Formal Features of Cyberspace: Relationships between Web Page Complexity and Site Traffic

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Although the Internet is not without its critics, many popular and academic writers are particularly effusive in their praise of the World Wide Web's interactive features. A content analysis of the formal features of 496 Web sites, drawn randomly from a sample of the top 5,000 most visited sites determined by 100hot.com, was performed to explore whether the capabilities of the World Wide Web are being exploited by Web page designers to the extent that the literature suggests they are. Specifically, the study examines the differences between the formal features of commercial versus noncommercial sites as well as the relationship between Web page complexity and the amount of traffic a site receives. Findings indicate that, although most pages in this stage of the Web's development remain technologically simple and noninteractive, there are significant relationships between site traffic and home-page structure for Web sites in the commercial (.com) as well as educational (.edu) domains. As the Web continues to expand and the amount of information redundancy increases, it is argued that a site's information packaging will become increasingly important in gaining users' attention and interest.

Introduction

The World Wide Web has been characterized as a new mass medium with the reach, content diversity, and technological sophistication of more traditional media (Morris & Ogan, 1996). Although the Internet or metaphoric Information Superhighway is not without its critics (see Elmer, 1997; Stoll, 1995), many trade publications and popular writers are particularly effusive in their praise of the Web's capabilities. Since 1994, *Newsweek* has devoted a special "Cyberscope" page in each issue to highlight the latest on-line innovations. The recent integration of push technology, streaming audio and video, and animated Java applications has received particular attention. Through convergence, the synthesis of once separate technologies into new hybrid forms, the Web "is moving to a post-HTML environment, a world way past a Web dominated by the page, and fast into a land of push–pull, active objects, virtual space, and ambient broadcasting" (Kelly & Wolf, 1997, pp. 12–13). Technologically, the Web is thought to be evolving so quickly that it is rendering previous versions of itself obsolete within a few years. "Comparing the Web today with its 1995 counterpart is not unlike comparing, say, the first Technicolor epics with a silent film" (Reid, 1997, p. 188).

Created in 1990 as a global hypermedia system to allow distant researchers to collaborate on large problems through the Internet (Schwartz, 1997), the World Wide Web is growing at a faster rate than any previous new communication medium (Berthon, Pitt, & Watson, 1996), in part due to increasing promotion in the traditional mass media (*Internet World*, 1997). There are approximately 79 million adult Internet users in the United States and Canada, and over 120 million internationally (CommerceNet, 1998). The amount of money spent on Web advertising, close to $600 million in 1997 (Internet.com, 1998), is expected to increase to $8.1 billion by the year 2002 (ZDNet, 1998). The estimated number of unique Web sites varies, with one tracking service conservatively placing that number over one million (*Web Techniques*, 1997). The vast majority of sites are commercial in nature (Kosters, 1997).

With the introduction of any new medium there is a lag between the technology's diffusion throughout society and systematic empirical research measuring the nature of the medium itself and its potential effects on users (Rogers, 1995; Wimmer & Dominick, 1997). When analyzing media environ-

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ments, it is important to distinguish between content and form. Content consists of the verbal and visual informational components of a message (e.g., story topic, emotional images), while form refers to the packaging of that information (e.g., format structure, editing, digital effects)—what Huston et al. (1981) have termed *formal features.* The history of mass communication research suggests that, with each new medium, scholars typically examine message content and demographic characteristics of the audience first, treating formal features and the effects of message structure as an afterthought (Wimmer & Dominick, 1997). The literatures on the prevalence of sex and violence in the media, bias in news reporting, and misleading or negative advertising appeals testifies to the emphasis on message content in traditional media research. Consistent with this research emphasis, Aikat (1995), in one of the first systematic analyses of the Internet, examined the information content of 1,140 academic, government, and commercial Web sites.

Although content should remain a central concern of media research, a significant amount of the variance in what a person takes from a media message is explained by the form that message takes, as McLuhan (1964) observed in his seminal analysis. Part of the appeal and power of any audio–visual medium, including the World Wide Web, depends on the way information is packaged. A growing body of media research has shown that important effects of media messages, including increased attention, arousal, memory, and liking, are the product of an interaction between content *and* form (see Lang, 1990; Lang, Bolls, Potter, & Kawahara, in press; Reeves & Nass, 1996). Surveys of Web users indicate that form is important to the perceived attractiveness, usefulness, and value of Web pages (Pitkow & Kehoe, 1995). Several books have been written on Web page and interface design (DiNucci, 1997; Lynch & Horton, 1999; Nielsen, 1998; Shneiderman, 1998), and many suggestions for the design of effective Web sites are available on-line (King, 1997; Levine, 1995; Nielsen, 1995b, 1996). Nielsen cautions that cost is not a reliable measure of a site's design effectiveness. "Advertising agencies are happy to charge from $20,000 to $150,000 to design a Web site that looks like a series of beautiful magazine ads but doesn't necessarily take full advantage of the interactive medium" (Nielsen, 1995a, p. 1).

