Enhancing learning through use of interactive tools on health-related websites

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The Internet offers a unique means of health promotion through the use of interactive tools like chat rooms, E-mail, hyperlinks and the like. This paper reports a study examining links between learning and interactivity of health-related websites. We address three research questions. First, are tools of interactivity present in health-related websites? Second, how prevalent is the occurrence of these interactive tools for three relevant top level domains (TLD) (e.g. .com, .gov and .org)? Finally, are there differences in how representative websites of diverse TLDs employ these interactive tools along nine dimensions of interactivity? A content analysis of 30 websites revealed that while the majority of sites in our sample do use interactive tools, overall the occurrence is quite low. An examination of the use of tools of interactivity across three different TLDs revealed that .com sites used a greater number of tools, followed by .gov sites and, lastly, .org sites. We also found support for our third research question, that different TLDs employ these tools of interactivity differently. How these differences may impact learning are discussed.

Introduction

As use of the Internet as a source for health promotion increases, there is a growing belief that this new technology can help to transform both personal and public health. The importance of the Internet to health education should not be underestimated. Today there are more than 100 000 health-related websites (Kolata, 2000) and reports indicate that nearly half of Internet users utilized the web to research health information in 1997 (Eng *et al*., 1999). Access to good information is essential to health-related decision making. Yet how people learn from the web is little understood.

Interactivity has been identified as one of the traits of new media like the World Wide Web (WWW) (Street and Rimal, 1997). Some claim that interactivity is the most important factor to differentiate between media, allowing for interactivity between users and messages, between the consumer and the machine, and between senders and receivers (Cho and Leckenby, 1997). It is this potential for interactivity that makes the web a dynamic medium for influencing learning, attitude change and behavior. However, a paucity of research addresses how use of the web with its unique qualities for interactivity might impact the effectiveness of message delivery, and subsequent attitude and behavior change by visitors to the site.

Not everyone agrees on what interactivity is and the study of the web has been approached from either of two different but complementary perspectives: a system-centered perspective and a user-

centered perspective. The main goal of a system-centered perspective is to find the best guidelines for the design of technology. Research tends to examine the medium's interactive traits. Meanwhile, a user-centered perspective studies the interaction between humans and the technology (Unz and Hesse, 1999). The research presented here is an example of a system-centered perspective because our objective is to identify the technological characteristics that health-related websites currently possess.

In examining the medium's interactive traits, some researchers view interactivity as the result of elements that are present in the site (Ghose and Dou, 1998; Ha and Lincoln, 1998; Frazer and McMillan, 1999). Other researchers view interactivity as the speed of response of the system (Street and Rimal, 1997), the control of the information flow (Ariely, 2000), the possibility of the user to traverse information (Bezjian-Avery *et al*., 1998) or, more specifically, the use of hyperlinks in a site (Sundar *et al*., 1999).

Other studies focus on the user as the center of interactivity. For example, Wu (Wu, 2000) designed a scale to measure the perception of interactivity of users on particular websites. Similarly, Cho (Cho, 1999) asked subjects about their desire to interact with banner ads, while other researchers have studied the uses and gratifications obtained through the utilization of the WWW (Eighmey, 1997; Eighmey and McCord, 1998).

Another issue that makes the study of interactivity a dynamic area of research is its costs and benefits (Ariely, 2000). Some of the benefits found by researchers link interactivity with positive attitudinal measures like attitude to the ad (Cho and Leckenby, 1998) and attitude to the website (Chen and Wells, 1999). Also, interactive functions have been found to be a good indicator of the perceived quality of a commercial website (Ghose and Dou, 1998).

Notwithstanding these positive results, some authors warn that interactivity also may require a higher use of cognitive resources by the user of the interactive system (Ariely, 2000). Gerdes found that some interactive elements might be a distraction, particularly for subjects who are novices (Gerdes, 1997), while Bezjian-Avery *et al*. found that the persuasiveness of an interactive message was lower than that of a static message (Bezjian-Avery *et al*., 1998). Finally, there is a considerable body of research that addresses the uncertain link between communication or educational objectives and the use of interactive technologies (Unz and Hesse, 1999).

