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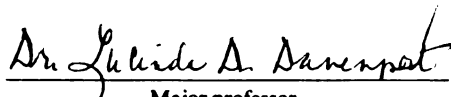
A DUAL CODING THEORY PERSPECTIVE
ON THE EFFECTIVENESS OF MULTIMEDIA
PRESENTATION MODES ON WEB NEWS SITES

presented by

David Weinstock

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**A DUAL CODING THEORY PERSPECTIVE ON THE EFFECTIVENESS OF
MULTIMEDIA PRESENTATION MODES ON WEB NEWS SITES**

By

David Weinstock

A DISSERTATION

**Submitted to
Michigan State University
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ABSTRACT

A DUAL CODING PERSPECTIVE ON THE EFFECTIVENESS OF MULTIMEDIA PRESENTATION MODES ON WEB NEWS SITES

By

David Weinstock

This work has two significant parts. The first part evaluates dual coding theory (DCT) as a means to examine the efficacy of online news sites. It was found to be especially useful, owing to its assertion that memories are more concrete when stimulated by both text and images. Using DCT as a guide, the second portion of this work compared the efficacy of four multimedia presentation modes based on subjects' recall of news items presented in a format mimicking an online news site. The experiment successfully proved most of the hypotheses, suggesting that online content providers who use all of the Web's multimedia functions will achieve the highest recall with their audiences.

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This work is dedicated to the Weinstock Family--past, present, extended and future members--who through their constant support, love, encouragement and no small amount of nagging, made this work not only possible but also complete. And especially to Mom, who has always been my Muse.

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LIST OF ABBREVIATIONS

Replace this text and begin typing your List of Abbreviations here.

INTRODUCTION

This work will attempt to serve two audiences: the news media industry—those who might create online content for news audiences—and mass media researchers—those who might study Web news sites in an effort to discover how to best deliver news content to audiences.

While the goals of both are the same—to find the means to best serve the news audience—the means by which they achieve that goal are far different. Commercial operations, driven by profit, test various iterations of their products against audience responses in efforts to elicit the highest response rate, the greatest reader approval, the best indicators of reader interest. Mass media researchers, on the other hand, use theories to explain human behavior and to guide their research. The experiments they conduct test the validity of theories as tools for explanation of behavior, while at the same time attempting to prove or disprove hypotheses about the results of experiments they conduct.

This work will attempt to jointly serve these two related and yet distinct audiences. For the news media, it will attempt to show that the best way to present online news is to use the World Wide Web's¹ full multimedia² capabilities

¹ The World Wide Web is a global network of computer networks that allows people all over the world to view visual and text information at computer stations as long as they can gain access to that network.

² Multimedia is a term that describes the use of text, photographs or other graphic material, audio and video files together on a single Web page to present content to audiences. In the strictest sense, the simple combination of text and photography might be construed as multimedia. But when used to describe content presented on the World Wide Web, it refers to content that represents a convergence of electronic media content with print media content presented within a single context.

because content presented in this manner will engage readers' attention sufficiently to create the greatest recall.

For academics, this work will show that a cognitive psychological theory, called Dual Coding Theory,³ created in the early 1970s, and since used almost exclusively within the realm of educational research, shows great potential in evaluating this new media channel called the Web. It will deliver a lengthy evaluation of this theory against competing theories, it will match the theory against the practice of reading news online and it will use the theory as a foundation for an experiment in multimedia news recall.

Since this work is purposed for an academic endeavor, the first order of business in this chapter will be to introduce the theory and its proposed applicability to the problem. What follows is an introductory discussion of the channel and how media are attempting to create Web media. This chapter also contains a short history of the development of the Internet, email and the World Wide Web that serves as both a technological and historical backdrop for the work.

Good theory

Dual coding theory is a good theory.

What makes a theory good? In the social sciences, many researchers say a good theory is one that explains a large amount of human behavior. Another way to determine if a theory is good theory is the number of people who seem to believe in it, how many are willing to accept it as a paradigm for prediction of

³ Paivio, Allan. Imagery and Verbal Processes, New York: Holt, Rinehart and Winston, 1971.

outcomes. One measure of this might be how often a particular theory is cited in peer-reviewed journals. Academic researchers use theories as a roadmap or guide for experimentation. Theories provide a central assumption upon which researchers base hypotheses or predicted outcomes that will result from their tests or experiments. In this sense, they are charts or maps whose most-traveled routes are well documented, each twist and turn marked and tabulated to eliminate confusion future travelers down these same paths might have. Each new bit of research momentarily clouds the map until the researcher, using the new knowledge their work created, adds more clarity to the map than it originally afforded. Following this line of thinking, then, the goal of research should be the creation of additional theoretical knowledge to further refine the “map’s” clarity.

As time passes, the world changes and good theories only get better with time. They continue to explain as much as they did when they were first formulated. Good theory bends and does not break in the face of changing times and an evolving society. Instead, it grows with change to afford continuing opportunities for knowledge creation. Good theory should seem to resemble the very fabric of change both before and after it occurs. Dr. Steven Lacy of the Michigan State University School of Journalism perhaps put it best when he told an undergraduate mass media and society class the test of a good theory was that it could be used to explain the past, analyze the present and predict the future.⁴

⁴ Lacy, Stephen, Lecture, “Introduction to Mass Media,” Michigan State University, College of Communication Arts and Sciences, Fall 1995.

Dual coding theory (DCT) is a good theory because it does each of those things. Developed in 1971 by Allan Paivio, a Canadian cognitive psychologist, it has been argued, challenged, tested but never dismissed as one of the major explanations for how humans create memory from things they have experienced. These “things” might be sights, sounds, touches, odors, or events that are comprised of each of these single things or combinations of several or all of them experienced together. Once our minds have collected, processed and stored these experiences, we recall them and then associate them with other similar experiences to construct meaning. DCT explains how we collect, process, store, associate, re-associate and learn from these memories.

Like many theories, DCT has a number of assumptions, but its central one is that there are two systems at work in memory: imagery systems and verbal systems.⁵ We use these two systems to encode all we experience and learn into memory—hence, the name: dual coding theory. All the things we can recall can be categorized within these two systems, depending on how we conjure that information in our minds. Nearly 30 years of research has shown how we use non-verbal images to create more concrete, less abstract knowledge than we can with verbal information alone. In addition, DCT tells us when verbal information is accompanied by non-verbal information, learning is improved; it is improved to the point that there is an additive effect on recall when non-verbal information is presented with verbal information.⁶

⁵ Paivio, Allan. “Dual Coding Theory: Retrospect and Current Status, Canadian Journal of Psychology 45.3 (1991): 258.

⁶ Paivio, “Retrospect” 264-265.

DCT explains much of how we humans build our internal experiential databases. As time passes, the means by which we acquire information changes. Sometimes content has changed our tastes so that we are perhaps more interested in a particular genre or medium than we were before. Or we, ourselves, might have changed: perhaps we have experienced some kind of hearing loss or our sight may have diminished, causing us to prefer a different kind of sensory stimulus. But unless we have experienced some measure of brain damage, the elemental process of thought does not change; and that is what DCT attempts to explain. DCT argues that environment—that which we experience (process) in the present—and memory—that which we have already experienced, helps us create a way to construct meaning from reality.⁷ Therefore, it survives the first test of what a good theory is by being able to explain a large percentage of human behaviors.

DCT is one of the major cognitive psychological learning theories in use today. Anyone conducting a search of bibliographies and library sources would find hundreds of references to it. It began in the late 1960s and early 1970s⁸ with researchers matching nouns and verbs with pictures. Today, those studies continue, as does applied research on teaching techniques using pictures, audio-visual aids and multimedia software teaching products.⁹ Thus, as we consider the amount of citations this theory accrues and the research continuum this

⁷ Paivio, "Retrospect" 258.

⁸ e.g., Paivio, Allan. "Paired-Associate of Learning and Free Recall of Nouns as a Function of Concreteness, Specificity, Imagery and Meaningfulness," Psychological Reports 20.1 (1967): 239-245.

⁹ e.g., Najjar, Lawrence J. "Multimedia Information and Learning," Journal of Educational Multimedia and Hypermedia 5 (1996):129-150.

theory has been used to review, we can see how it has withstood time's test and remained relevant, satisfying the last two criteria of being a good theory.

This paper will take DCT beyond its traditional boundaries in cognitive psychology and education into mass media research. Currently, this theory has found itself well used within the bounds of memory study,¹⁰ teaching methods,¹¹ reading¹² and classroom learning performance.¹³ It has seen little exposure in mass media research. Much of that is because a large portion of mass media research does not concern itself with the results of verbal and non-verbal news element interaction. A great deal of attention is focused on the effects or outcomes of combined text and graphic messages delivered to the audience¹⁴ and how content is created.¹⁵ Indeed, much of today's literature in visual communication evaluates impact,¹⁶ is part of some kind of content analysis or is used to measure some societal outcome.¹⁷ Few researchers concern themselves with the cognitive processes readers and viewers bring into play as they read/view the news. Eye-trac¹⁸ studies,¹⁹ in which researchers tracked where and

¹⁰ e.g., Marschack, M.L. and Hunt, R.R., "A Re-Examination of the Role of Imagery in Learning and Memory," Journal of Experimental Psychology: Learning, Memory and Cognition, 15 (1989): 710-720.

¹¹ e.g., Baggett, P. and Ehrenfeucht, Andrej. "Encoding and Retaining Information in the Visuals and Verbals of an Educational Movie," Educational Communication and Technology Journal, 31 (1983): 23-32.

¹² e.g., Sadoski, Michael. "An Exploratory Study of the Relationship Between Reported Imagery and the Comprehension and Recall of a Story," Reading Research Quarterly, 19.2 (1983): 110-123.

¹³ e.g., Najjar, Lawrence. "Dual Coding as a Possible Explanation for the Effects of Multimedia on Learning," Georgia Tech Graphics Visualization & Usability Center Technical Report, 1995.

¹⁴ e.g. Lowe, Phillip J. "The Effect of Flashback on Children's Understanding of Television Crime Content," Journal of Broadcasting and Electronic Media, 43 (1999): 83-98.

¹⁵ e.g., Bielby, Denise B. "Whose Stories Are They? Fans Engagement with Soap Opera Narratives in Three Sites of Fan Activity," Journal of Broadcasting and Electronic Media, 43 (1999): 35-52.

¹⁶ e.g., Middlestadt, Susan E. and Barnhurst, Kevin G. "The Influence of Layout on the Perceived Tone of Newspaper Articles," Journalism & Mass Communication Quarterly, 76.3 (1999): 264-276.

¹⁷ e.g., Perry, Stephen D. "Inhibiting Speech Through Exemplar Distribution: Can We Predict a Spiral of Silence?" Journal of Broadcasting and Electronic Media, 44 (2000): 268-282.

¹⁸ Eye trac research uses low-powered lasers directed at subjects' pupils to track eye movement.

how peoples' eyes flowed across pages of print and illustration, were done and duplicated to the point that editors and designers learned how to construct pages to lead reader's eyes to wherever they wished. But with the advent of a new channel—the Web—study of the basic processes must begin again so that we might assure ourselves that what we hold true about information processing in traditional print and broadcast media is also true (or not) for this new medium.

Upstart business

Online publishing is an upstart business. Born in the early part of this decade, by 1997 there were approximately 1,600 online newspapers on the World Wide Web.²⁰ By 2001, this number has blossomed considerably to more than 13,000.²¹ Precious little research has been published about how these products should be constructed. This paper proposes to create a new research framework and then test the new framework in an experiment to determine which kinds of information presentation modes—text alone, text with still photography, text with streamed multimedia video²² or text with multimedia video and embedded audio²³—will best facilitate reader recall of the news. An experimental study, it will feature a single issue of a fictitious online news site called the

¹⁹ e.g., Stark, Pegie and Garcia, Mario. *Eyes on the News*, St. Petersburg: Poynter Institute of Media Studies, (1991).

²⁰ “Newspapers Worldwide: North America,” *NewsDirectory.com*. 1997, (<http://www.ecola.com/news/press/na/us/>).

²¹ *Editor & Publisher MediaInfo Links Online Media Directory*, 23 Oct. 2001, (http://www.editorandpublisher.com/editorandpublisher/business_resources/mediastats.jsp).

²² Streamed video is video that is transmitted to computer stations so that a buffer of unviewed video or audio is created before viewing or listening begins. If network connections lag or computers slow in the processing of that video or audio, the buffer of streamed video/audio will allow viewers to watch/listen to content uninterrupted while either machines or the networks catch up to refill the buffer.

²³ Embedded audio refers to the practice of creating a link to a sound file and placing that link within text. Thus, a reader might read an article and encounter a link within its text; when they click on that link, the computer would access and play the audio file.

Lansing Eagle. This site will contain four articles—each using the different visual modes mentioned above—to depict the news of the day for subjects to read. Immediately following their reading, subjects will take a short test to determine their recall of the news and answer a few questions regarding their ethnicity and computer skills to identify potential interaction effects. The results will be analyzed using one-way analysis of variance to determine the differences in news recall the various presentation modes might create.

This research will use DCT as its guide. A cognitive psychological learning theory, it predicts readers retain more concrete images from text accompanied by illustration than by text alone. This project hopes to show that use of more sophisticated, illustrative multimedia on online news sites will facilitate even higher rates of recall than text accompanied by simple photographs or even text alone.

This is a key point. In fact, it is the next logical step to launch from a 1992 study that showed recall for news text presented on computers was, in fact, better than it was in newspapers, television and radio.²⁴ Yet this research hopes to prove this is not true for younger audiences who will someday step up to be the mainstay of the news audience. If successful, this research will underscore the importance of what all online news providers are currently using on their sites, while at the same time, making the case that all online news sites—not just the larger news sites hosted by larger media corporations—should take the next step to incorporate multimedia video and embedded audio into their publications.

²⁴ DeFleur, Melvin, Davenport, Lucinda, “Audience Recall of News Stories Presented by Newspaper, Computer, Television and Radio,” *Journalism Quarterly*, 69.4, 1992 Winter: 1010-1022.

In doing so, they will complete the technological iteration of media convergence. Online news sites will no longer be online newspaper, or Web TV or Web radio sites. Rather, they will be online news sites that are perhaps owned by radio, TV or print media enterprises but are simply Web media, in their own right. For the Web is a channel, much like a newspaper edition or a broadcast signal. It is a means by which information is transmitted from senders to receivers and, as such, is a new medium unto itself.

More and more, as news media organizations acclimate to the multimedia possibilities of the World Wide Web, the traditional boundaries between print and broadcast media are blurring. Multiple daily deadlines are no longer the exclusive province of electronic media. Deadlines at sites owned by print media firms and corporations are limited only by the number of times their Webmasters choose to add material during any given day.

Therefore, convergence—the integration of digital, audio, visual and text information into all-purpose data networks—has created a new medium within the WWW channel that at once merges technology into a common base and also eliminates rigid distinctions between media systems.²⁵ It is important to conceptualize online news sites as a whole, rather than as online newspapers, Web TV news or Web radio news sites. It is wrong to think of the online medium as Web radio or Web TV. For, in truth, conceptualization like this would have categorized news being read at a radio station as “audio newspapers” or

²⁵ Straubhaar, Joseph, and LaRose, Robert. “The Changing Communications Media Environment,” Communications Media in the Information Society, Belmont: Wadsworth, 1997: 40.

television news as “video newspapers,” which we know today to be irrelevant categorizations.

We must cease categorizing online media according to the look of the traditional media their Web designers attempt to emulate in the design of the site. We must also not categorize online sites based upon the offline businesses of their owners. This is not a huge leap in habitual thinking. Large media corporations own various kinds of media outlets. For example, The Tribune Company, Chicago, Ill., owns newspapers, television and radio stations. It also owns and operates several new media ventures. This thinking just needs to be extended to all Web media enterprises, not just the majors. What works for national and international news will work for local news, too. If there are local television and radio stations within the community covering the news, and local news media think the market will sustain an Internet news enterprise, then this work’s results will prove that even these operations must build partnerships in either the print or the electronic media to assure maximum recall rates.

A good example of how convergence is already serving to eliminate traditional media boundaries are the Web sites of two large news media concerns, *The New York Times* and CNN. The *New York Times* Web site²⁶ features headlines, banners, photos and cutlines, just as one might expect from any newspaper. And yet, so, too, does *CNN Interactive*.²⁷ A television news operation, its Web site also features headlines, banners, photos and cutlines. Consider, too, that news video clips are as likely to appear on the *New York*

²⁶ *New York Times on the Web*, 1998: <http://www.nytimes.com/>.

²⁷ *CNNi*, 1998: <http://www.cnn.com/>.

Times on the Web as they are to appear on *CNN Interactive*. Therefore, based on appearances and content, both these ostensibly different Web media have converged in form, substance and design on the Web.

Truly, the channel has shaped the media it carries and not vice-versa. Web developers can easily digitize news content,²⁸ be it film, audio or text, and make it available for access. Just as in the radio and television businesses, as long as the audience possesses the appropriate technology, in this case, a computer capable of Internet access, it can consume any or all of that content. Pages that feature too much text get very little traffic through them, no matter how compelling the text is. Why? Because computer screens are unlike books in one crucial way: they are a light source; people cannot focus their eyes on material that requires too much eye contact, owing to the eye-strain it will cause, over extended periods of time. Again, the channel acts to shape the medium. Designers cannot impose traditional news media design imperatives on this new and different channel and hope to be successful with audiences. Previously, each channel carried a singular kind of content. Newsprint conveyed a newspaper firm's message to its audience. The newsprint allowed ink to be used to imprint images of pictures and letters upon it to create one-way communication from a single source to many recipients. The broadcast media, similarly create specific signals to carry encoded images or audio signals to be decoded by signal-specific receivers, again, to large numbers of people.

²⁸ A taped interview, for example, is easily converted from an analog video signal into a digital file using a comparatively inexpensive software program, such as Adobe Premiere. The operation involves playing a VCR tape into a computer, then saving the analog signal as a binary file.

But the Web is a medium capable of distributing a wide variety of content forms either together or separately. On the other hand, the Internet is a channel capable of transmitting both interpersonal and mass communication. It is alternately capable of creating one-to-one (e.g., email) and one-to-many (e.g., email, Web pages) communication. Another of its characteristics is that communication on this channel is facilitated with a tool. This makes it part of family of communication called *mediated communication*. Just as television and radio both require receivers, Internet communication requires computers, software and network access before communication may occur. Properly configured, this array of equipment imparts a particular attribute upon this mediated communication, called interactivity. Previously limited to interpersonal communication, this characteristic is the means by which users influence the form or content of the media experience with their own inputs into the mediated presentation.²⁹ It differs from the response generated from mechanical equipment, such as vending machines, because computers make various responses to input based on previous input users made. Mechanical equipment, on the other hand, responds to users with the same action each time a particular switch is activated; previous activity will, in no way, modify that response. Thus, online media consumers can determine when they might choose to consume their news as well as what kind of content—text, graphic or multimedia—all within the same channel. In some cases, online news consumers can even engage in interpersonal communication with the creators or even the subjects of the news

²⁹ Steuer, J., "Defining Virtual Reality: Dimensions Determining Telepresence," eds: Biocca, Frank and Levy, Mark R., Communication in the Age of Virtual Reality Hillsdale:Lawrence Erlbaum

content they have just accessed, via email or Internet chat. The Internet makes all this possible. A significant number of the world's citizenry owns or works with a computer equipped with a modem³⁰ or a direct network connection. This combination of technology, used in concert with software, opens a gateway to whoever else in the world is also connected to the same network.

But it takes more than a network to create a new medium. The hardware, the software and the ingenuity must be in place first. What is so fascinating about the online news evolution is that its genesis was within recent memory, in the mid-1970s. Over a five-year span, from the mid-1970s to the early 1980s, personal computers, those that could be distinguished from the mainframes³¹ and mini-computers,³² went from a dream to a reality. It all began in January 1975 when *Popular Mechanics* announced the availability of the Altair.³³ Available only in kit-form, it had no keyboard, monitor or software and no graphics capability. Users loaded programs by toggling switches on the front of

Associates 1995: 33-56.

³⁰ The word, "modem" is actually an abbreviation for the operation that computers perform on data when it is transmitted over a telephone line. The reason this conversion must occur is because most telephone lines cannot transmit anything but analog signals. Therefore, the first thing that happens to data about to be transmitted from one computer to another is that at the transmission's source, a modem, modulates digital information into analog information so that it can be transmitted through telephone lines. Then, at its destination, data is demodulated from its analog form back into its original digital form so that it can be used and interpreted by the computer receiving the information. Thus, the "MODulation-DEModulation" process this equipment performs was abbreviated into the word, "modem."

³¹ Mainframe computers are large computers capable of high-speed processing for multiple, simultaneous users. These computers were originally designed to handle the computing needs of businesses and large institutions. Their design is obsolete, though some might argue that so-called supercomputers, used to calculate simulations and perform high-end physics and engineering calculations, are based on mainframe designs. Today, most mainframes are used primarily for data storage.

³² A computer built between 1963 and 1987, smaller and less powerful than a mainframe, typically about the size and shape of a chest of drawers, that was mounted on a single tall rack. Mini-computers were characterized by limited hardware and software facilities and small physical size. Their low cost made them suitable for a wide variety of applications, such as industrial control, where a small, dedicated computer, which was permanently assigned to one application, was needed.

³³ Straubhaar and LaRose. Communications Media 292.

the box. Initially, its only function was to allow users to imitate flashing light patterns on its control panel. Subsequent models expanded its functionality. The following year, the Altair offered video capability and users were able to purchase a Polymorphics Systems video board that allowed them to view text and low-resolution graphics on the same screen. Much of the video board's memory was spent in determining whether the individual cells on the screen would display text or graphics. The screen had 64 cells in 16 lines; graphic cells were two wide and three high, with a 128- X 48-pixel screen resolution;³⁴ today, most monitors default to 640 X 480 per screen, and are capable of offering resolutions upwards of 1280 X 1024. Also during this time, a hacker from Seattle, named Bill Gates, then a freshman at Harvard, sold Altair a computer language to allow users to program advanced functions. His success with this venture prompted him to found Microsoft Corporation with a friend.³⁵

In 1976, pre-assembled, mass-produced microcomputers were born. The inventors, Steve Jobs and Steven Wozniak, called it the Apple.³⁶ A year later, the upgraded Apple II offered a keyboard, a built-in power supply and a color monitor. In 1980, a mainframe computer company downsized its products into desktop machines and dubbed them PCs, an acronym for "personal computer." At the time, most American consumers conceived of computers as room-sized machines that computed fantastically complex calculations. All of a sudden, anyone could own a box that fit on a desktop for about the cost of a used car and

³⁴ Senzig, Don, CYHISTCommunity Memory: Discussion List on the History of Cyberspace, Posted Message. 7 Nov. 1998.

³⁵ Straubhaar and LaRose. Communications Media 292-293.

³⁶ Straubhaar and LaRose. Communications Media 293.

use it to write letters, play games, do taxes and a host of other everyday activities. It was the beginning of the information revolution.

By the mid-1980s, IBM and a burgeoning host of new companies convinced enough people they wanted these new desktop models that the personal computer industry was born. Other industries and businesses embraced them as they offered such huge advantages over the far-more-costly mainframe computers already on the market to say nothing of giving them more direct control over the more sensitive operations of their companies, such as accounting and inventory systems. These new machines brought such things as low-cost, instantaneous communication, in the form of email; easy-to-use, inexpensive accounting systems, so-called spreadsheet packages; and smaller database programs offering the same data analysis capabilities previously available only on room-sized mainframes.³⁷

Personal computer manufacturers priced their products so that this technology could be exported out of the office and into U.S. households. Business people, already familiar with this technology in the workplace, welcomed it into their homes. These same manufacturers also captured the imagination of teachers, who saw personal computers as tools to make their jobs easier, and children, who, once exposed to them, found them useful, playful and exciting. By the late 1980s, it seemed a large part of the U.S. population either had personal computers or wanted one.

Computer networks developed in a parallel fashion, but, interestingly enough, on a much faster and earlier track than PCs did. As the Space Age

commenced in the late 1950s and in its wake, nuclear détente, the U.S. Department of Defense became intrigued with the notion of a network of computers that might communicate with each other, and continue to do so in the event of a nuclear conflict. Research in the 1960s using telephone technology yielded a 1,200 bit per second modem.³⁸ It communicated data well enough, but not within a secure or interference-free channel.

Thus, in 1969, the U.S. Department of Defense commissioned the design and construction of the Advanced Research Projects Agency Network (ARPANET),³⁹ the wide area network (WAN)⁴⁰ that one day would become the Internet. It officially funded the project in 1973. Interestingly enough, email was actually invented in 1971 by Bolt, Beranek and Newman, a computer network-consulting firm, two years before the Internet's design was even funded.⁴¹ The first Internet network connected four host computers at four U.S. universities, allowing them to share information and resources. By 1976, the network consisted of host computers at 37 U.S. universities; the following year, it went international, making connections in England and Norway.⁴²

One of the ARPANET's distinctive features was a set of networking communication rules, called a *transmission protocol*.⁴³ The first set was called

³⁷ Straubhaar and LaRose. *Communication Media* 291-292.

³⁸ "ARPANET and Beyond," *The World-Wide Web Virtual Library: The Internet Studies Page*, Tappendorf, Sean. 1995
<<http://www.ciolek.com/WWWVLPages/QtyPages/NetStudies.html>>.

³⁶ ARPANET's original purpose was to create a secure computer network for the Pentagon to communicate with its university-based research teams.

⁴⁰ A wide area network is a computer network that extends more than two miles in distance.

⁴¹ Cerf, Vinton. *CYHIST Community Memory: Discussion List of the History of Cyberspace*, 12 Dec. 1998: posted message.

⁴² Tappendorf, "ARPANET" <" <http://www.ciolek.com/WWWVLPages/QtyPages/NetStudies.html>>.

⁴³ Transmission protocols are sets of rules computers use when they transmit data on networks of any kind.

network control protocol (NCP). Implemented in 1971-72, NCP's limitation was that it could only communicate with other computers on the same network.⁴⁴ But ARPANET's designers knew all kinds of computer networks needed to be able to communicate with each other to create a network that might one day circle the globe. Therefore, in 1973, ARPA commissioned Vinton Cerf of the Stanford Research Institute to develop a new protocol capable of *internetworking*, creating communication among different computer networks. Five years later, Cerf and Robert Kahn of ARPA completed work on Transmission Control Protocol/Internet Protocol (TCP/IP), which is still in use today.⁴⁵ Not only does this protocol allow various networks to communicate with each other, it also allows users of any kind of computer to communicate *with each other* on those networks. Both NCP and TCP/IP used a process called *packet switching* to transmit information through the Internet from source to destination. "Packet switching is the breaking down of data into *datagrams* or packets that are labeled to indicate the origin and the destination of the information and the forwarding of these packets from one computer to another computer until the information arrives at its final destination computer. This was crucial to the realization of a computer network. If packets are lost at any given point, the message can be resent by the originator."⁴⁶ Still in use today, it is the primary reason why email seems to be a near-

⁴⁴ The Internet Society "A Brief History of the Internet" Leiner, Barry M., Cerf, Vinton, G., Clark, David D., Kahn, Robert E., Kleinrock, Leonard, Lynch, Daniel C., Postel, Jon, Roberts, Larry G. and Wolff, Stephen. 2001 <<http://www.isoc.org/internet/history/brief.html#Origins>>.

⁴⁵ "The History of the Internet," Kristula, David. <<http://www.davesite.com/webstation/net-history.shtml>> 1997.

⁴⁶ The 'Lectric Learning Web Center "ARPANET--The U.S. DoD-Sponsored Network," Baran, Paul. 1995 <<http://www.chaos.com/learn/History.html>>

instantaneous means of communication. When email is sent from one host⁴⁷ to another, the message is broken into small data packets. Computers attach labels that include the destination address to each packet and send them out into the Internet. These packets, instead of following a direct line route to their destination, flow through the part of the network that, at that particular nanosecond, has the least amount of network traffic on it. Upon reaching the email's destination, each packet is then reassembled into the original message, ready for reading.⁴⁸ Thus, packet switching eliminates the need for dedicated lines to connect one computer to another. Instead, many users can share a single high-speed transmission system with fewer channels.⁴⁹

University researchers involved in defense research used ARPANET to communicate with each other. As time passed, and they became accustomed to this new instantaneous means of communication, the universities they worked for saw the potential of using a similar communication network for all faculty. In 1986, the National Science Foundation "initiated the development of the NSFNET, which, today, provides a major backbone communication service for the Internet."⁵⁰

At roughly the same time U.S. DoD launched ARPANET, the Xerox Corporation introduced the first local area network⁵¹ (LAN) standard. Xerox called

⁴⁷ A host is a computer connected to a network. It is a term used to differentiate them from other network equipment, such as routers and printers.

⁴⁸ Free Online Dictionary of Computing. "Packet Switching" 2001 <<http://www.foldoc.org>>.

⁴⁹ Straubhaar and LaRose, Communications Media 304.

⁵⁰ The Internet Society. Cerf, Vinton G., "A Brief History of the Internet and related Networks" 2001: <<http://www.isoc.org/internet/history/cerf.html>>.

⁵¹ A data communications network that is geographically limited (typically to a 1 mile radius, though many times within a single building or room) that allows easy interconnection of terminals, microprocessors and computers. The main reason for creating LANs is to allow users to share

it the Ethernet.⁵² It, too, created a network, but unlike ARPANET, it was designed to connect fewer computers together within a more limited space. The distinction between a LAN and a WAN is largely how much geography it covers. LANs tend to connect computers located within space limited to single rooms or even a single building. WANs tend to connect computers located within a larger area, such as a city or college campus. From a technical standpoint, the difference between a LAN and a WAN is one of transmission speed and the physical location of data links.⁵³

The diffusion of computer network use to home-users was very similar to that of PC diffusion from offices to home. Companies began to discover that computer networks allowed them to share hardware and software resources and accomplish tasks more cost-effectively. As this technology diffused through industry and commerce, networks became an everyday appendage of corporate culture. By the early 1990s, when word of the Internet began to emerge in the popular press, networks were a familiar concept, making home adoption of technology necessary to access a network a relatively easy step to take, assuming the proper technology and knowledge was in place. With network access, workers could communicate and, with direct access to computer data from home, extending workplace productivity into their homes.

It wasn't until 1992 that the World Wide Web evolved out of the computer network known as the Internet. Prior to this time, the Internet was a network

resources, such as software; instead of buying individual packages for each workstation, enterprises can buy site licenses for software that charge a reduced rate, on a per station basis, for individual network users.

⁵² Ethernet is a local area networking protocol now recognized as the industry standard.

seeded with repositories of data existing in binary (digital)⁵⁴ and text information alone. There was no formal organization of the Internet and hence, no means to map where information was stored.

By and large, Internet users in this early era simply knew where the information they needed was and went there to get it. But as time passed and information storage capability grew, it became more apparent there was far more data available on the Internet than even its most expert users could catalogue. At that point, the Internet changed from a shining example of modern information storage technology to a really good example of a system falling into chaos. Users opposed a central authority to impose order, fearing regulation would ruin the unfettered nature of this environment. Yet they also recognized the need for some attempt at mapping this space.

The first effort to create a map of the Internet was embodied in a program called Archie. Created by programmers at McGill University, it automatically gathered the locations of stored information on the Internet.⁵⁵ The original program did nothing more than create a list of domains,⁵⁶ where anonymous FTP⁵⁷ sites were located. FTP (file transfer protocol) sites are actually computers that allow users access to them to store and download text or binary files (programs or images) to their own personal computers via the Internet. The reason they are called "anonymous FTP sites" is because users are not required

⁵³ Verner, Kipp. personal interview 1997 Aug. 8.

⁵⁴ Non-text computer data is referred to as binary, or digital, because when viewed in machine language, it appears to be nothing more than 1's and 0's.

⁵⁵ Free Online Dictionary of Computer Terms, "Archie," 2001 <<http://www.foldoc.org>>.

⁵⁶ Domains are the names applied to the group of computers that store the content of a particular Web site.