Shneiderman (1998), a leading researcher of interface design, suggests eight underlying principles of design for interactive systems—among them: strive for consistency; enable frequent users to use shortcuts; offer informative feedback; permit easy reversal of actions; support an internal locus of control; and, reduce short-term memory load (pp. 74–75). He comments:

> The limitation of human information processing in short-term memory (the rule of thumb is that humans can remember "seven plus-or-minus two chunks" of information) requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced, and sufficient training time be allotted for codes, mnemonics, and sequences of actions (p. 75).

In his usability studies, Nielsen (1994, 1997b) found that Web users are impatient, do not want to be slowed by "cool" features or overuse of "bleeding edge" technology, prefer to scan rather than read text, and appreciate the ability to search on-line. These findings suggest that formal elements of Web design may be central to holding users' attention and interest. Yet Nielsen (1997b) cautions against overkill; just because certain features exist does not mean they should be applied. Animation, he stresses, is almost always annoying. Moreover, wild background patterns disrupt page reading, splitting pages into frames is highly confusing, and colored text should be used with care (Nielsen, 1997b). Too many hypertext links per display may also introduce cognitive overload and impede search performance (Khan & Locatis, 1998).

To date, much of the analysis about the Web's content and form has been qualitative (e.g., McLaughlin, 1996; Morris & Ogan, 1996) or proprietary to industry (e.g., CommerceNet/Nielsen Media Research, 1998) and only partially released. Proprietary studies, driven by market concerns, focus largely on the growth of Web advertising, the Web usage patterns of consumers, and the expansion of the online population (e.g., Internet.com, 1998; Jupiter Communications, 1998; NetRatings, 1997). The lack of baseline data on the Web's formal features means that both descriptions and criticisms of this new medium are necessarily based on subjective impressions, anecdotal evidence, or convenience samples and may, therefore, be unfounded. Although qualitative observations may serve journalistic imperatives to tell the World Wide Web "story," they provide an unstable foundation for systematic and cumulative research of an important new medium.

This study represents an early attempt to systematically analyze the formal features of cyberspace. While acknowledging the importance of content, this study focuses exclusively on the formal dimensions of the World Wide Web. Specifically, the study asks if the interactive capabilities of the Web are being exploited by Web page designers to the extent that the popular literature suggests they are. Moreover, this study investigates whether there are significant differences between the formal features of commercial versus noncommercial sites, and if the elements and complexity of Web page design vary by the amount of traffic a site receives. Because the usability of a site is affected by its design (Nielsen, 1994), the analysis also considers the extent to which Web pages violate accepted design rules, including overuse of page frames, animated images and text, and complicated background patterns. According to user interface designer Jakob Nielsen (1996), "A web page should not emulate Times Square in New York City in its constant attack on the human senses."

Empirical Web Research

The empirical literature of the Web is still emerging; however, a few preliminary attempts have been made to analyze the formal features of certain categories of Web

sites. In a content analysis of the interactive features of 110 business sites, Ha and James (1998) found a discrepancy between the capabilities of the Web and the actual implementation of interactive features online. Most of the business sites contained hyperlinks within the same site (an average of 12.2), but they did not integrate links directing users to relevant information from third-party sources (averaging less than 1 per site). Only a third of the sites allowed for consumer feedback (via e-mail, direct orders, on-line surveys, or toll-free numbers). Overall, Ha and James (1998) conclude that the interactivity in business sites was quite low.

Several studies have examined the adaptation of traditional media, especially television, to the Web. An examination of 61 local TV broadcasters' use of the World Wide Web in 1995 revealed that most station home pages made little use of visuals, including icons, graphics, and photos, or video and audio clips, but did include links (Bates & King, 1996). A year later, a follow-up content analysis of 416 TV news sites showed that the sophistication of Web page design increased markedly, with increased use of graphics, image maps, site indices, frames, incorporated search engines, animated graphics, and links to audio and video (Bates, Chambers, Emery, Jones, McClung, & Park, 1997). Advertising also emerged, with almost 40% of sites featuring ad icons and 7% of sites containing advertising "panels."

Niekamp (1996) examined 123 television news station Web sites and found that e-mail links to the station was the most frequent feature on the home pages, followed by links to program schedules and the local news department. While 34.1% of stations featured textual information to supplement the station's news operation, only 7.3% posted any pictures and 1.6% offered links to audio. Online advertising appeared in 8.9% of the sample. In a follow-up survey to 108 television stations who maintain a Web presence, Niekamp (1997) determined that links within news stories that lead users to related information were the only interactive features that significantly predict accesses. A content analysis of the online versions of three U.S. newspapers (the *New York Times, Washington Post,* and *USA Today*) found that graphics appeared primarily on home pages, while the inner pages were dominated by text; news content was highly interconnected via hyperlinks, and on the *New York Times* site 95% of the news articles were linked to related stories and other information (Li, 1998). The study, conducted in 1996, concludes that Web newspapers did not take full advantage of available technology.

Research Questions

Given the above discussion, the following research questions are proposed:

RQ1: are the capabilities of the Web being exploited by Web page designers to the extent that the popular literature suggests they are?

RQ2: how much advertising is on the Web and are there significant differences in the amount of advertising for commercial and noncommercial sites?

RQ3: is there a relationship between the complexity of Web page design and the amount of traffic a site receives? Do these relationships vary by domain?