Given that our study is an analysis of the current state of health-related websites, we focus on the medium's interactive traits and examine the presence or absence of tools that are considered as enhancers of interactivity. The approach leads this research to use a definition from the system-centered perspective where interactivity is defined in part as the designed responsiveness of the medium (Rafaeli, 1988), but also as the capability of a new medium to `remember' and use past interactions between the medium and a user to create a tailored experience (Ghose and Dou, 1998).

While there is a lack of consensus in the literature on a precise definition of `interactivity', most researchers agree that it is the `extent to which users can participate in modifying the form and content of a mediated environment in real time' [(Steuer, 1992), p. 84]. Those researchers who

have examined interactivity in use of the web often delineate a set of dimensions or some method for combining or clustering the various web-based tools used to construct the site. For example, Steuer identified three dimensions of interactivity including the speed of the interaction, the range of users' options to alter the environment and mapping (i.e. the ways that human actions are connected to actions within the interactive environment).

This notion of dimensions of interactivity allows for a theory-based approach of how communication goals of learning and persuasion might exploit the potential of interactivity to build synergy for communication effectiveness. While a multimedia environment, modularity, and the user's control of the direction and pace of the medium constitute important features of our definition of interactivity, Bagui claimed that these characteristics parallel the way people learn, boost users' learning with the employment of multiple senses and motivate them to learn (Bagui, 1998). Research on educational multimedia lends support to dual-coding theory (Paivio, 1971), speculating that information processed through both verbal and non-verbal channels enhances learning [see (Najjar, 1996)]. At this point, however, studies focusing on how websites use interactive technology to maximize the potential effectiveness of the site are few (Ha and James, 1997; Ghose and Dou, 1998; Bucy *et al.*, 1999).

This paper reports the first part of a two-stage study examining interactivity and learning. In this paper, we present a model for linking interactivity and learning, and address three research questions. First, are tools of interactivity present in health-related websites? Second, how prevalent is the occurrence of these interactive tools for three relevant top level domains (TLDs) (e.g. .com, .gov and .org)? Finally, are there differences in how representative websites of diverse TLDs employ these interactive tools?

Identifying a set of interactive tools and dimensions of interactivity

Researchers have studied the content of websites in order to measure their interactive features (Ha and James, 1998; Bucy *et al.*, 1999), their attractiveness based on the interactive functions of the sites (Ghose and Dou, 1998), the use of interactive elements in websites of a particular industry (Witherspoon, 2001) and how websites adhere to published design guidelines (D'Angelo and Little, 1998).

For the current research we relied upon Ghose and Dou's six forms of interactive functions as a foundation for our own code scheme (Ghose and Dou, 1998). The changes to their code scheme reflect our examination of a different domain of websites (Ghose and Dou examined business sites). We modified their code scheme to accommodate differences in information, users and overall quality of interaction that might be expected between a health-related site and, for example, an E-commerce website that sells computers. In the end, the code scheme employed in the present study is a product of an analysis of the academic and trade publication literature examining websites and an examination of guidelines established by health-related organizations to address health issues on the web. One of these organizations is Health on the Net (HON) (http://www.hon.ch/). This organization grants a seal of approval to websites that meet certain standards. For this study, we analyzed HON's evaluative criteria for websites to obtain the

elements and considerations required of a website to be certified as an adequate medium for health information.

Based upon this review, a list of interactive tools to be coded was compiled. However, the list offers little insight into the function of interactive tools without a structured organization. In an attempt to provide a useful understanding of website characteristics, the elements were then clustered into meaningful groups.

Given the objective of this research to determine and find the tools that create a rich learning experience on the WWW, one of the major facets of the Internet, the dimensions that organize the interactive tools of websites were developed considering the cognitive and affective elements that delineate learning theory, where learning is defined as a change of a person's knowledge, attitudes and/or beliefs about specific issues (Simons-Morton *et al.*, 1995). In creating the dimensions of interactivity we also addressed theoretical perspectives based on a representative set of recent studies in instructional science, hypermedia and computer-assisted instruction that explore the link between new media, technologies and learning. Substantiation for nine dimensions of interactivity is presented below. These dimensions include: accessibility, delivery of message, navigation, data entry and use, personalized content, entertainment, promotions, formation of relationships, and time.