⁵⁷ FTP is a transmission/communication protocol that allows a user on one computer to transfer files to and from another computer over a TCP/IP network.

to login with specified user names or passwords. Access is gained to these sites simply by entering the word "anonymous" into the space for the username and leaving the password space blank, though later, designers requested users enter their email account names for use as a password. Improved versions of the Archie program, dubbed Jughead (Jonzy's Universal Gopher Hierarchy Excavation And Display)⁵⁸ and Veronica (the Very Easy Rodent Oriented Net-wide Index to Computerized Archives, created at the University of Nevada),⁵⁹ improved the sought-after Internet mapping by returning lists of sites along with the title of the documents and files stored there. Subsequent versions of these programs featured limited search functions of the FTP sites they listed. Archie's, Jughead's and Veronica's chief limitation was that they merely found documents and listed their existence.⁶⁰ Once found, people used other programs, such as complicated DOS⁶¹-based FTP programs, or an easy-to-use Apple FTP tool developed at Dartmouth University, called Fetch, to retrieve documents and programs from FTP sites.

The next generation of Web navigation came in the form of a client/server⁶² program called Gopher.⁶³ Created at the University of Minnesota

⁵⁸ Free Online, "Jughead," (<http://www.foldoc.org>).

⁵⁹ Enzer, Matisse. "Veronica," Glossary of Internet Terms, (<http://www.matisse.net/files/glossary.html>): 2001.

⁶⁰ "Stroud's Reviews: Gopher/Archie/Finger," Hedgedus, Peter. 2001, <<http://www.internet.com/cws/gopher.html>>.

⁶¹ DOS is the acronym used to denote "disk operating system," the name of the system Microsoft invented to drive personal computers.

⁶² A common computing system in which software is split between server (computer) tasks and client (user) tasks. A client sends requests to a server, according to some protocol, asking for information or action, and the server responds. This operation could be likened to a customer sending an order on an order form to a supplier, who dispatches the goods and an invoice. The order form and invoice are part of the "protocol" used to communicate, in this case. There may be either one centralized server or several in various locations. This model allows clients and servers to be placed independently on networks and hosts.

as a campus information retrieval system in 1991, it did more than list locations of documents; it actually *retrieved* the documents it found. Users accessed Gopher servers located at various firms and universities around the world via Gopher client software. These interconnected servers catalogued information stored on computers within certain geographic regions. Gopher client software programmers designed it to organize Gopher server information into folders representing the file directories of various Internet hosts, thereby making it easier to find and retrieve Internet information.

The same year Gopher was released, Timothy Berners-Lee, a researcher at a Swiss particle physics laboratory called CERN, created W3, based on a paper he wrote in 1980,⁶⁴ what would become known as the World Wide Web. Aimed at the high-energy physics community, W3 was a networked information system designed to allow internationally dispersed scientists to communicate with each other and affiliated support groups. Berners-Lee created a structure of documents and links using a new communication protocol called hypertext transmission protocol (HTTP). A new kind of software, called a "browser," used HTTP to allow users to either search document archives using a keyword or to use their mouses to click on a link to access documents or other information on the network.⁶⁵

Ironically, it was the failure of the phone modem that caused the U.S. Department of Defense to create the Internet as a more secure alternative to

⁶³ Gopher is a program designed as a "document retrieval system." Users access servers that have lists of documents on them with software clients.

⁶⁴ W3C. "A Little History of the World Wide Web," 2000. < <http://www.w3.org/History.html>.>

⁶⁵ World Wide Web Consortium Web Page. "World Wide Web--Summary," 1992

telephone data communication. Yet it was this same instrument that caused consumers to flock to access the Internet in droves. Connected, as it were, with an inexpensive modem, personal computers allowed users to access the Internet and the world. Once phone modems diffused into about 10 percent of U.S. households, America "discovered" online communication. Among the first online products confronting consumers were online services. In 1979, two of the first information services—CompuServe Information Services (CIS) and The Source—were born.⁶⁶ Called *videotex services*, these businesses were a kind of commercial library, meeting place and shopping mall, all rolled into one. Their existence endowed people who owned personal computers with the information and communication potential the prophets of the information revolution had promised. Initially, access and connection fees were high. CIS charged \$6 per hour for access and targeted businesses as primary customers, hoping to attract them with business news, stock market reports and demographic databases. Free access to data similar to that being offered by videotex services began with the creation of BITNET (Because It's Time Network) in 1981.⁶⁷ Launched as a cooperative network at NYU, its first connection was with Yale University. This network offered email, listservs and FTP. Its audience was almost entirely academic professionals.

But as diffusion of personal computers led into consumer markets, services like CIS⁶⁸ eyed consumers as well. Competition for consumer audiences

<http://www.w3.org/Summary.html>.

⁶⁶ My Home Page. Theys, Mitchell. 1998 <http://garage.ecn.purdue.edu/~theys/stuff/misc/comp_hist>.

⁶⁷ Matisse, "BITNET," <<http://www.matisse.net/files/glossary.html>>.

⁶⁸ CompuServe Information Services, is an early videotex service headquartered in Columbus, Ohio.

grew when other services—America Online, Delphi and Prodigy—were formed in the mid-1980s. These services differed from original videotex offerings providing reference materials, meeting places and electronic shopping malls aimed specifically at capturing the fancies of the American family. Each could be accessed for monthly fees similar to those charged for cable TV subscriptions. For a time, these businesses flourished. But it quickly became apparent the main reason why people joined these services was to get an email account.⁶⁹ Other offered services languished as customers discovered many of these same offerings could be found on the Internet at much more competitive prices. Today, only America Online (AOL) remains as an independent company. Much of their traffic centers on providing access to the Internet and interpersonal communication via email and instant messaging rather than the host of services offered when it entered the market.

The evolution of the Internet into a worldwide network of computer networks has taken about 20 years. According to the Computer Industry Almanac Inc. there were over 400 million Internet users worldwide at year-end 2000—up from less than 200 million Internet users at year-end 1998, with 134 million of those users living in the United States. Users were defined as people aged 16 years or older who used the Internet on a regular or occasional basis. Usage is also high in Japan, Germany, Canada, the United Kingdom, South Korea and China were the countries with the highest populations of Internet users.⁷⁰

⁶⁹ Vonder Haar, Steven. "AOL Slows Growth as Membership Churns," Inter@ctive Week, May 20, 1996: 15.

⁷⁰ Computer Industry Almanac. "U.S. Has 33% Share of Internet Users Worldwide Year-End 2000 According to the Computer Industry Almanac," 2001 <<http://www.c-i-a.com/>>.

Interestingly, the Georgia Visualization Unit's 9th Internet User Survey, the last of these surveys to be done in recent years, points to Internet usage in Europe as being concentrated in more youthful demographic groups because the primary means of Internet access is still centered in universities.⁷¹ Here in the United States that survey indicated 62.5 percent of users were aged 16-40.⁷² Overall, online gender ratios are balancing themselves closer to population norms.⁷³

Data, commerce and communication stream everywhere around the globe, at speeds we can only imagine. Growth in electronic commerce is considerable. In 1997, online purchases totaled \$191 annually, the average income of an Internet shopper was \$65,000 per year and the average percentage of repeat customers at Internet sites in 1998 was 33 percent.⁷⁴ According to an Ernst & Young report released January 15, 2001, average income of online shoppers had fallen to \$52,300 per year, and the profile of an average shopper was a 42-year-old, married female with some or no college education.⁷⁵ The combination of age and buyer demographic information bodes well for Web media content providers. According to 1998 FIND/SVP market data,⁷⁶ 62 percent of all adults who logged onto the World Wide Web clicked on an ad. Yet care should be exercised in how they interpret this information. News content providers need to recognize this data is extremely useful as a profile to use to market ad space to advertisers; yet it is of limited value as a profile for a potential

⁷¹ GVU's Ninth WWW User Survey, "General Demographics Summary--Primary Place of WWW Access," 1998. <http://www.gvu.gatech.edu/user_surveys/survey-1998-04/reports/1998-04-General.html>.

⁷² GVU, 1998. <http://www.gvu.gatech.edu/user_surveys/survey-1998-04/graphs/general/q34.htm>.

⁷³ FIND/SVP. "Free Data," 1998. <http://www.cyberdialogue.com/free_data/free_data.html>.

⁷⁴ Cyberstats Online "Profile of a Net Buyer," 1997. <<http://www.zdnet.com/zdimag/cyberstats/1997/06/users.html>>.

⁷⁵ Ernst & Young, "Global Online Retailing: Key U.S. Findings," 15 January 2001.

paying customer for news. The reason for this lies in the existence of so-called "push services". These Internet businesses derive their name from the fact that instead of users pulling information from their sites, they deliver content without synchronous user request. These successful services⁷⁷ provide news information purchased from a variety of sources to customers free of charge. They take their profits from advertisers who want to market their products to an audience drawn in by the lure of free news content served up as a screensaver. In effect, this presentation mode devalues perceived monetary value of news content to the consumer, who does not pay for software, the service or the news. Indeed, today, most news firms have discovered that unless their audience consists of subscribers to highly specialized newsletters, the only real opportunity they have to "sell the news" on the Internet is to charge fees to users to access news archives.⁷⁸ The normal run of Internet news consumer knows they need not purchase the news when they can get it for free elsewhere.

The news industry discovered computer delivery at about the same time videotex services entered the market. The first online newspaper service was the *Fort Worth Star-Telegram* StarText bulletin board service (BBS) in 1982; it moved to the Web in 1995.⁷⁹ BBSes were the precursor to Web servers. Computer enthusiasts loaded their computers' hard drives with BBS software. This software created message archives, file libraries, chat rooms and online

⁷⁶ FIND/SVP, 1998. <<http://www.findsvp.com>>.

⁷⁷ e.g., Infogate. 2001. <<http://www.infogate.com>>.

⁷⁸ Indeed, this is the pricing practice for documents at NYTimes.com. The "price" of the day's news is nothing; to access documents in its archive, users are charged a fee.

⁷⁹ Harper, Christopher, And That's The Way It Will Be, New York: New York University Press, 1998: 202.

gaming areas on PC hard drives. Computer owners then offered other users access to their BBSes via phone modems.⁸⁰ By the beginning of 1994, about 20 newspaper online services were available worldwide; at year's end there are nearly 100 either operating or under development, including online editions of the *Atlanta Journal-Constitution* and the *Los Angeles Times* available on the IBM/Sears-owned Prodigy videotex service. A year later, there are 700 online newspapers, CNN had created a 24-hour-a-day Web news site called *CNN Interactive* and *USA Today* launched its online edition, first as a fee-based publication, then later offered it free of charge. At the end of 1996, the number of online news sites had stabilized at a little more than 1,600, pretty much where it remains today.⁸¹

Despite the large amount of participation in Web news product creation, the world's news industry has shown neither a great deal of sophistication nor much understanding of this new media channel. A good example would be the rather checkered online record of Knight-Ridder. This chain was the first large newspaper firm to recognize the potential of redistributing newspaper content on a new channel. In 1984, it launched an experimental news delivery service called Viewtron. This service delivered newspaper stories via cable TV for display on television screens. Three years and \$50 million later, Knight-Ridder shut the Viewtron project down. America was not ready for a new news medium yet.⁸² Undaunted, Knight-Ridder opened its Information Design Laboratory in Boulder,

⁸⁰ FOLDOC, "BBS." 2001. <<http://www.foldoc.org>>.

⁸¹ Harper, *The Way*, 201-206.

⁸² *E&P Online*, Outing, Steve. "Why Web TV is Not Viewtron Revisited" Dec. 9-10, 1996 <<http://www.mediainfo.com>>.

Colorado, in 1992. Headed by Roger Fidler, its mission quickly coalesced around a small computer known as a "video tablet." Touted as the hand-held computer newspaper of the next century, the device resembled a larger, heavier computer notebook that was to have been capable of downloading news from a variety of sources with all the readability and portability of a newsprint newspaper. Knight-Ridder abandoned the project and closed the lab in 1995.⁸³ Today, Knight-Ridder has one company-wide Web site, RealCities.com, which acts as a portal to city-based Web sites around the United States. These sites resemble search engines in appearance, providing free email accounts, and daily, regional news produced by its newspaper operations and local Internet advertising.

Over the years since mass media began in mid-19th century New York City with the penny press, to the present, the news industry has demonstrated a mastery of going out, getting the story and telling it in a compelling enough fashion to attract the attention of its audiences...until now. Knight-Ridder's experience mirrors that of the rest of the industry. On the Internet, the only thing news media have consistently demonstrated with their online products is how prone their management is to parochial thinking. Site after site attempts to present news content in a manner similar to that of the core newsprint product, which categorically ignores the multimedia presentation capability the Web channel offers. Web radio, TV and newspaper operations stream local content to an audience that is international and cares little about local council meetings and school board candidates.

⁸³ E&P Online. Outing, Steven. "Fidler Moves to Kent State," 9 Sept. 1996. <<http://www.mediainfo.com>>.

Content questions aside, how much do we really know about this medium? It is an amalgam of old and new media, but what do we really know about how people read text, look at illustrations and process information from Web news sites? Is it different or does it occur in the same fashion when a person reads a newspaper or watches a television news program? How does the addition of a computer and the Internet affect this process?

Dual coding theory suggests the multimedia potential of the Web channel must be used to facilitate audiences getting the most out of what they process. But most news sites offer little in the way of moving pictures, sound and animation, favoring the usual run of text, photography, cutlines, pulled quotes and headlines. Web TV and radio sites offer little more than daily programming schedules. Some have begun to offer Internet programming, but as yet, any advertising seems to be the province of the companies that create the client software that delivers content to Internet users. Not surprisingly, advertisers lead the charge in exploring the limits and possibilities the Web and its audience offers. Animation, video and even sound are frequent features of Web advertisements. Indeed, Internet advertising revenues indicate the success of this particular kind of online content. In 1998, Internet advertising revenue increased twofold over 1997 levels. Internet ad revenues outstripped outdoor advertising revenue, posting a \$1.92 billion year-end total in 1998; also quite significant is the fact that the leading category of online advertisements was for consumer goods. According to an independent study conducted for the Internet Advertising Agency by Price-Waterhouse-Coopers, "the categories [that] led

online spending during the 1998 fourth quarter were consumer-related (29%), computing (20%), financial services (19%), telecom (8%) and new media (7%). The report also found that the overwhelming number of revenue transactions, 93% continue to be cash-based with barter/trade and packaged deals accounting for 6% and 1% of total revenues respectively. Banner advertisements continue to be reported as the predominate type of advertising, accounting for 56%, with sponsorships (30%), interstitials (5%), email (1%) and other (8%) rounding out the category.⁸⁴ This success has continued through the 21st Century. Third quarter 2001 statistics peg Internet advertising revenues at \$1.795 billion and for the first nine months of that year at \$5.55 billion.⁸⁵

The news business has perhaps asked the right questions but not found the answers to what the convergence of computers, networks and news media bring to the table. In the face of this convergence, then, is the question, “How do people process news found on Web sites?” and additionally, “Do the reading and recognition patterns traditional media research has revealed still hold true for Web media consumers?”

These are the two larger questions this work will attempt to address. It will also evaluate which individual news presentation modes—embedded film and audio clips and photographs—will best create what the DCT literature refers to as an “additive, superior recall effect” when presented with text-based news stories.

⁸⁴ Internet Advertising Bureau. “Internet Advertising Revenues More Than Double in 1998,” 1998 <<http://www.iab.net/>>.

⁸⁵ Internet Advertising Bureau. “IAB Internet Advertising Revenue Report Pegs Total at \$1.792 Billion For 3Q 2001,” 2001 <<http://www.iab.net/>>.

Summary

This dissertation opened with an introduction that briefly described the project, presented the history of the Internet as a technological backdrop to provide context to how media is using this new channel to create new products. In addition, the introduction contains its justification and a brief introduction to the theory that will guide its construction. The introduction also contained a history of the development of the tools necessary to building an online new industry: personal computers, networks, the Internet and the World Wide Web.

Chapter 1 is a theoretical review of DCT that covers its models, constructs and assumptions and also argues why this theory is appropriate to use as a guide to new media study. In this process, it will then examine the DCT literature about how people read, add to their knowledge and memories and discern meaning from information they either already have in their possession or have just acquired. It will also discuss comparative news media recall research and examine the state of knowledge in human-computer interfaces and how people read and process information in computer environments versus the same material on paper. It also will evaluate relevant conflicting theories. Lastly, it will review educational literature that used dual coding theory to evaluate the efficacy of multimedia classroom tools. Conclusions drawn from this literature review will be used to create the theoretical framework that will guide an experiment conducted as part of this dissertation to determine which news elements best aid in news recall.

Chapter 2 is a literature review directed at evaluating scholarly pursuits in areas relevant to the construction of the experiment done using DCT as its guide. Chapters 3 and 4 outline the experiment's methods and results.

Chapters 5 and 6 cover the discussion of the results and conclusions drawn from the results of the experiment and the theoretical review. It is worth it to point out to readers that approximately five years passed from the time the experiment was performed, data was collected and computed to the time in which the data was evaluated, and the discussion and conclusions were derived.

Chapter 1

DUAL CODING THEORETICAL PERSPECTIVE

Introduction

This dissertation uses dual coding theory (DCT) to guide a project to compare recall of news items in online publications using various kinds of audio and pictorial representation. This chapter will examine the theoretical literature with the goal of how this cognitive psychological learning theory can be used to create a new theoretical framework for use in evaluating the effectiveness of online news products.

There is little mass media research that uses this theory to explain how people remember what they read, hear or view in the news media, and what few examples exist are atheoretical.⁸⁶ To date, the greatest body of work using this theory is in educational literature, where it is used extensively to test and evaluate the impact of various teaching methods on memory.

Allan Paivio's dual coding theory⁸⁷ will be used as a theoretical framework for this project. It will be used to explain how the use of pictures and, ultimately, multimedia, in concert with text improves younger readers' abilities to form concrete mental images about the information they process from online news. One of the reasons this theory presents itself as a good tool for this work is its history of usage in classroom effectiveness studies.⁸⁸ A classroom is a cutout

⁸⁶ e.g., Kenney, Keith, "Memory and Comprehension of TV News Visuals," News Photographer, August 1992: 53-54.

⁸⁷ Paivio, Allan. Imagery and Verbal Processes, Toronto: Holt, Rinehart & Winston, Inc. (1971).

⁸⁸ The collected work of Lawrence J. Najjar, then a graduate research assistant at the Georgia Tech

model of a mass media channel in that its message (the lesson or lecture) originates from a single sender (a teacher or lecturer) and is delivered to a large or small group of receivers (students) who provide feedback on that message (test or quiz performance).

A second reason why this theory is a good tool for this project is that its foundation lies in experimentation designed to test recall of younger populations.⁸⁹ Young, online newsreaders, for the purposes of the experimental portion of this work, are undergraduate students who were used to populate this study. Aside from their immediate availability in a university setting, young people represent an important audience segment to all media. Possessing a young audience segment implies a channel has a future, that if young people are accessing/reading/viewing/listening to that channel, as they grow older, they will continue their use of the channel.

Lacking a significant young audience segment is cause for concern because as older audiences age and move to fixed incomes in retirement, their ability to spend money on both acquiring media as well as the consumer goods advertised on them diminishes. By contrast, as younger audiences age, their buying power tends to increase, which generates a great deal of advertiser and media interest. Older audiences are also limited by their lifespan, in terms, of how long they will consume media products. As people age, their ability to consume media products diminishes (e.g., eyesight and hearing weaken or fail). This view is fostered somewhat by evidence in demographic studies of the

Research Institute, Atlanta, Georgia, is a good example of this research in this area. This work is cited in Chapters 1 and 3 of this dissertation.

dwindling reach of newspapers to the 18- to 24-year-old audience⁹⁰ and more recently, a dip in the number of young people who watch television news.⁹¹ In contrast, Internet demographic studies show large increases in audience numbers and unlike their traditional media counterparts, a growth trend.⁹² A larger question that has not been studied is: “Do these numbers, when considered as a whole, represent dwindling and increasing interest in various media types or do they represent a kind of churn—with audiences moving back and forth among the various media as their needs, preferences or ages change?” This is a question for another work.

Allan Paivio, a psychological researcher at the University of Western Ontario, proposed DCT, a cognitive psychological learning theory, a little more than 20 years ago.⁹³ It has stood the test of time and competing doctrines, including, but not limited to significant theoretical challenges from supporters of elaboration and schema theories of memory.⁹⁴

Much of the mainstream theoretical research involves testing subject recall of text and image pairings. Effects of vowel and consonant pairs, different kinds of imagery's (illustrations, graphics, pictures, paintings, etc.) effects on both

⁸⁹ e.g., Paivio, “Paired” 239-245,

⁹⁰ Tolley, B. Stuart. “Newspaper Effectiveness: The Data,” Journal of Advertising Research, 31.1 Feb./March 1991: 12.

⁹¹ Pew Research Center for the People and the Press. “TV Viewership Falls: Fall Off Greater for Younger Adults and Computer Users,” 18 March 2001. <<http://www.people-press.org/mediarpt.html>>.

⁹² Nua Internet Surveys “How Many Online?”, 18 March 2001. <<http://www.nua.com.ie>>.

⁹³ Paivio, Imagery.

⁹⁴ e.g., Sadoski, Mark, Paivio, Allan, and Goetz, Ernest T. “A Critique of Schema Theory in Reading and a Dual Coding Alternative,” Reading Research Quarterly, 26.3, Fall 1991: 463; Wilson, Brent, and Cole, Peggy, “A Critical Review of Elaboration Theory,” Educational Technology Research and Development, 40.1, 1992: 63-69.

long- and short-term memory seem to make up the general run of its basic theoretical research.⁹⁵

This theory is also well accepted in educational research for studying the use of graphic and pictorial imagery in teaching material and presentations.⁹⁶ Some research using this theory evaluates uses and methods for teaching various kinds of technical and non-technical material to various student audiences.⁹⁷ Again, researchers test both long- and short-term recall of subject matter in an effort to prove the general superiority of the use of illustrative material (as opposed to text-only) material for teaching purposes.

Since multimedia has entered the classroom as an educational material delivery tool, educational researchers have employed DCT to examine the benefits of its use, both in the classroom and in distance education venues.⁹⁸ Some of this literature applies dual coding theory to how computer imagery aids in memory creation in the learning process.⁹⁹ There have also been papers written that evaluate hypermedia from a dual-coding perspective.¹⁰⁰ In all cases, this research is aimed at evaluating how these new tools either add or detract from the classroom goal of educating students.

⁹⁵ e.g., Kosslyn, Stephen M. and Pomerantz, James R. "Imagery, Propositions and the Form of Internal Representations," *Cognitive Psychology*, 9, 1977: 52-76.

⁹⁶ e.g., Najjar, Lawrence J. "A Review of the Fundamental Effects of Multimedia Information Presentation on Learning," *Technical Report GIT-GVU-95-20*, June 1995.

⁹⁷ e.g., Najjar, Lawrence J. "Dual Coding as a Possible Explanation for the Effects of Multimedia on Learning," *Technical Report GIT-GVU-95-29*, September 1995.

⁹⁸ Jerram, Peter, "Who is Using Multimedia?" *New Media*, October 1994: 48-58.

⁹⁹ Rieber, L.P., Tzeng, S., Tribble, K., & Chu, G., "Feedback and Elaboration within a Computer-Based Simulation: A Dual Coding Perspective," American Educational Research Association annual meeting. New York, New York. April 1996.

¹⁰⁰ e.g., Najjar, "Multimedia" 129-150.

Mass media research can be summarized with the single question: "Who sends/receives what message, in which channel, to what effect?" Mass media researchers seem to be less interested in how audiences process information, doing more results-oriented work about the effects of the messages. Surprisingly few journalistic research projects have used DCT as a map for work.¹⁰¹ This is especially surprising considering the huge body of research testing audience recall of news information, as well as the equally large body of research that compares recall among various media types. The mass media literature is rife with publications applauding the prospects of online journalism, yet aside from a few advertising researchers, no one has examined the process receivers would employ to consume the message, despite a growing number of studies looking at access questions from an information gap hypothesis perspective.¹⁰² In terms of visual communications, there is a profound amount of literature on Web page design principles;¹⁰³ but again, there is nothing about the audience recall process of this material. DCT's presence in this literature is nonexistent. It is as if mass media researchers take the memory process for granted, assuming that memory works the same, no matter what news or commercial messages the audience consumes. Interestingly enough, there has been a little audience recall work done with Web advertisements, but, owing to the newness of the media channel, it focuses on the early stages advertising/editorial packaging and on audience

¹⁰¹ e.g., Kenney, "Memory" 53-54.

¹⁰² Pluck, G.C., and Brown, R.G. "Curiosity is Stimulated by Incomplete Information," Proceedings of the British Psychological Society, 7, 1999: 5.

¹⁰³ e.g., Coyle, James, and Brill, Ann, "Examining Metaphor Use in On-Line Advertising," Association of Educators in Journalism and Mass Communication annual meeting, Baltimore, MD. 1998.

recall of advertising bundled with varying Web content.¹⁰⁴ But like its traditional mass media counterpart, it is more concerned with *if* memory occurs and *how much* memory occurs rather than *how* memory occurs—and rightfully so. For if it is to grow beyond a “new” channel into a viable one, its commercial success will only be assured once participants have the answers to those questions.

There have been some projects that compare reading news on computers to other news media channels.¹⁰⁵ Yet there is little, if any, experimental literature evaluating the efficacy of online news products. Such as there is has been of a comparative nature, likening news products produced by newspaper firms to offline, paper products or Web radio or Web TV products to their broadcast, offline counterparts.¹⁰⁶

These comparisons serve well enough in establishing media research for a new channel. They serve to ground the research community with ties from institutions they understand to those they don't. However, for Web research to legitimize itself, it must move past this stage of comparing one channel to another and begin to evaluate the channel with a ruler whose purpose is to measure individual channel efficacy.

This work proposes to do that. It will propose a theoretical framework for evaluating online news, which is a wholly separate and different channel than its segmented, offline counterparts. The method it proposes evaluates the channel's efficacy based on the Web audience's ability to recall news messages presented

¹⁰⁴ Lindlof, Thomas R., and Schatzer, Milton J., “Media Ethnography in Virtual Space: Strategies, Limits and Possibilities,” Journal of Broadcasting and Electronic Media, 42.2, 1998: 170-189.

¹⁰⁵ Lee, Seungwhan, “The Convergence of the Web and Television: Current Technological Situation and Its Future,” Association for Education in Journalism and Mass Communication. Baltimore, MD. 1998.

within the channel. It does not engage in comparative recall but, instead, evaluates Web news delivery based upon its own merits. This work will also test this proposed framework with an experiment using DCT as a roadmap to guide its findings to prove its usefulness as a tool in evaluating Web media effectiveness.

Theoretical framework

Dual coding theory (DCT) is a cognitive psychological learning theory that has been around for a little more than 30 years.¹⁰⁷ It explains how people remember information they have processed into memory.

DCT is based on the notion that cognition—the process of knowing things in the broadest sense, including perception, memory and judgment¹⁰⁸—consists of the manner in which symbolic representation systems, such as memory of environmental information, serve functional or adaptive behavioral goals. These systems process behavioral, perceptual and emotional information. Human communication is unique because language, as far as we have been able to determine, is the only communication system that is capable of creating both verbal and non-verbal imagery from the same inputs and outputs. Thus it creates both linguistic input and output while serving a symbolic function for non-verbal objects, events and behaviors.¹⁰⁹

¹⁰⁶ Lee, “Convergence.”

¹⁰⁷ Paivio, *Imagery*.

¹⁰⁸ *Webster’s New World Dictionary of American English*, 3rd College Edition, ed.: Neufeldt, Victoria, New York: Prentice Hall, 1994, 271.

¹⁰⁹ Paivio, Allan, *Mental Representations: A Dual Coding Approach*, New York: Oxford University Press, 1990. 53.

According to DCT, there are two processes the human mind uses to deal with sensory stimuli. One, the symbolic subsystem, is specialized for handling information derived from nonverbal objects and events; the second deals directly with linguistic inputs. Paivio refers to the symbolic subsystem as the “imagery” system, owing to its critical function of analyzing scenes and generating mental images from a variety of sensory modalities, such as speech, sound, smell or touch. He refers to the linguistic subsystem as the “verbal” system. Both the imagery and verbal systems are structurally and functionally distinct; however, they are not totally independent. These two systems are independent in that either system can operate without the other, or both can operate at the same time. Yet they are interconnected so that activity in one system can stimulate activity in the other. Paivio asserts that verbal systems symbolically represent the structural and functional properties of language and that non-verbal systems do the same for the non-linguistic world.¹¹⁰ His theory assumes an orthogonal relationship between symbolic systems and specific sensorimotor systems. Yet both text and non-text systems are manifested within different modalities (e.g., visual systems can be triggered by printed words or visual objects).¹¹¹ For example, the smell of a lemon might evoke the word, “lemon”; the word, “lemon,” might invoke the memory of the color, yellow, or it might trigger a memory of a sour taste.

Thus we can begin to see DCT’s theoretical relevance to testing online news environments. DCT assumes the existence of verbal and non-verbal

¹¹⁰ Paivio, Allan, “Dual Coding Theory: Retrospect and Current Status,” Canadian Journal of Psychology, 45.3, Summer 1991: 257.

systems within a larger symbolic system. Online media products are constructed similarly. Individual stories have both verbal and non-verbal subsystems that are comprised of verbal and non-verbal elements. When considered together, these two subsystems can either function independently to create meaning, as a multimedia video might stand alone on a page, unaccompanied by text, to tell its story, or it might be one of several independent but related elements to tell several aspects of a larger story.

“Structural representations” of DCT refer to stable, long-term memory information that corresponds to verbal and non-verbal perceptually identifiable objects and activities. “Processing” is the activity that surrounds the verbal and imagery systems, including activation either by stimuli, called “encoding,” activation of one by the other, called “recoding,” organization and development of information within each system, as well as information transformation, manipulation and retrieval from either system.¹¹²

Conceptually, the theory is organized into a hierarchical structure. At its topmost level, DCT is about systems that serve either symbolic or representational functions. These then are divided into verbal and imagery symbolic subsystems, which can be expanded into sensorimotor subsystems. At the lowest level, there are two representational units known as logogens—word generators—and imagens, image generators. Operative cognitive mechanisms occur at the lowest level of this hierarchy.

¹¹¹ Pavio, “Retrospect,” 257.

¹¹² Paivio, Mental, 54.

Here again, we see a similarity in structure between the theory and the objects it might be used to study. Online media products have a certain hierarchical structure as well. At their topmost levels, they are collections of stories used to create a representation of the day's events within a specified geographic area. These stories deliver either a verbal or non-verbal message or both. At their lowest level, these stories consist of words or pictures or words and pictures that, when presented together in a coherent fashion, create meaning for those who process them.

DCT assumes mental representations are developed from perceptual, motor and emotional experiences and that they retain those roots in memory.¹¹³ Therefore, representational structures and processes are modality-specific, depending on the individual. For this reason then, no mental representation can be completely abstract, nor does it deny the possibility of instinctual memories—those programmed into the human brain after conception. For example, the capacity to conjure images may not be uniquely human, yet it has been proven to have a hereditary base.¹¹⁴ But, according to DCT, whether an individual is inherently more comfortable processing verbal or imaged information depends entirely on that person's experiential dominance (i.e., whether their learning more acclimated to verbal or imagery inputs).¹¹⁵

Dual coding theory asserts that verbal and non-verbal systems organize and process information in distinctly different ways. Information in the verbal system is organized within a sequential or hierarchical structure, while non-verbal

¹¹³ Paivio, Mental, 56.

¹¹⁴ Paivio, Mental, 56.

systems are organized within nested structures.¹¹⁶ In the verbal system, an object would be described by arranging text-based descriptions of its individual components into words, sentences and paragraphs until the whole was completely described. Any new information that may be acquired is inserted into the sequential frame, augmenting or replacing its various elements. In a non-verbal system, there is no sequence or hierarchy of components. Rather, because the complete object can be visualized at once, each component can be recalled individually, but is conceptualized as part of a whole. For example, the image of a fish includes the intuitive inclusion of scales, fins, a tail, a mouth, gills and eyes that together comprise a unique and specific creature. These objects can be manipulated in memory according to dimension, sensory change (whether real or imagined) or movement. "Thus, imagens correspond to natural objects, holistic parts of objects and natural groupings of objects. The represented information includes, not only static appearance but dynamic and variable properties as well."¹¹⁷

Here, too, we can see how DCT theory parallels the media this project will study. Words organized into a story must be processed sequentially or their meaning will escape the audience. Stories that use video, embedded audio and multimedia video as elements to accompany the written text have nested objects that comprise a whole story that will impart meaning to the audience. When readers/viewers/listeners recall facts from stories, they visualize the complete

¹¹⁵ Paivio Mental, 59-61.