RQ4: to what extent do Web pages violate accepted design rules, including overuse of page frames, animated images and text, and excessive page length?

Methods

A sampling frame of the top 5,000 Web sites ranked by Web21's proprietary service 100hot.com was downloaded on November 3, 1997 using 100hot's InSite Pro service (available at http://www.100hot.com/welcome.chtml). This service tracks the usage patterns of over 100,000 Web users world wide and produces dynamically generated lists of the 200,000 Web sites most heavily visited by that sample. For accuracy, InSite Pro ranks sites based on unique page views or URL (uniform resource locator) requests and corrects for multiple frames so that sites with more than one frame are not counted twice (Web21, 1997). The hits for each Web site represent a daily average of page views for the previous 6 weeks.[1]

Approximately 60% of 100hot.com's sample are North American users and 40% are from other countries. Academic, business, and home users are represented among the sample, but America Online subscribers, for example, are not. Consequently, lists generated from InSite Pro reflect the general usage patterns of many, but not all, Web users.

From the list of 5,000 top-ranked sites, 500 Web sites were selected for coding using a systematic random sample method.[2] Students in an undergraduate research methods class participated in a group training session and coded 15 pages each for course credit. Coders accessed every tenth Web page on the list by typing the URL, or Web page address, in Netscape (version 2.0 or higher). Foreign language sites were coded, but adult sites, which were automatically filtered out of the sample by the InSite Pro ranking service, were not. When an address did not produce a page suitable for coding, the next Web site on the list was selected instead. Four pages out of the 500 were not coded, leaving a sample size of 496.

The unit of analysis was the home page, which, as Ha and James (1998) point out, serves as the "front door" for

[1] The page view data does not distinguish between hits and visits. Although the number of hits refers to the frequency with which a Web site is accessed, regardless of how or whether information on the site is used, a visit implies more time spent browsing and greater interaction between the user and the content (Berthon, Pitt, & Watson, 1996).

[2] By using a randomized sampling frame, this study included sites not restricted to any particular content area, enhancing the generalizability of the findings to the Web overall. At the time the sample was drawn, the Web ranking service 100hot.com (http://www.100hot.com) identified eight categories of Web content: technology, entertainment, business, shopping, lifestyle, game sites, sports, and news.

the entire Web site. Before proceeding, coders were instructed to enlarge the Netscape window to fill the entire screen to standardize the analysis and estimate the overall length of the page. All coders used standard, 15-inch computer monitors for the analysis.

Coding Instrument

The coding instrument probed general descriptive and specific formal dimensions of individual Web sites. General descriptive categories included domain name (commercial or .com, education or .edu, government or .gov, organization or .org, network or .net, military or .mil, and other), rank by number within the list of top 5,000 sites, and the average number of page views for the Web site by the InSite Pro sample over a 6-week period. Three component parts of each Web site were distinguished—the banner, general body or dominant window/frame, and advertisements—and analyzed for formal features and interactive links.

The Banner

The top of a Web page typically identifies the site in a distinguishable framed box called the banner. The banner resembles what newspaper layout and desktop publishing designers call the nameplate. According to Garcia (1993, p. 153) the nameplate in newspapers serves two basic functions. First, it is a "graphic ally" which reveals the character of the newspaper. Second, it visually carries the front page when other graphical elements such as photos or artwork do not stand out. It is fair to assume that the banner of a Web page serves similar functions as the nameplate of a newspaper.

Because the banner appears to be a prominent structural component of Web design, its presence or absence on home pages was assessed and the placement of advertisements and links internal to the banner were coded. Coders were instructed to use the mouse pointer to find "hand icons" that identify links in the banner. They also coded the dominant color of the banner.[3] Garcia (1993) notes that blue is the most popular color for newspaper nameplates and speculates that one reason for this might be the physiological effects of the color blue on readers. Unlike red, which is considered to be a warm color, blue has the capacity to lower respiration rates and blood pressure, as well as the number of eye blinks per minute (Bohle & Garcia, 1987).

In television, producers rely on camera movements (e.g., pan, tilt, zoom) and editing techniques to create dynamic audio–visual messages. Web designers may similarly use text movement to add vigor to Web pages. Thus, coders recorded color changes, animation, blinking text or images, and scrolling text or images in the banner. Interface designers disagree about the use of dynamic formal features. On the one hand, Shneiderman (1998) views dynamic features as instrumental in drawing attention to Web sites and providing navigational aid. More animation, auditory feedback, three-dimensional graphics, and rich information displays, he argues, will become commonplace on Web pages in the future. On the other hand, Nielsen (1996) warns against "design bloat" and recommends limited and, when necessary, motivated use of moving text.

Body of the Home Page

Several general design features in the body of home pages were coded, including logos, the number of screens and frames (areas that can be scrolled individually) per home page, and the presence of page guides or maps.[4] Nielsen (1997b) and Shneiderman (1998) regard page guides and maps as important navigational tools for Web sites; their incorporation, they assert, marks a thoughtful design.