The first dimension identified is accessibility. The capacity of access to information on the web might be regarded as technical access (i.e. a person owns a computer and pays for a connection to the Internet); skill, attitude and dispositional access (i.e. technophobia); practical access (i.e. having time to browse the WWW); and access relating to issues of form and content (i.e. interface design and information overload) (Burbules and Callister, 2000). In our study, we confine our attention to the last type of access, i.e. issues of form and content. Our intent is to analyze features that are part of the WWW and not the users' traits or situations. Then, the accessibility created by a website's features includes design elements that consider people with disabilities (i.e. no use of frames, large text or graphics options), users with computers and software that might not be current (i.e. additional software and their links, text only version of a site) or elements that make the interaction with the site easier (i.e. pull-down menus). Accessibility allows that users are *able* to get in to the site.

The second dimension identified is delivery of the message. One of the most controversial tools of interactive technologies and learning is the use of multimedia like video and audio. Studies do not show a clear tendency in favor of the use of these tools (Unz and Hesse, 1999). However, there is also research that indicates that multimedia can be used effectively in learning tasks that have certain characteristics and if they are used by individuals who are experts (Schacter and Fagnano, 1999). Notwithstanding the lack of clear results, multimedia is present in many sites and might be one of the most important ways to attract surfers who do not have a clear objective during their surfing (Wolfinbarger and Gilly, 2000). In this research the mix of video, audio and text in tools like push media and virtual reality (VR) was measured.

Navigation is another key dimension of interactivity. Learner control is an important element for successful learning experiences because it can have a positive impact on students' performance, improve attitudes toward learning and reduce the time of teaching. However, there are also

studies that show that students who control their learning experience do not learn as much as a program-directed group (Lawless and Brown, 1997). In the WWW one of the measures of control is the perceived navigation of the site (Wu, 2000).

Data entry and use comprise a fourth dimension of interactivity. Researchers like Unz and Hesse are among many whom have reviewed the literature in computer technology and its effects on learning, and admit that the results in this area are mixed at best (Unz and Hesse, 1999). The lack of consistency in studies that seek the benefits of interactive media in the classroom might be explained by the personal differences between users. It may be that interactive media should personalize the environment as much as possible to create a learning space that is optimal for a particular type of user.

Personalized content is also identified as a dimension of interactivity. One of the most important features of the web is the capacity to adapt to a person's input of information, use of the medium or personal requests (Deighton, 1996). In terms of learning, the use of a personalized environment leads to a relevant increase of learning and positive attitudes toward the medium (Schacter and Fagnano, 1999).

We identify entertainment as a sixth dimension of interactivity. Web users visit websites for many reasons and with diverse tasks in mind. Web users have identified entertainment value as a unifying element in websites (Eighmey and McCord, 1998). One way to create an entertaining site, for example, is by offering games on the site. Research on health education has found consistently that the use of games helps to increase variables like skill and feelings of self-efficacy (Thomas *et al.*, 1997).

The use of promotions, a common marketing tool, is another dimension of interactivity. Ghose and Dou consider that some commercial websites include events and links that lure users to visit a website regularly (Ghose and Dou, 1998). For example, an invitation to a sweepstake can motivate a person to visit the site frequently to be eligible for the prizes. Repeated exposure to a site (and relevant health information presented there) is a key element in learning.

Formation of relationships is another dimension of interactivity. The ability of the WWW to link people through the network creates the excellent opportunity to turn a receiver into a sender of information (Rimal and Flora, 1997). This exchange allows for two-way communication that can lead to a fuller relationship where users might help each other to learn (Ewing *et al.*, 1998) or provide social support (Braithwaite *et al.*, 1999). Also, the medium can be used to ask questions of professional care givers online (Hawkins *et al.*, 1997).