¹¹⁶ Sadoski, M. and Paivio, A. and Goetz, E., "A Critique of Schema Theory in Reading and a Dual Coding Alternative," Reading Research Quarterly, Fall 1999: 463-484.

¹¹⁷ Paivio Mental, 60.

object in their minds, while searching their memories for information gathered from story components. Information from each component can conceivably be recalled, but when conceptualized together, the photos, audio tracks and text will be remembered as a single story.

In a verbal system, each component would have to be described in detail and in list-fashion for the mental representation of the whole creature to be complete and accurate. Both verbal and non-verbal systems are assumed to be functionally independent; that is, each may operate without the other or may operate in parallel.¹¹⁸ When they do operate together, the theory assumes an additive effect on recall.¹¹⁹

Structural information can also be organized in a *simultaneous* way.¹²⁰ In other words, when people visualize parts that make up a whole, they can also visualize all those parts assembled and created as a whole. Consider an online news article with audio, multimedia video and text components. From a DCT perspective, individuals who read these articles will remember each component of the total article in response to being asked to recall the article. But they will first have to call up the memory of all the material contained in each of the elements *simultaneously*. To do this, then, they will call up the parts available for processing and fit them together in memory as a whole article. Logogens, too, can vary in size, but their structure is different than imagens in that they have components—letters—that make up parts of syllables, which are organized

¹¹⁸ Paivio *Mental*, 218-222.

¹¹⁹ Kobayashi, Susumu, "Theoretical Issues Concerning Superiority of Pictures Over Words and Sentences in Memory," *Perception and Motor Skills*, 3, 1986: 783-792.

¹²⁰ Paivio, Allan, "Imagery and Synchronic Thinking," *Canadian Psychological Review*, 1975, 147-163.

sequentially into words. Taken further, writing is the sequential ordering of words into thoughts and thoughts, when considered as parts of a whole, constitute memory. Thus, logogens can be nested but are always sequential in nature. Therefore, the sheer volume of sequential information that must be recalled limits the amount of exact verbal information that can be recalled. Visual logogens are a good example. Research has shown individuals can image letters and short words, but this function is limited, in general, to words of three to four letters.¹²¹ Early DCT research had subjects make “word” associations with pictures, even though the words were nonsensical letter combinations that were not actual words. Thus, subjects learned new word associations with familiar visual images and allowed researchers to measure new memory creation. This research showed that subjects visualized words in their minds, not just the images they associated with the word combinations. As such, these visualized letter combinations are “visual logogens”.

As stated earlier, verbal and imagery systems are functionally independent in the sense that one system need not be active for the other to be active or that both can be active in a parallel manner. Still, it is possible that activity in one system can catalyze or trigger activity in the other, but it is important to remember this activity is optional. This suggests interconnection between the two systems. The most direct evidence of these interconnections occurs when people make references to objects with words by pointing to named

¹²¹Weber, D. and Harnish, J.D. “Visual Imagery for Words: The Hebb Test,” Journal of Experimental Psychology, 54, 1974: 409-414.

objects (e.g., pointing to the word, “dog,” in response to seeing a picture of a dog).

Dual coding theory specifies two kinds of interconnections between imagens and logogens. The first is called a *referential interconnection*.¹²² It is a between-system link that connects imagens and logogens, allowing objects to be named and names to evoke images. In this example, most U.S. citizens can easily put the correct name to a picture of President George W. Bush, when seen on a Web news site. Similarly, when confronted with President Bush’s name in print, these same people can easily conjure an image of George W. Bush.

The second interconnection is called an *associative interconnection*.¹²³ This is a within-system link that allows logogens to be associated with other logogens and imagens to be mentally associated with other imagens. Both verbal and imagery systems are bi-directionally interconnected; interconnection is assumed to be one-to-many.¹²⁴ For example, an image is capable of evoking any number of different verbal or non-verbal representations. Which images or verbal descriptions will be activated will vary according to individual experience. Mass media does not leave this process to chance, however. Recognizing that bi-directional interconnection exists, text and visual components of news are seldom presented alone to the audience. Film has voiceovers, text is usually presented together with illustration or photography and that photography is usually accompanied by text cutlines to further explain what readers/viewers see.

¹²² Paivio *Mental*, 63.

¹²³ Paivio *Mental*, 69-70.

¹²⁴ Paivio “Retrospect,” 259.

Associative processing in the verbal system is assumed to be hierarchical. Thus the word, “fish,” would be a category label for such words as “trout” or “bass”. These hierarchies are based in the cultural organization of our language structures. Media depend heavily upon cultural organization of language structure to deliver messages to their audiences. This is especially true for those media that attempt to appeal to some kind of localized audience. “Speaking the same language” is very important to local media in terms of reaching their audiences. This point does not serve to make the study of Web media products difficult with this theory. While it is true Web media attempt to appeal to mass audiences, the Web’s audience is, in general, younger, hipper, has higher income levels and is more educated. Therefore, cultural organization of language structure for Web audiences is just as critical as it might be for more traditional, localized media, despite the global geographic diffusion of the audience.

Thus far, this theoretical discussion has primarily dealt with how memory, or as Paivio refers to it, *mental representation*, is created. Another portion of this process specific to DCT is how mental representations are activated. According to the theory, activation of both verbal and imagery representations is a joint function of stimuli and individual differences.¹²⁵ Put more simply, memory is activated jointly by the conditions that call for memory to be activated and the individual’s experiences (affective, behavioral and sensorimotor).

Two types of stimuli are part of this process. One is called target stimuli, which can be something presented for processing, such as various online news articles with different levels of multimedia in them. The second is contextual

stimuli—those stimuli that constitute an instruction set within which subjects put target stimuli to use to accomplish specified goals.¹²⁶ An example here might be a recall test on the editorial material contained in articles that experimental subjects just finished reading. Or it might be a business decision that calls for knowledge of the day's news.

Experimental data support the theoretical assumption that the activation of nonverbal representations in imagery processing creates more concrete mental representations than verbal stimuli.¹²⁷ Similarly, the use of more concrete verbal stimuli is more likely to create concrete mental representations than the use of abstract verbal stimuli.¹²⁸ DCT suggests, then that verbal representation activation is maximized when the words that serve as stimuli have a great capacity to arouse verbal associations, or if the task demands verbal processing and instructions to perform the task are delivered verbally to the subjects.¹²⁹

Still, DCT theorists recognize individual differences will also play a role in representational activation. Different people have different experiences or even different preferences for thinking verbally or visually. These differences are generally expressed in probabilistic terms—that they will influence the probability of how well verbal and nonverbal representations will be activated and put to use for the proposed task.

¹²⁵ Paivio *Mental*, 67-69.

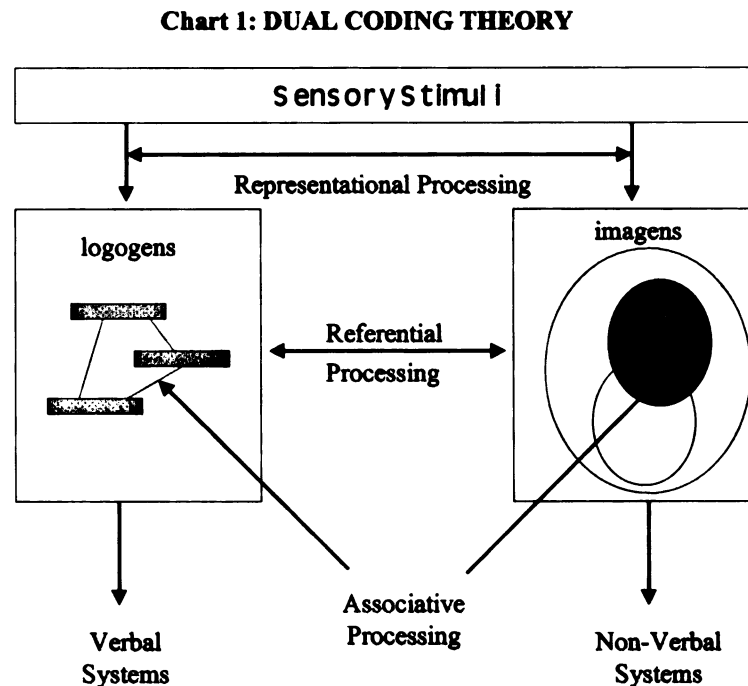
¹²⁶ Paivio *Mental*, 67-68.

¹²⁷ Op. cit., Paivio, Allan, "Coding Distinctions and Repetition Effects in Memory," ed: Bower, G.H. *The Psychology of Learning and Motivation*, New York: Academic Press:, 1975.

¹²⁸ Paivio "Retrospect," 261.

¹²⁹ Paivio *Mental*, 68.

DCT describes three kinds of processing people use to access mental representations using these two interconnections (See Figure 1).



The first, *representational processing*,¹³⁰ refers to direct activation of logogens by verbal stimuli and imagens by non-verbal stimuli. Researchers have shown activation using referential processing takes less time and is more direct than the two other kinds of processing, referential and associative processing. *Referential processing*¹³¹ is the processing required for the cross-system activation in imaging to words or conversely, how a word might evoke an image. From a theoretical standpoint, this kind of processing is believed to be more indirect because it involves a mental crossover from the verbal to imagery systems or vice versa. Paivio notes one reason for this is that image generation

¹³⁰ Paivio Mental, 70.

and object naming tasks often involve other kinds of processing as well as use of both verbal and imagery systems. *Associative processing*¹³² consists of the within-system activation of one logogen by another or of one imagen by another. All cognitive tasks require representational processing, but some may involve all three.¹³³

At this time, it is appropriate to note that one function of mental representation is that of active organization or reorganization. As we assimilate new information, we must reconcile the new with the old. Theoretically, DCT suggests that memory is dichotomized along verbal and imagery lines and so, too, is memory organization.¹³⁴ Thus, in reorganization, the verbal system rearranges representational processing according to a sequential process while imagery systems generate synchronous and spatial structures in memory.¹³⁵

Over time, research has shown that both imagery and verbal systems have important functions in encoding, storage and retrieval of new information. Paivio asserts the *evaluative* function of mental representation is rooted in the verbal system when we engage in an attempt to assign some relative or absolute value to information.¹³⁶ The reason, he says, is because we give ourselves verbal, unspoken or unconscious instructions to trigger the evaluative process, which is ultimately quantitative.¹³⁷ Even when we evaluate the pros and cons of abstract concepts, we still would place one concept in a superior position and the

¹³¹ Paivio *Mental*, 69.

¹³² Paivio *Mental*, 69.

¹³³ Paivio "Retrospect," 259-260.

¹³⁴ Paivio *Mental*, 141.

¹³⁵ Paivio *Mental*, 142.

¹³⁶ Paivio *Mental*, 74-75.

¹³⁷ Paivio *Mental*, 74.

other in an inferior rank position. In effect, we have sequenced this information, which, as noted earlier, is a function tied to the verbal system.

Another function served by representational systems is the *mnemonic* function.¹³⁸ This function serves to explain how imagery and verbal systems aid in creating memory. One assumption that governs this part of DCT is that the pathway used to create a particular memory is modality specific.¹³⁹ In other words, if the memory was encoded verbally, it will be retrieved verbally and similarly, if it was encoded by means of the image system, it will be recalled as an image. Representational coding—words evoking word memories, images evoking imaged memories—is usually sufficient for some level of accuracy in recognition and recall tests. Referential encoding is also possible, as long as the contexts in which the input items are presented are not confusing. For example, viewing a multimedia news video on an online news Web site would be a contextually appropriate way to view news material. Therefore, it would be possible that subjects would be able to referentially encode information gathered by reading/viewing news material on a Web site. DCT also notes that the probability for successful referential encoding will be much higher if subjects are given instructions as to the nature of the tasks prior to processing the information.¹⁴⁰ Objects, such as sliders, radio buttons and links fulfill this function on Web pages. Since experienced Web users intuitively know how to use these devices, their function serves as instruction on how to access material and also provides clues as to the nature of the material they will access in using these

¹³⁸ Paivio Mental, 71.

¹³⁹ Paivio Mental, 149.

features prior to processing this information. For example, a slider button underneath a framed visual image cues viewers they are confronted with a video frame on a Web page. It tells them the information they are about to process is moving and not a still photo and will likely, but not always be accompanied by a sound track. Thus, the user is "instructed" to receive information in a particular way by the frame surrounding the text or images they are about to process. Associative encoding is the activation of associated representations in the same symbolic modality as the input item.¹⁴¹ Thus, a subject who recalled the subject matter in a video as a mental representation of a film clip in which news was imparted would have engaged in associative encoding to put that information into memory.

Mnemonic retrieval involves recoding, "jogging" a subject's memory with material related to the information input.¹⁴² An example of this might be an objective question in a news recall test that sought a particular answer to a particular event related in a news story via text, film or embedded audio. This question would be subtly worded to remind viewers of the subject matter without answering the question. Recoding during retrieval can occur if the query material is similar in structure to the material when it was initially encountered.

But, following the theory, verbal representations make it more difficult to recall verbal information. Subsequent research used to develop the theory has shown that pictures are easier to remember than words due "entirely to the

¹⁴⁰ Paivio Mental, 122-124.

¹⁴¹ Paivio Mental, 76.

¹⁴² Paivio Mental, 236.

mnemonic superiority of image code over the verbal code."¹⁴³ As stated earlier, the two codes are independent of each other but research indicates pictures are additively encoded.¹⁴⁴ In an experiment in which participants were first asked to name or generate images for pictures and for words, then unexpectedly asked to recall the words or names of pictures, imaging to words doubled recall relative to imaging for words that had only been pronounced.¹⁴⁵ In addition, imaged words were recalled about as well as named pictures. In another experiment, Paivio used a repetition-lag model in which he again demonstrated non-verbal systems' mnemonic strength over verbal systems. The lag effect occurs when recall of repeated items increase with the number of other items that intervene between repeated items.¹⁴⁶ Interestingly, zero-lag items, those that are successively repeated, are "less than additive."¹⁴⁷ But overall, in terms of mnemonic value, Paivio notes that empirical evidence shows imagery codes to have a 2:1 advantage over verbal codes.¹⁴⁸ The sum of experimental research shows that imagery surpasses even concreteness as a predictor of recall.¹⁴⁹

Pictures and words contribute unequally to recall with pictures contributing approximately twice as much to their additive effect as words. This advantage occurred in both massed repetitions and once-presented item pairs.¹⁵⁰

¹⁴³ Paivio "Retrospect," 265.

¹⁴⁴ Paivio, Allan and Csapo, K. "Picture Superiority in Free Recall: Imagery or Dual Coding?" Journal of Cognitive Psychology, 1973:176-206.

¹⁴⁵ This finding might well be tested again with recall of complementary embedded audio in online news text.

¹⁴⁶ Op. cit., Paivio, "Retrospect,"; Paivio, Allan, "Coding Distinctions and Repetition Effects in Memory," ed.: Bower, G.H., The Psychology of Learning and Motivation, New York: Academic Press, 1975.

¹⁴⁷ Paivio "Retrospect," 265.

¹⁴⁸ Paivio Mental, 76.

¹⁴⁹ Paivio Mental, 159.

¹⁵⁰ Paivio, Allan, "Spacing of Repetitions in the Incidental and Intentional Free Recall of Pictures and

This lag phenomenon was once identified but then mislabeled in mass media research in a study on news audience recall literature. A researcher performed a study testing audience recall of television news, in which he incorrectly rejected dual coding theory in favor of a single-coding hypothesis.¹⁵¹ The reason, it seems, is that he was unaware of the lag phenomenon mentioned above. His experiment showed how words are remembered as pictures and pictures are remembered as words, which is consistent with referential processing. He called this a "translation phenomenon," but noted that it was more likely to occur 48 hours after viewing a news story than immediately, which also supports the lag phenomenon reported above and not a single-coding hypothesis that suggests all messages are stored the same in memory.

As seen above, there is evidence of limited usage of dual coding theory in mass media study. One reason might be that it is simply overlooked. Another reason might be that, thus far, researchers have merely been concerned with the end results—what actual recall was and how it compared to that for material in other media—and less so with how it is stored in memory. Because publishers are now placing news products on the World Wide Web,¹⁵² researchers must now concern themselves with discovering if visual communications design principles that work well in the print and broadcast media will also work well within the computer medium.

Words," *Journal of Verbal Learning and Verbal Behavior*, 13, 1974: 497-511; op. cit., Paivio, Allan, "Coding Distinctions and Repetition Effects in Memory," Bower, G.H., ed., *The Psychology and Motivation*, New York: Academic Press, 1975.

¹⁵¹ Grimes, Tom, "Encoding TV News Messages into Memory," *Journalism Quarterly*, 67.4, Winter 1990: 757-766.

¹⁵² NYTimes.com, CNN.com, LATimes.com, MSN-NBC.com to name a few.

Psychologists divide memory into as many as six different categories.

DCT eschews this discussion in favor of addressing the difference between two of these categories—those being semantic¹⁵³ and episodic memory¹⁵⁴. Semantic memory is the part of memory in which information is manipulated, transformed and compared to create meaning.¹⁵⁵ Episodic memory is memory about specific events at a particular time and place.¹⁵⁶ Both semantic and episodic memories are relevant to the study of news recall. News, in and of itself, is episodic in nature; it is event-driven and as such, for those who do not witness the events they depict, reading the news becomes the event for them. This is especially true for news presented on the Web. With multimedia capabilities, readers/viewers/listeners may actually witness, hear about and view events all at the same time. Semantic memory becomes important once news has been experienced. Once mental representations are processed, some measure of semantic processing occurs so that we might create meaning from what we have just processed. As we process what we learned from the news, we relate the newly acquired facts to what is already stored in memory to create meaning and meaningful memories.

DCT approaches semantic memory from a holistic perspective. As mentioned earlier, the process recognizes that its objects are made of connected, sequenced or nested units. Thus, the end of the process is not the representation of the parts, but rather the representation of the whole. Paivio

¹⁵³ Paivio Mental, 120-139.

¹⁵⁴ Paivio Mental, 140-176.

¹⁵⁵ Paivio Mental, 120-121.

¹⁵⁶ Tulving, Endel, "Episodic and Semantic Memory," Eds.: Endel Tulving and Wayne Donaldson,

notes that DCT does not distinguish any structural or functional differences between episodic and semantic memory.¹⁵⁷ This, too, bodes well for study of a channel that presents multimedia information that must be recalled from both sequenced and nested memory structures. Recall then must be measured against memory of the whole rather than memory of information imparted by specific components.

The theory refers to the meaning creation process as *memory trace*.¹⁵⁸ It assumes memory creation processing is also modality specific and is derived from two separate kinds of sources: external and internal.¹⁵⁹ We derive external sources directly from sensory stimulation and we derive internal sources, associatively, from our experience. Paivio thinks external sources are more reliable than internal sources because external sources are directly derived from sensory stimuli.¹⁶⁰ He reasons external memory sources are derived from specifically recalled events while internal sources' accuracy may be difficult to assess "in the absence of ...objective (criteria)."¹⁶¹

The theory also has assumptions about how encoding storage is organized. Essentially, it suggests encoding follows a dual-track, modal-specific path (or trace).¹⁶² The image system, as stated earlier, is best suited to encoding spatial and synchronous information while the verbal system is best suited for sequential information.

Organization of Memory, New York: Academic Press, 1972: 58-74.

¹⁵⁷ Paivio Mental, 140.

¹⁵⁸ Paivio Mental, 76.

¹⁵⁹ Paivio Mental, 141.

¹⁶⁰ Paivio Mental, 141.

¹⁶¹ Paivio Mental, 141.

¹⁶² Paivio Mental, 143.

But it is important to note that while some information will be encoded into memory by the verbal system, other information will be encoded via the image system and that still other information will be encoded by both the verbal and image systems. Here again, it is important to note that the theory assumes and experimentation has proven that memory items that are encoded dually will be remembered better than those encoded singly.¹⁶³

In addition to following the general structural assumptions of DCT, encoding also follows the model's processing assumptions. Representational encoding, for example, suggests information destined for memory creates perceptual memory traces in the same manner in which they are received.¹⁶⁴ Printed words, in part, create verbal traces, filmed events produce visual traces and audio tracks create auditory traces. Additionally, these traces activate others like them or related to them from within semantic memory. Completely new information, information that is totally outside an individual's experience, is encoded according to its input mode but rarely elaborated significantly.

Referential encoding involves memory items that are derived from verbal and imagery memory traces. Interestingly, printed words are usually encoded, or, more accurately, recoded into an auditory-motor form called the *phonemic form*.¹⁶⁵ In other words, memory derived from printed words comes not only from the verbal structure of the input item, but also from the auditory structure of the sound of the word reverberating within a person's consciousness. Thus, memory trace gathered from reading is referential encoding, involving both imagery and

¹⁶³ Paivio, "Spacing," 497-511.

¹⁶⁴ Paivio Mental, 144.

verbal systems together. Taken further, then multimedia information viewed/read/heard on Web pages will use both systems as well, no matter if the information appears in the form of printed words or multimedia video.

Imagery and verbal information presented together are remembered together, even if there is no prior association between the images and the verbal information. Thus, an online news story about the Russian premier's visit to Lima, Peru, that presents information in verbal, audio and video forms will be referentially encoded from both the verbal and imagery forms in memory together, even if the two countries were never associated together in memory before.

Associative encoding involves the elaborative processing mentioned earlier within either verbal or imagery processing systems. It can be based on the material in its original form or it can be based upon previous knowledge retrieved from semantic memory.¹⁶⁶

To sum up encoding then, episodic memory performance depends on the type of code involved—verbal or imagery—the number of codes or traces that are involved in creating the memory and the number of relations individuals generate between trace components.

Alternate Theoretical Explanations

There are a large number of psychological theories used to explain how people learn information from text, audio, video and even multimedia materials. This next section will identify a number of these theories, provide brief explanations of

¹⁶⁵ Paivio Mental, 143.

¹⁶⁶ Paivio Mental, 144-146.

them and discuss briefly why they are not as well suited to the task of explaining how people process news from online news sites as DCT is.

There are also a large number of psychological theories used to explain memory and learning. Many of these presume the existence of prior experience and suggest various ways in which what is being learned can be compared to what is in experience. Essentially, they attempt to explain recall based on the audience's receptivity to the message. Cognitive dissonance theory is a good example of this kind of theory. This theory assumes people seek a consistency among their beliefs and opinions.¹⁶⁷ When inconsistency is encountered between attitudes and behaviors, *dissonance* occurs and individuals attempt to create consistency.¹⁶⁸ Dissonance usually occurs when individuals must choose between two incompatible beliefs or actions; the greatest dissonance usually occurs when two alternatives appear equally attractive. The theory predicts attitudes will be changed to accommodate behavior.¹⁶⁹ The number of beliefs an individual has and the importance attached to each belief determines the strength of the dissonance. Thus, it is easy to see that cognitive dissonance theory, and others like it, would not be useful in research like this because they concern themselves more with persuasion than they do with cognitive function.

Experimental subjects in this work are viewing news presented within several presentation modes from the same source,¹⁷⁰ processing various kinds of

¹⁶⁷ DeFleur, Melvin L. and Ball-Rokeach, Sandra, "Theoretical Strategies for Persuasion," Theories of MassCommunication, (Longman: New York, NY), 1989: 276-277.

¹⁶⁸ DeFleur Theories, 277.

¹⁶⁹ DeFleur Theories, 277.

¹⁷⁰ For example, a single news story might be delivered via text, embedded audio and multimedia video, all presenting complementary information about the same subject matter from the same Web page.

information through various sensory systems. Many of alternative cognitive psychology theories fail to account for these different channels, though some suggest subjects have media preferences or predispositions that enable them to process information more efficiently. Aptitude-Treatment Interaction Theory is one example. This theory suggests certain media are more or less effective for particular individuals, depending upon their specific abilities.¹⁷¹ While this theory sounds good, researchers in this area have found aptitude interactions to be difficult to clearly demonstrate.¹⁷² Another problem they quote is that various learning styles can be linked to individual and aptitude variables but they also tend to vary within individuals, depending on the task, which makes them very difficult to operationalize.¹⁷³

A number of cognitive psychological learning theories have been created to explain problem-solving outcomes. Anchored Instruction Theory is a good representative theory in this genre. Similar to grounded theory in mass media, it suggests learning and teaching activities should be designed around an “anchor” that is based on a real-life or case-study situations. Learners, without supervision, then explore this material.¹⁷⁴ This theory is used extensively in research that evaluates videodisc and multimedia classroom equipment.¹⁷⁵ In

¹⁷¹ Cronbach, L. and Snow, R., “Aptitude-Treatment Interaction,” The Theory in Practice Database, 1999, <<http://tip.psychology.org>>.

¹⁷² Snow, R., “Aptitude-Treatment Interaction as a Framework for Research on Individual Differences in Learning,” eds: Ackerman, P., Sternberg, R.J., Glaser, R. Learning and Individual Differences New York: W.H. Freeman, 1989.

¹⁷³ “Framework,” p. 51.

¹⁷⁴ Bransford, John D., and Stein, Barry S., The Ideal Problem Solver: A Guide to Improving Thinking, Learning and Creativity, New York: W.H. Freeman, 1984.

¹⁷⁵ e.g., Glaser, Candyce Williams and Prestidge, Linda K., “Using Technology to Support Special Education Teachers’ Implementation of the Theory of Anchored Instruction,” American Educational Research Association Annual Meeting, Washington, D.C., 21 April 1995.

this case, news might reasonably be considered anchored material and certainly audiences do consume news without supervision. But as mentioned above, news is not material that is customarily used in problem solving situations.

Gestalt theory offers some interesting possibilities for those who would study Web page design. At the center of gestalt theory is the notion of grouping stimulus characteristics that cause individuals to structure or interpret what they see in a certain way.¹⁷⁶ The theory describes four primary factors—proximity, similarity, closure and simplicity—as the chief determinants of grouping.¹⁷⁷ Proximity states elements are grouped according to their nearness; similarity, that those with similar attributes are grouped together; closure, items that seem to be parts of the whole of a particular entity; and simplicity, items are organized according to symmetry, regularity, and smoothness.¹⁷⁸ Gestalt's failing, however, is that it speaks only to perception and again, problem solving. It, too, falls short in terms of providing explanations of how items are implanted into memory and why visual ones seem to be more memorable than text.

Another theory that also shows promise for would-be design theorists is information pickup theory. Similar to gestalt, it suggests that perception depends entirely on such factors as terrain and its variables—shadows, texture, color, convergence, symmetry and layout—that determine what individuals perceive.¹⁷⁹ Unlike other cognitive theories, it discounts previous experience as a cognitive

¹⁷⁶ Kearsley, Greg, "Gestalt Theory," The Theory in Practice Database, 2001. <<http://tip.psychology.org>>.

¹⁷⁷ Kearsley, "Gestalt."

¹⁷⁸ Wertheimer, Max, Productive Thinking, New York: Harper & Row, 1959. 8-13.

¹⁷⁹ Kearsley, Greg, "Information Pickup Theory," The Theory in Practice Database, The Encyclopedia of Psychology Society. 2001. <<http://tip.psychology.org>>.

function and instead declares perception to result directly from environmental stimulus.¹⁸⁰ Information pickup suffers the same shortcoming gestalt theory does. It describes only perception and does not delve deeply enough into memory function.

Level of processing theoretical framework suggests that the more processing a person performs on information, the more it will be retained and remembered. Information that is processed more deeply is more likely to be remembered. Information that is more likely to be processed deeply includes strong visual images or information that has an association with previous memories. Processing is unconscious and automatic unless we pay attention to it directly.¹⁸¹ Thus this theory suggests strong visual material and material with previous associations in memory facilitate memory processing.

Yet video and photographic material is not always strong; many times, accompanying video and photos are merely supportive. In addition, news, by its very nature is new information. Being able to make a connection between what is being read and what is in memory may not always occur. Therefore, the level of processing framework fails to fully explain recall of various multimedia news presentation modes in online news stories.

Elaboration theory very nearly contends with DCT to explain how readers/viewers/listeners might retain information from online news stories. It proposes seven major presentation strategy components: (1) an elaborative

¹⁸⁰ Gibson, James Jerome, The Senses Considered as Perceptual Systems, (Boston: Houghton Mifflin), 1966: 30-35.

¹⁸¹ Craik, F. and Lockhart, R. "Levels of Processing on a Variety of Memory Tasks: New Findings and Theoretical Implications," Consciousness and Cognition, 5.1, 1996: 142.

sequence, (2) prerequisite sequences, (3) summary, (4) synthesis, (5) analogies, (6) cognitive strategies, and (7) reader control.¹⁸² The elaborative sequence is defined as a simple or complex sequence in which the first presentation highlights the ideas and skills that follow. Elaborative sequencing should be accomplished with a single type of content, although two or more types may be elaborated simultaneously, and should present only a few ideas or skills.¹⁸³ Headlines, decks and even lead sentences perform this same precise function. Within a single content type, they present information in summary or synthesis fashion immediately prior to readers processing more text or multimedia that elaborates on the initial presentations.

Elaboration theory suggests that material presented in an order of increasing complexity is the best way to maximize recall.¹⁸⁴ For example, when presenting information, the simplest version of the information should be presented first. Subsequent presentation should provide additional versions of the information until the full range of information is presented. With each presentation, the theory suggests, audience members should be reminded of all versions presented thus far in summary or synthesis form.¹⁸⁵

Ultimately, this theory is tailored to classroom presentations far better than multimedia news presentations. Its required redundancy of presented information is one reason why elaboration theory cannot be used to compare multimedia

¹⁸² Reigeluth, Charles M., Instructional Theories in Action: Lessons Illustrating Selected Theories and Models, Hillsdale: L.Erlbaum Associates, 1987: 24-25.

¹⁸³ Kearsley, Greg, "Elaboration Theory," The Theory in Practice Database, The Encyclopedia of Psychology Society. 2001. <<http://tip.psychology.org>>.

¹⁸⁴ Kearsley "Elaboration".

¹⁸⁵ Kearsley "Elaboration".

news presentation methods. The journalistic style for news writing strictly forbids this kind of redundancy. In addition, this experiment randomized treatments and each of the multimedia components of each story were carefully selected to assure the messages each presented were not redundant with either other multimedia material or material in the text.

A key idea of elaboration theory is that readers need to develop a meaningful context into which subsequent ideas can be assimilated.¹⁸⁶ News stories with multiple multimedia information sources that are, in effect, nested together to create a Web news site presents information in the manner in which this theory requires.

Theory proponents claim elaboration results in more stable cognitive representations—fostering better retention and transfer—and increased reader motivation through the creation of meaningful contexts.¹⁸⁷ But it is the successive, redundant nature of the required information presentation that makes elaboration a poor choice for this research.

Yet another theory that also shows potential in explaining how audiences process multimedia news information is symbol system theory.¹⁸⁸ Much of the work done with this theory has been on television and film, but like DCT, there has been a significant amount of work done recently with computer content.¹⁸⁹ The theory proposes that each medium is capable of conveying content via

¹⁸⁶ Kearsley "Elaboration".

¹⁸⁷ Kearsley "Elaboration".

¹⁸⁸ Salomon, Gavriel, Interaction of Media, Cognition, and Learning, Hillsdale: L Erlbaum Associates, 1994: 54.

¹⁸⁹ Kearsley, Greg, "Symbol Systems," The Theory in Practice Database, The Encyclopedia of Psychology Society. 2001. <<http://tip.psychology.org/>>.

certain inherent symbol systems.¹⁹⁰ For example, television requires less mental processing than reading. Meaning secured from viewing television tends to be less elaborate than those secured from reading. Meaning extraction from various media is based on individual differences.¹⁹¹ Thus, a person may acquire information about a subject they are familiar with equally well from different media but be significantly influenced by a single medium for certain information. There are symbol systems associated with the various media that affect how information can be acquired. Some of these symbol systems relate directly to the kind of content being presented.¹⁹² Others vary according to the relative ease with which information is encoded into memory; for example, as noted above, television takes less effort to imprint than does text. "Thus, symbol systems partly determine who will acquire how much knowledge from what kinds of messages."¹⁹³ Symbol system theorists argue schema play a major role in determining how messages are perceived. Individuals create individual anticipatory biases that influence what information is selected and how it is interpreted.¹⁹⁴

Symbol system theory offers a plausible explanation as to how memory might be created from reading news. But for the purposes of this work, the reliance it places on individual differences makes it too difficult to control for all individual variables that might affect their predispositions for relating to various

¹⁹⁰ Kearsley "Symbol."

¹⁹¹ Kearsley "Symbol."

¹⁹² Kearsley "Symbol."

¹⁹³ Salomon Interaction, p. 227.