The background of the home page body was identified as either a solid color[5] or wallpaper. Photos, textured designs (e.g., marble), graphic designs, drawings, and other wallpaper patterns were coded as options within the wallpaper background category. Backgrounds and effective use of color can indicate the sophistication of a Web site's design.[6] According to White (1990), the impact of color on the human perceptual system should be taken into account by designers of electronic media interfaces. Warm colors (red, yellow, orange) attract more attention and appear closer to the viewer than cool (blue, green, violet) ones. Thus, warm colors should be used for the foreground and cool colors for the background. In a test of 24 color combinations, Pace (1984) found that the use of blue as a background color on visual display units was associated with reduced error rates for reading. Design experts (e.g., Garcia, 1993; Nielsen, 1997b; Shneiderman, 1998) recognize the potential artistry of a wallpaper design but tend to recommend a solid background color to facilitate usability. Indeed, multiple colors surrounding an object of interest have been found to be distracting (Bohle & Garcia, 1987; Garcia & Fry, 1986). In general, subjects report a preference for one dominant color over many competing colors (Covert, 1987; Shneiderman, 1998).

Among other functions, newspaper images serve to attract attention and visually encapsulate a story. From a design perspective, Garcia (1993) sees images as stepping stones that help the reader's eyes jump between stories. The

[3] Black, white, gray, red, blue, yellow, green, orange, purple, brown, multicolor, other.

[4] Nielsen (1997) found that Web users are becoming more willing to use the scroll function to move between frames. In 1994, he found that only 10% of Web users scrolled. In 1997, most users used this function. This leads him to recommend multiple frame designs limited to no more than three screenfulls on an average monitor.

[5] Black, white, gray, red, blue, yellow, green, orange, purple, brown, multicolor, other.

[6] Similarly, studies have shown that newspaper readers indicate a strong preference for color layouts over black and white versions (Click & Stempel, 1976, 1982; Stanton, 1986). Among the print media audience, color can enhance evaluations of interest, pleasantness, excitement, and power (Bohle & Garcia, 1987).

presence of photographs in particular encourages reading of accompanying textual material (Wolf & Grotta, 1985). On Web sites, images may similarly compel attention and guide the user along the page. The coding instrument, therefore, included categories to assess the presence of still and video images. The number of nonphotographic or video images (graphs, drawings, and other graphic designs), black and white photographs, color photographs, and photographs of people that appeared as foreground material in the main body were also coded. Streaming, full-motion video, is one of the most advanced technological features on Web sites; consequently, links to full-motion video, pictures from Web cameras, and real-time video locations were counted as well.

Several investigators have identified hyperlinks, whether audio, video, or e-mail, as inherently interactive (see Bates et al., 1997; Niekamp, 1997; Tremayne, 1997). Tremayne (1997) emphasizes the importance of any link in defining news Web sites as interactive. Nielsen (1997b) also lists surveys and chat forums as important interactive design features. For the purposes of this analysis, interactive features included on-line address forms and surveys, e-mail links, text links, nontext links (buttons and other icons), links to video and audio, addresses, telephone numbers, and visitor counters.

Finally, four categories were devised to capture text movement in the main body of Web sites, similar to those used for coding the banner. These include color changes, animation, text blinks, and text scrolls. "Other" categories were included to exhaust the textual effect and link possibilities.

Advertisements

Nielsen (1997a) argues that the Internet is not an appropriate medium for advertising, yet the World Wide Web's potential to generate advertising income enjoys much attention (see Berthon et al., 1996). Coders were instructed to assess the presence of advertisements and to identify their location in the banner or the body. In the body of the home page, the coding instrument distinguished between cycling and noncycling advertisements. A cycling advertisement was defined as one that changed content frequently (several times a minute), whereas a noncycling advertisement was defined as remaining fixed on one product or service. Movement (blinking, animation, color change, scrolling, and other movement) was also noted in the three noncycling advertisements closest to the top of the home page, excluding the banner.

Intercoder Reliability

From the sample of 496 coded Web pages, a subsample of 91 sites (18% of the sample) were double coded to test intercoder reliability. For nominal (yes/no) variables, percent agreement was calculated, while Krippendorff's alpha was calculated for interval and ratio-level data. Reliabilities, calculated on a total of 54 variables, ranged from a low of 0.37 to perfect agreement (1.0). The average reliability across all variables coded was 0.84, which was deemed an acceptable measure of agreement. Half of the variables had good to excellent reliabilities, above 0.90 and 12 variables had reliabilities between 0.80 and 0.89. Just five variables fell below 70% agreement, including color photographs (0.67), number of clickable graphics (0.64), drawings and pictures (0.55), noncycling ad locations (0.54), and banner links (0.37). One reason reliability may be low for ad locations, pictures, and photographs might be due to page updates. The data collection period last 2 weeks, from November 3–17, 1997, and many of these sites may have been updated over that period. A second reason is that, in the case of on-line advertisements, specific ads may vary each time they are visited by a second coder because many sites determine which ads to show based upon unique user profiles.