Finally, time is a dimension of interactivity. According to Nielsen's NetRatings (http://www.nielsen-netratings.com), users in the US average less than 1 min of time on a single web page. Therefore, it seems important to measure elements that might constrain the time lapse for interaction between a website and a person visiting the site. Such elements include the requirement that users register prior to gaining further access to a site as well as the use of complex graphics that can slow the time required for a site to load. Users are likely to leave a site if it takes too long to download. Time is the *willingness* of users to invest personal time while browsing.

Table I presents the dimensions and the interactive tools used to measure the dimensions discussed above.

View this table: [in this window] [in a new window]	**Table I.** *Dimensions and their underlying variables*

In this study we use content analysis to assess the interactive tools used in a sample of health-related websites. As communication researchers attempt to better understand the nature of web-based communication and how it works, content analysis can bring messages into focus. While the web is a dynamic medium, presenting unique challenges for use of this method, it is an increasingly common method for examining web-based content and can be used successfully when used with rigor and creativity (McMillan, 2000).

While one stream of research focuses on the accuracy of information on health-related websites (Jadad and Gagliardi, 1998; Silberg *et al*., 1998), in this study we focus only on the interactive tools of the site. A paucity of research has examined the interactive traits of health-related websites. Rice *et al*. concluded that commercial (.com) and government (.gov) health database websites exhibit differences in the formal features of the sites in line with their different structural incentives and constraints (Rice *et al*., 2001). In another study, Witherspoon found that top ranked HMOs do not take advantage of available interactive features used elsewhere on health-related websites (Witherspoon, 2001). She identified an opportunity for sites to enhance two-way communication with their members. While E-mail links were common, listservs and chat rooms were not.

Method

Procedure

The content analysis of the sampled websites was based on previous research analyzing commercial (Ghose and Dou, 1998; Ha and James, 1998) and health-related websites (Witherspoon, 2001). Also a literature search in trade magazines (e.g. *The Internet Standard*) was performed to find new tools to integrate to the coding scheme. The resulting code scheme consisted of 56 items to assess nine different dimensions of interactivity discussed previously (i.e. accessibility, delivery of message, navigation, data entry and use, personalized content, entertainment, promotions, relationships, and time).

Coders were trained as a group using online examples to illustrate coding items. They were provided with a code sheet for coding websites and also a codebook that contained the definitions of terminology. The code sheet and the codebook were modified over the course of training to clarify the meaning. Coders worked independently to code a subset of websites that were not part of the study sample and coders then proceeded to independently code the sampled websites.

Coders were instructed to surf the entire site to confirm occurrence (or absence) of each of the 56 interactive tools coded. Assessment of all web pages was done using equipment with T1 line access. Coding was completed within a rigid time frame to reduce possible error stemming from changes made to the websites.

Each site was coded by two coders and coding disagreements were resolved by a third coder. The overall intercoder reliability was 0.83, based on frequency of agreement. Interestingly, the intercoder reliability differed based on the top level domain of the sites, with reliability being the highest for .gov sites, followed by .org sites and then .com sites. This finding is likely due to the progressive complexity of the different types of sites, as discussed below.

Sample

A review of several print (offline) as well as web-based (online) resources was undertaken to identify a set of evaluated and/or recommended health-related websites directed to general consumers. We found that health-related websites can be categorized by their target users and by main health topics discussed on the website. Target users are most frequently divided into consumers, health professionals (e.g. physicians, nurses and academic researchers) and website developers or designers. Health topics covered on websites are categorized by diseases (e.g. allergy, asthma and immunology; AIDS; cancer), gender (e.g. men's health, women's health) and age groups (e.g. kids' health). Websites are also characterized by TLD, which is the last part of any URL. For example, in www.drkoop.com, the `.com' indicates a type of TLD. At the time of this study, website TLDs were limited to the following five: .edu, .gov, .com, .org and .net. The first TLD (or extension), .edu, is used for college and university websites, while .gov is reserved for agencies and branches of the US federal, state and local government websites. Although organizations and companies interested in having a website can choose the use of a .com, .net or .org extension on their own discretion, it is typical that websites intended for commercial use get the .com TLD, while not-for-profit organizations typically select a .org extension (Network Solutions; http://www.networksolutions.com).