¹⁹⁴ Kearsley "Symbol."

media. DCT, with its simple picture superiority effect on recall makes research of this kind easier to explain and control for.

Conclusions

DCT has been used effectively in educational research to study the efficacy of multimedia classroom tools (e.g., computers) as compared to traditional teaching methods. Classrooms, by definition, are similar to mass media. Messages are delivered from a single source to a large group. It has also been used extensively to compare text and pictorial symbols' advantages in creating recall.¹⁹⁵ Yet, for some reason, mass media researchers have not used this theory to any great degree in comparative media recall studies or others for that matter.

This is very surprising, especially considering the parallel structure of the theory and many of the multimedia products this dissertation proposes to test. DCT's assumption of a hierarchical structure of language closely tracks the hierarchical structure of media. The nested structure it assumes for imagery systems tracks the nested organization that occurs when visual elements are added to a Web site. The inter-relatedness of verbal and imagery systems, especially during the process of meaning creation also tracks how Web pages are organized to present news information.

Lastly, this theory, unlike many others concerns itself almost completely with imprinting information in memory. If news-editorial is indeed an end, then recall of news is the way to measure it. DCT is the roadmap that maps the paths that memory must take for news recall to occur.

¹⁹⁵These studies will be cited in the literature review portion of this dissertation, where appropriate.

Chapter 2

LITERATURE REVIEW

Introduction

The World Wide Web is a media channel that is affecting its more traditional competition in much the same way each traditional media channel did when it was not traditional, but, in fact, “new” and entering the world media market for the first time. New media traditionally emerge in the media market and erode others' audiences, wooing first young people, then more mature audiences from more traditional competitors. As advertisers watch their market audiences migrate away, they, too, move their trade to these new media channels. Like their advertising counterparts, media firms follow their audiences as they see them migrate to other channels. They follow, using their capital to purchase access and then create content in these new channels.¹⁹⁶

Consider what happened when TV entered the media market in the late 1940s. Heretofore, radio had enjoyed a golden age. Advertisers wishing to efficaciously reach mass audiences, especially national mass audiences, had no choice but to run ads on the radio networks of the day.¹⁹⁷ But when television entered the market, viewers flocked to this new medium, despite the relatively high cost of the TV signal receivers necessary to capture the signals. The same firms that enjoyed a market success in the radio broadcast business, migrated to

¹⁹⁶ This is evidenced by the creation of any of a number of Web sites, such as CNN.com, NYTimes.com or LSJ.com.

¹⁹⁷ LaRose, Robert, and Straubhaar, Joseph, “Audio Media: Radio and Recorded Music,” Communications Media in the Information Society, Belmont: Wadsworth, 1997: 177-178.

television.¹⁹⁸ Advertisers followed the firms and audiences to TV, with many national accounts forsaking radio for TV and embracing the novelty of being able to present their products visually and with sound.¹⁹⁹

Similarly, the Web is beginning to steal audience members away from mainstream media. A 1996 Pew Research Center study showed network news audiences were losing audience and that the greatest audience losses were among young people and computer users.²⁰⁰ According to a 1998 Pew Research Center report, 46 percent of all Internet users began using the channel that year. A little more than 50 percent of these users were aged 30-49 and 25 percent were aged 18-29. Almost 60 percent of this group earned \$30,000 or more per year, with 35 percent of those earned more than \$50,000. More than half accessed the Internet for pleasure, as opposed to work purposes.²⁰¹ These trends speak to a promising future for the Web. The audience is both young—promising longevity—and well moneyed, which is attractive to advertisers.

In a 1998 survey of more than 5,000 Web users, there is evidence the Web is supplanting other media use. One of the questions the survey posed dealt with the frequency of their use of the Web instead of watching TV. More than 80 percent of respondents said they used the Web daily and weekly instead

¹⁹⁸ LaRose "Audio," 180.

¹⁹⁹ LaRose "Audio," 180.

²⁰⁰ Pew Research Center for the People and the Press. "TV News Viewership Declines: The Internet News Audience Goes Ordinary," 2001. <<http://www.people-press.org/mediarpt.htm>>.

²⁰¹ Pew Research Center for the People and the Press. "Online Newcomers More Middle-Brow, Less Work-Oriented: The Internet News Audience Goes Ordinary," 1999. <<http://www.peoplepress.org/tech98sum.htm>>.

of watching TV; similarly, nearly 50 percent said they used the Web daily and weekly instead of reading newspapers, magazines or books.²⁰²

While audiences are seeking newer, more novel media channels, advertisers have not yet made this same decision. Thus, even though an audience exodus from television has clearly begun, that is precisely what it has done: it has only just begun. The same is true for the commercial exodus that must accompany this trend for it to repeat other historical audience exoduses.

Network programming, once the king of the prime time audience, has lost considerable market share to cable TV. In 1979, 90 percent of television's prime-time audience watched network programming. By 1997, networks drew only 50% of the prime-time audience.²⁰³ This trend is very similar to one associated with newspaper readership. From 1945 to 1970 newspaper circulation rose steadily in this country. Since 1970, it has stayed roughly the same, despite population increases. Today, despite flat circulation increases, those who do read newspapers spend less time doing so.²⁰⁴

A top-rated TV show, such as *ER*, draws 30 million viewers per episode.²⁰⁵ Cable TV claims a presence in only two-thirds of U.S. households.²⁰⁶ A hit cable program draws from two to three percent of the national cable audience.²⁰⁷ Therefore, it is not surprising that network TV still attracts the lion's

²⁰² GVU. "GVU's Tenth WWW User Survey Graphs" 2001.

<http://www.gvu.gatech.edu/user_surveys/survey-1998-10/graphs/graphs.html#technology/>.

²⁰³ Barans, Stanley J. "'Media, Media Industries and Media Audiences: Television," Introduction to Mass Communication: Media Literacy and Culture, Mountain View: Mayfield, 2001, 288.

²⁰⁴ Barans, Stanley J. "Media, Media Industries and Media Audiences: Newspapers," Introduction to Mass Communication: Media Literacy and Culture, Mountain View: Mayfield, 1999, 102.

²⁰⁵ Barans "Television," 282.

²⁰⁶ LaRose "Multichannel Media," 251.

²⁰⁷ LaRose "Multichannel Media," 251.

share of TV advertising revenues. In 1999, network TV pulled in a little more than \$21 billion in ad revenue, while cable TV earned only \$13.6 billion.²⁰⁸

Globally, Internet advertising totaled an estimated \$2.1 billion in 1998,²⁰⁹ \$4 billion in 1999²¹⁰ and \$8.2 billion in 2000.²¹¹ Thus, though the Web has not yet surpassed its more traditional competitors' ad revenue numbers, it is gaining on them.

Clearly, network TV has little to worry about from the Internet in the near term, but it cannot discount it either. Certainly, the mergers between Microsoft and NBC and Time-Warner and AOL presage a bold new online world. There can be no mistaking the vision that went into these mergers. Wedding the world's foremost software publisher and videotex service with two of the world's largest media content distributors are classic examples of modern day vertical integration, especially in light of Microsoft's near-proprietary interest in the World Wide Web. As the publisher of the leading Web browser product in use today,²¹² Internet Explorer, Microsoft effectively controls how the majority of Web denizens view its content. One needs look no further than its proprietary channel architecture, now known as "Windows Media".²¹³ The company has created an archived content system that offers the most sophisticated and logically

²⁰⁸ Barans "Television," 283.

²⁰⁹ Nua Internet Surveys. "Total Revenue From Advertising - 1998," http://www.nua.ie/surveys/analysis/graphs_charts/1998graphs/ad_revenue.html.

²¹⁰ Interactive Advertising Bureau. Price-Waterhouse, "IAB Internet Advertising Revenue Report: 1999 Third-Quarter Highlights," March 2000, <http://www.iab.net/>.

²¹¹ Interactive Advertising Bureau. "Interactive Advertising Bureau (IAB) Reports \$8.2 Billion Ad Revenue in the United States for Year 2000; Fourth Quarter Totals \$2.2 Billion", 2001. <http://www.iab.net/>.

²¹² Proffitt, Brian. "BrowserWatch Stats Station," 2001. <http://browserwatch.internet.com/stats/stats.html>.

²¹³ Windowsmedia.com, 2001. <http://www.windowsmedia.com/>.

organized offering of Web content available today. Users need not search, nor laboriously enter URLs to access content. A simple point-and-click interface instantly delivers a sophisticated offering of the Web's best original, multimedia "programs" ranging from The Discovery and the Arts and Entertainment Channels to Warner Bros. cartoons.

All the elements are in place for traditional media to migrate news products to the Web. Useful client software, such as RealPlayer Plus²¹⁴ and Windows Media Player,²¹⁵ now enable users to conveniently access a wide variety of online news content packaged in sound and video files, as well as traditional content such as scanned images, static art and text.

Previously, many users shied away from video and audio files because they were so large and took so long to download, then play. But the advent of streaming technology has changed all that. Today, even those with 56.6-kilobaud per second dialup connections can listen to Internet radio shows or watch CNN newscasts without waiting for them to first download, then convert, then play. Streaming technology downloads content to create a buffer between that which is being viewed and that which is downloaded and processed for viewing.²¹⁶ As long as the content continues to stream to the user's computer—uninterrupted—viewers can view content with a minimum of down time, making the viewing experience much more similar to that of actually watching TV or listening to a radio.

²¹⁴ Real.com. RealPlayer Plus, <<http://www.real.com>>.

²¹⁵ Microsoft Corporation. Windows Media Player, <<http://www.windowsmedia.com/>>.

²¹⁶ Howe, Dennis. Free Online Dictionary of Computing, <<http://foldoc.doc.ic.ac.uk/foldoc/>>, 2001

Internet 2, a consortium of universities and companies that have networked together as part of a joint Internet media research and development effort, also promises new Internet technology to aid multimedia development on the Web. In existence for approximately two years now, this consortium of "corporations, colleges and universities will use I2 to explore areas of instruction, research, and public service, such as learning ware (software designed for classroom and distance learning), digital libraries, tele-immersion, and virtual laboratories. Eventually, the plan is that the technology will be available to everyone."²¹⁷

There is also a vast array of access options available to consumers. Cable companies offer high-speed Internet access with Internet-to-home-computer connection speeds, known as *downstream* connections, ranging from 500 kilobits per second up to 1.54 megabits per second (referred to as T1).²¹⁸ Regional Bell operating companies have been offering Digital Subscriber lines (xDSL) to customers. This service, which, like cable modems, requires a special modem to be installed, offers access speeds varying from a low of 256 kilobits per second to a high of 8 megabits per second, depending on how far consumers live from the area's switching office. xDSL's chief advantage is that it provides high-speed access via regular telephone lines.²¹⁹ Lately, as AT&T has competed mergers with a number of cable TV companies to become the largest cable TV provider in the United States, the firm has begun offering its own "broadband"

²¹⁷ Lundsten, Apryl and Doiel, Robert. "Internet 2: What is I2?", 27 April 1999.
<<http://www.builder.com/Servers/Internet2/index.html>>.

²¹⁸ Cable Television Laboratories, Inc. "Cablemodem.org," 2001.<<http://www.cablemodem.org>>.

²¹⁹ Howe FOLDOC, <<http://foldoc.doc.ic.ac.uk/foldoc/>>.

services, featuring combinations of DSL, satellite access and cable modem service. All these new access schemes are priced generally at \$50 per month and will likely be offered for less as more consumers seek faster access speeds.

Thus, from a technical standpoint, consumers who wish to access multimedia content from the Web have some of the necessary tools available to them and will have even more available soon. What remains is for networks to develop further to allow higher speed access and for content providers to deliver it. Why they have not begun to do so on a large scale seems mystifying.

One reason perhaps is that most news operations are in fact, single medium rather than multimedia operations. They have contented themselves with Web media products that scratch at the surface of the Web's capability to deliver news to mass audiences. They have not crept far beyond offering rudimentary graphic presentations of text, pictures and some animated charts and graphs. Only a few sites²²⁰ have attempted to meld video, audio, text and scanned photographs together in an effort to present multimedia news. For many, the reason is a lack of access to the media materials they do not directly produce. Indeed, for such conglomerated media operations as Time-Warner, Cox and even the Tribune Co., securing content that might be converted to multimedia online news presentations are relatively easy. For most, however, it would be a significant hardship, involving negotiating complex licensing agreements and royalty arrangements, before such content would be presented.

²²⁰ By late 2001, The New York Times, BBC, CNN and MSNBC were the major news firms that ventured into multimedia presentation of Web news.

To be convinced such complicated and arduous undertakings are necessary to media operations, it would be fruitful to explore if multimedia news presentations are worth delivering to Web audiences. Media history is spotted with many well-intentioned flops that promised new visual and sensual experiences, only to fall flat in the face of audience ambivalence. Who can forget such mass media debacles as Viewtron, 3-D movies and Smell-O-Vision?

This dissertation proposes to explore the value of multimedia presentation of news by testing subject recall of news presented within a variety of presentation modes: text alone; text and photography; text and multimedia video; and text, multimedia video and embedded audio. This section of the dissertation will review the experimental and theoretical literature that is related to the experiment that tests the theoretical framework laid out in Chapter 2. As such, it will serve as a comprehensive examination of all related literature not covered in depth in the previous chapter and will focus itself primarily on the literature that relates to the experimental portion of the dissertation.

Instrument Design

More and more media are entering the World Wide Web with news pages. This phenomenon is due, in part, to the growing connectivity that is occurring in U.S. households. But the same media firms that are putting the news on the Web are still casting about looking for ways to best present news on this channel.

This study proposes to test and compare four modes of online news presentation delivered to young audiences. Experimental subjects will be tested

on their recall of the facts associated with the news stories they read and listened to on the online news Web pages constructed for the experiment.

Each of the presentation modes to be studied in this work is a representative of the media that comprise the multimedia environments available to all who would build Web sites. Each component medium has its strengths, its weaknesses, its audiences and its non-users. Individually, they represent a segmented news audience whose preferences follow lines drawn by age, income, education and even geographic location.²²¹ But presented together, they represent a powerful new combination that is a singular medium, just as its parts are.

Owing to the relative novelty of this new media channel, very little research has been done to evaluate it. Therefore, a more integral approach to literature review was pursued to create this chapter. Among the research areas to be examined in this work will be text and reading comprehension within multimedia and computer environments, Web page design studies, graphical user interface design studies and content recall research. Some review of dual coding theory related work will be covered in this chapter, but only those studies that are media related. For a detailed handling of dual coding theoretical literature, please refer to Chapter 3.

At the outset of any discussion of computer media, some measure of interactivity must be considered. Interactivity refers to the unique exchange of information that occurs between a computer and a computer user.²²² This

²²¹ "GVU's WWW User Survey," <http://www.gvu.gatech.edu/user_surveys/survey-1998-10/graphs/#use>.

²²² Najjar, Lawrence. "Multimedia Information and Learning," Journal of Educational Media and

exchange is mediated by the information provided by both user and machine and will vary according to what is provided by both participants during the exchange.²²³ This active participation by users may well create greater reader attention than those who read text in non-interactive media, such as books, newspapers or magazines. It may also lead to greater reader involvement, and perhaps even comprehension, since they are actively manipulating this information on the way to acquiring it.

By and large, reading text online is a task involving working memory and content format. This experiment will look closely at content format. Working memory is that part of memory that takes care of temporary information storage and processing when individuals are engaged in more complex tasks.²²⁴ Its function is closely tied to the referential processing described in dual coding theory.²²⁵ Working memory takes newly acquired information and ties it to related information stored in long-term memory.²²⁶ Referential processing is necessary to text comprehension. Research has shown that less complex text tends to diminish the gap in text comprehension between those individuals with greater and lesser amounts of working memory.²²⁷ Therefore, news copy would be far less working memory-intensive than other kinds of texts. Thus, the task of balancing content acquisition skills (such as Web page navigation or on-site

Multimedia, 5, 1996: 129-150.

²²³ Sims, Roderick C. "Engagement, Control and Learner: A Theoretical Appraisal of Interactivity," Australian Society for Computers in Learning in Tertiary Education Conference, Adelaide, 1996.

²²⁴ Baddeley, Alan D. Short Term Memory, New York: Oxford University Press, 1986.

²²⁵ Paivio, Mental 69.

²²⁶ Sentius Corporation. "Guide to Online Publishing for Reading Comprehension – Section II," 1997. <<http://www.sentius.com/>>.

²²⁷ Budd, D., Whitney, P., and Turley, K.J. "Individual Differences in Working Memory Strategies for Reading Expository Text," Memory and Cognition, 23.6, 1995: 735 - 748.

search engine operation) with information related to the media content would likely have less effect on recall. Part of this might also be attributed to the amount of reader involvement in the act of processing information.

Roger Fidler spent a number of years working for Knight-Ridder developing a portable "news tablet". This device was designed to download news information from remote locations to provide readers with the same portability they experienced with paper news products.²²⁸ Fidler contends digital media forms must be as "comfortable" to read as paper media.²²⁹ In some research he was involved in, the findings indicated a preference among subjects for "portrait-oriented" text (as opposed to landscape-oriented).²³⁰ Historically, PC screens have been landscape-oriented (i.e., having a horizontal orientation). Original designs, prior to the release of the IBM-PC in 1981, featured portrait-oriented screens (screens that feature more vertical views) that were originally fashioned to mimic a single page of 8-1/2 x 11-inch paper.²³¹ Both these facts point to a recognition by computer hardware and Web designers that even though Web material is presented via computer, it is still essentially viewed as a document. Indeed, a study that compared reading speed and comprehension of screen and

²²⁸ Maney, Kevin. "High Tech Tablets: Next Step for Newspapers," USA Today Tech Report, 28 Feb. 1999. <<http://www.usatoday.com>>.

²²⁹ Fidler, Roger. Mediamorphosis: Understanding New Media. (Thousand Oaks: Pine Forge Press, 1997: 236.

²³⁰ Wearden, Stanley T., Fidler, Roger, Schierhorn, Ann B., and Shierhorn, Carl. "Portrait vs. Landscape: Potential Users' Preferences for Screen Orientation," Association for Education in Journalism and Mass Communication annual convention, Newspaper Division, New Orleans, 1998.

²³¹ Smith, Douglas, and Alexander, Robert. Fumbling the Future: How Xerox Invented, Then Ignored the First Personal Computer, New York: Morrow, 1988: 89.

paper texts found no differences between reading text on paper and reading text online.²³²

Similarly, a case study dealing with how International Monetary Fund economists gathered and processed information concluded that documents that did not rely on their linear structure and were used for search and retrieval tasks on small sections of text and well-defined texts (such as manuals or dictionaries) were better suited to digital presentation.²³³ Again, at least some of these attributes are common to news copy.

The beginning of the PC revolution in the late 1970s brought computers that were previously too large or too expensive into homes and offices.²³⁴ These computers could be dedicated to singular tasks, as opposed to larger, heavy-duty computational tasks mainframes and mini-computers of the day were doing. But one of the drawbacks to these earlier machines was that their interfaces—the screen views that interpreted machine language into human language so that people could effectively interact with their computers—were not very highly developed. This relegated early PCs to those people who could learn the extensive DOS and software package command languages, thus eliminating much of the public from participating in the personal computer revolution.

²³² Osborne, D.J., and Holton, D. "Reading from Screen versus Paper: There is No Difference," International Journal of Man-Machine Studies, 28, 1988:1-9; O'Hara, Kenton and Sellen, Abigail. "A Comparison of Reading Paper and Online Documents," CHI 97, Atlanta, Georgia, 22-27 March 1997.

²³³ Sellen, Abigail, and Harper, Richard. "Paper as an Analytic Resource for the Design of New Technologies," CHI 97, Atlanta, Georgia, 22-27 March 1997.

²³⁴ LaRose "The Computer Industry," 293.

But in 1984, Apple Computers introduced the Macintosh, and with it, the first high-resolution graphical interface.²³⁵ It captured the imagination of many potential computer users who were put off by the dark screen, the single carat and the single, blinking block of the disk operating system (DOS) screen. This interface even captured the imagination of Microsoft Corporation, which incorporated the graphical user interface into its next generation operating system, which would be called Windows.

Today, graphical user interfaces "contribute to the ease of use of computers. Interfaces based on windows, icons, menus and pointing allow fairly non-trivial operations to be performed with a few mouse clicks."²³⁶ Research on graphical user interfaces has shown that graphic or animated visuals aid greatly in computer user interfaces. For example, a 1995 research project done at the University of Wisconsin found that still graphic and animated visuals in online help instructions enabled users to perform tasks in less time and with fewer errors than those who used online help that did not contain visual graphic elements.²³⁷ This finding is in concert with dual coding theory principles that suggest that the presence of images with instructional text enhances humans' abilities to learn.²³⁸

The World Wide Web uses a graphical user interface to allow users to navigate its sites. Apple Computers originally introduced the navigation scheme

²³⁵ LaRose "The Computer Industry," 294.

²³⁶ Worden, Aileen, Walker, Neff, Bharat, Krishna and Hudson, Scott. "Making Computers Easier for Older Adults to Use: Area Cursors and Sticky Icons," CHI '97, Atlanta, Georgia, 22-27 March 1997.

²³⁷ Harrison, Susan M.. "A Comparison of Still, Animated or Non-Illustrated Online Help with Written or Spoken Instructions in a Graphical User Interface," Proc. of Computer-Human Interfaces '95.

²³⁸ Paivio "Mental," 206.

the Web employs now in a 1987 programming package called HyperCard.²³⁹

This package enabled designers to create user interfaces whose purpose was to deliver content to audiences. HyperCard enabled users to create "stacks" of cards that were actually screens, much like today's Web pages. Another similarity Web pages have to HyperCard stacks is that screen-to-screen navigation, or in this case, card-to-card navigation, was enabled by buttons users mouse-clicked, linked text and cards that featured both text and graphics on the same page.²⁴⁰

Conceptually, HyperCard was the precursor to HTML editors and, in doing so, was the precursor to Web page architecture. This architecture constitutes a universal language among Web users worldwide that directs how they navigate the space in which content is located. It also directs how they navigate within web sites, leaving memory free for higher order tasks, such as processing content and committing it to short-term or long-term memory.

A fair amount of DCT research on reading text on computer screens exists, much of it dealing with developing graphical user interfaces (GUIs).²⁴¹ There is also research that deals with reading news text on computers, but these studies presented news material on computers while failing to provide an environment that mimicked current online news media appearance. This occurred either because the studies were done when the only online news

²³⁹ Straubhaar, Joseph, and LaRose, Robert. "Computer Media and the Internet," Media Now: Communication Media in the Information Age, Belmont: Wadsworth. 2000: 21.

²⁴⁰ Howe FOLDOC, <<http://www.foldoc.org>>.

²⁴¹ e.g., Lomicka, Lara L., "To Gloss or Not to Gloss: An Investigation of Reading Comprehension Online," Language Learning and Technology, January 1998: 41-50; Chun, Dorothy M., and Plass, Jan L. "Research on Text Comprehension in Multimedia Environments," Language, Learning and Technology, July 1997: 60-81.

material were still being offered as part of videotex services, such as AOL and CompuServe, or even prior to that, when newspapers were experimenting with other services, such as Knight-Ridder's "news tablet" and Viewtron projects.

One of the first considerations of this experiment was how do people read and process online information. For the purposes of this experiment, since it focuses on news presentation modes, it seemed wise to target research dealing with multimedia information processing. For this kind of information, it was necessary to turn to the educational literature. In that sector, researchers have been evaluating the efficacy of multimedia as a classroom tool for a number of years. Since this project is using dual coding theory (DCT) as its guide, it was also necessary to look specifically at research that used DCT.

First, however, it is important to define what *multimedia* is. There are a number of definitions throughout many genres of research literature. Most seem to agree, however, that multimedia uses text, graphics, animation, pictures, video and sound to present information.²⁴² Some limit this definition to an attribute of microcomputers.²⁴³ Still others note this content presentation mode is not limited to one particular medium, such as computers, but instead represent the convergence of several different media.²⁴⁴ Perhaps the best definition for the purposes of this work is that it is the *integration* of audio, visual and text information that erases distinctions between media systems.²⁴⁵

²⁴² e.g., Najjar, Lawrence J. "Multimedia Information and Learning," Journal of Educational Multimedia and Hypermedia, 5, 1996: 129-150.

²⁴³ Barans Introduction, 493.

²⁴⁴ Wolfe, Mark R. "The Wired Lot: Lifestyle Innovation Diffusion and Industrial Networking in the Rise of San Francisco's Multimedia Gulch," Urban Affairs Review, May 1999: 707-728.

²⁴⁵ Straubhaar, Joseph and LaRose, Robert. "The Changing Communications Media Environment," Communications Media in the Information Society, Updated Edition, Belmont: Wadsworth. 1997: 20.

Thus, if media have converged within this channel to present a veritable rainbow of content types, will the audience's ability to process this information collectively match or even surpass its recall recorded from viewing/reading the individual media components within their native environments? Will newspaper recall be higher or lower than multimedia news recall? Similarly will broadcast news recall be higher or lower than multimedia news recall?

These are natural questions we ask of any new media, especially if previous historical patterns of media adoption by audiences hold true. Are so-called "new media" necessarily better than what we have now? In diffusion of innovation theory, this concept is known as *relative advantage*.²⁴⁶ How much improvement will this new thing offer over what we are now using? Clearly this is a question media firms must ask and answer before entering the Web with new media products.

Educational research has generated large numbers of studies detailing the benefits people believe can be derived from using multimedia to aid in learning.²⁴⁷ There is another old saw—unsupported by any research—bouncing around journals, speeches and lectures: "...people generally remember 10 percent of what they read, 20 percent of what they hear, 30 percent of what they see (and) 50 percent of what they hear and see...."²⁴⁸ All this folklore has

²⁴⁶ Rogers, Everett M. Diffusion of Innovations, New York: Free Press. 1995: 73.

²⁴⁷ Op. cit., Najjar. "Multimedia," 129; Bosco, J. "An Analysis of Interactive Video," Educational Technology, 25, 1986:7-16; Fletcher, D. "The Effectiveness and Cost of Interactive Videodisc Instruction," Machine-Mediated Learning, 3, 1989: 361-385; Rigny, J.W. and Lutz, K.A. "Effect of Graphic Analogies of Concepts in Chemistry on Learning and Attitude," Journal of Educational Psychology, 68, 1976: 305-311.

²⁴⁸ Treichler, D.G. "Are You Missing the Boat in Training Aid?" Film and A-V Communication, 1967: 14-16.

combined to give people a general sense that multimedia is desirable if message delivery is their goal.

But there is a fair amount of support for this feeling in the literature as well. Georgia State University educational researcher Lawrence Najjar cited meta-analyses that examined more than 200 studies comparing learning information presented in traditional classroom lectures to learning the same information from computer-based, multimedia instructions.²⁴⁹ Subjects ranged from K-12 and higher education students to people from industry and the military.²⁵⁰ Subject matter varied over a wide variety of topics including the sciences, electronic equipment operation and foreign language study.²⁵¹ Control groups usually learned in classrooms or via classroom lectures combined with hands-on experience.²⁵² Comparison groups usually learned information from interactive videodiscs or some other kind of computer-based instruction.²⁵³ Learning was most often measured using tests of achievement or performance.²⁵⁴ Over this wide range of students and topics, learning performance was greater when information was presented with computer-based multimedia systems.²⁵⁵ Other studies showed that learning using multimedia systems took less time than conventional learning methods.²⁵⁶

One of the reasons for this seems to be interactivity. Interactivity refers to situations in which real-time feedback is collected from receivers of messages

²⁴⁹ Najjar "Multimedia," 130.

²⁵⁰ Najjar "Multimedia," 130.

²⁵¹ Najjar "Multimedia," 130.

²⁵² Najjar "Multimedia," 130.

²⁵³ Najjar "Multimedia," 130.

²⁵⁴ Najjar "Multimedia," 130.

²⁵⁵ Najjar "Multimedia," 130.

and used by the source to continually modify the message sent back to the receiver.²⁵⁷ For example, where a user clicks a mouse on a screen determines what kind of feedback the Web site will send to the receiver. Clicking on different parts of the screen will elicit different responses. Because users must click their mouses, this kind of communication requires a measure of engagement and involvement in content that is, at least somewhat higher than someone who is merely reading a book and turning pages. Mouse clicks result in continued delivery of content. Contrast this to a classroom lecture, in which involvement does not result in continued feedback (the lecture will go on, whether or not the receiver is involved in taking notes or listening). By contrast, educational researchers view interactivity as mutual action between the learner, the learning system and the learning material.²⁵⁸ From their perspective, multimedia-based learning system success is due to the interactivity the learning tools deliver to the information.

Najjar also reviewed nearly 40 multimedia studies that pointed to a temporary, positive novelty effect on learning. When compared to traditional classroom lecture learning, improvements were higher for groups that used multimedia for four weeks or less but the learning advantage tailed off significantly after eight weeks.²⁵⁹

²⁵⁶ Najjar "Multimedia," 130.

²⁵⁷ Straubhaar *Communications*, 12.

²⁵⁸ Op. cit., Najjar "Multimedia," 131; Fowler, B.T. "The Effectiveness of Computer-Controlled Videodisc-Based Training," diss., University of Iowa, 1980.

²⁵⁹ Najjar "Multimedia," 132.

Perhaps more significant, as it relates to this work, is the meta-analysis of redundant multimedia and "monomedia."²⁶⁰ Redundant multimedia is defined as a learning system in which the same verbal information is presented using audio and printed text together; monomedia is a learning system that presents information within a single media mode, such as audio alone, or text alone. Research has shown redundant media improve learning when compared to monomedia presentations with older students but not with children. In fact, one study,²⁶¹ published in 1987, exposed college students to a series of voice-over news stories that varied in their amounts of audio and visual channel redundancy. The students' recall of both auditory and visual information was measured; the researchers found higher auditory recall and story understanding in a high redundancy condition. The reverse was true for visual information: recall was higher in low redundancy conditions. Clearly, this experiment and the previous paper show that recall is affected by redundancy and should therefore be avoided in any experiment whose goal is to compare the efficacy of various media presentation modes.

Nearly all the recall studies reviewed for this work analyzed the data collected for it using Analysis of Variance (ANOVA). ANOVA is used to test hypotheses about differences between two or more means.²⁶² When there are only two means to test, the T-test is used, but when there are more than two means, as in the case for this experiment, which features recall tests of four

²⁶⁰ Najjar "Multimedia," 133.

²⁶¹ Kenney "Memory and Comprehension of TV News Visuals," News Photographer, August 1992: 52-53.

treatments, repeated use of T-tests creates a marked increase in the possibility of a Type I error (in which a true null hypothesis might be incorrectly rejected).²⁶³ It is more preferable to use a within-subjects design and to test those results for significance.²⁶⁴ In this kind of design, each subject is tested at each level of the experiment. In this case, an individual level is defined as each one of the media presentation modes. Thus, each subject will read each of the stories that represent each of the levels of the experiment and each of their mean recall scores will be compared to other subjects'.

Reading and Publishing Online

People read text in a variety of ways:²⁶⁵

- linear - sequential reading - novels
- hierarchical - navigating, using a table of contents or tree
- structure - dictionary, reference materials
- reading reference texts using focused (e.g., keyword) retrieval - encyclopedias, indexes
- mixed reading with linear and nonlinear navigation - textbooks
- nonlinear browsing - jumping around different topics to form a chain of associations (path of ideas) - hypertext

²⁶² HyperStat Online. Lane, David M., "ANOVA," http://davidmlane.com/hyperstat/intro_ANOVA.html/>.

²⁶³ HyperStat Online. Lane, David M., "Type I and Type II Errors," <http://davidmlane.com/hyperstat/A18652.html>/>.

²⁶⁴ Lane "ANOVA."

²⁶⁵ Chignell, Mark H., and Valdez, J. Felix. "Methods for Assessing the Usage and Usability of Documentation," Third Conference on Quality in Documentation, Waterloo, Ont., 1993.

When people read the news, they use several of these reading behaviors. Whether on or offline, readers engage in some hierarchical reading. Online and traditional print media incorporate both tables of contents and sections to organize and package news in each edition. Those who use browsers practice focused retrieval with the find function (Ctrl-F, Apple-F) built into this software to search out news of interest within online news systems. Linked text also facilitates non-linear browsing.