Results

Results are divided into four sections: analysis of the sample as a whole, analysis of particular categories of formal features, analysis of Web advertising, and the relationship between page complexity and site traffic. The sample consisted of 344 commercial (.com) pages (69.4% of the sample), 68 network (.net) pages (13.7%), 35 educational (.edu) pages (7.1%), 27 organizational (.org) pages (5.4%), 12 government (.gov) pages (2.4%), 1 military (.mil) page (0.20%), and 9 unidentifiable pages coded as "other" (1.8%). Governmental sites received the most traffic on average, with 7,761 mean page views, followed closely by commercial sites, with an average of 7,399 page views. The next most visited category of Web sites were educational pages, with an average of 3,776 page views, followed by network pages with 2,384 page views, the "other" category with 2,267 page views, organization pages with 1,626 page views, and the one military page with 1,534 page views. As discussed below, these page view averages change markedly when considering the top quintile of most visited sites.

To facilitate interpretation of the results, three tables were constructed to present the occurrence of formal features on home pages and home page banners, as well as the percentage of ads and ad features in the sample. Percentages are shown for each feature for the sample overall as well as the top quintile of most visited sites. In addition, the six Internet domains present in the sample were collapsed into three broad categories—commercial (.com/.net), educational/nonprofit (.edu/.org), and government-related (.gov/.mil)—for further analysis.[7]

[7] Because the sample was drawn randomly, the group sizes of the different domains are not balanced. Such disproportionate cell frequencies can give rise to nonorthogonality when performing analysis of variance on a dependent measure (see Winer, Brown, & Michels, 1991). Consequently, ANOVA was not used to determine significant differences between domains.

TABLE 1. Percentage of formal features on home page banners.

Banner	Sample overall $N = 496$	Top 20% of sites $n = 99$	.com/.net $n = 412$	.edu/.org $n = 62$	.gov/.mil $n = 13$
Banner color					
White	42.1	35.1	40.4	45.0	75.0
Black	15.0	10.8	16.4	5.0	12.5
Blue	8.0	5.4	8.2	7.5	0.0
Gray	5.9	4.1	5.7	7.5	0.0
Other	4.3	2.7	3.8	10.0	0.0
Yellow	1.9	0.0	1.9	2.5	0.0
Red	1.3	1.4	0.9	5.0	0.0
Green	1.3	2.7	1.6	0.0	0.0
Purple	1.3	1.4	1.6	0.0	0.0
Multicolor	18.8	36.5	19.6	17.5	12.5
Banner features					
Links	46.3	50.5	49.6	29.0	23.1
Ads	16.0	15.2	18.7	1.6	7.7
Color changing	5.5	7.1	6.1	3.2	0.0
Movement[a]	21.6	19.2	23.4	6.5	7.7

[a] Includes scrolling, blinking, and other movement.

Banners

Most of the home pages sampled featured a banner (75.4%, $n = 373$). As Table 1 shows, the most common banner color overall was white (42.1%), followed by multicolor patterns (18.8%), black (15%), and blue (8%). Banners on pages in commercial domains (.com/.net) featured these colors the most. A greater percentage of banners on commercial and network pages also incorporated links, advertisements, color changing, and movement than educational/nonprofit, or government-related home pages. Overall, banners were largely static, although one-fifth (21.6%) featured blinking, scrolling, or other movement and 5.5% a color-changing effect.

Home Page Structure

As shown in Table 2, home pages averaged 2.4 screens of content in length. The vast majority of pages presented three or fewer screens of content (86%) and used one or more frames (79.4%). Page maps were offered on almost three-fourths of all sites in the sample (72.4%), but only 10.1% incorporated hit counters. Similar to the banners, the most common home page background color was white (65.5%), followed by black (12.7%), multicolor (5.1%), and blue (4.1%). Pages in commercial domains again featured these colors the most. The HTML default color gray, suggesting an absence of color, was used for 6% of all backgrounds.

Graphical elements

Almost all of the home pages (95.2%, $n = 472$) featured at least one graphical element (a logo, photo, drawing, or picture), with an average of 4.4 graphical elements per page. The most frequently occurring graphical elements were logos (on 83.9% of the pages), followed by drawings or pictures (44.6%), color photographs (31.9%), and photographs of people (20.8%). Only 5% of the pages featured black-and-white photographs. For the most part, home pages in educational/nonprofit and government-related domains featured a higher percentage of graphical elements than pages in commercial domains.

Dynamic elements

Dynamic elements, including color changing, scrolling, and moving text, as well as animated graphics and icons, were present in almost a third of the home pages sampled (32.7%, $n = 162$). Among these sites there was an average of 2.3 dynamic elements per home page. Moving text was the most common dynamic element, present in 12.7% of home pages sampled, followed by image/icon movement (11.9%), blinking text (9.7%), scrolling text (5.8%), and color-changing text (4.2%). Commercial domains featured a higher proportion of moving and blinking text, but educational/nonprofit and government-related domains incorporated color-changing text and image/icon movement more often.

Asynchronous interactive elements

Consistent with the classic distinction between synchronous and asynchronous on-line communication modalities (see Morris & Ogan, 1996), interactive home-page elements were divided into two categories: real-time (instant) and asynchronous (delayed). There were far more pages with asynchronous elements (98.9%, $n = 491$), including text and picture links, e-mail links, on-line surveys, and contact information (phone numbers and mailing addresses), than real-time features in the sample (15.9%, $n = 79$). The

TABLE 2. Percentage of formal features on home pages.