Since our goal was to examine the most popular health-related websites among general consumers, we sampled websites that targeted the general consumer public and covered general health topics.

Several organizations as well as newspapers, magazines and journals have evaluated and/or recommended health-related websites. Sources referred to for our sampling of websites included *Consumer Policy Review, Consumer Reports on Health* (Consumer Reports on Health, 1997), *Guide to Health Care Resources on the Internet*, Internet Public Library (http://www.ipl.org/ref/RR/static/hea1200.html), *Journal of American Medical Association*, Nutritional Navigator (Tuft University) (http://navigator.tufts.edu/ratings.html), Mental Health Net (http://mentalhelp.net/help/ratings.html), *Newsweek*, Searchwords.com (http://www.searchwords.com/tophealthsites.html), Six Senses (http://www.sixsenses.com/FAQ.html), Top Ten Links (http://www.toptenlinks.com), *Wall Street Journal*, Webby Awards (http://www.webbyawards.com) and Yahoo! (http://dir.yahoo.com/health/general_health). These sources were identified by searching library databases such as ABI/Inform and Lexis/Nexis, and the WWW. Some sources disclosed the

evaluation criteria and the profile of evaluators while other sources did not provide any information on their evaluation criteria.

A pool of approximately 200 websites was constructed based on the ratings and recommendation by the sources above. To make a comparison across TLDs, from the pool, 30 websites, 10 each from the pool of commercial, organization and government sites, were sampled based on the frequency of reference by the sources. A partial list of the commercial (.com) websites analyzed include Dr Koop, HealthCentral, InteliHealth and Thriveonline. Organization (.org) websites analyzed included American Medical Association, Health web, Kaiser Permanente and MayoHealth, among others. Government (.gov) sites analyzed included CancerNet, Centers for Disease Control, Healthfinder and MEDLINEplus, among others. (A complete list of sites analyzed can be obtained from the lead author.)

Results

The first research question asked whether tools of interactivity are present in health-related websites. To examine this, frequencies were calculated on the occurrence of the 56 tools in the sample of websites. Table II lists the interactive tool, and the number of sites and percentage of sites where the tool was present. A total of 31 of the 56 tools measured were present in the coded sites.

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Table II. *Elements of interactivity used by health-related websites*

Only a few interactive tools were commonly present in the majority (over 90%) of the sample of sites, including use of links (internal and external), E-mail to communicate with people involved with the site and search engines. Additionally, some interactive tools occurred in over half of the sites, including presence of a site map, advanced options for a search engine, pull down menus, FAQs, links to additional software required to adequately access the website (i.e. links to Adobe's website for the latest version of Acrobat Reader) and a newsletter sent via E-mail to users who volunteer their addresses. Roughly 30–40% of the sites included surveys, cross-promotions, on-line orders, the site ability to serve as a repository of health information and the offer of virtual classes. It is clear that interactive tools are present in health-related sites and 10 such tools are present in 60% of the sample of websites coded. However, many tools expected to be present by the researchers did not appear at all in any of the 30 coded websites. For example, use of more complex interactive tools like `Gooey', `Face Time' or games played among various web visitors were not found in any of websites in the sample.

To better understand the occurrence of these interactive tools, we created an index of `general interactivity' which is an average of the interactive tools or positive relevant feature for the site.

The General Interactivity Index (GII) was calculated by dividing the number of interactive tools present in the website by the total number of interactive tools being measured ($n = 31$). Some items were reverse coded to reflect notions presented in the literature. For example, in this study the use of frames was coded as a presence–absence variable. However, this item was reversed because the accessibility of a site is enhanced when there is no use of frames. The GII for the sample of websites ranged from 0.60 to 0.21 (mean = 0.41). The range of the GII for this sample of sites captures a marked descending pattern of difference between sites with more interactive tools present to sites with fewer interactive tools present. It is important to note, however, that the index is a measure to be used as a comparison gauge between websites in the study. In other words, it has little meaning as an absolute measure.