The computing literature refers to reading behavior as *text navigation strategy*,²⁶⁶ conceiving it as a way in which people move their attention through a document. Computer interface researchers seem less concerned with learning outcomes and more concerned with reading process.²⁶⁷ They also differentiate between reading computer documentation and printed matter and frequently attempt to compare the two. The computer documentation most often studied in this realm of research is called *hypertext*. Hypertext is defined as "...documents [in which] the user can follow paths of links through text and graphics by selecting terms (anchors) marked by the author of the document in some way (i.e., underlining, using a different color for the word, etc)."²⁶⁸

²⁶⁶ Harrison, Susan M.. "A Comparison of Still, Animated, or Non-Illustrated Online Help with Written or Spoken Instructions in a Graphical User Interface," ACM Special Interest Group Computer-Human Interaction Conference, Denver, Colorado. 1995: 2.

²⁶⁷ e.g., Harrison, "Comparison"; Altman, Erik, Larkin, Jill H., and John, Bonnie E. "Display Navigation by an Expert Programmer: A Preliminary Model of Memory," ACM Special Interest Group, Computer-Human Interaction Conference, Denver, Colorado. May 1995; Furnas, George W., "Effective View Navigation, ACM Special Interest Group, Human-Computer Interaction Conference, Atlanta, Georgia. 1997.

²⁶⁸ Chignell, "Methods".

In the late 1980s and early 1990s, there was a large body of research comparing hypertext to printed documentation.²⁶⁹ Principally, these studies compared the "usability" of these two kinds of documentation. Usability studies attempt to determine how well and easily users can use programs and, in this case, documentation, in the manner in which its designers intended they be used.²⁷⁰ The findings of many of the studies in this era were contradictory and inconclusive in terms of awarding a clear advantage to either hypertext or printed documentation, especially when they created experiments with linear comparisons that used printed documentation as a control or objective standard in the experiment.²⁷¹ Yet when researchers compared the utility of hypertext online against similar characteristics of printed documentation, they were able to conclude that the best way to use hypertext was in ways in which its fullest capabilities could be used.²⁷² In other words, simply placing text online created no value or advantage over printed documents. Using links and anchors within text to encourage reader browsing and other non-linear reading behavior greatly added to the utility of online documentation.²⁷³

In this way, then, the value of the online material is enhanced because users can experience its full functional range with their computers. Text that does not

²⁶⁹ e.g., Monk, A.F., Walsh, P., and Dix, A.J. "A Comparison of Hypertext, Scrolling and Folding Mechanisms for Program Browsing," in Jones, D.M. and R. Winder, R., eds., People and Computers IV, London: Cambridge University Press. 1988: 421-435; Egan, D.E., Remde, J.R., Landauer, T.K., Lochbaum, C.C. and Gomez, L.M. "Behavioral Evaluation and Analysis of a Hypertext Browser," Proc. of CHI'89, Conference on Human Factors in Computing Systems, Association of Computing Machines, New York. 1989; Walker, J.H., Young, E., and Mannes, S. "A Case Study of Using a Manual Online," Machine Mediated Learning, February 1990.

²⁷⁰ Karat, John and Dayton, Tom. "Practical Education for Improving Software Usability," ACM Special Interest Group, Human-Computer Interaction Conference, Denver, Colorado. 1995.

²⁷¹ e.g., Harrison "Comparison," 9.

²⁷² Lomicka "Glossing," 10.

feature functions that require computers may just as well be published as printed documents. After all, a book can be easily placed next to a computer for ready reference and be just as handy as online documentation. It is the addition of computer-aided functionality—such as keyword searches, and task-sensitive links—that creates perceived value in online text applications.

There are a number of measures document designers consider when deciding if the material they wish to publish should be made available online or as printed documentation:²⁷⁴

- Does the value of the online information exceed the cost of putting it online?
- Does the information take advantage of the speed, storage and display capabilities of the online medium?
- Does it "communicate timely and critical information?"
- Is it an evolving document, one that is updated or reissued often?
- Does it contain inter-related information?
- Is it a large, searchable document?

Online news meets or exceeds all of these measures. News has one significant advantage over online documentation: it is generally accompanied by advertising. Since advertising's purpose is to offset the cost of printing, paper and delivery and to generate a profit, then publishing news on the Web that is

²⁷³ O'Hara "Reading," 9-15.

²⁷⁴ Horton, William. "What Should and Should Not Go Online," Designing & Writing Online Documentation: Help Files to Hypertext, New York: John Wiley & Sons. 1990: 16-23.

accompanied by advertising surpasses the first standard of exceeding the cost of putting it online.

News is a timely commodity, thereby satisfying the "timely and critical" standard. The speed with which online news can be made available and updated (satisfying yet another standard) to audiences adds a timeliness to news products that is not possible with other media. Some media firms are using the Web's full multimedia possibilities to create online news sites. Others, especially print enterprises have discovered an after-market for archived news, selling access to "old issues" via database access.²⁷⁵ Thus, the storage available via servers can be used very efficiently and the documents are searchable, thereby satisfying all the remaining standards for online use.

The timeliness and accessibility that having the news stored and available via the Web actually creates value for some users. Because this information is available on a 24-hour, seven day-a-week basis, and is constantly updated, the value it accrues because it is available online is much greater than it would as a printed product alone. Print products are not archive-able, not searchable, unless filed in filing cabinets and therefore, are not as valuable.

Computer and Media Attitude Testing

Certainly one aspect common to many research projects dealing with any kind of evaluation of computer use includes the use of computer attitude questions.

These questions are generally designed to discover if research subjects have any attitudes that might create artifacts within the data gathered in the experiment.

They are especially necessary when researchers use analysis of variance (ANOVA) to determine the accuracy of averaged data.²⁷⁶ Questions dealing with media preference and computer attitudes are crucial to identifying "error term." Error term refers to the differences each subject has with each other.²⁷⁷ In the case of this experiment, it refers to varying attitudes subjects have about computer use and media. Once identified, the ANOVA results can be tested against their presence to determine if these attitudes had a significant influence on the responses subjects made, as a group, to study questions.

As varying computer attitude categories were unearthed in research, researchers sought to test them for validity. There are a number of these studies in the literature today that define valid scales for testing computer attitudes, such as computer anxiety, computer confidence, computer liking and computer usefulness.²⁷⁸ Since this study will use undergraduate students from a major midwestern university, it is believed the relevance of these scales may have passed. More and more, undergraduates attending universities are well schooled in the use of computers and use them with the same skill they might a typewriter and view them as necessary to their education as notebooks, pens and pencils. Still, it would be foolhardy in the extreme to assume this would be true for all

²⁷⁵ 365-Day Archive. <<http://archives.nytimes.com/archives/>>.

²⁷⁶ HyperStat Online. Lane, David M., "Interaction," <<http://davidmlane.com/hyperstat/glossary.html>>.

²⁷⁷ HyperStat Online, Lane, David, "Within-Subjects," <<http://davidmlane.com/hyperstat/within-subjects.html>>.

²⁷⁸ Loyd, Brenda H. and Loyd, Douglas E. "The Reliability and Validity of an Instrument for the Assessment of Computer Attitudes," Educational and Psychological Measurement, 1985: 903-908; Loyd, Brenda H. and Gressard, Clarice. "The Effects of Sex, Age and Computer Experience on Computer Attitudes," AEDS Journal, 1984: 67-77; Loyd and Gressard. "Reliability and Factorial Validity of Computer Attitude Scales," Educational and Psychological Measurement, 1984: 501-505; Koslowsky, Meni, Lazar, Aryeh and Hoffman, Michael. "Validating an Attitude Toward Computer Scale," Educational and Psychological Measurement, 1988: 517-520.

students, especially those who come from more rural areas of the region, where computer use in classrooms is not as prevalent as it might be in larger, more urban school districts. For this reason, then, valid and reliable survey questions drawn from this genre of research were used to assess research subject computer attitudes.

Another area likely to create artifacts that might adversely affect the research's ability to discern advantages to various news presentation modes would be attitudes towards various media. Research has shown that various people have varying biases about certain media. Audience research has shown, for example, that fewer than 30 percent of 18-29 year-olds in this country read newspapers.²⁷⁹ A 1996 media-use survey of U.S. citizens showed nightly network news audiences had slipped to 42 percent of households—from 48 percent in 1995 and 60 percent in 1993—that regularly watched one of three of the nightly news broadcasts. Numbers were higher for local news content viewing (65 percent), but this segment was slipping, too (72 percent in 1995). Like newspaper circulation, radio news audience numbers have flattened recently (a little more than 40 percent).²⁸⁰

According to a recent study performed by Knowledge Networks/Statistical Research, "households with Internet access, and one or more PCs, are more likely to rent VHS tapes and DVDs, buy pay-per-view programming and pay \$50 or more per month for cable or satellite services."²⁸¹ While this data does not

²⁷⁹ Barans Introduction, 116.

²⁸⁰ Pew Research Center for the People and the Press. "Falloff Greater for Young Adults and Computer Users: TV News Viewership Declines," 1996. <<http://www.people-press.org/mediarpt.htm>>.

²⁸¹ Nua Internet Surveys. "Net and TV Are Not Mutually Exclusive," Dec. 2001.

speak to media credibility, it does speak to media preference. Stating a specific preference for one media over another speaks to the potential existence of media bias. Certainly a study that would compare various media presentations might very well cause people to evaluate or consume different kinds of media content with varying attention or even dispensation, based on personal biases. This, too, had the possibility of creating error term, making it necessary to ascertain its existence with a number of questions dealing with media preference.

Thus, the two error terms this experiment elected to control for were media bias and computer attitudes.

Recall and the News

Dual coding research has discovered what it refers to as a lag phenomenon.²⁸² When subjects are presented with repetitive memory items, recall is better with more items between the two repetitive items than it is when the items are presented successively.

This lag phenomenon was once identified but then mislabeled in mass media research in a study on news audience recall literature. A researcher performed a study testing audience recall of television news, in which he incorrectly rejected dual coding theory in favor of a single-coding hypothesis.²⁸³ The reason, it seems, is that both he and his reviewers were unaware of the lag

<<http://www.nua.ie/surveys/>>.

²⁸² Paivio, Allan, "Episodic Memory," *Mental Representations: A Dual Coding Approach*, New York. Oxford University Press. 1990: 161; Paivio, Allan, "Dual Coding Theory: Retrospect and Current Status," *Canadian Journal of Psychology*, 45, 1991: 265.

²⁸³ Grimes, Tom, "Encoding TV News Messages into Memory," *Journalism Quarterly*, 67.4, Winter

phenomenon discovered in dual coding theory research. His experiment showed how words are remembered as pictures and pictures are remembered as words, which is consistent with referential processing. He called this a "translation phenomenon," but noted that it was more likely to occur 48 hours after viewing a news story than immediately, which also supports the lag phenomenon reported above and not a single-coding hypothesis that suggests all messages are stored the same in memory.

As seen above, there is evidence of limited usage of dual coding theory in mass media study. One reason might be that it is simply overlooked. Another reason might be that, thus far, researchers have merely been concerned with the end results—what actual recall was and how it compared to that for material in other media—and less so with how it is stored in memory. Because publishers are now placing news products on the World Wide Web, researchers must now concern themselves with discovering if visual communication design principles that effectively communicate news in the print and broadcast media will be able to do the same thing within the computer medium or if new design principles are needed.

First, though a few words that deal with the difference between recall and recognition would be in order. News recognition is a person's simple acknowledgement, when presented with a basic description of a news story, that they read or heard about the event or topic. By contrast, news recall is a person's ability to remember, when cued, the details of a particular story.²⁸⁴

1990:757-766; Kenney "Memory," 52-53.

²⁸⁴ Price, Vincent, and Czilli, Edward J. "Modeling Patterns of News Recognition and Recall, Journal of

In an experiment in which fragments of drawings were used to help subjects recreate drawings from memory, researchers effectively demonstrated how components could be used to aid in recall of the whole.²⁸⁵ While it must be granted this experiment dealt with imagery components, any subject will also engage in referential processing in cued recall tasks. Retrieval from memory, according to DCT, assumes that in either cued recall or recognition tasks, a similarity match must be constructed between the evoked cue and the memory trace.²⁸⁶ Therefore, questions created for the purpose of discerning subjects' news recall of recently read items should be derived as directly as possible from the text. This suggests that access to the correct answer by means of cued recall or recognition is probabilistic because the memory trace that is activated by the stimulus may or may not be the one that might satisfy the condition of correctness. Therefore, it behooves researchers to assure cues are as direct as possible toward the required response. Accurate retrieval depends, to some extent on associative factors, but more so on the similarity between the encoding pattern that occurs when the event transpires and the retrieval cue offered when a correct response sought.

Some news is so inherently memorable that care must be made to assure it does not skew the results of this proposed study. For this reason, when selecting stories to be used for study, researchers should err to the cautious by selecting follow-up news items instead of breaking news. In addition, it shows the

Communication, Spring 1996: 55-78.

²⁸⁵ Bower, G.H., and Glass, A.L. "Structural Units and Redintegrative Power of Picture Fragments," Journal of Experimental Psychology: Human Learning and Memory, 2, 456-466.

²⁸⁶ Paivio Mental, 146.

need for complementary visual information accompanying text and the dangers of what might happen if it is too independent of supporting text.

The first example speaking to the need for care in visual selection is a study that used dual coding theory to determine the role of verbal imagery in recall of deviant news.²⁸⁷ The author defined deviant news as news stories that were "schema-incongruent of events that are unexpected."²⁸⁸ Schemas are knowledge structures based on abstractions or generalizations of our perception of the world around us. We use these structures to evaluate new information. Parts of these are our expectations of people and how things happen. Deviant news, then, is news that violates expectations.²⁸⁹

A test of referential interconnection—the ability of words to evoke pictures—the study sought to discover the power of the printed word. By singling out deviant news and the powerful imagistic language that seems to go hand-in-hand with these kinds of stories, the researcher tested reader recall of deviant versus non-deviant news leads. But in doing so, the author recognized that deviance itself might certainly affect recall, as would the degree of deviance within various stories. To this end, he created two story categories that juxtaposed imagery and deviance: high deviance/low imagery and low deviance/high imagery.²⁹⁰ The advantage to using dual coding theory is that it predicts a main effect only for imagery (both verbal and non-verbal) but not for

²⁸⁷ David, Prabu. "Role of Imagery in Recall of Deviant News," Journalism & Mass Communication Quarterly, 73.4, Winter 1996: 804-820.

²⁸⁸ David, "Deviant," 807.

²⁸⁹ An example of a story that runs counter to expectations is the cliched example journalism educators use to teach news values, "Man Bites Dog."

²⁹⁰ Elsewhere in this article (805), the author alluded to the possibility that imagery may explain why "concrete, event-driven articles have better appeal than abstract, issue-driven articles."

deviance, something born out by this study.²⁹¹ Yet it is also interesting to note that this research did not compare visual imagery to text, thus it did not test the additive nature of pictures for recall. Subjects read only lead paragraphs of news stories, which suggests the possibility of an additive recall effect for highly imagistic language.

Effects of content and illustration

Paivio stated picture superiority over verbal systems under dual coding theory is so sound that it is an "empirical generalization."²⁹² There is also evidence that audiences gain more information from positive visual material than from negative visual material. Extremely negative visuals, such as those that depict excessive violence, are believed to disturb viewers so greatly that they can be distracted from verbal messages.²⁹³ In a 1992 study on the effects of negative TV news images on memory, researchers found that intense, vivid images inhibited encoding of visual and verbal information presented prior to it.²⁹⁴ For this reason then, video used in this experiment was carefully chosen to assure it was neither too vivid nor intense that its presence would affect normal recall rates. Narrative that preceded the image presentation was also not remembered as well as voice-over was.²⁹⁵ To avoid this pitfall, film used in the experiment has voice-overs that were complementary to the information presented in the video and not redundant to it.

Personalization...is another technique to make the story more concrete."

²⁹¹ David "Deviant," 818.

²⁹² Paivio "Retrospect," 266.

²⁹³ Robinson, John P. and Levy, Mark R. The Main Source: Learning From Television News, Beverly Hills: Sage. 1986.

²⁹⁴ Scott, Randall K. and Goff, David H., "How Excitation from Prior Programming Affects Television News Recall," Journalism Quarterly, 69.4, 1992, 615-620.

Yet there are still some bothersome questions about certain media, especially in terms of what constitutes verbal and what constitutes images in television. There is quite a bit of variability in the research literature. How can researchers categorize spoken words on television as verbal and film footage as visual? Since the audience is processing all information from television news within a visual channel, isn't the kind of processing that is going on here more likely associative processing of images? Yet a case can be made that film-footage stories may be categorized as non-verbal, while news narratives can be counted as verbal because the TV anchor presented this information in narrative form, unaccompanied by graphic or visual illustration. This kind of story is presented in verbal fashion. Secondly, there is empirical evidence of a picture superiority effect between these two kinds of stories. In a study reported in 1991, audience news comprehension was shown to be at its lowest when the entire newscast consisted of verbal news narratives delivered by TV anchors. It improved when newscasts consisted entirely of stories accompanied by film and was best when film-footage stories were alternated with news narratives.²⁹⁶ From a dual coding perspective, then, this study suggests that in the broadcast media, at least, broadcast information that allows for referential processing will aid recall greater than associative processing alone. Still, for the purposes of this study, a traditional dual coding perspective of what is imagery and what is verbal information will be adopted.

²⁹⁵ Price and Czilli "Modeling," 55-78.

²⁹⁶ Brosius, Hans-Bernd. "Format Effects on Comprehension of Television News," *Journalism Quarterly*, 68.1, Fall 1991:396-401.

There is also evidence to suggest care should be taken to select visual information that complements text information rather than visual information that independently adds information not covered in the accompanying text.²⁹⁷ The study showed that while graphics enhanced reader recall of information about the geological makeup of both the San Francisco Bay and the Los Angeles areas, they detracted from reader recall of information available only from the text. This study also suggests that unless the text prompts some measure of associative processing and non-verbal information is unable to create referential processing, then the only processing possible is representational. Therefore, this study reinforces the notion of the *additive effect* of picture superiority in dual coding theory by showing what kind of processing occurs in the absence of additive visual material.

It is well known in the industry that certain kinds of stories create more interest than others. Researchers have looked at this and have confirmed the findings: news based on domestic issues is far more likely to be recalled better than international news.²⁹⁸ Vivid visual components and localized stories are also better recalled than others.²⁹⁹ In addition, others credit various media certain advantages over the rest. Some mass media researchers believe television has

²⁹⁷ Ramparasad, J. "Information Graphics in Newspapers," Newspaper Research Journal, 12.4, 1991:92-103.

²⁹⁸ Pew Research Center for the People & the Press. "Muted and Mixed Public Response to Peace in Kosovo," 1999. <<http://www.people-press.org/>>.

²⁹⁹ Graber, Doris A. "Seeing is Remembering: How Visuals Contribute to Learning in Television News," Journal of Communications, 40.3, 1990: 134-155; Gunter, Barrie. Poor Reception: Misunderstanding and Forgetting Broadcast News, Hillsdale: Erlbaum. 1987; op. cit: Price and Czilli, p. 58.

a greater hold over audiences who have lower cognitive ability or lack strong interest in the news.³⁰⁰

Visual processing

In January 2000, a pair of communication researchers from the Netherlands used a dual coding perspective to examine why it seemed children derived more information from television news than from print news.³⁰¹ They tested 192, 4th-through 6th-graders abilities to recall news from television news stories, a text-only version of the same stories, a print form supplemented with a photo and an audio version. The results of this experiment were consistent with dual coding theory—that recall was greatest for television news. TV's superior recall, the researchers noted, occurred when verbal information was supplemented with redundant television images. TV stories were also recalled better than audio and text-only versions and printed versions accompanied by photos.³⁰² These results, when considered within a dual coding theory framework, are consistent with the theory. However, this study attempts to make the point that the television superiority recall effect is due to redundant images. This distinction is made based on early DCT research that showed subjects paired pictures and letter combinations. But it fails to account for more recent DCT research, which notes that image information is nested.³⁰³ When we invoke a visual information memory, it recalls visual information sequentially to build a whole. For this

³⁰⁰ Neuman, W. Russell, Just Marion, R., and Crigler, Ann. N. Common Knowledge: News and the Construction of Political Meaning, Chicago: University of Chicago Press, 1992.

³⁰¹ Walma van der Molen, Juliette H. and van der Voort, Tom H.A., "The Impact of Television, Print and Audio on Children's Recall of the News: A Study of Three Alternative Explanations for the Dual Coding Hypothesis," Human Communication Research, 26.1, January 2000: 3-26.

³⁰² Walma van der Molen "Impact," 21.

³⁰³ Paivio, "Mental," 38-39.

reason, then, complementary visual and verbal information, when presented together as part of a whole, are, in effect, a nested object, which is also consistent with DCT theory.

Dual coding theory was first postulated in the early 1970s, a little more than a decade before computers had diffused to the consumer market. Once personal computers entered the market, the educational community quite naturally embraced them as a useful learning tool. Thus, educational researchers began to apply dual coding theory to this new channel. Indeed, a parallel development was occurring in journalism. In the personal computer's early days, it was used to create the news, but by the late 1980s, media pundits began to foresee it as a delivery channel.

As early as 1992, research was being published that pointed to the potential for the Web as an innovative news channel. One such study compared news recall based on presentations by newspapers, television, radio and computer screens; it featured a large diverse sample of university students drawn from three U.S. higher education institutions.³⁰⁴ Subjects were able to recall news from presentations read in newspapers and computers at much higher levels than from broadcasts in two electronic media.

One point educators seem to know about intuitively is that younger audiences process information far better in the visual modality than they do in text or verbal ones. Fortunately, as we grow older, we seem to develop complementary skills in assessing verbal symbolism.³⁰⁵ The educational

³⁰⁴ DeFleur, 1010-1022.

³⁰⁵ Simpson, Timothy J., "Message into the Medium: An Extension of Dual Coding Hypothesis," Proc.

literature speaks to the value of combining verbal and visual stimuli to assure the most effective transfer of information.³⁰⁶ Thus, we see the educational community looks to referential processing as the place to go for the best learning experiences.

Indeed, Paivio points out in his literature describing referential processing that when we are confronted with a visual image alone (imagens), our minds call up a word to describe it.³⁰⁷ Similarly, when we are confronted with verbal or textual information alone (logogens) we conjure a mental image from our memory.³⁰⁸ Thus we see a case being made in both the theoretical and educational literature for the necessity of using complementary imagens and logogens together to deliver messages to the audience. Educators suggest using imagens to convey "striking" information, while reserving logogens for presentations that describe impact, that describe logical progressions or even persuasive messages.³⁰⁹ These are principles that precisely track the goals of photojournalism, electronic news photography and taped interviews in radio journalism, which strengthens the case for use of DCT in this proposed research.

Educational researchers are also using DCT to study hypermedia.³¹⁰ One reason is because of the multiple modalities DCT explains that people use to create mental images in memory. Because people use multiple modalities, the

of International Visual Literacy Association, 12-16 October 1994:255-263.

³⁰⁶ Op. cit., Simpson, "Message,"; Mayer, R.E., and Anderson, R.B. "Animations Need Narration: An Experimental Test of Dual Coding Hypothesis," Journal of Educational Psychology, 83, 1991: 484-490; Mayer, R.E., and Anderson, R.B. "The Instructive Animation: Helping Students Build Connections Between Words and Pictures in Multimedia Learning," Journal of Educational Psychology, 84, 1992: 444-452.

³⁰⁷ Paivio "Mental," 62-63.

³⁰⁸ Paivio "Mental," 62-63.

³⁰⁹ Simpson "Medium," 259.

literature says, the multiple presentations hypermedia uses to present information will only enhance learning. Additionally, since people personalize information with imagens and logogens drawn from their own memories, this, too, will enhance learning, according to DCT.³¹¹ Additionally, presentation of information within multiple modalities will certainly facilitate associative processing.

Research Questions

The experimental portion of this dissertation will suggest a means to test the referential processing functions of memory that, according to DCT, occur as people process imagens and logogens. The larger question deals with whether or not the superior effect of pictures will enhance recall of information of both verbal and non-verbal information in news stories. More specific questions will deal with superiority of recall of among various text and text and visual presentations.

As should be the case, the literature will drive the formation of the questions to be answered in the experimental portion of this work. Thus, there are four questions posed for discovery in the experiment. The first of these will test the picture superiority effect DCT research has reported within its experimental literature, that the addition of images to text in any presentation aids in memory creating more concrete images of those presentations:

³¹⁰ Najjar "Multimedia," 134.

³¹¹ Borsook, Terry K., and Higgenbotham-Wheat, Nancy. "A Psychology of Hypermedia: A Conceptual Framework for R&D," Association for Educational Communications and Technology annual meeting, 5-9 Feb. 1992:13-14.

H₁: Subject recall scores for news accompanied by visual presentations will be higher than news without accompanying visual presentations, or:

$$\mathbf{H_1: } M_v > M_t$$

The null hypothesis for this is the difference between the mean scores collected in the recall tests for articles accompanied by visual presentation will be less than or equal to those for articles without visual presentations, or:

$$\mathbf{H_1: } M_v = M_t$$

The second hypothesis speaks to the differences between each of the proposed visual presentation mode. These include text with still photos, text accompanied by complementary (as opposed to redundant) multimedia video or text accompanied by complementary multimedia audio and video content:

H₂: Recall of online news stories consisting of text accompanied by still photographs will be higher than those consisting of text alone, or:

$$\mathbf{H_2: } M_t < M_p$$

The alternative hypothesis for H₂ is:

$$\mathbf{H_2: } M_t > M_p$$

H₃: Recall of online stories consisting of text accompanied by streamed (multimedia) video will be higher than both stories accompanied by still photography or stories consisting of text alone or:

$$\mathbf{H_3: } M_t < M_v \text{ and } M_p < M_v$$

The alternative hypotheses for H₃ are:

$$\mathbf{H_3: } M_t > M_v \text{ and } M_p > M_v$$

H₄: Recall of online stories consisting of text accompanied by streamed multimedia video will be higher than stories accompanied by still photography, streamed video or stories consisting of text alone, or:

$$\mathbf{H_4: } M_{vma} > M_{mv} \text{ and } M_{vma} > M_p \text{ and } M_{vma} > M_t$$

The alternative hypotheses for H₄ are:

$$\mathbf{H_4: } M_{mva} \leq M_{mv} \text{ and } M_{mva} \leq M_p \text{ and } M_{mva} \leq M_t$$

This last hypothesis suggests a linear increase in recall scores with the lowest recall being expected from text alone, and the highest recall being expected with the multimedia-intensive mode of text, video and embedded audio. Thus, the text alone score is expected to be lower than the recall scores of all other presentation modes. The text with photo recall score is expected to be higher than the recall scores of text alone, but lower than those achieved by the

stories accompanied by multimedia video and multimedia video and embedded audio. Similarly, the text and multimedia video mode recall scores are expected to be lower than the text and multimedia video and embedded audio mode recall scores. Lastly, the text and multimedia video and embedded audio mode recall scores are expected to be the highest recall scores collected in this experiment.

Conclusions

All the elements are in place to support multimedia news sites. There are a plethora of new access channels available; there are enough Internet-ready, low-cost computers available that the time is right for a new mass audience to emerge, equipped with the necessary tools to access it; streaming has come to the fore as an interim multimedia technology that will put audio and video into the hands of even those whose only access is a dialup connection; and Internet 2 promises sufficient innovation to diminish the negative effects of multimedia access that lacks the bandwidth to handle it.³¹²

With so many online news media sites now on the Web, clearly, the time has passed to ask whether news should be offered on the Web. Instead, the more pertinent question is, how should news be presented on the Web. The experiment detailed in the following pages looks closely at that question with an eye toward recall. What is the best way to present news on the Web, if recall of the news is the goal?

No research has looked at news media in a native environment. That is, what little research has been done on this question has mimicked online news

³¹² CNN Sci-Tech. Kellan, Ann, "Internet 2 Holds Promise of Technological Leap," 24 Feb. 1999. <<http://www.cnn.com/TECH/computing/9902/24/internet2/>>.

venues. This is not a limitation of the researchers and their research; rather, it is a limitation imposed by the absence of a large number of multimedia news sites and the desire by their managers to present news that is not produced solely by the parent firm. Thus, radio stations create so-called Web-radio sites that produce audio output alone;³¹³ TV stations create so-called Web-TV sites that produce multimedia video output alone;³¹⁴ and print media firms produce so-called online newspapers that produce print, photo and graphical illustrations alone.³¹⁵

This research project will look at how well multimedia information serves audiences when presented on the same site together. However, Instead of looking at how the synergy of all four presentation modes work together, this project takes the logical first step of evaluating the component presentation modes' individual abilities to engender news recall by measuring it and applying a traditional quantitative means (supported by the literature) of evaluating that in the form of analysis of variance.

There have been a great deal of studies looking at computer-based classroom teaching tools that compare classroom performance of those taught using conventional methods versus those taught using computer-based tools. As presented above, computer-based teaching methodologies provide a clear advantage to those taught with computer-based tools. Based on these results, it

³¹³ e.g., Netradio.com. 2001. <<http://www.netradio.com/>>.

³¹⁴ e.g., ABCNews.com. 2001.
<http://www.abcnews.go.com/sections/us/video_index/video_index.html>.

³¹⁵ e.g., LansingStateJournal.com. 2001. <<http://www.lansingstatejournal.com/>>.

might easily be surmised that news recall might be improved when viewed as computer media compared to more traditional, offline news products.

Reading and navigation research points to the less memor- intensive nature of the news reading task. In addition, research has shown reading comprehension on computers is similar, if not better, than reading text-based documents. More recent research shows a clear recall advantage for visual presentation of the news, as long as the material is redundant. But what if the material presented in the news site is not redundant, but is complementary? That is another unique question this research will address. Will news recall be higher for visual information, as current research with redundant material shows, and as dual coding theory also suggests? Or will it be lower, as some attention theory-based research suggests?

Lastly, it is important to consider the theoretical perspective this project proposes to create. If we believe that theories are indeed the roadmaps by which we plot the results of our research, then it is important to identify theories that will serve both traditional and evolving media formats.

Chapter 3

METHODS

This study will assess the values of various ways to deliver online news content. It will compare average recall rates of news items that are text-only, text accompanied by a single still photograph, text accompanied by a single digitized video segment and text accompanied by embedded audio and a single, digitized video segment. Using dual coding theory as a guide, it was hypothesized the highest recall rates would be generated by those multimedia presentation modes that used a combination of text and images to deliver the message.

The study portion of this dissertation was constructed along traditional methodological lines already used by previous studies in the dual coding theory experimental literature. Subject pool size, experimental structure and data analyses tracked experiments conducted over the nearly 20-year history of this theory's existence.

Sample

Subjects who participated in this study were undergraduate students, aged 18-25, recruited from a mass media and society lecture class at Michigan State University. They were each offered extra credit toward their class grades for participating in the study. An estimate of required sample size was computed, using the following formula:

FIGURE 2: Estimate of Required Sample Size Formula

$$n = \left[\frac{T\alpha \text{ } Sd}{\text{projected difference}} \right] + K$$

In this computation, which is derived from hypothesis testing, n is the required sample size for the Analysis of Variance (ANOVA), the statistical procedure used to analyze the data collected in this study. Researchers use significance to test hypotheses to see if the same results would occur if a different approach were used to seek the same results. $T\alpha$ (or T-alpha) is the significance level of the test, which in this case is 0.05 (5%). "In the research literature, results of statistical tests are usually reported using the p-value. The p-value provides an objective measure of the strength of evidence, which the data supplies in favor of the null hypothesis. It is the probability of getting a result as extreme or more extreme than the one observed if the proposed null hypothesis is correct."³¹⁶ Smaller p-values suggest the null hypothesis is incorrect. Sd is the standard deviation, which in this case, was set to .25. Sd was set to .25 as a conservative standard deviation unit. One standard deviation unit away from the mean within a normal curve represents 68 percent of the population. The literature predicted mean recall scores to occur within a relatively narrow range of 40 to 55 percent. It was for this reason this conservative standard deviation was used. The *projected difference* was derived from the literature, which ranged from five to eight percent. K is the number of confounders identified. Similar to

³¹⁶ Hyperstat Online. "Logic of Hypothesis Testing," Lane, David M. 2002.

the projected difference, potential confounders were derived from the literature. In the end, 105 subjects were recruited and 95 actually completed the study.

Research instrument

Subjects accessed Web pages designed to mimic the look and feel of an online news site. Originally designed to appear as if it were a local online newspaper, it was named the *Lansing Eagle* (See Appendix C for a sample page template). The design of the instrument was based on a survey of Web designs of 160 randomly selected U.S. online newspaper sites, which at the time³¹⁷ represented approximately 10 percent of all online newspapers on the Web. First, the survey determined if sites had an index (a table of contents) and if they did, how and in what position on the page they displayed it. Nearly all those analyzed—98 percent—displayed their site index in a banner device somewhere on the page. The remaining two percent simply listed their contents within a column.