Formal features	Sample overall $N = 496$	Top 20% of sites $n = 99$	.com/.net $n = 412$	.edu/.org $n = 62$	.gov/.mil $n = 13$
Home page structure					
Frames	79.4	78.8	78.6	83.9	69.2
Screens[a]	2.4	2.2	2.5	1.9	2.2
Page map	72.4	77.8	70.9	77.4	84.6
Visitor counter	10.1	8.1	9.2	11.3	15.4
Graphical elements					
Logo	83.9	81.8	83.5	83.9	92.3
Drawings/pictures	44.6	52.5	43.9	43.5	46.2
Color photographs	31.9	38.4	29.4	40.3	61.5
People photographs	20.8	23.2	19.4	25.8	30.8
B&W photographs	5.0	7.1	5.1	6.5	0.0
Dynamic elements					
Moving text	12.7	12.1	13.1	9.7	0.0
Blinking text	9.7	12.1	10.7	6.5	0.0
Scrolling text	5.8	10.1	5.1	5.5	0.0
Color-changing text	4.2	7.1	4.6	1.6	7.7
Image/icon movement	11.9	10.1	12.1	4.8	30.8
Asynchronous interactive elements					
Text links	97.8	97.0	97.6	98.4	100.0
Picture links	66.1	70.7	67.0	58.1	53.8
E-mail links	49.4	38.4	49.3	48.4	53.8
Phone number	14.5	12.9	12.9	24.2	15.4
Mailing address	8.5	8.7	8.7	12.9	7.7
Survey forms	4.2	5.6	5.6	1.6	7.7
Real-time interactive elements					
Chat	9.7	13.1	10.9	3.2	0.0
Video links	4.4	2.0	4.6	4.8	0.0
Audio links	4.4	1.0	4.4	6.5	0.0
Web cameras	1.8	3.0	1.7	1.6	7.7
Background color					
White	65.5	59.4	63.4	71.0	100.0
Black	12.7	11.5	13.9	8.1	0.0
Gray	6.0	8.3	5.7	8.1	0.0
Blue	4.1	3.1	4.5	3.2	0.0
Other	3.3	2.1	3.5	3.2	0.0
Red	1.2	4.2	1.2	1.6	0.0
Yellow	0.8	0.0	0.7	1.6	0.0
Green	0.6	1.0	0.5	1.6	0.0
Purple	0.4	0.0	0.5	0.0	0.0
Orange	0.2	0.0	0.2	0.0	0.0
Multicolor	5.1	10.4	5.9	1.6	0.0

[a] For the screens variable, the mean number is reported because all sites have at least one screen.

most frequent asynchronous elements were text links, which featured in 97.8% of the home pages sampled, followed by picture (66.1%) and e-mail (49.4%) links. Contact information appeared much less frequently, with only 14.5% of the home pages overall posting phone numbers, 8.5% including mailing addresses, and 4.2% offering survey forms. Overall there was an average of 27.1 asynchronous elements per page. By domain, educational/nonprofit pages featured more phone numbers and mailing addresses, but fewer survey forms and e-mail links than commercial and government-related pages.

Real-time interactive elements

Real-time elements were used much less often than asynchronous elements. Among the 15.9% of pages with real-time features, including video links, audio links, Web camera links, and chat rooms, there was an average of 2.4 real-time elements per page. The most common real-time feature was chat rooms, present in 9.7% of the home pages, followed by video links and audio links, both of which were present in 4.4% of the home pages. Web camera links were quite rare, appearing in just 1.8% of the home pages overall (and perhaps disproportionately represented on 7.7% of government-related pages).

Most Visited Sites

Interesting differences emerge among the top quintile of home pages sampled (average page views = 25,993, $n = 99$) compared to the sample overall (average page views = 6,045, $N = 496$). Tables 1 and 2 show that, among the

TABLE 3. Percentage of ads and ad features.

	Sample overall $N = 496$	Top 20% of sites $n = 99$	.com/.net $n = 412$	.edu/.org $n = 62$	.gov/.mil $n = 13$
Web advertising					
Sites with ads	54.1	53.5	59.4	27.4	23.1
Banner ads	16.0	15.2	18.7	1.6	7.7
Cycling ads	7.5	9.1	8.5	3.2	0.0
Noncycling ads	47.8	50.5	51.9	25.8	23.1
Ad movement[a]					
First ad	13.1	12.1	14.1	9.7	0.0
Second ad	5.4	10.1	6.3	1.6	0.0
Third ad	1.8	2.0	2.2	0.0	0.0

[a] Ad movement includes blinking, scrolling, other movement, and color change in the noncycling (stationary) ads.

top 20% of most visited home pages within the sample, multicolor banners and banner links were used more frequently than the sample overall, as were multicolor and patterned backgrounds in the body of the page. Graphically, the top pages incorporated more photographs (color, black-and-white, and of people) and more animated text features, such as scrolling, blinking, and color changing. Consistent with the emphasis on graphics, there were also more picture links. Links to Web cameras and chat rooms appeared more frequently, enhancing interactivity. Finally, heavily visited sites featured more page guides but fewer e-mail links and phone numbers than the sample overall. These results suggest that formal features on the Web may indeed vary by the amount of traffic a site receives.

