satisfaction with and thus, their willingness to continue to utilize a particular online health information system for their information needs.

The size and characteristics of the sample used in this study place important limitations on the generalizability of these results. The small sample size is one limitation of this study. The differences found in this study might diminish or, conversely, additional relationships might be discovered if more participants had been tested. Another limitation is that only college students were tested. They are just a small subset

of potential users of a web-based health information and might not be representative of all health information seekers.

Based on the results of this and previous studies showing a relationship between learning style and technology, the following recommendations are made to designers of web-based health information systems to ensure effective use of their systems: (1) usability testing of systems should include users of each of the four learning styles so that potential users' learning styles are accommodated and their satisfaction with the system optimized and (2) information presented at the site should be indexed so that it can be easily found by both Field-Independent and Field-Dependent users.

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Appendix A: Email Recruitment Message

Usability Testing of the healthfinder® web based Health Information

Email Subject Header: Access to Web-based Health Information

Email message:

Dear UNC-Chapel Hill Student:

We are inviting you to be in a research study that will examine if there is a relationship between learning style and the perceived usability of a web based health information system by performing usability testing of the healthfinder® Health Information System.

The study is being conducted by Martha Ballenger, a master's student in the School of Information and Library Science at the University of North Carolina at Chapel Hill, under the supervision of Professor Barbara M. Wildemuth.

The study will take approximately one hour and all participants will be entered into a prize drawing (approximately 40 participants will be studied) with the following prizes: 1st prize = $125.00, 2nd prize = $75.00 and 3rd prize = $50.00.

INCREASE YOUR CHANCE TO WIN: If you complete the study before May 8, 2002, your name will be entered in the drawing twice.

What Will Happen During the Study: Participants will be scheduled to come to the School of Information and Library Science's Computer Laboratory (Manning Hall) where they will participate in the following activities, which should take approximately one hour to complete:
(1) Learning Style Evaluation: Participants will complete a brief Learning Style Inventory; (2) Baseline Evaluation: Participants will complete a questionnaire about their prior experience with computers;
(3)Participants will complete six tasks using the healthfinder® Health Information System; (4)After completion of the tasks, participants will complete a questionnaire evaluating the usability of healthfinder®.

If you wish to participate:

Please email your desire to participate and times you are available to Martha Ballenger at ballm@ils.unc.edu.

Thank you for your consideration.

Martha Ballenger
Master's Student
School of Information and Library Science
University of North Carolina at Chapel Hill

Appendix B: Consent Form
Usability Testing of the healthfinder® web based Health Information System

Introduction to the Study:

We are inviting you to be in a research study that will examine if there is a relationship between learning style and the perceived usability of a web based health information system by performing usability testing of the healthfinder® Health Information System.

Martha Ballenger, a master's student in the School of Information and Library Science at the University of North Carolina at Chapel Hill, is conducting this study under the supervision of Professor Barbara Wildemuth. If you have any questions or concerns about being in this study, you should call Martha Ballenger at (919) 967-7468 or Barbara Wildemuth at (919)962-8072.

Purpose:

The purpose of this study is to determine if access to information contained in web based health information systems can be increased by accommodating the learning styles of potential system users

What Will Happen During the Study:

Participants will be scheduled to come to the School of Information and Library Science's Computer Laboratory (Manning Hall) where they will participate in the following activities, which should take approximately one hour to complete.

1. Learning Style Evaluation: Participants will complete The LSI-IIa Learning Style Inventory developed by Kolb.
2. Baseline Evaluation: Participants will complete the QUIS(version 7.0) Part 1: System Experience and Part 2: Past Experience.
3. Participants will be given a list of six tasks to complete after the investigator has started the computer on the MEDLINEplus Health Information System homepage.
4. After completion of the tasks, participants will complete Parts 3: Overall User Reactions; 4: Screen, 5: terminology and System Information; 6: Learning and 10: Multimedia of the QUIS Survey.

Your Privacy is Important:

We will make every effort to protect your privacy.

We will not use your name in any of the information we get from this study or in any of the research reports.

No information we collect in the study will be recorded with your name or any other identifier that would allow for your responses to be identified.

Risks and Discomforts:

The only risk is that you might access information that you find objectionable if you leave the web site being evaluated.

Your Rights:

You decide on your own whether or not you want to be in this study.
You will not be treated any differently if you decide not to be in the study. If you decide to be in the study, you will have the right to stop being in the study at any time.
If you decide not to be in the study or to stop being in the study, this will not affect your education at the University of North Carolina at Chapel Hill.

Institutional Review Board Approval:

The Academic Affairs Institutional Review Board (AA-IRB) of the University of North Carolina at Chapel Hill has approved this study.
If you have any concerns about your rights in this study you may contact the Chair of the AA-IRB, Barbara Davis Goldman, Ph.D., at CB#4100, 201 Bynum Hall, UNC-CH, Chapel Hill, NC 27599-4100, (919) 962-7761 email: aa-irb@unc.edu

Summary:

I understand this is a research study to determine if access to information contained in web based health information systems can be increased by accommodating the learning styles of potential system users

I have had the chance to ask any questions I have about this study, and they have been answered for me.

I have read the information in this consent form, and I agree to be in the study. There are two copies of this form. I will keep one copy and return
the other to the investigator.

_____
Signature of Participant

_____
DATE