The *Lansing Eagle* featured a banner identifying the publication across the top. It used a three-column format, featuring non-functional editorial and advertising links on the outer columns and news copy in the middle column. This design was consistent with approximately 68 percent of the existing online news sites of the time, as determined by the design survey (See Appendix B for the tabulated results of this survey).

Stories appeared in each of the four proposed formats or levels—text alone (T), text and a still photograph (T + PH), text accompanied by a multimedia video

<http://davidmlane.com/hyperstat/>).

³¹⁷The survey of online news site designs was conducted during the summer of 1998.

clip embedded within the story (T + V) and text with both embedded multimedia video and embedded audio (T + V + A). Again, this range of presentation modes represented the full range of available content delivery modes being used on the Web at the time.

News copy and still photography used in the study were taken from both the *New York Times* and *Washington Post* online news sites, while television news stories were collected from CNN News daily broadcasts. Three TV news segments were first taped, using a VCR, from a cable television broadcast, then converted to computer files using Apple Macintosh computers. Two of the segments were then converted into QuickTime movie formats, using QuickTime Pro. The third film segment was used to create the embedded audio soundtrack. The segment used for this piece was a short clip featuring a taped interview between a reporter and a seated man. The sound track from this clip was saved into a .wav file, using SoundEdit then compressed into an audio digital file, using Adobe Premiere.

Delivering all this multimedia material through a single campus network, via the World Wide Web, to even 18 subjects at a time (the limitation imposed by seating in each of the computer labs used for the experiment), would have been more than any network of the day could sustain. The bandwidth required would have taxed the small lab, which, at the time, used the Appleshare network protocol. Thus it was necessary to store all the Web documents, the Java scripts, QuickTime Movies, the Web pages, the still photography, the text and the .wav files locally, within a single file, on each individual computer desktop used in the

study. Stored locally, file access did not move through networks and create slowdowns. Instead, subjects could view news material at speeds they might normally experience when viewing online news as individuals.

Computers subjects used to view the news material were PowerPCs, each equipped with multimedia capabilities and hypertext browsers, QuickTime Movie Players and headphones. Subjects used headphones to listen to sound from the experiment's news material because subject matter presentation was randomized with a Java script.³¹⁸ Thus, subjects sitting next to each other but listening to multimedia content from different articles would be less likely to be disturbed by messages from other, different articles being listened to at neighboring stations. In addition, subjects used headphones because researchers hoped to create an optimal online news reading experience by eliminating as much competing noise from the lab environment as possible.

As mentioned earlier, the online news articles were presented to subjects in four different viewing orders, randomized at its particular station by a Java script embedded in the Web sites and stored on each computer's desktop along with the HTML code for the Web page. This script caused the computer to present the four news story pages of the *Lansing Eagle* in random order to each viewer. This practice is called counterbalancing and was done to avoid confounding the variables. Confounding occurs when variables vary together in such a way that it becomes impossible to determine which variable is responsible

³¹⁸ My former student, Andrew Kurtz, then a designer employed by Michigan State University's Communication Technology Laboratory, East Lansing, Michigan, graciously provided coding for this Java script.

for an observed effect.³¹⁹ In this case, if every subject viewed the multimedia news stories in the same order, the presentation mode and the viewing order would be confounded. There would be no way to know if the various presentation modes cause recall to be higher or lower, or if it was simply the most recently read/viewed mode that was remembered best. Counterbalancing—randomly varying the order in which subjects view the pages of the Web site—was used to reduce the risk that the order of presentation of the material might influence how well or poorly subjects recalled information they processed from articles.

Viewing the news

Subjects were asked to refrain from reading, listening or viewing any news for 48 hours prior to their participation in this experiment. This action attempted to minimize their familiarity with the day's news events and the possibility that this familiarity might skew the experiment's results. Subjects were then scheduled into seven groups of approximately 16 subjects each to view all four levels of news presentation modes.

When subjects sat down at each individual computer station, they were confronted by a white computer screen with a single line of text, asking them to wait for instructions before mouse-clicking on the link that provided them access to the online news site. Subjects were not told, prior to the experiment, that the questions they would be asked would be about the stories. Rather, they were instructed to read the news material as they normally would any material on the Web. The goal here was for subjects to pay the normal amount of attention they paid when viewing material on the Web. The strategy worked for most subjects.

³¹⁹ Lane, "Counterbalancing."

A number of subjects noted in the verbal comment section at the end of the questionnaire that their recall scores might have been higher had they been informed of the questions they would be asked.

Once subjects clicked on the link to the news site, they were presented with what appeared to them to be the first page of the site. In fact, they were each confronted with one of the four pages presented in random order. Stories appeared within a form that featured the site's banner across the top of each page, with news story and advertising banners along both sides of each page. According to instructions they received prior to accessing the news on the site, subjects read through each of the four Web pages then stopped when confronted with the white page with the single line of text. Then they filled out a questionnaire that asked a number of questions dealing with the facts of the story as well as a number that attempted to identify potential interaction effects. Questions were carefully worded so that their complexity was similar from one question to another. In general, their length was limited to one of below 30 words. Each was cast in an interrogative form and addressed itself directly to facts contained within single sentences or single graphical or audio items within each story.

Once subjects finished filling out the questionnaire, they were excused. Each new group of subjects entered the labs and chose lab stations only after the previous group had left the room. This reduced the possibility of subjects sharing information about the experiment with those about to enter the lab to participate.

It should also be pointed out at this time that a conscious decision was made to assure the various multimedia portions of the article were, in no way, repetitive or redundant with the text or other multimedia components of the same story. With stories constructed so that redundancy did not exist, it freed the researcher to be able to test the efficacy of each presentation mode with little fear that the recall response might be skewed by the presence of redundant material.

Recall questionnaire

Questionnaires' first sheet consisted of a consent form required by Michigan State University's Human Subjects Committee. In it, subjects were informed they were being asked to "participate in a study that deals with how people process news information from Web sites." They were also informed that their participation in this study would net them some extra credit in their TC 100, Introduction to Mass Media class and were reminded they had agreed not to read newspapers nor listen to radio or TV newscasts for 48 hours prior to the study. The remainder of the consent form was filled with boilerplate language provided by the university assuring them their participation in the study was voluntary and all individual responses would be kept private. Lastly, the consent form asked that subjects confirm that they were aged 18 years or older.

The questionnaire was subdivided into two sections (See Appendix A for a sample questionnaire copy). The first section consisted of 20 short-answer, objective, close-ended questions dealing with the facts of each story; four to six questions each dealt with content on a story-by-story basis. It was reasoned that

questions should be grouped according to the stories, rather than be randomized because dual coding theory specifies that text information is stored sequentially and image information is stored in a nested fashion. Whether remembered data from the stories was either imaginal or textual or both, the goal of the study was to determine if subjects retained information. Thus it was essential to test subjects in a fashion that would parallel their memory structure.

Care was taken to assure that each question dealt specifically with information that was wholly contained within a single story element. For example, there was a particular question that dealt with a filmed segment about how some stolen money was used. There was also another question about the same story, dealing specifically with the substance of an audio interview.

The second section of questions consisted of 20 questions aimed at eliciting demographic and attitudinal information that might create interaction effects within the data analysis. Interaction occurs when the effect of one independent variable differs because of the level of the other variable or if the combination of the variables leads to unanticipated results.³²⁰

Question 1 asked subjects to specify if they were male or female. At the time this study was performed in late 1997, use of online venues was a male-dominated activity. It wasn't until several years later that those numbers began to approximate real population norms. Question 2 asked subjects to stipulate their race. The idea here was to cross match responses against ethnic backgrounds to see if any behaviors were peculiar to particular ethnic backgrounds. Questions 3 and 4 asked if subjects' primary language was English or if they had any trouble

reading the English language. Since all articles, film and audio were done in English, it would be important to determine which subjects might have had difficulty with reading and understanding the material. Questions 5-7 probed subjects about any other physical disability (hearing, sight, learning disability) that might interfere with their reading, listening, watching or understanding the material. Question 8 asked if there was any "particular problem" with completing the experiment. This question was asked in an attempt to detect any unforeseen problems with either the research instrument or the questionnaire.

Questions 9-15 attempted to discern negative or positive attitudes subject may have held about the use of computers in general. At the time the research was conducted, there were a number of studies that showed the presence of negative attitudes about computers that might skew the results of studies that involved computer use.³²¹ Presented as Lickert scale questions, the queries were selected, based on their reliability scores, from a number of articles that listed various attitudinal checks on computer use among various demographic groups.³²²

The last five questions on the questionnaire were designed by the researcher to determine if subjects held any biases for or against various media. Four questions presented subjects with a Likert scale asking them if they

³²⁰ Lane, "Interaction."

³²¹ e.g., Loyd, Brenda H. and Loyd, Douglas E. "The Reliability and Validity of an Instrument for the Assessment of Computer Attitudes," Educational and Psychological Measurement, 45, 1985: 903-908.

³²² Loyd, "Reliability, 903-908; Loyd, Brenda H. and Gressard, Clarice. "The Effects of Sex, Age and Computer Experience on Computer Attitudes," AEDS Journal, 17, 1984: 67-77; Loyd and Gressard. "Reliability and Factorial Validity of Computer Attitude Scales," Educational and Psychological Measurement, 44, 1984: 501-505; Koslowsky, Meni, Lazar, Aryeh and Hoffman, Michael. "Validating an Attitude Toward Computer Scale," Educational and Psychological Measurement, 48,

considered each kind of media trustworthy or untrustworthy. The fifth question asked from which medium did they get most of their news: print media, radio, TV or the Internet.

Consideration was also given as to whether to administer the questionnaire online or not. It was decided to eschew an online questionnaire since most students of the day were accustomed to taking exams and quizzes that were paper-based. The goal of this particular portion of the experiment was to have subjects focus on recalling the information in the Web site and to not allow things like interactivity and novelty interfere or improve that memory process. Granted, interactivity and novelty certainly played a role in the subjects' reading of the new content; but in choosing a traditional means to test recall, the possibility of the results being tainted by the novelty or interactivity of the testing instrument were eliminated so that results of that effect might be linked directly back to the Web media and not the testing instrument.

Data analysis

The model for this study is as follows:

$$\text{Recall} = f(\text{modes, demographics, confounders}) - \text{error}$$

Recall was measured by an objective test that determined the amount of information remembered from the various articles. It is a function of the text and images presented in each presentation mode and the subjects' minds' abilities or inabilities to process what they read into short-term memory. The modes in this model include a text-only article, an article accompanied by a single photo, and

article accompanied by a single news video and an article accompanied by a single news video and an embedded audio track.

Data collected in this study was analyzed using Analysis of Variance (ANOVA), according to a within-subjects design. Simply put, each subject was exposed to each of the four presentation modes. The reason for this design is that subjects are inevitably different from each other. Some might have been better readers than others are or some might have been better acclimated to the use of computers than others. In statistical analysis, all differences among subjects' scores that cannot be explained by the experimental treatment are said to be "error," though some scholars say it would be more accurately defined as "unexplained variation."³²³ It is not error, in the traditional sense that it is due to some kind of mistake. Rather, within this kind of experimental design, error is used to explain whatever differences exist among the subjects can be measured and separately identified.

The within-subjects design was used to reduce error. In a within-subjects design, the same subjects are tested in each condition, which allows differences among subjects to be measured and separated from error. This design also increases the power of the results from the study. Power is defined as "the probability of rejecting a false null hypothesis."³²⁴ Experiments with little or no power are generally inconclusive. Since each subject viewed each of the four presentation modes, the statistical measures are more capable of explaining individual differences among subjects in the experiment.

³²³ HyperStat Online. Lane, David M., "Partitioning the Sums of Squares," <<http://www.ruf.rice.edu/~lane/hyperstat>>.

Historically, DCT experimental literature shows typical predicted differences among treatments to be from 5 to 8 percent. Expected mean scores generally range from 40 to 55 percent and with the range seeming to vary from 25 percent to 60 percent.

³²⁴ Lane, "Power."

Chapter 4

RESULTS

The experimental portion of this dissertation was designed to use the theoretical framework proposed earlier in this work to test the representational, referential and associative processing functions of memory that, according to DCT, occur as people process imagens and logogens. The larger question deals with whether or not the superior effect of pictures and sound enhances recall of information of both verbal and non-verbal information in news stories and to what degree. More specific questions deal with superiority of recall among various text, text and visual and text and visual and audio presentation modes.

A total of 107 subjects viewed the news presented in the *Lansing Eagle* Web news site. Eight of the subjects questionnaires had to be discarded owing to them either not following directions to complete the study correctly or for failing to fill out the questionnaire correctly. The total number of subjects who correctly completed the study and filled out questionnaires was 95. Overall, 51 were males (53.7%), and 44 were females (46.3%), which roughly approximates the sexual characteristics of U.S. population data. Data collected were analyzed using a one-way analysis of variance.

Table 1: Recall Score Means and Standard Deviations

	Mean	Std. Deviation
MM Video and Embedded Audio	.589	.289
MM Video, Text	.312	.267
Text and Photo	.314	.259
Text alone	.434	.310

The table above shows the mean recall scores and standard deviations. The multimedia video and embedded audio treatment had the highest recall score; the text-only treatment had the next highest average recall scores; and both the text with still photos and text with multimedia video treatments had nearly identical average recall scores and ranked third in the experiment. The mean recall score for the multimedia video and embedded audio presentation mode was 58.9% with a standard deviation of .289. The next highest average recall score was for the text-only presentation mode, with a mean score of 43.4% and a standard deviation of .310. Both single-item treatments netted nearly identical recall rates, which was consistent with dual coding theory. Text with a still photo had an average recall score of 31.2% and a standard deviation of .267 and text with multimedia video had an average recall score of 31.4% with a standard deviation of .259.

Further analysis, using contrasts of means, showed that all the means were different from each other, save multimedia video and still photography, both of which were considered the same. Though this runs counter to the proposed hypothesis for this study, it is theoretically consistent with dual coding theory. This result will be discussed more thoroughly in the discussion chapter of this

dissertation. All the recall score means were significant at the .95 level. In addition, it should be noted that each of the modes had p-values of .000.

Table 2: Comparison of Means

Source	F	Significance
MM Video, Embedded Audio, Text Vs. Text Only	25.043	.000
MM Video, Embedded Audio, Text Vs. Still Photo and Text	16.270	.000
MM Video, Embedded Audio, Text vs. MM Video and Text	15.455	.000
Text Only Vs. Still Photo, Text	66.16	.000
Still Photo and Text Vs. MM Video and Text	.006	.941

The first hypothesis for this study tested the picture superiority effect DCT research has reported within its experimental literature:

H₁: Subject recall scores for news accompanied by visual presentations will be higher than news without accompanying visual presentations, or:

$$\mathbf{H_1: } M_v > M_t$$

The alternative hypothesis for this is the difference between the mean scores collected in the recall tests for articles accompanied by visual presentation predicted the scores would be no different to those for articles without visual presentations, or:

$$\mathbf{H_1: } M_v = M_t$$

This research failed to unequivocally disprove the H_1 alternative hypothesis. Mean recall for the multimedia video and embedded audio plus text page was the highest of all tested presentation modes at 58.9%. Yet recall of news presented in multimedia video plus text (31.2%) and photography plus text (31.4%) modes were both below the text-only recall score (43.4%).

The second hypothesis spoke to the differences between each of the proposed visual presentation modes:

H_2 : Recall of online news stories consisting of text accompanied by still photographs will be higher than those consisting of text alone, or:

$$H_2: M_t < M_p$$

The H_2 alternative hypothesis, $M_t > M_p$, was not disproved. Average recall scores for the story accompanied by a still photo (31.4%) were lower than the average recall score for the story presented in text-alone mode. This result runs counter to DCT literature, which suggests higher recall scores should have resulted from the text accompanied by a photo.

As part of the analysis of variance, 20 questions discussed in the previous chapter were included in the questionnaire in an attempt to identify potential interaction effects. None of these interaction affects tested significant at the .95 level, and thus, they were excluded from any further consideration.

All of this suggests some kind of experimental design error on the part of the researcher. One possible explanation for this could be that the text-alone story consisted of breaking news, while the other three stories consisted of follow-up news stories. This will be expanded upon in the Discussion section of this dissertation.

H₃: Recall of online stories consisting of text accompanied by streamed video will be higher than both stories accompanied by still photography or stories consisting of text alone or:

H₃: $M_t < M_v$ and $M_p < M_v$

This research also failed to disprove the H₃ alternative hypotheses, $M_t > M_v$ and $M_p > M_v$. Average recall of material in the text-alone presentation mode was higher than average recall of stories in both the still-photo-with-text and multimedia-with-text presentation modes. In addition, both the still-photo-with-text mode and the multimedia-with-text mode average recall scores were nearly equal. Again, this particular finding is likely a result of the same experimental design error described in the section above, and will be discussed in more detail in the Discussion section of this dissertation.

Average recall scores for the still-photography-with-text presentation mode (31.4%) was virtually the same to average recall for the multimedia-video-with-text (31.2%) presentation mode. Though these results are inconsistent with the hypothesis, they are consistent with the theory. DCT research suggests single

visual elements accompanying stories would net these kinds of similar scores. Thus, this research points to a conclusion supported by the theory that single visual elements, will return the same recall scores simply, because they are single visual elements accompanying text. Whether these image components are moving or still does not appear to affect recall.

H₄: Recall of online stories consisting of text accompanied by streamed multimedia video and embedded audio will be higher than stories accompanied by still photography, streamed video or stories consisting of text alone, or:

$$\mathbf{H_4: } M_{vma}>M_{mv} \text{ and } M_{vma}>M_p \text{ and } M_{vma}>M_t$$

The alternative hypothesis for H₄ would be mathematically expressed as:

$$\mathbf{H_4: } M_{mva}\leq M_{mv} \text{ and } M_{mva}\leq M_p \text{ and } M_{mva}\leq M_t$$

As expressed, this research did not unequivocally disprove the H₄ null hypothesis. The hypothesis that news presented with text and embedded audio and multimedia video would have greater recall scores than all other treatments was proven. However, the linear progression that suggested multimedia video with text, still photography with text and text-alone presentation modes would have recall scores in descending order was not borne out.

In the end, the presentation mode with the greatest number of multimedia modes accompanying the text news stories had the highest recall score. This result is consistent with the theory. Additionally, the fact that the stories

accompanied with single visual elements had equal scores is also consistent with the theory, though not with the hypotheses. Finally, the text-alone presentation's second highest recall score is not consistent with the theory nor is it consistent with previous experiments. The text-alone story was the only story of the four presented in the experiment that was breaking news. For this reason, it is believed this resulted from a design error. Had the research attempted to control for interest shown in all four stories, it is quite possible this explanation might have been born out with facts. In the absence of this question, the reason for why recall occurred in the all-text mode can only be surmised to be content novelty.

Chapter 5

DISCUSSION

Introduction

The experimental data collected in this trial show some remarkable information that speaks to an almost preordained success for multimedia news. The theory used to guide this research, dual coding theory, states that the most concrete memories created when people process imaged information along with text information.

In this particular study, 18- to 25-year-old college students read an online news publication in a laboratory environment that had four Web news presentation modes: text-only, text with photos, text with video and text with video and embedded audio. Immediately following their reading of this material, the students were tested on their recall of information presented in the articles.

Data collected was analyzed using analysis of variance. The total number of subjects who correctly completed the study and filled out questionnaires was 95. Overall, 51 were males (53.7%), and 44 were females (46.3%), which roughly approximates the sexual characteristics of the U.S. population. The results of the study showed that the highest recall rate was nearly 60 percent for the multimedia video and embedded audio, plus text treatment. The next highest recall rate was generated by the text-only treatment at a little more than 43 percent, followed by nearly identical scores fractionally higher than 31 percent, for both the still photo plus text mode and the multimedia video plus text mode.

Mixed results

These results represent a mixed bag of success when considered in context of dual coding theory. Since the early 1970s, when dual coding theory was first drafted, a so-called “picture superiority effect on recall” has been documented. Based on the combined experimental experience of nearly three decades of research, it was not surprising to see the multimedia video and embedded audio mode to have the highest recall rate.

The inclusion of two separate imagery modes in this treatment virtually guaranteed this treatment would score the highest, according to DCT. What was perhaps the most telling part of this was that neither the text, the video nor the embedded audio contained any redundant material; none of the information in the article was repeated to subjects in any way in this mode, nor in any other mode. This was done deliberately to assure no recall score results were skewed by reiteration that would not normally occur in real-life news reading.

With an average recall score nearly 20 percent higher than the nearest scoring mode, clearly, the embedded audio and multimedia video treatment scored the highest recall. This is not surprising when the additive effects described by DCT research are considered. Called the *additivity hypothesis*,³²⁵ it was first proposed to explain the superior ability of concrete words to be recalled over subjects’ ability to recall abstract words and later extended to explain a similar picture superiority effect. For example, DCT predicts symbolic comparisons of concrete objects will be faster with pictures than with words because the imagens are accessed more quickly when pictures serve as

stimuli.³²⁶ In episodic memory, “the mnemonic contribution of the non-verbal (visual-image) trace component consistently turned out to be greater than that of the verbal component.”³²⁷

Therefore, it should not be a surprise that the highest scoring treatment in this study had the greatest amount of recall among the subjects. The fact that these two image components—the embedded audio and the multimedia video—were complementary³²⁸ and were *not* repetitive, enabled the experiment to avoid the repetition lag paradigm of free recall. Repetition lag refers to the phenomenon in which recall of repeated items in a list increase with the number of items that intervene between repeated events.³²⁹ Images separated by blocks of text might call into question the recall subjects exhibited for the information contained in the multimedia video and embedded audio mode story. By making the information contained in the two imagery components of the story non-repetitive, neither item was repeated and could therefore not be the cause of the repetition lag.

There were two surprises in the experimental data. First was the fact that the text-only treatment scored second highest in the recall test. This runs counter to theoretical expectations. The text-only treatment should have scored the lowest, since it was not accompanied by any image information whatsoever.

³²⁵ Paivio “Retrospect,” 265.

³²⁶ Paivio, Allan. “Manipulation and Use of Representational Information,” Mental Representations: A Dual Coding Approach, New York: Oxford University Press, 1990: 180.

³²⁷ Paivio Mental, 142.

³²⁸ The material presented in video and audio forms in no way repeated information presented in the article’s text.

³²⁹ Paivio “Retrospect,” 265.

There is one possible explanation for this occurrence. This article was derived from information originally published in a New York Times article about negotiations between then-U.N. Secretary General Anan Kofi and Libyan President Muammar Qaddafi to release prisoners in that country suspected to be terrorists responsible for blowing up a commercial passenger plane in the skies of Ireland the previous year. The error committed here was that unlike the articles presented in the other three modes, this one was the only breaking news story. The other three were all follow-ups to stories already broken and part of continuing coverage. For this reason, it is believed, the story garnered the second highest recall score.

News, especially breaking news is quite popular. In fact, one of the more interesting outgrowths of online news is how often stories may now be updated within a single day. For the first time since it's inception, broadcast news is experiencing significant competition in an area it heretofore had no competition in—its ability to update stories. Unlike print media, electronic media could break into any part of its program day to bring new information to its audience. Now Web media are capable of the same thing. Since the audience for this media is asynchronous—they “tune in” and consume news on their own schedules, and are not limited to the editions or programs times—online journalists have felt free to update the news whenever events dictate.

The novelty of news is what attracts us to it. Each day, it involves a unique panoply of events and people, as unpredictable as the next day's

direction of the wind. As readers and daily consumers of this new information, we pay it our highest homage by reading it first and giving it our greatest attention.

In this experiment, newsreaders did precisely that—to a point. Recall of two stories that, according to DCT, should have featured higher scores than the text-only treatment, did not outscore the text-only story. And yet, the one story that had the most multimedia components, and was still merely a follow-up news story, outscored the news of the day.

While it may be argued that this story was an international news story, and, as such, would generally score lower in reader interest than anything with a domestic slant, the margin by which this story outscored all others clearly points to an effect that goes way beyond mere news interest. The multimedia story outscored the text-only story by nearly a 20 percent difference and the nearest multimedia competitors—text and still photos and text and video—by almost 30 percent.

Another point should be raised here, too. Why did both the text with photos and text with multimedia video score nearly identical recall scores? The answer to this question is one that is consistent with the theory. DCT experimental literature says text, when accompanied by images, will be remembered better. Consistent with the high score of the multimedia video and embedded audio mode, the theory bears out that the more imagery data that accompanies text, the higher the recall. Consequently, the two treatments that were accompanied by only one image each both scored nearly identical scores. This, too, is consistent with the theory, since the theory does not accord greater

power to either still photography or video, in terms of making memory of text more concrete.

Though it can be legitimately argued, from a statistical analysis standpoint, that reader interest in various stories may certainly impact on recall, it remains to be seen if that could actually be controlled for. How could a question be framed to get at that particular interaction that did not strike at the heart of what is reader recall? After all, interest is what draws us into a story, what keeps reading and what sparks our memories into recalling. Therefore, in an attempt to account for it, we might actually find ourselves in the unenviable position of trying to control for our dependent variable.

In sum then, the general ranking of most multimedia as the highest recall and the two single-element image and text modes gaining near identical scores were consistent with what DCT predicted. The overall ranking, in order from highest amount of accompanying imagery to lowest amount was not borne out, but can be directly attributed to researcher error.

Conclusions

There are so many Web media sites today that it is easy, from a news consumer perspective to view the Web as a separate channel. Despite the relative ease with which news audiences are embracing the Web, it is clear that news content providers are not approaching this channel with the same reckless abandon audiences are. There are several media databases claiming to index more than 15,000 online publications.³³⁰ More than 5,300 of these are newspapers.³³¹ Yet

³³⁰ One such database is NewsStation.com <<http://www.newsstation.com>>.

³³¹ This was the number of online newspapers featured on E&P Online's MediaOnline directory in

relatively few of these sites are using or even experimenting with multimedia news presentations.

Two of the more advanced sites using this form are *NewYorkTimes.com* and *CNN.com*. Both these sites began this multimedia experimentation little more than two years ago. Since then, *MSN.com* is the only major news outlet to adopt a similar delivery strategy.

One reason for this is that while the Web has emerged as a major new commercial channel, the news industry has failed to generate as much money from it as it has from its offline products. For this reason, they seem reluctant to invest money in online news products until they see greater returns from them in the form of advertising revenues or access fees. Another is that traditional media rarely, if ever, combine forces to present news jointly. They are more accustomed to competing with each other to deliver news faster, more comprehensively to the audiences they serve.

But Web media represent a confluence of news product delivery. As this study has shown, online news producers must reorient their thinking, in terms of news delivery, if maximizing recall is a desired goal. Web sites will compete for audience share with multimedia product offerings, not single medium offerings, as it has been done in the past. Additionally, if multimedia increases recall of editorial material, it should similarly increase recall of advertising material in consumers' minds. Differences between print and broadcast products will disappear as the weaknesses and strengths of each channel converge to support

each other and create a more complete and efficient news product on a wholly separate channel.

What appears to baffle most new media venture management teams, especially those employed by firms whose experience lies chiefly in print, is how to fashion the delivery vehicle. With the arrival of the World Wide Web on the populist scene in 1993 or so, media firms began looking to the Web as a vehicle for content delivery. Now with worldwide Web audiences being estimated at a little more than 200 million people, with a little more than 112 million logging on from Canada and the United States,³³² the way is clear for news organizations to launch online multimedia projects.

One of the goals of this work was to show that the Web is indeed a singular and new media channel, just as TV, radio and print media are each individual channels used to transmit information from senders to receivers. The various media products people consume via this channel are all *Web media* and not individual online newspapers, Web radio or Web TV; it is the Web's multimedia capability that melds all these disparate media into a single new medium as well as melding each of their individual abilities to deliver audiences news content via a new and singular channel. The greatest benefits and returns from the Web are in store for those who conceptualize Web media as such and forego less relevant categories, such as online newspapers, online TV or online radio.

³³² Nua Internet Surveys. "How Many Online?", Dec. 2001.
<http://www.nua.ie/surveys/how_many_online/index.html>.

Categories, such as “online newspapers,” serve only to limit the opportunities available to Web media entrepreneurs. Sites whose content is conceptualized using traditional media models are limited by the parameters of those models. This research has shown that the presence of visual elements on an online news site enhances the ability of that site to deliver memorable news content. The news recall scores created by the multimedia video and embedded audio treatment (approximately 60 percent) outperformed recall scores for articles accompanied by only one visual element (30 percent) by nearly 100 percent margin. And yet, the model for using visual elements to accompany news text in traditional newspapers is to seldom have *any* accompanying visual material in the news hole, and if any is used at all there, it is seldom more than one visual element. Yet clearly, the theoretical imperative demonstrated in this experiment is that the more visual elements that accompany a story, the more recall their presence will engender.

To extend this logic further, perhaps the magazine model of using multiple images to illustrate news might be a better model to use to conceptualize online news sites, but for one thing: magazines use static images to illustrate content and in this experiment, the news treatment that scored highest featured non-static visual components embedded audio and multimedia video). Granted, the single-element, static and moving visual component treatments scored nearly identical in the recall trial, but the treatment that featured multiple visual elements stood head and shoulders above all other treatments in terms of recall scores. This seems to again point to the relative uselessness of using traditional media

models for online content sites because there is *no* traditional news media model that uses multiple channels—text, video and audio—to deliver the same message at the same time to the same audience with such high recall scores.

Another point worth raising is the apparent equal value the younger audience in this experiment accorded both the static-image photo and the multimedia video. These results point to a visually jaded audience segment. Considering their exposure since early childhood to television and radio, videocassette recorders, televisions that receive not 10-15 channels, but hundreds and now, as they pass from adolescence to early adulthood, they are presented with the Web. All this accompanies the traditional media experience available to their parents' generation.

While it is true that dual coding theory predicted single visual elements scoring identical recall scores, it must also be remembered that dual coding theory is primarily a theory derived from classroom experimentation. The content it was created to evaluate, word and picture pairs, initially, then classroom material, is hardly as compelling as news content might be. In this experiment, the researcher purposefully chose follow-up news items in an attempt to reduce the compelling nature of the news and thus remove it as a possible factor in the recall scores.

The experimental part of this dissertation was, by and large, a success. It was not without its flaws. But those flaws did not detract from the overall goal of determining which multimedia presentation modes are most effective in delivering news to online newsreaders.

Ultimately, this work shows that for those online news producers who seek the greatest amounts of news recall, dusting off the age-old adage of “hit-‘em-with-it-and-hit-em-with-it-again” will no longer carry the day. Instead, the new media adage should read: “hit-‘em-with-it-and-show-it-to-them-again”. The old, one-two punch of summarizing the quote in the sentence immediately prior to actually delivering the quote is a tried-and-true method of underscoring the importance of information in feature writing. Online news media content providers must take that one step further. They must use that time-tested method print media method, certainly, but additionally, bring the news home to online audiences with audio and video embedded in the same interactive article. DCT shows us the value of accompanying text with imagery. But a newsperson’s instinct tells them it was the synergy and plethora of components that sold the information to readers far more effectively than mere partnering of words and images.

In addition, the value of novelty and interactivity cannot be ignored either. At the time this experiment was performed, online news, especially online video news was almost unheard of. The possibility was acknowledged, but issues of bandwidth precluded their inclusion in normal media streams. For this reason, it is possible that a measure of the substantially higher recall the multimedia video- and embedded audio-laden piece of news garnered in this experiment might legitimately be laid at the feet of novelty.

Yet, interactivity, also, clearly plays a role in this. The sum total of “interactivity” demanded by newspaper—turning pages and reading—or even in

television—"channel-surfing" with a remote are no more attention getting nor engaging than simply reading or staring at the screen.

However, the point and click of a mouse, the required keystrokes necessary to navigate the Web by means of URLs acts as a primer to readers' mental pumps prior to digesting news content from Web sites. Certainly, this attention they must focus to merely turn the page must act, at some level, to catalyze greater attention to be focused on the news itself.

Lastly, though the novelty of the Web may now be dimming, it is still, in the words of words of Michael Lewis, "the new, new thing."³³³ As such, the casual users of this newer channel are just now gaining an expertise in using it and, for a while, at any rate, will continue to approach their news with a greater freshness to it, to perceive it as a more novel thing than they will other, less attractive (to them), more traditional channels.