Web Advertising

The prevalence of advertising in the sample indicates that the Web is indeed beginning to gain popularity as an advertising medium. Table 3 shows that over half of all home pages in this analysis (54.1%, $n = 268$) contained advertising of some kind, including banner ads, noncycling or stationary ads, and cycling ad locations.[8] The percentage of pages with advertising increases to 59.4% when examining only those sites in commercial domains. As would be expected, more pages with .com and .net addresses featured advertising than educational/nonprofit and government-related pages. Not surprisingly, when segmented into two groups—commercial and noncommercial—commercial sites (.com, .net, and "other") featured significantly more ads overall, $m = 1.96$, than noncommercial sites (.edu, .gov, .mil, and .org), $m = 0.67$, $t = 3.81$, $p < 0.0001$. Among the top 20% of all home pages sampled, commercial pages contained an average of 2.7 ads per page.

Web advertisements, like the pages they were on, had surprisingly few dynamic or interactive effects. In the ad features analysis, only pages containing at least one noncycling ad were used (47.8% of the sample, $n = 237$). A composite value was created that tallied the occurrence of blinking, movement, color change, and scrolling effects for each ad. Just under a third of the pages with noncycling ads (31%, $n = 74$) had at least one dynamic advertising feature, and a majority of these home pages (76%) were commercial. The mean number of formal features per ad for these sites, however, was less than one ($m = 0.82$), indicating that dynamic advertising effects are somewhat of a novelty and do not apply to every ad on a page. As shown in Table 3, when dynamic effects were employed, they appeared most often on the first ad—and more so on commercial pages than educational/nonprofit and government-related pages.

Page Complexity and Site Traffic

To investigate the question of whether there is a relationship between the formal features and complexity of Web page designs and the amount of traffic a site receives, correlations were run between six composite structural variables and the number of page views a site received.[9] The six composite structural variables corresponded to the four categories of elements analyzed in the body of the page above (graphical, dynamic, asynchronous interactive, and real-time interactive), plus a page structure variable consisting of the number of frames, screens, page maps, and visitor counters on home pages, and an omnibus structure variable consisting of all the elements in the previous five categories.[10]

[8] When examining the formal features of Web advertising, coders were instructed to analyze the first three noncycling ads that appeared when scrolling from the top of the site.

[9] Because the page view variable increases in a nonlinear fashion, a linear transformation was performed, creating a new variable representing the reciprocal of page views. Linear transformations were also performed on three composite formal variables: graphical elements, dynamic elements, and the omnibus structure variable.

[10] The validity of the composite variables was conceptually rather than statistically derived. Consequently, factor analysis, which identifies the underlying dimensionality of a set of related variables, was conducted but not relied on. Exploratory factor analysis of all 25 formal variables produced an 11-factor result (all Eigenvalues > 1) explaining 63.1% of the variance, with many individual items pairing in ways consistent with the composite variables. Given that reliability in content analysis is generally assessed through intercoder reliability measures (Singletary, 1994, p. 294), alpha reliabilities appropriate for scale or index construction were not performed.

Several significant relationships emerged between page structure and traffic in the sample. As with the advertising data, the sample was divided into commercial and noncommercial pages. For commercial pages there was a significant correlation between graphical elements ($r = 0.11$, $p < 0.02$, $n = 400$) and the number of page views a site received. In addition, asynchronous interactive elements were positively associated with page views, but at a 94% confidence level ($r = 0.08$, $p < 0.06$, $n = 421$). For noncommercial pages there was a significant and stronger association between page views and asynchronous interactive elements ($r = 0.30$, $p < 0.004$, $n = 75$); as traffic at noncommercial sites increases, so do the opportunities to contact and interact with the organization sponsoring the site.

The same set of correlations was also run separately by domain to determine if the associations between page structure and traffic varied by page type. The relationships between page views and graphical elements ($r = 0.11$, $p < 0.02$, $n = 327$), as well as page views and asynchronous interactive elements ($r = 0.10$, $p < 0.03$, $n = 344$), remained significant for commercial (.com) pages but not network (.net) pages. There was also a near-significant association between page views and the omnibus structure variable for commercial sites ($r = 0.08$, $p < 0.06$, $n = 342$). These findings are not surprising, as commercial sites were the most prevalent in that category (81.7%, $n = 344$). Among noncommercial pages, the strongest associations between page views and formal features emerged for educational (.edu) sites. There were significant correlations between page views and page structure ($r = 0.44$, $p < 0.004$, $n = 35$), asynchronous interactive elements ($r = 0.30$, $p < 0.04$, $n = 35$), and the omnibus structure variable ($r = 0.34$, $p < 0.02$, $n = 35$).

Discussion and Study Limitations

Results from this analysis suggest that the answer to the first research question, whether the capabilities of the Web are being exploited by Web page designers to the extent that the popular literature suggests they are, is no. The vast majority of pages in the sample did not feature such basic real-time interactive elements as video and audio links or Web cameras, let alone the more advanced features touted by the popular press. Asynchronous interactive elements, which facilitate delayed communication, are far more common than features that allow real-time interaction. Signs of design sophistication are evident, however, in the widespread use of logos, text and picture links, and page maps. Web designers are much more likely to integrate drawings, photographs, and hypertext links into their home pages than dynamic elements that entail more advanced programming skills and require greater processing capacity.