The second research question asked how prevalent the occurrence of these interactive tools is for three relevant TLDs, i.e. .com, .gov and .org. To address this, we sorted the sites according to their TLD (.com, .gov and .org) using the GII. Distinct differences in the GII were found among three types of TLDs, most notably between the .com sites and the .org sites. In this sample, .com sites in general use a greater number of interactive tools (GII range 0.60–0.40; mean = 0.52) than .org sites (GII range 0.45–0.21; mean = 0.32). Sites sponsored by governmental agencies fall in the middle, between .com and .org sites in terms of the number of interactive tools used (GII range 0.47–0.28; mean = 0.32). While there is a range among the websites within each TLD, in this sample .com sites clearly used a greater number of interactive tools than either .gov or .org sites.

The third research question asked whether there are differences in how websites representative of diverse TLDs employ these interactive tools. We expected that websites developed by government agencies (.gov) or non-for-profit organizations (.org) would have fewer interactive tools than commercial sites (.com) that are driven by the competition of business.

An analysis of variance (ANOVA) was the first step. In this analysis it was found that there is a statistically significant difference of the GII between the TLDs ($F = 24.68$, $P < 0.01$). Using a more in-depth analysis using Bonferroni *post hoc* technique we concluded that .com sites were statistically different than the other two TLDs, while .org and .gov sites were statistically similar (.com versus .gov $P < 0.01$, .com versus .org $P < 0.01$, .gov versus .org $P > 0.05$).

Second, we examined the occurrence of the different dimensions within the entire sample. Based on our review of the literature to develop dimensions of interactivity, nine dimensions were created by adding together the frequency of occurrence of the respective tools that are posited to represent each dimension. For example, the dimension `Delivery of Message' was created by summing the presence of five tools such as audio, push media, text only, video and virtual reality. (As indicated before, Table I presents these dimensions and their tools.) After obtaining a sum for each dimension, a Dimensions of Interactivity Index (DII) was created by dividing the number of tools found in each website per dimension by the total number of tools measured in each dimension. Table III presents the relative presence of each of the nine dimensions in the sample of 30 websites.

View this table: [in this window] [in a new window]	**Table III.** *DII by TLDs and results of ANOVA*

The two dimensions occurring most frequently in the sample are Navigation (DII = 0.78) and Time (DII = 0.64), followed by Accessibility and Relationship (both DII = 0.45). Interactive tools indicative of the dimensions of Navigation and Time are present in many of the sites, and several of the tools of these dimensions were being utilized in a majority of the sites. Accessibility and Relationship ranked second with a much smaller index, but they were still indicative of the use of the tools that comprise the dimensions in the sample of websites. The remaining four dimensions, Personalized Content (DII = 0.37), Promotions (DII = 0.30), Delivery of Message (DII = 0.11) and Entertainment (DII = 0.08) were present much less frequently in the sample.

To examine the differences in the occurrence of these dimensions across the three different TLDs, a series of one-way ANOVAs were used. In the ANOVA for the dimensions of interactivity (DII), we found that there are significant differences between some of the dimensions (Table III♠). At the level of 0.01 significance or less, the Relationship dimension showed that the domains with a .com TLD had the highest index (mean = 0.86), followed by .org (mean = 0.33) and .gov (mean = 0.26) (F = 37.54). Promotions showed a similar pattern where .com had the highest index (mean = 0.73), while .org (mean = 0.10) and .gov (mean = 0.08) followed (F = 7.77). In contrast, .com (mean = 0.50) had the highest level of Personalized Content but the second place went to .gov (mean = 0.33) TLD, followed by .org (mean = 0.27) (F = 8.08). Finally, the Time dimension was in stark contrast to the above-mentioned results because .gov (mean = 0.83) and .org (mean = 0.73) were significantly higher than .com (mean = 0.37) (F = 11.35).