³³³ Lewis, Michael. The New, New Thing: A Silicon Valley Story, New York: W.W. Norton Publishing, 1999.

Chapter 6

CONCLUSIONS

Introduction

This chapter contains a discussion of what has come before.

First, it will evaluate Allan Paivio's Dual Coding Theory (DCT) for fitness as an evaluative tool for the messages and content in traditional mass media. Then it will consider its value as an evaluative tool of Web media. As mentioned earlier in this work, DCT has gone through a similar progression as an evaluative tool for classroom tools.

Next, the chapter will contain a discussion of the evolution of the World Wide Web and Web media. It will also consider how the Web, access to it and the changing face of the mass media industry segment has spurred change within this media channel. It will also discuss various economic and technological obstacles that might impede rapid advancement of technology in this segment.

Another area this discussion will delve into is the issue of convergence and how that will affect the success of this new media channel. The Web exists as a channel, but how well will media companies be able to use it to communicate with disaffected audiences, such as young people, aged 18 to 34.

Who is this mass audience, where is it, what are its tastes and what is its technology, its interests, will traditional mass media products survive? Or is this audience segmented, even more so than cable TV? If it is, why is it? And what of

the digital divide? Are the disenfranchised an audience, too? Or are they truly disenfranchised? How wide is that gap? Or is there a gap at all?

What is the future of news? What is the future of mass media? Will it still be advertising driven? Or will there be a new economy...one in which information is the commodity? Can we legitimately label computer media and, more specifically, "mass media?"

There is another parallel area worth a bit of discussion, as well. Since DCT enjoys some popularity among educational researchers, a discussion of media convergence in the classroom would also, certainly be in order, especially in the context of journalism education and journalism education research.

At the base of any discussion of this material, the first question that needs to be answered is, "Is recall a desired objective in journalism?" Put simply, "Do we want people to remember what they read, hear or see in the news media?"

The answer is yes, we do. The U.S. Constitution calls for a public that can discuss the issues of the day within a free forum and its First Amendment calls for a free press to provide information to stimulate this discussion within a free forum of ideas. Thomas Jefferson, the Constitution's author, in crafting this philosophy, borrowed from Libertarian principle, which calls for a marketplace of ideas in which citizens gather information so they can discover the truth and create good from it. Today, this country runs on a democratic system that absolutely relies on an informed public. Press freedom has guaranteed people have enough information to operate this free society the Constitution, along with its citizens, has created.

Thus, those engaged in the craft of writing and reporting news should naturally be concerned that they present information to their audiences in a way in which it can be easily remembered. If it is easily remembered, then citizens' abilities to participate freely and equally in the marketplace of ideas will be enhanced. Recall, then, is a highly desirable goal.

From an international perspective, news recall is also a highly desirable goal. Over and over again, we have been shown that North America is not an island. Improved communication has done what it has done throughout history: it has served to reduce the physical and cultural distances between people. Knowing where disasters strike enables us to know where to direct aid. Knowing where wealth accumulates enables us to determine where economic opportunity exists. Knowing where war is being fought, enables us to know where we might try to bring peace. If these ends and means are indeed valuable, and can be aided by creating more memorable news accounts, then again, news recall is a highly desirable goal.

DCT: a mass media research tool

Steve Lacy once told an introduction to mass media class at Michigan State University that a good theory is one explains the past, relates to the present and predicts the future.³³⁴ Another MSU professor, Robert LaRose once said that a theory is a roadmap for research, charting the process of exploration and that a good research progress adds to the map.³³⁵

³³⁴ Lacy, Steven. Lecture, "Introduction to Mass Media," Michigan State University, College of Communication Arts and Sciences, Fall 1995.

³³⁵ LaRose, Robert. Evergreen Grill, East Lansing, MI, Fall 1997.

By any measure dual coding theory survives the first measure. It was derived in the early 1970s and has been used since that time to address how people place information into long and short-term memory. Research has run a full gamut of making picture-word associations for pre-school children on up to comparisons students learning subjects via traditional classroom teaching versus multimedia computer programs. The second measure can will be determined at the end of this work. Chapter 2 and this one will discuss DCT's validity as a mass media research tool.

DCT is a theory that fits well with mass media research. When we read, we process verbal information and place it in long- and short-term memory. DCT explains how we process information for memory. Briefly, the theory suggests that the human mind learns information far better when it processes both verbal and visual information on a subject than when it is confronted with text information alone. Verbal information is defined as text and numbers, while visual information encompasses a continuum of external stimuli ranging from images to sound, smells, tastes, even touch. When we recall things, the more that we can draw from memory about the information we wish to recall, according to DCT, the easier it is to recall it. Research, over time, has demonstrated an additive, superior recall effect associated with pictures, defined as images by the theory.

From this brief description of a theory about which several books have been written, it is easy to see how useful it might be to study mass media. The print media produces information that is either text only or text with images in both editorial and advertising material. Sometimes the text presents information

alone or it also features photographic material. Other times, photographic material presents its information alone.

Television is a visual medium that also incorporates text. The amount of visual information TV presents far outweighs the text it presents, but it does combine both kinds of information. Radio presents information that, as defined by DCT, is solely considered imagery. Web media presents information that in both visual and text forms.

Thus, there are three broad, mass media genres that present news information in a way that, according to DCT, maximizes its ability to be stored in long-term memory. The fourth, radio, presents information to audiences in a way that shows a greater propensity for learning than just text alone.

DCT assumes the existence of two cognitive processes: verbal and imagery systems. Though each of these systems are structurally and functionally distinct, they are not independent. They can operate independently; people can learn and recall material using either system or both at the same time. Little mass media content appears as text or imagery alone. Most content is a mixture of verbal and text information, which lends itself to studies that use a theory suggesting verbal and imagery systems stimulate memory together. Yet DCT also addresses imagery or text that does stand alone, stating that it creates less concrete and more abstract memories without the presence of both.

For online media, the theory has an even greater relevance. Since DCT assumes verbal and non-verbal systems act in concert to stimulate memory function, this theory, then, shows a great deal of promise in evaluating how

people process multimedia information—media products that feature text, photos, video and audio together.

Indeed the experiment in this dissertation points to greater recall with complementary material and lower recall with fewer audiovisual story components. This seems to build on the picture superiority recall effect Paivio notes in earlier studies. This study shows the addition of more imagery along with text, that is (contrary to previous studies) *not redundant with text*, provides the highest recall.

DCT's hierarchal structure parallels the structure of the proposed items of study, online news articles. Consider at the top of this structure is a sensory stimulus of some kind that triggers memory function. Online news consumers go to news sites because they associate specific sites from visual, even auditory cues—in the case of Real.com's RealPlayer—that tell them this place they are visiting contains news. Site logos, sounds stimulate memory through representational or symbolic memory functions that what they are about to read, watch or listen to will be news. The structure of the articles they read are very similar to the next level of the theory: articles can be subdivided by components, into verbal or imagery system-related pieces. Some pieces with consist of only text, while others will consist of text and photos and still others might consist of compressed broadcasts alone. At the lowest level of DCT's structural hierarchy are the imagens and the logogens, representational units that generate word- and image-related memories. Similarly, words within articles or visual objects within pictures and film trigger memories and enable recall to occur.

Mass media researchers has devoted a substantial amount of time and energy to determine which media, broadcast or print, generates the highest news recall rates. DCT focuses this question on the individual, asking if a person is inherently more comfortable processing verbal or imagery system-based material. Theorists suggest this determination can only be based on an individual's experiential dominance—that which they have been exposed to most over time. Media preference studies have shown that younger audiences, as a group, tend to favor broadcast media over print media. Thus, from a theoretical standpoint, younger audiences tend more favorably toward image-based memory systems. However, research using school children as subjects continues to underscore the underlying assumption of DCT that verbal *plus* imagery system-based material creates the most concrete memories. If anything, then, the theory tells us what we already know—that text alone will not hold readers' interest and thus, will likely affect their ability to recall what news they've read in that form.

Another interesting parallel created by DCT is the way in which it theorizes verbal and image system data is committed to memory. The theory suggests that people commit verbal information sequentially and that non-verbal information is placed in memory within a nested structure. Sentences are words placed within a certain sequence to provide meaning. It stands to reason that material presented sequentially, read sequentially will likely be recalled sequentially. This underscores the importance of the news writing style (the inverted pyramid writing style), which calls for paragraphs to refer backward to the previous paragraph and forward to set up what will be written in the following paragraph.

In essence then, adherence to this writing style will foster the sequential nature of the information that will enhance recall. Images and sound, too, must use composition forms to create nested environments. Engaging photos and broadcasts should be set against backdrops that created nested environments to enhance recall. Backdrops or sound in the background will aid viewers and listeners in creating associations that will later aid in recall. Broadcasts that feature talking heads, photos that feature landscapes alone or people alone (“grip-and-grins” and “talking heads,” for example) are less likely to engender recall, according to DCT, for their lack of nested environments.

Structural information, according to DCT, is recalled in a simultaneous way. When people visualize parts that make up a whole, they can also visualize all those parts assembled and created as a whole. Similarly, when people attempt to recall verbal and image systems presented together, such as an online news story, they remember all the pieces together as they look for the relevant image they wish to recall specifically. Here again, to aid in that simultaneous recall, it makes sense to construct news stories with components that fit easily together, whose organization is intuitive, so that when simultaneous recall is required, it can be accomplished easily with as little mental hesitation as possible.

One of the means by which recall is catalyzed, according to DCT, is by means of *referential interconnection*. This is a between-system link that connects imagens and logogens so that objects can be named and names can evoke images. It is important to note that this interconnection does not run

counter to the assumption that the verbal and imagery systems are independent. DCT's notion of independence simply states that one system need not be in operation for the other to be in operation. However, it is possible that logogens might stimulate image-based memories, just as imagens may stimulate verbal-based memories. From a journalistic perspective, then, most U.S. citizens can easily put the correct name to a picture of President George W. Bush, when seen on a Web news site. Similarly, when confronted with President Bush's name in print, these same people can easily conjure an image of George W. Bush.

A second interconnection is called an *associative interconnection*. This is a within-system link that allows logogens to be associated with other logogens and imagens to be mentally associated with other imagens. Both verbal and imagery systems are bi-directionally interconnected; in other words, each can be used to recall the other. DCT also assumes interconnection to be one-to-many; that various logogens and imagens will stimulate recall of not one single memory, but several, or in some cases, many memories. Again, using George W. Bush example, some might recall the questionable manner in which the Florida vote was tallied in his election when confronted by his photo; or they might recall that his daughters were arrested for underage drinking; or they might recall how he looked while inspecting the demolished World Trade Center in September 2001. Similarly, his name in print might evoke pictures of all these images in our minds as well. Mass media seems to already recognize that bi-directional interconnection exists. Text and visual components of news are seldom presented alone to audiences. Film has voiceovers, text is usually presented

together with illustration or photography and that photography is usually accompanied by cutlines to further explain what readers/viewers see.

DCT assumes associative processing in the verbal system is hierarchical. For example, “vehicle,” is a category label for “truck” and “car”. The theory says hierarchies are based in the cultural organization of our language structures. Media depend heavily upon cultural organization of language structure to deliver messages to their audiences. This is especially true for those media that attempt to appeal to some kind of localized audience. “Speaking the same language” is very important to local media, such as newspapers, non-network-affiliated radio and broadcast television stations, in terms of reaching their audiences. This point does not serve to make study of Web media products difficult with this theory. While it is true Web media attempt to appeal to mass audiences, the Web’s audience is, in general, younger, hipper, has higher income levels and is more educated. Therefore, cultural organization of language structure for *that* audience is just as critical as it might be for more traditional, localized media, despite the global geographic diffusion of the audience.

Thus far, discussion has covered how memory is created and how it is created so that it might be easily recalled. DCT also addresses how memory is activated. As might be expected, DCT states that memory is activated by the joint functions of stimuli and individual difference, simply put, the need to recall memory and affective, behavioral and sensorimotor qualities of individuals. DCT specifies two kinds of stimuli that come into play in memory activation: *target* and *contextual* stimuli. Target stimuli are those things that trigger memory—an article

or photo at which a reader might be looking. Contextual stimuli are those objects within the photo or text that act as an instruction set to activate or recall other information already in memory. For example, we are reading an article in the *Wall Street Journal* that live hog prices have fallen lower than they have in nearly 50 years. The article is the target stimulus. The words, “live hog prices,” are the contextual stimuli that cause us to begin to recall many things we might associate with hog prices—hog farmers we know, the lowest prices we can remember, the things that low prices will cause.

The uses of imagery, more concrete words and descriptive terms have all been shown, through experimentation, to create more concrete memory than simple verbal stimuli does. Journalists write using simple terms, short sentences and use active voice. By minimizing the use of descriptive terms, adjectives and eliminating passive voice, reporters write clearly, concise, and, in doing so, write more concretely. According to DCT, then, by accompanying this more concretely written text with photographs, or, in the case of Web pages, with embedded audio or multimedia video, journalists increase the ease with which memory of the material in their stories can be activated.

Memory creation: news recall

When memories are activated, three different processing tasks are activated, depending upon the form of stimuli activated. The most direct means is by direct activation of logogens by words or imagens by images. This is referred to as representational processing. Thus seeing a familiar face in a photo or reading a familiar turn of phrase in a story would both be examples of *representational*

processing. Each of the contextual triggers directly stimulate memories of words and images read or seen in other stories read previously. *Referential processing* is cross-system stimulation of words that evoke images or images that evoke words. Theoretically, this form of processing is considered more indirect since it does involve a mental crossover of systems to activate memories. *Associative processing* involves activation of one logogen by another or one imagen by another.

In direct activation, information read in an article from a Web news site would trigger a memory of information in a reader's memory in an act of representational processing. Information in the stories, delivered by means of still or video images, sound files, even text act as a contextual triggers to activate data stored in our memories. In an example of cross-system stimulation, words might activate old images; new images might activate memories derived from previous readings in text, thus triggering the act of referential processing. Additionally, associative processing also occurs when online news readers see news in text and their memories are stimulated, recalling information they read in the original or first story they read on a subject either the previous day or even, as is the practice in online news, on a story written the previous hour.

Each of these kinds of processing functions is not unique to the online venue. which once again, leaves this researcher in a state of surprise over the lack of previous research in traditional media that might have used this theory as a guide. DCT's utility as a means to describe how people read and process information would have been the same for older media studies since the process

(readers reading, listening or watching news stories), aside from the tools used to access this information, is virtually the same.

Representational systems serve another function in creating memory. Called the *mnemonic* function, it explains how imagery and verbal systems aid in creating memory. One assumption that governs this part of DCT is that the pathway used to create a particular memory is modality specific.³³⁶ In other words, if the memory was encoded verbally, it will be retrieved verbally and similarly, if it was encoded by means of the image system, it will be recalled as an image. Representational coding—words evoking word memories, images evoking imaged memories—is usually sufficient for some level of accuracy in recognition and recall tests.

Referential encoding is also possible, as long as the contexts in which the input items are presented are not confusing. Viewing a multimedia news video on an online news Web site would be a contextually appropriate way to view online news material. Online news readers can referentially encode information gathered by reading/viewing news material on a Web site because it is presented to them in an expected fashion. The history of news presentation is such that we have come to expect news to be presented visually, because as an audience we already have experience with TV news and photojournalism, in an audio format, since we have already experienced radio news and news in text because we have already experienced newspapers. By contrast, we may experience difficulty in recalling information from animated graphics, because as an audience, we have very little if any experience with information presented in this venue.

DCT also notes that the likely success of referential encoding will be much higher if subjects are given instructions as to the nature of the tasks prior to processing the information.³³⁷ Objects, such as sliders, radio buttons and links fulfill this function on Web pages. Since experienced Web users learn how to use these devices through experimentation or on-site instruction. Their function serves as instruction on how to access material and also provides clues as to the nature of the material they will access in using these features prior to processing this information. For example, a slider button underneath a framed visual image cues viewers they are confronted with a video frame on a Web page. It tells them the information they are about to process is moving and not a still photo and will likely, but not always be accompanied by a sound track. Thus, the user is “instructed” to receive information in a particular way by the cues created by the frame surrounding the text or images they are about to process. Additionally, the presence of these cues serves another purpose: they serve as a cue to the presence of interactive material. Since this material is interactive, it requires some action on the part of the reader beyond simply reading or watching information displayed on a screen. Readers must engage in an activity to activate this information, thereby heightening their awareness of what is in front of their eyes, which readies them for a flow of information from the Web site. In effect, this interactive material serves to stimulate readers from the mental lethargy that may have resulted from continued exposure to text material or still images, which excite less involvement on a reader’s part since it requires only visual and mental

³³⁶ Paivio *Mental*, 55-58.

³³⁷ Paivio *Mental*, 250.

processing and not some measure of physical activity, such as button pushing or slider activation.

Associative encoding is the activation of associated representations in the same symbolic modality as the input item.³³⁸ Thus, a subject who recalled the subject matter in a video as a mental representation of a film clip in which news was imparted would have engaged in associative encoding to put that information into memory. What is interesting about this theory is that video has no greater value than does still photography. The theory makes no qualitative distinctions between these two visual modes. Instead, it suggests a quantitative variable that exists; that the only modifier on the concreteness or quality of memory is the *amount* of visual information that accompanies text. In fact, DCT suggests is that multimedia is a superior recall creator because it stipulates a superior picture recall effect: the presence of images *accompanying* text, creates far more concrete images in memory than either text alone or images alone can create.

Statements made by Paivio in which he said research showed the “mnemonic superiority of images” was pegged at having a 2:1 advantage over verbal codes further support this point³³⁹ It clearly lays out a theoretical imperative that a multimedia channel dedicated to information delivery should use images whenever possible. It keeps coming back to the goal of news organizations: to inform entertain and educate audiences. Each of these goals requires the audience to learn some of the material they read, to commit

³³⁸ Paivio Mental, 144.

³³⁹ Paivio Mental, 76.

something to memory, if for no other reason than to add it to their memories' collective. Indeed the results this dissertation's experiment underscores this same mnemonic superiority. The mode that netted the highest recall score (58.9%) featured two image codes—multimedia video and embedded audio. This score was nearly twice the recall scores of the still photo mode (31.2%) and that of the multimedia video (31.4%).

These experimental results illustrate the additive nature of images when presented in concert with text. Here again, we see the additive nature of the presence of image codes (sound and video). When twice as many image codes are present in different modes, the results show a linear improvement in recall. Based on this, it is surprising there are so many news Web sites that do not feature as much image coded material as possible to sell their messages to their audiences.

Theoretically, though seemingly not borne out by the experiment done in this study, text alone is far more difficult to use in memory creation. Memory created from verbal information must be stored sequentially, and is recalled sequentially. Because verbal stimulated memory creation is sequential, according to DCT, any words used to create memory must be extremely well written and very well organized. This requirement may speak more eloquently than any other reason as to why it seems so difficult to create memory from text alone. So much of what we read is not written as well as it might be, or, more accurately has not been edited as well as it might be. Poorly written material doesn't "hang together" very well, frequently because it is poorly organized.

Organizational problems in writing would make a sequentially ordered memory creation process a difficult task.

Similarly, it can also be noted that single-coded information, stand-alone text, stand-alone photos, audio or film, according to the theory, will not generate as much recall as multimedia information will because information presented to users that contains both text and image information creates more concrete memory. Additionally, it will be stored as both imagery and verbal information because it will have been received as text and imagery information.

When readers consume online news, they must engage two kinds of memory to make sense of what they are reading: episodic and semantic memory. Semantic memory is the part of memory in which information is manipulated, transformed and compared to create meaning.³⁴⁰ Episodic memory is memory about specific events at a particular time and place.³⁴¹ News is inherently event-driven and thus, on some level, those who read, listen to it or watch it are processing it in terms of what has occurred or what they have experienced previously as it relates to the subject matter. Thus, at least a portion of the kind of memory engaged to process news information is episodic. This is especially true for news presented on the Web since it is updated far more frequently than news in other media. Another thing inherent to news is that events must be related to those who they involve; in other words, news consumers evaluate and relate what they read against how the events contained in it might affect them or others they know. DCT recognizes that semantic

³⁴⁰ Paivio Mental, 120-121.

³⁴¹ Tulving, Endel., "Episodic and Semantic Memory," Eds.: Endel Tulving and Wayne Donaldson,

memory objects are made of connected, sequenced or nested units. Similarly, episodic memory tends to be sequential. But beyond this at the end of the information presentation the process, what is remembered or recalled is not the representation of the parts, but rather the representation of the whole. It is not letters we remember, nor phrases nor even sentence fragments. Instead, we remember concepts imparted by the text and synthesized against what we know.

Another important point is that DCT assumes no structural or functional differences between the episodic or semantic memory. Thus when studying a multimedia channel, the theory driving the research suggests a methodology that lends itself to certain kinds of research and not others. Research aimed at the function of mass media, that which asks questions of the end result—recall or some comparative measure of recall—will find DCT more useful than those who would delve more deeply into the cognitive process of deriving meaning from what is read, listened to or watched.

Meaning creation, or *memory trace*, as it is referred to in DCT literature, is derived from both external and internal stimuli. We see a story on a Web site about a successful attack on the Afghan city of Kabul. The external stimulus is the Web site on which a user finds the news item as well as the news item itself. The internal stimuli might be the knowledge a user might have that Kabul is the capital city of Afghanistan, which allows this user to realize that this attack is aimed at a significant target and that it is of strategic importance. When this information is stored in memory, it would then be stored within the context of

information about the capital of Afghanistan, the war being fought in Afghanistan and other related memory items.

Just as there are three kinds of encoding, so, too, are there three kinds of processing, or decoding. These three means of decoding memories are identified using the same distinctive labels as types of encoding: representational, referential and associative. Representational decoding occurs from text as a result of direct activation by language stimuli and it occurs from images as a result of direct activation by non-language stimuli. Referential decoding occurs as visual information stored in memory helps add meaning to linguistic stimuli and text information stored in memory will also aid in meaning construction when viewing visual information. Since both kinds of stimuli would be present, it theoretically stands to reason that whatever meaning is synthesized from material that contains both kinds of information—linguistic and imagery—the factual information derived in this fashion will be more concrete than memory derived from either linguistic material alone or imagery alone. Associative decoding relies on episodic memory, which, in essence is memory called up that is essentially “jogged” or stimulated by what is being read. This associative encoding and decoding are essentially the grist of follow-ups. News, especially big news, is seldom handled in a single story. Were it not for associative memory in any form, follow-ups would be a tiresome exercise at best, with too great a necessity to rewrite stories from their beginnings. Our associative memories allow reporters to write but a few paragraphs, run the same sound or video clip to

refresh readers/listeners minds about the news of yesterday that now has a new twist.

The experiment

The experimental part of this dissertation was, by and large, a success. It was not without its flaws. But those flaws did not detract from the overall goal of determining which multimedia presentation modes are most effective in delivering news to online news readers.

The experimental portion of this dissertation was designed to use the theoretical framework proposed earlier in this work to test the representational, referential and associative processing functions of memory that, according to DCT, occur as people process imagens and logogens. The larger question deals with whether or not the superior effect of pictures and sound will enhance recall of information of both verbal and non-verbal information in news stories and to what degree. More specific questions deal with superiority of recall among various text, text and visual and text and visual and audio presentation modes.

Clearly, the embedded audio and multimedia video treatment scored the highest recall. This is not surprising when the additive effects described by DCT research are considered. Called the *additivity hypothesis*, it was first proposed to explain the superior ability of concrete words to be recalled over subjects' ability to recall abstract words and later extended to explain a similar picture superiority effect. For example, DCT predicts symbolic comparisons of concrete objects will be faster with pictures than with words because the imagens are accessed more

quickly when pictures serve as stimuli.³⁴² In episodic memory, “the mnemonic contribution of the non-verbal (visual-image) trace component consistently turned out to be greater than that of the verbal component.”³⁴³

Therefore, it should not be a surprise that the highest scoring treatment in this study featured two image components (audio and multimedia video) in addition to the verbal (text) component. The fact that these two image components—the embedded audio and the multimedia video—were complementary³⁴⁴ and was *not* repetitive, enabled the experiment to avoid the repetition lag paradigm of free recall. Repetition lag refers to the phenomenon in which recall of repeated items in a list increase with the number of items that intervene between repeated events.³⁴⁵

Ultimately, what this means is that for those online news writers who seek the greatest impact, in terms of news recall, will merely dust off the age-old adage of “hit-'em-with-it-and-hit-em-with-it-again.” The old, one-two punch of summarizing the quote in the sentence immediately prior to actually delivering the quote is a tried-true-and-true method of underscoring the importance of information in feature writing. This same strategy is clearly useful for delivering information to news audiences. DCT shows us the value of accompanying text with imagery. But a newsperson’s instinct tells them that it was the synergy and plethora of components that sold the information to readers far more effectively than mere partnering of words and images.

³⁴²Paivio Mental, 180.

³⁴³Paivio, Mental, 142.

³⁴⁴The material presented in video and audio forms in no way repeated information presented in the article’s text.

In addition, the value of novelty and interactivity cannot be ignored either. At the time this experiment was performed, online news, especially online video news was almost unheard of. The possibility was acknowledged, but issues of bandwidth precluded their inclusion in normal media streams. For this reason, it is possible that a measure of the substantially higher recall the multimedia video- and embedded audio-laden piece of news garnered in this experiment might legitimately be laid at the feet of novelty.

Yet, interactivity, also, clearly plays a role in this. The sum total of “interactivity” demanded by newspaper—turning pages and reading—or even in television—“channel-surfing” with a remote are no more attention getting nor engaging than simply reading or staring at the screen.

However, the point and click of a mouse, the required keystrokes necessary to navigate the Web by means of URLs act as a primer to readers’ mental pumps prior to digesting news content from Web sites. Certainly, this attention they must focus to merely turn the page must act, at some level, to catalyze greater attention to be focused on the news itself.

Lastly, though the novelty of the Web may now be dimming, it is still, in the words of words of Michael Lewis, “the new, new thing.”³⁴⁵ As such, those who are denizens of this newer channel are just now gaining an expertise in using it and, for a while, at any rate, will continue to approach their news with a greater freshness to it than they will other, less attractive, more traditional channels.

³⁴⁵ Paivio, “Retrospect,” 265.

³⁴⁶ Lewis, New.

Another portion of the experiment that deserves at least some discussion are its flaws: the fact that the text-only portion of the experiment was the second highest scorer and that there was not an attempt to discern if interest in the stories read might have skewed the results.

News is interesting or there wouldn't be newspapers, TV and radio news programs and online news. In fact, one of the more interesting outgrowths of online news is how often stories may now be updated within a single day. For the first time since it's inception, broadcast news is experiencing significant competition in an area it heretofore had no competition in—its ability to update stories. Unlike print media, electronic media could break into any part of its program day to bring new information to its audience. Now Web media are capable of the same thing. Since the audience for this media is asynchronous—they “tune in” and consume news on their own schedules, and are not limited to the editions or programs times—online journalists have felt free to update the news whenever events dictate.

The novelty of news is what attracts us to it. Each day, it involves a unique panoply of events and people, as unpredictable as the next day's direction of the wind. As readers and daily consumers of this new information, we pay it our highest homage by reading it first and giving it our greatest attention.

In this experiment, newsreaders did precisely that—to a point. Recall of two stories that, according to DCT, should have featured higher scores than the text-only treatment, did not outscore the text-only story. And yet, the one story

that had the most multimedia components, and was still merely a follow-up news story, outscored the news of the day.

While it may be argued that this story was an international news story, and, as such, would generally score lower in reader interest than anything with a domestic slant, the margin by which this story outscored all others clearly points to an effect that goes way beyond mere news interest. The multimedia story outscored the text-only story by nearly a 20 percent difference and the nearest multimedia competitors—text and still photos and text and video—by almost 30 percent.

Though it can be legitimately argued, from a statistical analysis standpoint, that reader interest in various stories may certainly impact on recall, it remains to be seen if that could actually be controlled for. How could a question be framed to get at that particular interaction that did not strike at the heart of what is reader recall? After all, interest is what draws us into a story; it's what keeps us reading and what sparks our memories into recalling. Therefore, in an attempt to account for it, we might actually find ourselves in the unenviable position of trying to control for our dependent variable. Perhaps the only way to do this would be to ask a set of questions at the end that attempted to identify high- and low-reader interest by subject area such as international news, or by issue, such as "the war in Kosovo." The questions would probe reader interest with test subject matter prior to their participation in the experiment. However, these answers might be colored by the fact that test subjects had just read articles on this particular subject.

What of the Web?

At this point, it is important to note that while many of the larger operations in online journalism are already constructing news sites that feature as much multimedia as the Web can sustain, the majority of *all* online media are not. Many, many operations that might do this, still don't, now more than 10 years after the Web's popularization as a mass medium. And that is a point worth making. Clearly, nearly every newspaper in the country is convinced of the wisdom of having its own Web site. Yet the vast majority *still* merely repackages print news onto Web sites with neither thought nor care about the fact that the Web is inherently a different channel with an inherently different audience than traditional print media. While many media consultants pay lip service to convergence, only the major news organizations are actually following through on assuring convergence—the use of text, still photography, videos and embedded audio—is a part of their Web offering.

It can be argued that many of the operations that have not incorporated multimedia into their content do not do so because they either do not have access to that kind of material nor can they afford to purchase it, or, if they could purchase it, could not purchase it in a timely enough fashion to be useful to a news operation. Then, too, the same kind of economy that exists in print and electronic media today, is proving disturbingly elusive on the Web.

Just this past quarter, Amazon.com posted its first quarterly profit after nearly five years of existence. These same woes seem to plague Internet advertisements. The sheer breadth and depth of the Web has served to diffuse

the relatively small amount of Internet advertising available to relatively few sites, making profits in this channel somewhat scarce. With advertising profits low and subscription fees non-existent, or nearly so, the question becomes how can any publication not making money from its Internet operation justify purchasing freelance editorial material?

Simply put, it cannot. And since many cannot, and do not have affiliations with broadcast operations, multimedia remains far out of the grasp of the majority of online news sites, the revelations of this work, notwithstanding. Until Internet news operations show profits, it is unlikely they will embrace multimedia as they should to maximize reader recall.

This begs the question, then, what are steps these operations might take to incorporate multimedia into their sites that do not quite reach video and embedded audio? The answer is to mimic the actions of advertisers. Internet advertisers have long been using animation to attract attention to their messages. Why could Web news operations resort to the same tactics? Indeed, using animations to liven up information graphics or to create enticing photo-illustrations might well aid in improving reader recall of online news information.

Lastly, it should be noted that bandwidth, the capacity of the Web to handle large amounts of data, be they graphics, audio or video information is still largely limited—too limited for large scale use of video and audio on Web news sites. Internet 2, the consortium of universities and corporations devoting substantial amounts of time resources and personnel to solving Web bandwidth issues with hardware and software innovation has yet to make significant gains in

large-scale bandwidth improvement. Thus, web media must wait for newer, faster communication protocols that will allow high-speed transfer of high-capacity data.

In the absence of real improvement in Web-wide bandwidth, the best solution for web companies is to minimize the size of multimedia files and lengths of presentations. That way, Web media can still present multimedia content delivery to audiences and not overload the network. In recent years, the more ubiquitous diffusion of broadband access, such as digital subscriber lines (DSL), cable modems and integrated service data networks (ISDN), have all contributed to greater speed available through last-mile connections. These advances have occurred within the last two years and their adoption bodes well for higher-capacity services, such as online media, that wish to incorporate more high-capacity content into their offerings. Indeed, the same is true for wireless communication. Once this protocol gains an advantage in bandwidth capacity, it, too, will aid in online news sites' quest to include more multimedia into news delivery.

One other concern weighs heavily on any discussion of the Web and that is of the so-called Digital Divide. This concept holds that there is a population that cannot avail itself of the value of the Internet. The reasons vary: for some, they lack the economic means to purchase the necessary equipment to access the content; others lack the necessary English language skills that the majority of Internet users have; and for still others, the cultural landscape is so alien, that access is, by no means relevant.

For those in the former condition, relief seems to be on the way.

Computers are cheaper now than they have ever been.

Conclusion

No research project may be called complete before an agenda for further discovery might be laid out. This work is no exception.

First, it should be replicated to see if the results from this work can, indeed be replicated. If the original results can be replicated, then this work will be proven to be all the more valid. Additionally, now that high-speed Internet access is far more ubiquitous than it was when this work was done, there is also merit in replicating the work to see if further interest in this content might be spurred by higher speed access.