In answer to the second research question, how much advertising is on the Web, this analysis found that more than half the pages sampled contained some advertising. The prevalence of ads speaks to the Web's emergence as a new mass medium and audience delivery vehicle for advertisers (Berthon et al., 1996). At the time this sample was drawn there were far more stationary or noncycling ads in the body of home pages than either banner ads or cycling ad locations. For the most part, noncycling ads are not very dynamic and, the more ads that appear on a page, the more static they are likely to be. The analysis also found predictable differences in the amount of advertising for commercial and noncommercial sites, with commercial sites containing significantly more ads than noncommercial sites.

The third research question asked if there was a relationship between the complexity of Web page design and the amount of traffic a site receives. For both commercial and noncommercial pages, the analysis found that the amount of asynchronous interactive elements does seem to be associated with Web site traffic. By domain, significant relationships between traffic and page structure hold for commercial (.com) pages, as well as pages in the educational (.edu) domain. Although we would expect commercial page designs to encourage traffic, the finding for educational pages is surprising. Perhaps the strict Web design guidelines enforced by many colleges and universities contribute to their overall sophistication and user appeal.

The last research question asked to what extent home pages seemed to violate accepted design rules, including overuse of page frames, animated images and text, and excessive page length. Interestingly, the use of page frames appears to be minimal, as does the display of animated images and moving text. Only a third of the pages sampled incorporated any dynamic elements in the body of the page, and an even smaller percentage featured movement in the banner. In terms of coloration, white was the most popular background color, with black a distant second choice. At least in this sample, overdesigning did not seem to be a problem. Most of the pages were technologically simple yet thoughtfully designed. They seemed to avoid violating accepted design rules almost by default; they simply lacked many of the features measured. Indeed, the "average" page was 2.4 screens in length, contained 4.2 graphical elements, and featured a logo, banner, and page map, one advertisement, and 27.1 asynchronous interactive elements on a background that was white.[11]

Given the inherent limitations of a study of this nature, the above findings should be regarded as a systematic but less than definitive portrait of the relationship between Web page complexity and site traffic. The study did not take into account the content of home pages, an undoubtedly influential factor. On the World Wide Web, compulsion to fill a particular information need might be a stronger motivator to visit a particular site than design features. As the uses and

[11] Supporting the comparison of Web page designs to print media presentations, this finding evokes the definition of a well-designed contemporary newspaper layout, which Siskind (1979) suggests "is simple, utilizes abundant white space, has relatively few (five or six) stories per page, uses eye-catching photographs and other design elements, and is orderly and straightforward" (p. 55).

gratifications literature suggests in regard to traditional media, and as recent studies have shown in relation to the Internet, information seeking is a major motivation for online media use (Katz & Aspden, 1997; Perse & Dunn, 1998; Pew Research Center, 1999). Some information-oriented users may even search the Web with their browsers set to text-only mode. Nevertheless, for users of graphical interfaces, formal features may well interact with content and direct attention to certain page elements over others.

Follow-up research should attempt to segment users who browse the Web casually from those who are primarily motivated by finding answers to questions—groups Berthon, Pitt, and Watson (1996) refer to as passive and active information seekers—to determine the relative impact of different formal features. Work along these lines might further investigate patterns in site traffic by distinguishing between *hits* and *visits.* Converting brief hits to bonafide visits, where users spend an appreciable amount of time on a page, requires both appealing content *and* features that enable interaction (Berthon et al., 1996). Mechanisms that contribute to this conversion process, and which have the potential to hold the attention of active information seekers, include appealing graphics, intuitive interfaces, interesting audio and video, interactive elements, and regular updates. With more precise page view data, the composite variables devised for this study could be applied to different content areas to determine which features drive extended visits. Another potentially influential factor driving site traffic concerns download times; for many users, long waits due to limited bandwidth may discourage extended stays or repeated visits. Assessing the full relationship between Web page complexity and site traffic will require attention to these issues.

Conclusion

As the World Wide Web continues to grow and expand, the amount of information redundancy or duplication within similar genres of sites will become increasingly evident. An example of this can already be seen on news sites, where media organizations that are obliged to cover the same spectrum of stories (or risk being scooped and losing audience share) must rely on creative information packaging and interactive features to distinguish their product, or content. In such a milieu, one of the primary means by which Web site designers may differentiate their product is through the adept use of presentation techniques. Interestingly, when traditional media such as newspapers and television newscasts want to increase their competitiveness, they often become more flamboyant and concerned with appealing layouts and story packaging (Utt & Pasternack, 1985). Far from mere window dressing, formal features have been found to compel attention, increase arousal, enhance memory, and impact subjective evaluations of media content. Their significance in on-line environments is recognized by interface designers who stress the importance of structure in gaining and holding users' interest. As an early examination of home-page structure, the present analysis offers a cross-sectional description of the formal features of cyberspace. Future research should chart the evolution of Web pages over time, and investigate the interaction between form and content on users' on-line experiences.

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