In the mean time, at the level of 0.05 significance or less, the Accessibility dimension showed a similar trend in favor of commercial websites. Sites with a .com TLD had the highest mean (mean = 0.55) followed by .gov and .org (mean = 0.52 and mean = 0.37, respectively; F = 4.12). Another dimension that showed at a 0.05 significance level differences between TLDs was Data Entry and Use. This dimension followed the same trend that favors commercial websites (mean = 0.49) over organization (mean = 0.23) and government sites (mean = 0.13) (F = 5.51). The dimensions Navigation, Delivery of Message and Entertainment showed no significant differences between TLDs.

Discussion

Effective health communication should be able to change knowledge, attitudes and/or behavior of individuals (Lapinski and Witte, 1998). At the same time, health-related websites should be considered as instruments for learning. We consider that the dimensions of interactivity found in websites can respond to this need to link learning and the new media's capabilities.

Two of the dimensions of interactivity developed in this research can precede and make possible the learning experience. Accessibility and Time are in some way antecedents of learning because learning theories assume that people will not change their knowledge, attitudes or behaviors without exposure or attention to the pedagogical material. More specifically, lack of good accessibility of a website is likely to hinder a person's visit. For example, the use of frames in a website, which is a measure of Accessibility, makes difficult or impossible the visit of blind or partially sighted people who use a screen reader or browser (Royal London Society for the Blind, 2000). Also, a website that takes a long time to download or overburdens the user with registration forms that have to be completed before interacting with the site or particular elements of it, could impede the motivation of a person to interact with a site. This is especially crucial considering that the average user spends less than 1 min on a website page (Nielsen//NetRatings).

Encouragingly, in this research it was found that Time and Accessibility dimensions were relatively high in all three TLDs. However, easier access to websites should be emphasized to organizations (.org) in order to begin the process of learning and interaction with their users. A similar recommendation can be directed to commercial (.com) sites, too, that reported low levels of the Time dimension. While one might hypothesize that government (.gov) sites should be both easy to access as well as take minimal time to down load and gain entry to (thereby resulting in greater prevalence of both Accessibility and Time in .gov sites as opposed to .com sites), we found that .gov sites scored best on Time, but .com sites scored best on Accessibility. We suspect there may be a confounded effect here. Government sites are likely to be less complex in design to insure use by the most people with the least sophisticated level of equipment (e.g. a 28.8 modem in lieu of a T1 line) and therefore would require fewer tools to allow users to access the site. This is in line with Rice *et al*.'s (Rice *et al*., 2001) notion that cultural imperatives and structural incentives and constraints differ across different TLDs. Government sites must allow users entry without the burden of additional tools to allow access and must demand less commitment of time on the part of users. They also do not necessarily need to be accountable in the way commercial sites might need to be (e.g. how many hits are received by a page to appease advertisers). On the other hand, as part of their cultural imperative, commercial sites must attract users and therefore need to burden their sites with many tools, images and complex text to attract many visitors.

Effective message communication usually requires more than one exposure to the information. Therefore, dimensions like Promotions and Entertainment, which might be considered as peripheral to learning tasks, should be considered as useful to entice users to stay longer and visit the site more frequently (Ghose and Dou, 1998). Unfortunately, it was found that both of these dimensions were not common among websites in our sample, particularly in organizational and governmental sites. Even commercial sites present a low index of the Entertainment dimension.

Health information is complex, dynamic and some times even contradictory. These obstacles to the increment of learning can be eluded in part by the Internet's multimedia capability. A rich medium will aid the understanding of the messages by using multiple forms like text, video and audio. Also the Navigation dimension, especially hyperlinks, is likely to help learning with its networked structure that parallels how the human brain works (Bagui, 1998). Finally, enhanced knowledge and understanding of health-related issues can be boosted by the interaction between users and health professionals as well as between different users, which is measured in our study

as the Relationship dimension (Feldman *et al.*, 2000). The Navigation dimension is strong in many of the websites analyzed and Relationship is present in the majority of commercial sites, while the multimedia delivery of message is low in the majority of the sites.

Knowledge is just one of the steps toward a behavioral change (Simons-Morton *et al.*, 1995). One way to translate knowledge into action is to provide the opportunity for a person to rehearse or practice the skills for behavioral change in a safe environment. A website can offer the opportunity to the users by providing games where players can practice their skills and abilities to alter the environment or respond to stimuli in order to change their `virtual' behavior. Later, in a `real-life' situation, they may feel a higher level of self-efficacy that will lead to higher success rates of behavioral change (Lieberman, 1997).

The interactive tools that enhance the relationship dimension can also boost individuals' feelings of self-efficacy through modeling (Blomquist, 1986) and interaction of novices with experts (Schacter and Fagnano, 1999). For example, chat rooms can be a cyberspace where people at different levels of the stages of change (Prochaska *et al.*, 1997) can receive or give advice and support or interact with experts on a particular health topic.

Learning theory considers as one of the key elements the feelings that individuals have toward the learning experience. Therefore, it is important to create positive affect for effective message processing and the interest in visiting and staying in the site. Promotions, entertainment tools, a multi-approach to the message delivery, easy navigation in the site and the possibility to interact freely with other users can influence positively the attitude toward the site (Chen and Wells, 1999) or having a positive emotional experience (Villegas and Stout, 2001).

In the present study, a look at the occurrence of tools of interactivity revealed that while the majority of sites in our sample do use these tools, overall the occurrence is quite low (RQ1). An examination of the use of tools of interactivity across three different TLDs revealed that .com sites used a greater number of tools, followed by .gov sites and, lastly, .org sites (RQ2). We also found support for our third research question, that different TLDs employ these tools of interactivity differently. For all nine dimensions, .com sites were most likely to employ these tools in their sites. In this instance, the differences between .org and .gov sites were not so clear. These findings partially support our model for linking interactivity with message effectiveness.

While the present study is one of the first to examine the interactive traits of the medium for health-communication related sites, it has some limitations. In this study, we coded a small sample of websites. A larger sample of sites could reveal a different picture in the presence of interactive tools and dimensions, and their relative occurrence across the different TLDs. The speed with which the content of websites changes presents a unique situation for coders and web content is probably best archived to capture a specific point in time. This process can require a great deal of computer memory, however. The complexity of sites also presents a challenge to coders. In our sample, .com sites were more difficult for coders since many more coding decisions were required, compared to .org sites, for example. Future research should pay particular attention to addressing issues related to content coding of this medium (McMillan, 2000). A less cumbersome and labor intensive method of web content assessment might also be

useful. In this study the entire website was coded while most content analyses examine only the homepage (Bucy *et al*., 1999).

The intent of this study was to examine interactive traits of the medium. Any study of this type would be stronger, however, to include an examination of the user's perceptions of interactivity. Perceived interactivity may in fact be a better predictor of learning than actual interactivity (Wu, 2000). Future research should consider perceived interactivity and use of qualitative methods or `debriefing' users after a session of surfing to enhance what we know about how interactivity works. Users' individual differences, like need for cognition, involvement, prior knowledge and level of technical expertise, might be very important to better understand how the delivery and structure of the message can be optimized to target individuals.

Our review of the literature yielded a plethora of definitions of interactivity and its associated dimensions. Future researchers should be clear in how the construct is defined and operationalized. How this definition might differ between web designers and users of the web will be interesting to know for planning effective messages.

Future research should also focus more systematically on understanding how the medium's interactive traits can be optimized to enhance communication objectives of the site. Health-related websites offer potential for doing more than providing information to the consumer.

Our findings indicate that while health-related websites do make use of a range of tools of interactivity, they may not be employing those tools most likely to facilitate knowledge, attitudes and behavior concordant with their goals. Our findings clearly indicate that .com sites are well ahead of the curve in using interactive tools to facilitate effective messages. Sadly, while .gov sites may be viewed as having the greatest `source credibility' for health-related information, the sites provide few interactive capabilities. Future research needs to address how and when interactivity enhances message effectiveness via consumers' exposure and assessment of websites.

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