This work looked at how 18-25 year old college students read online news and remembered what they read. But there are many of groups worthy of that same look, especially more middle-aged mainstream newspaper reading groups. It should also be duplicated across various educationally representative groups within the news reading public.

There are lessons to be gained by Web advertisers from this work as well. Many printed publications seek the same answers about their advertisements as we might about editorial. How well is it read? How much do people remember? How might recall be enhanced? Does the presence of certain kinds of content enhance advertising recall? And what of advertorial? Do the same rules for recall apply for this kind of content as in editorial material?

All these questions bear investigation, using DCT as a guide to further our understanding of how readers read and process online information.

APPENDICES

ONLINE NEWS RECALL QUESTIONNAIRE

Part I

1. What did Gail Lloyd say Admiral Scudi did with the money?
2. What did Scudi do to provoke the anger of his superior officers in the U.S. Navy?
3. What did Robert Maginnis have to say about the U.S. Navy's handling of the Scudi case?
4. What penalty did the U.S. Navy impose on John Scudi?
5. How did women's advocacy groups have to say about the Navy's handling of John Scudi?
6. To which ethnic background do the rebels near Kosovo belong?
7. What do western diplomats believe the Serbian leader will respond to rebel activities in the region?
8. What do the Albanian rebels call themselves?

9. Why is it so difficult to control the Albanian rebels?
10. What evidence is there that even the region's children are at risk from the Albanian rebels?
11. What did Republican New York Congressman Peter King say about the chances Congress would vote to proceed on impeachment hearings?
12. What were the two conditions the GOP would require in a proposal to censure President Clinton?
13. What issue about President Bill Clinton did the House Judiciary Committee decide to drop in favor of considering the facts surrounding the president's relationship with Monica Lewinsky?
14. What kind of plan did Rep. Peter King create for dealing with President Clinton?
15. Who is Annan Kofi?

16. What did he want to talk to Libyan Leader Muamar Gadhafi about?

17. Where are the suspects being held?

18. If Annan's discussion is successful, where might the suspects be tried?

19. Where might the suspects be jailed?

20. Why did Libya's news agency say Gadhafi was not qualified to sign any agreements on Libya's behalf?

Part II

Please circle the appropriate answer.

1) You are:

Male

Female

2) Please indicate your race:

Black

American Indian

Hispanic

Asian

Caucasian

Other

3) Is English your primary language?

Yes

No

4) Do you have trouble reading the English language?

Yes No

5) Do you have a learning disability (dyslexia, attention deficit disorder, etc.)?

Yes No

6) Do you have a severe hearing problem that would affect your ability to listen to the news?

Yes No

7) Do you have a severe vision problem that would affect your ability to watch the news?

Yes No

8) Did you have any particular problems completing the experiment?

Yes No

If yes, please explain:

Indicate how much you agree or disagree with each of the following statements, on a scale of one to five, where 5= Strongly Agree and 1= Strongly Disagree.

9) I don't feel in control when I use a computer.

Strongly Agree 1 2 3 4 5 Strongly Disagree

10) I have problems using computers.

Strongly Agree 1 2 3 4 5 Strongly Disagree

11) Computers are a fast and efficient means of getting information.

Strongly Agree 1 2 3 4 5 Strongly Disagree

12) Computers are bringing us into a bright new era.

Strongly Agree 1 2 3 4 5 Strongly Disagree

13) I would hate to go without using a computer for more than a few days.

Strongly Agree 1 2 3 4 5 Strongly Disagree

14) I often use computers for recreational activities.

Strongly Agree 1 2 3 4 5 Strongly Disagree

15) I often use computers use computers for news and information gathering.

Strongly Agree 1 2 3 4 5 Strongly Disagree

16) Which of the following best describes your feelings about news in print media?

Trustworthy 1 2 3 4 5 Untrustworthy

17) Which of the following best describes your feelings about television news?

Trustworthy 1 2 3 4 5 Untrustworthy

18) Which of the following best describes your feelings about radio news?

Trustworthy 1 2 3 4 5 Untrustworthy

19) Which of the following best describes your feelings about news on the Internet?

Trustworthy 1 2 3 4 5 Untrustworthy

20) Where do you get most of your news? (Circle only one.)

Print media Radio TV Internet

APPENDIX B

ONLINE NEWS SITE DESIGN ANALYSIS SURVEY DATA – SUMMER 1997

Note: The “NAME” column is the name of the online news site. The “INDEX” column notes if the index was depicted in a banner along the side of the page or set off in frames. “TEMPLATE” refers to a particular color scheme used on the page, either two color (2/C), three-color (3/C) or four-color (4/C) and whether the page was justified-left (JL) or centered (CTR.) “MM” referred to whether or not multimedia was in evidence anywhere on the site; “AUDIO”, “VIDEO”, “ANIM” and “STILLS” referred to whether or not audio, video, animation or still photography was in evidence on the site. Starred responses (*) in these four categories indicate the individual multimedia mode was in evidence in the site’s advertising content only

Name	Index	Template	MM	Audio	Video	Anim	Stills
Alabama Live	Frames	2/C - JL	No	No	No	No	Yes
Birm. (Ala.) Post-Herald	Banner	3/C - JL	No	No	No	Yes	Yes
Decatur Daily	Frames	Mixed	No	No	No	Yes	Yes
Anchorage Daily News	Columns	2/C – Center	No	No	No	No	No
Juneau Empire	Banner	2/C - JL	No	No	No	No	Yes
Arizona Republic	Banner	2/C - JL	No	No	No	Yes	No
Arizona Daily Star	Banner	2/C - JL	No	No	No	No	Yes
Prescott Courier Online	Banner	1/C - JL	No	No	No	Yes	Yes
Yuma Daily Sun	Banner	1/C - JL	No	No	No	Yes	Yes
Arkansas Online	Banner	2/C - JL	No	No	No	No	Yes
NW Ark. News Online	Banner	1/C - JL	No	No	No	Yes*	Yes
Cabot Star-Herald	Banner	1/C - JL	No	No	No	No	Yes
Log Cabin Democrat	Banner	1/C - JL	No	No	No	Yes	Yes

Name	Index	Template	MM	Audio	Video	Anim	Stills
Alameda Times-Star	Frames	1/C - JL	No	No	No	Yes	Yes
Bakersfield Californian	Banner	2/C - JL	No	No	No	Yes	No
Contra Costa Times	Frames	2/C - JL	No	No	No	Yes	No
Fresno Bee	Banner	2/C - JL	No	No	No	Yes*	Yes
Daily Independent	Banner	2/C - JL	No	No	No	Yes	Yes
Desert Dispatch	Frames	1/C - JL	No	No	No	No	Yes
SF Examiner/Chronicle	Banner	1/C - JL	No	No	No	Yes	Yes
LA Times	Banner	3/C - JL	No	No	No	Yes*	Yes
Malibu Times	Frames	1/C - JL	No	No	No	No	Yes
Modesto Bee	Banner	2/C - JL	No	No	No	No	Yes
Orange County Register	Banner	3/C - JL	No	No	No	Yes	Yes
Pasadena Herald Tribune	Frame	2/C - JL	No	No	No	Yes	Yes
Riverside Press-Enterprise	Frames	1/C - JL	No	No	No	No	Yes
SignOn San Diego	Banner	3/C - JL	No	No	No	Yes*	Yes
Telegram Tribune Online	Banner	2/C - JL	No	No	No	Yes*	Yes
Santa Rosa Press Dem.	Banner	3/C - JL	No	No	No	No	Yes
Stockton RecordNet	Banner	2/C - JL	No	No	No	Yes	Yes
Press Telegram (LA)	Frames	3/C - JL	No	No	No	No	Yes
Sacramento Bee	None	3/C - JL	No	No	No	Yes*	Yes
San Jose Mercury News	Banner	3/C - JL	No	No	No	No	Yes
Torrance Daily Breeze	Banner	1/C - JL	No	No	No	Yes	No
Boulder Daily Camera	Banner	2/C - JL	No	No	No	Yes	Yes

Name	Index	Template	MM	Audio	Video	Anim	Stills
Denver Post Online Banner		3/C - JL	No	No	No	Yes*	Yes
Colorado Springs Gazette Banner		1/C - JL	No	No	No	No	Yes
Glenwood Post Banner		1/C -JL	No	No	No	No	Yes
Greeley Trib Online Banner		2/C - JL	No	No	No	Yes	Yes
Hartford Courant Banner		2/C -JL	No	No	No	Yes	No
Washington Post Banner		1/C - JL	No	No	No	No	Yes
Bradenton Herald Banner		1/C – Ctr.	No	No	No	No	Yes
Florida Times Union Banner		4/C - JL	No	No	No	No	Yes
The Miami Herald Banner		Mixed - JL	No	No	No	Yes*	Yes
Naples Daily News Banner		1/C - JL	No	No	No	Yes	Yes
Ocala Star Banner	Banner (r)	1/C - JL	No	No	No	Yes*	Yes
Palm Beach Post Banner		2/C - JL	No	No	No	Yes*	Yes
Fort Myers News-Press Banner		1/C - JL	No	No	No	Yes*	Yes
St. Augustine Record Frame		Mixed - JL	No	No	No	Yes	Yes
Ft. Laud. Sun-Sentinel Banner	(r)	2/C - JL	No	No	No	Yes	Yes
Gainesville Sun Banner		2/C - JL	No	No	No	No	No
Tallahassee Democrat Banner		1/C - JL	No	No	No	No	Yes
Tampa Tribune Banner		1/C - JL	No	No	No	Yes	Yes
TC/Palm Beach Banner		Mixed - JL	No	No	No	No	Yes
Atlanta J-C Banner		2/C - JL	No	No	No	Yes*	Yes
Augusta Chronicle Banner		2/C - JL	No	No	No	Yes	Yes
Columbus Ledger-Enquirer Banner		2/C - JL	No	No	No	Yes	Yes

Name	Index	Template	MM	Audio	Video	Anim	Stills
Macon Telegraph	Banner	2/C - JL	No	No	No	No	Yes
Athens Daily News	Banner	1/C - JL	No	No	No	No	No
Savannah Morning News	Banner	2/C -JL	No	No	No	Yes	No
Chicago Tribune	Banner	2/C - JL	No	No	No	Yes	Yes
Chicago Sun-Times	Banner (top)	1/C - JL	No	No	No	No	Yes
Arlington Hts. Dly. Herald	Banner	2/C - JL	No	No	No	Yes	Yes
Edwardsville Intelligencer	Banner	2/C - JL	No	No	No	Yes	No
Evansville Courier	Banner	2/C - JL	No	No	No	Yes	Yes
Gary Post Tribune	Frame	1/C - JL	No	No	No	Yes	No
Fort Wayne News Sent.	Frame	2/C - JL	No	No	No	Yes	No
Indianapolis Star	Banner	1/C - JL	No	No	No	No	Yes
Cedar Rapids Gazette	Banner	1/C - JL	No	No	No	No	Yes
Topeka Capital Journal	Banner	2/C - JL	No	No	No	No	Yes
Newton Kansan	None	2/C - JL	No	No	No	No	Yes
Witchita Online	Column	4/C - JL	No	No	No	No	Yes
Courier Journal Online	Banner	1/C - JL	No	No	No	No	Yes
Kentucky Connect	Frame/Banner	3/C - JL	No	No	No	Yes*	Yes
NOLA Live	Banner	1/C - JL	No	No	No	No	No
The Capital Online	Banner	1/C - JL	No	No	No	No	Yes
Sunspot	Banner	2/C - JL	No	No	No	Yes*	Yes
Boston Globe Online	Banner	2/C - JL	No	No	No	No	Yes
GazetteNET	Banner	2/C - JL	No	No	No	Yes	Yes

Name	Index	Template	MM	Audio	Video	Anim	Stills
Detroit News Online	Banner	1/C - JL	No	No	No	Yes	Yes
HDT Info Connect	None	1/C - JR	No	No	No	No	No
Holland Sentinel Online	Banner	2/C - JL	No	No	No	No	Yes
Brainerd Dispatch Online	Banner	2/C - JL	No	No	No	No	Yes
TribUniverse Duluth	Banner	1/C - JL	No	No	No	No	Yes
PioneerPlanet	Banner	Mixed - JL	No	No	No	Yes*	Yes
startribune.com	Banner	Mixed - JL	No	No	No	No	Yes
Sun Herald Online	Banner	2/C - JL	No	No	No	No	Yes
The Examiner	Banner	1/C - JL	No	No	No	No	Yes
Hannibal Courier-Post	Banner	1/C - JL	No	No	No	Yes	No
The Star.Kansas City	Banner	1/C - JL	No	No	No	Yes*	Yes
POSTnet	Banner	2/C - JL	No	No	No	No	Yes
theIndependent.com	Frame	2/C - JL	No	No	No	No	Yes
RJ Online	Banner	2/C - JL	No	No	No	No	Yes
SUN Online	Banner	Mixed	No	No	No	Yes	Yes
Billings Gazzette	Frames	2/C – JL	No	No	No	Yes	Yes
Bozeman Daily Chronicle	Column	2/C – JL	No	No	No	No	Yes
Havre Daily News	Column	2/C – JL	No	No	No	Yes	Yes
Helena Independent	Banner	3/C – JL	No	No	No	No	Yes
Daily Inter Lake	Banner	3/C – JL	No	No	No	No	Yes
Livingston Enterprise	Frames	2/C – JL	No	No	No	No	Yes
Missoulian Online	Banner	2/C – Ctr.	No	No	No	No	Yes

Name	Index	Template	MM	Audio	Video	Anim	Stills
Alliance Times-Herald	Frames	2/C – JL	No	No	No	No	Yes
Grand Island Daily Independent	Banner	3/C – JL	No	No	No	Yes*	Yes
Kearney Cyber Hub	Banner	3/C – JL	No	No	No	No	Yes
North Platte Telegraph	Banner	2/C – JL	No	No	No	No	Yes
starherald.com	Banner	2/C – JL	No	No	No	No	Yes
Columbus Telegram.com	Banner	2/C – JL	No	No	No	No	Yes
Hastings Tribune	Banner	2/C – JL	No	No	No	Yes	Yes
Lincoln Journal Star	Banner	3/C – JL	No	No	No	No	Yes
Norfolk dail News	Column	1/C – JL	No	No	No	No	No
Omaha.com	Column	3/C – JL	No	No	No	No	Yes
RJ Online	Banner	3/C – JL	No	No	No	No	Yes
Las Vegas SUN	Column	3/C – JL	No	No	No	Yes*	Yes
Nevada Appeal	Banner	3/C – JL	No	No	No	No	Yes
Elko Daily Free Press	Column	3/C – JL	No	No	No	Yes	Yes
tahoe.com	Column	3/C – JL	No	No	No	Yes*	Yes
NevadaNet	Banner	3/C – JL	No	No	No	Yes	Yes
Concord Monitor Online	Banner	3/C – JL	No	No	No	No	Yes
Foster's Daily Democrat	Banner	3/C – Ctr.	No	No	No	Yes*	Yes
N.H. Sentinel Source	Column	2/C – JL	No	No	No	Yes	Yes
The UnionLeader.com	Frame	2/C – JL	No	No	No	Yes	Yes
The Telegraph	Banner	2/C – JL	No	No	No	No	Yes

APPENDIX C

ONLINE NEWS SITE TEMPLATE

IMAGES IN THIS DISSERTATION ARE PRESENTED IN COLOR.



- ▶ Top Stories
- ▶ Sports
- ▶ Entertainment
- ▶ Business
- ▶ Lifestyle
- ▶ Calendar
- ▶ Weather



Local Data



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Headline News:



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Apollo 11 Mission

Apollo 11 Mission Celebrated

Text with more text with more text for you to put in. Text with more text with more text for you to put in. Text with more text with more text for you to put in. Text with more text with more text for you to put in. Text with more text with more text for you to put in.

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BIBLIOGRAPHY

Bibliography

- ABCNews.com. American Broadcasting Company. 2001.
<http://www.abcnews.go.com/sections/us/video_index/video_index.html>.
- "A Little History of the World Wide Web." W3C. W3 Consortium. 2000.
<<http://www.w3.org/History.html>>.
- Baddeley, Alan D. Short Term Memory. New York: Oxford University Press, 1986.
- Baggett, P. and Ehrenfeucht, Andrej. "Encoding and Retaining Information in the Visuals and Verbals of an Educational Movie," Educational Communication and Technology Journal, 31 (1983): 23-32.
- Baran, Paul. "ARPANET—The U.S. DoD-Sponsored Network," The 'Lectric Learning Web Center. 1995. <<http://www.chaos.com/learn/History.html>>.
- Barans, Stanley J. "Media, Media Industries and Media Audiences: Television." Introduction to Mass Communication: Media Literacy and Culture. Mountain View: Mayfield, 2001.
- Bielby, Denise B. "Whose Stories Are They? Fans Engagement with Soap Opera Narratives in Three Sites of Fan Activity," Journal of Broadcasting and Electronic Media, 43 (1999): 35-52.
- Biocca, Frank and Levy, Mark R., Communication in the Age of Virtual Reality Hillsdale: Lawrence Erlbaum Associates, 1995.
- Borsook, Terry K., and Higgenbotham-Wheat, Nancy. "A Psychology of Hypermedia: A Conceptual Framework for R&D." Association for Educational Communications and Technology annual meeting, 5-9 Feb. 1992:13-14.
- Bosco, J. "An Analysis of Interactive Video," Educational Technology, 25 (1986): 7-16.

Bower, G.H., and Glass, A.L. "Structural Units and Redintegrative Power of Picture Fragments." Journal of Experimental Psychology: Human Learning and Memory, 2 (1986): 456-466.

Bransford, John D. and Stein, Barry S. The Ideal Problem Solver: A Guide to Improving Thinking, Learning and Creativity. New York: W.H. Freeman, 1984.

Brosius, Hans-Bernd. "Format Effects on Comprehension of Television News," Journalism Quarterly, 68.1 (1991): 396-401.

Budd, D., Whitney, P. and Turley, K.J. "Individual Differences in Working Memory Strategies for Reading Expository Text." Memory and Cognition, 23 (1995): 735 - 748.

Cable Television Laboratories, Inc. "Cablemodem.org," Cablemodem.org. CableLabs. 2001. <<http://www.cablemodem.org/>>.

Cerf, Vinton. CYHIST Community Memory: Discussion List of the History of Cyberspace, Posted Message. 12 Dec. 1998.

Challis, Bradford, Velichkovsky, Boris and Craik, Fergus. "Levels of Processing on a Variety of Memory Tasks: New Findings and Theoretical Implications," Consciousness and Cognition, 5 (1996): 142-165.

Chun, Dorothy M., and Plass, Jan L. "Research on Text Comprehension in Multimedia Environments," Language, Learning and Technology. July (1997): 60-81.

CNN, Turner Broadcasting. 1998: <<http://www.cnn.com/>>.

Coyle, James, and Brill, Ann. "Examining Metaphor Use in On-Line Advertising." Association of Educators in Journalism and Mass Communication Annual Meeting. Baltimore, MD. 1998.

Cronbach, L. and Snow, R., "Aptitude-Treatment Interaction," The Theory in Practice Database. The Encyclopedia of Psychology Society. 1999. <<http://tip.psychology.org/>>.

David, Prabu. "Role of Imagery in Recall of Deviant News," Journalism & Mass Communication Quarterly, 73.4 (1996): 804-820.

DeFleur, Melvin, Davenport, Lucinda, "Audience Recall of News Stories Presented by Newspaper, Computer, Television and Radio," Journalism Quarterly, 69.4, (1992): 1010-1022.

DeFleur, Melvin L. and Ball-Rokeach, Sandra, "Theoretical Strategies for Persuasion," Theories of Mass Communication, Longman: New York, 1989: 276-277.

Enzer, Matisse. "Veronica," Glossary of Internet Terms. Matisse Enzer. 2001. <<http://www.matisse.net/files/glossary.html>>.

Ernst & Young, Global Online Retailing: Key U.S. Findings. 15 January 2001.

Fidler, Roger. Mediamorphosis: Understanding New Media. Thousand Oaks: Pine Forge Press, 1997.

Fletcher, D. "The Effectiveness and Cost of Interactive Videodisc Instruction," Machine-Mediated Learning, 3 (1989): 361-385.

"Free Data," FIND/SVP. 1998. <http://www.cyberdialogue.com/free_data/free_data.html>.

"General Demographics Summary—Primary Place of WWW Access," GVU's Ninth WWW User Survey. Georgia Tech University. 1998. <http://www.gvu.gatech.edu/user_surveys/survey-1998-04/reports/1998-04-General.html>.

Gibson, James Jerome, The Senses Considered as Perceptual Systems. Boston: Houghton Mifflin, 1966.

Grimes, Tom, "Encoding TV News Messages into Memory," Journalism Quarterly, 67.4, Winter 1990: 757-766.

Glaser, Candyce Williams and Prestidge, Linda K., "Using Technology to Support Special Education Teachers' Implementation of the Theory of Anchored Instruction," American Educational Research Association Annual Meeting, Washington, D.C. 21 April 1995.

Graber, Doris A. "Seeing is Remembering: How Visuals Contribute to Learning in Television News." Journal of Communications, 40.3 (1990): 134-155.

Gunter, Barrie. Poor Reception: Misunderstanding and Forgetting Broadcast News. Erlbaum & Associates: Hillsdale. 1987.

"GVU's Tenth WWW User Survey Graphs" Graphics Visualization Unit. 2001. Georgia Tech University.
http://www.gvu.gatech.edu/user_surveys/survey199810/graphs/graphs.html#technology/.

Harper, Christopher, And That's The Way It Will Be, New York: New York University Press, 1998.

Harrison, Susan M.. "A Comparison of Still, Animated or Non-Illustrated Online Help with Written or Spoken Instructions in a Graphical User Interface," Proc. of Computer-Human Interfaces, 1995.

Hedgedus, Peter. "Stroud's Reviews: Gopher/Archie/Finger," internet.com. INT Media Group Incorporated. 2001.
<<http://www.internet.com/cws/gopher.html/>>.

"How Many Online?" Nua Internet Surveys 18 March 2001. Scope Communication Group. <<http://www.nua.com.ie/>>.

"IAB Internet Advertising Revenue Report Pegs Total at \$1.792 Billion For 3Q 2001." Internet Advertising Bureau. Internet Advertising Bureau. 2001
<<http://www.iab.net/>>.

"Interactive Advertising Bureau (IAB) Reports \$8.2 Billion Ad Revenue in the United States for Year 2000; Fourth Quarter Totals \$2.2 Billion." Interactive Advertising Bureau. Interactive Advertising Bureau. 2001.
<<http://www.iab.net/>>.

Infogate. 2001. Infogate Inc. <<http://www.infogate.com/>>.

"Internet Advertising Revenues More Than Double in 1998." Internet Advertising Bureau. Internet Advertising Bureau. 1998 <<http://www.iab.net/>>.

Jerram, Peter, "Who is Using Multimedia?" New Media. October 1994: 48-58.

Kearsley, Greg, "Elaboration Theory," The Theory in Practice Database, The Encyclopedia of Psychology Society. 2001. <<http://tip.psychology.org/>>.

Kearsley, Greg, "Gestalt Theory," The Theory in Practice Database, The Encyclopedia of Psychology Society. 2001. <<http://tip.psychology.org/>>.

Kearsley, Greg, "Symbol Systems," The Theory in Practice Database, The Encyclopedia of Psychology Society. 2001. <<http://tip.psychology.org/>>.

Kellan, Ann. "Internet 2 Holds Promise of Technological Leap." CNN Sci-Tech. 24 Feb. 1999. <<http://www.cnn.com/TECH/computing/9902/24/internet2/>>.

Kenney, Keith, "Memory and Comprehension of TV News Visuals." News Photographer, August 1992: 53-54.

Kobayashi, Susumu, "Theoretical Issues Concerning Superiority of Pictures Over Words and Sentences in Memory," Perception and Motor Skills, 3 (1986): 783-792.

Koslowsky, Meni, Lazar, Aryeh and Hoffman, Michael. "Validating an Attitude Toward Computer Scale." Educational and Psychological Measurement, 48 (1988): 517-520.

Kosslyn, Stephen M. and Pomerantz, James R. "Imagery, Propositions and the Form of Internal Representations." Cognitive Psychology. 9 (1977): 52-76.

Kristula, David. "The History of the Internet." Dave's Site. davesite.com. 1997. <<http://www.davesite.com/webstation/net-history.shtml/>>.

- Lee, Seungwhan. "The Convergence of the Web and Television: Current Technological Situation and Its Future." Association for Education in Journalism and Mass Communication. Baltimore, MD. 1998.
- Lane, David M. "ANOVA." HyperStat Online. 1999.
<http://davidmlane.com/hyperstat/intro_ANOVA.html/>.
- Lane, David M. "Logic of Hypothesis Testing." Hyperstat Online. 2002.
<<http://davidmlane.com/hyperstat/>>.
- Lane, David M. "Partitioning the Sums of Squares." HyperStat Online. 1999.
<<http://www.ruf.rice.edu/~lane/hyperstat/>>.
- Lane, David M. "Type I and Type II Errors." HyperStat Online. 1999.
<<http://davidmlane.com/hyperstat/A18652.html>/>.
- LansingStateJournal.com. Gannett News Corporation. 2001.
<<http://www.lansingstatejournal.com/>>.
- Leiner, Barry M., Cerf, Vinton, G., Clark, David D., Kahn, Robert E., Kleinrock, Leonard, Lynch, Daniel C., Postel, Jon, Roberts, Larry G. and Wolff, Stephen. "A Brief History of the Internet." Internet Society. Internet Society. 2001. <<http://www.isoc.org/internet/history/brief.html#Origins>/>.
- Lewis, Michael. The New, New Thing: A Silicon Valley Story. New York: W.W. Norton Publishing, 1999.
- Lindlof, T.R. and and Schatzer, M.J. "Media Ethnography in Virtual Space: Strategies, Limits and Possibilities." Journal of Broadcasting and Electronic Media, 42 (1998): 170-189.
- Lomicka, Lara L. "To Gloss or Not to Gloss: An Investigation of Reading Comprehension Online." Language Learning and Technology. January (1998): 41-50.
- Loyd, Brenda H. and Gressard, Clarice. "Reliability and Factorial Validity of Computer Attitude Scales." Educational and Psychological Measurement, 44, (1984): 501-505.

- Loyd, Brenda H. and Gressard, Clarice. "The Effects of Sex, Age and Computer Experience on Computer Attitudes." AEDS Journal, 17 (1984): 67-77.
- Loyd, Brenda H. and Loyd, Douglas E. "The Reliability and Validity of an Instrument for the Assessment of Computer Attitudes." Educational and Psychological Measurement, 45 (1985): 903-908.
- Lowe, Phillip J. "The Effect of Flashback on Children's Understanding of Television Crime Content." Journal of Broadcasting and Electronic Media, 43 (1999): 83-98.
- Lundsten, Apryl and Doiel, Robert. "Internet 2: What is I2?", Builder.com. CNET Networks Inc. 27 April 1999.
<<http://www.builder.com/Servers/Internet2/index.html>>.
- Maney, Kevin. "High Tech Tablets: Next Step for Newspapers." USA Today Tech Report, Gannett News Corporation. 28 Feb. 1999.
<<http://www.usatoday.com/>>.
- Marschack, M.L. and Hunt, R.R., "A Re-Examination of the Role of Imagery in Learning and Memory," Journal of Experimental Psychology: Learning, Memory and Cognition, 15 (1989): 710-720.
- Mayer, R.E., and Anderson, R.B. "Animations Need Narration: An Experimental Test of Dual Coding Hypothesis." Journal of Educational Psychology, 83 (1991): 484-490.
- Mayer, R.E., and Anderson, R.B. "The Instructive Animation: Helping Students Build Connections Between Words and Pictures in Multimedia Learning." Journal of Educational Psychology, 84 (1992): 444-452.
- "Mediainfo.com," Editor & Publisher MediaInfo Links Online Media Directory, The Editor and Publisher Company, Inc. 23 Oct. 2001.
<http://www.editorandpublisher.com/editorandpublisher/business_resources/mediastats.jsp>.
- Middlestadt, Susan E. and Barnhurst, Kevin G. "The Influence of Layout on the Perceived Tone of Newspaper Articles," Journalism & Mass Communication Quarterly, 76 (1999): 264-276.

"Muted and Mixed Public Response to Peace in Kosovo," Pew Research Center for the People & the Press. 1999. <<http://www.people-press.org/>>.

Najjar, Lawrence J. "A Review of the Fundamental Effects of Multimedia Information Presentation on Learning," Technical Report GIT-GVU-95-20. June 1995.

Najjar, Lawrence J. "Dual Coding as a Possible Explanation for the Effects of Multimedia on Learning," Georgia Tech Graphics Visualization & Usability Center Technical Report GIT-GVU-95-29. 1995.

Najjar, Lawrence J. "Multimedia Information and Learning," Journal of Educational Multimedia and Hypermedia 5 (1996):129-150.

Neuman, W. Russell, Just, Marion R. and Crigler, Ann. N. Common Knowledge: News and the Construction of Political Meaning. Chicago: University of Chicago Press, 1992.

Netradio.com. 2001. <<http://www.netradio.com/>>.

New York Times on the Web, New York Times Company. 1998: <<http://www.nytimes.com/>>.

"Newspapers Worldwide: North America," NewsDirectory.com. Tucows Inc. Dec. 2001, <<http://www.ecola.com/news/press/na/us/>>.

"Total Revenue From Advertising –1998." Nua Internet Surveys. Scope Communication Group. 1999. <http://www.nua.ie/surveys/analysis/graphs_charts/1998graphs/ad_revenue.html/>.

O'Hara, Kenton and Sellen, Abigail. "A Comparison of Reading Paper and Online Documents," CHI 97, Atlanta, Georgia, 22-27 March 1997.

"Online Newcomers More Middle-Brow, Less Work-Oriented: The Internet News Audience Goes Ordinary," Pew Research Center for the People and the Press. 1999. <<http://www.peoplepress.org/tech98sum.htm/>>.

Osborne, D.J., and Holton, D. "Reading from Screen versus Paper: There is No Difference," International Journal of Man-Machine Studies, 28 (1988) 1-9.

Outing, Steve. "Why Web TV Is Not Viewtron Revisited" E&P Online. The Editor and Publisher Company, Inc. 9-10 Dec. 1996.
<<http://www.mediainfo.com/>>.

Outing, Steven. "Fidler Moves to Kent State." E&P Online. The Editor and Publisher Company, Inc. 9 Sept. 1996. <http://www.mediainfo.com>.

"Packet Switching." Free Online Dictionary of Computing. Imperial College. 2001. <http://www.foldoc.org>.

Paivio, Allan, "Coding Distinctions and Repetition Effects in Memory," ed: Bower, G.H. The Psychology of Learning and Motivation, New York: Academic Press, 1975.

Paivio, Allan. "Dual Coding Theory: Retrospect and Current Status." Canadian Journal of Psychology, 45, (1991): 255-287.

Paivio, Allan. Imagery and Verbal Processes. New York: Rhinehart and Winston, 1971.

Paivio, Allan, Mental Representations: A Dual Coding Approach, New York: Oxford University Press, 1990.

Paivio, Allan. "Paired-Associate of Learning and Free Recall of Nouns as a Function of Concreteness, Specificity, Imagery and Meaningfulness," Psychological Reports, 20, (1967): 239-245.

Paivio, Allan and Csapo, K. "Picture Superiority in Free Recall: Imagery or Dual Coding?" Journal of Cognitive Psychology, 1973:176-206.

Paivio, Allan, "Spacing of Repetitions in the Incidental and Intentional Free Recall of Pictures and Words," Journal of Verbal Learning and Verbal Behavior, 13 (1974): 497-511.

- Perry, Stephen D. "Inhibiting Speech Through Exemplar Distribution: Can We Predict a Spiral of Silence?" Journal of Broadcasting and Electronic Media, 44 (2000): 268-282.
- Pluck, G.C., and Brown, R.G. "Curiosity is Stimulated by Incomplete Information." Proceedings of the British Psychological Society. 7 (1999): 5.
- Price-Waterhouse. "IAB Internet Advertising Revenue Report: Third-Quarter Highlights, 1999." Interactive Advertising Bureau. March 2000. <<http://www.iab.net/>>.
- "Profile of a Net Buyer." Cyberstats Online. 1997. <<http://www.zdnet.com/zdimag/cyberstats/1997/06/users.html/>>.
- Proffitt, Brian. "BrowserWatch Stats Station." internet.com. INT Media Group Incorporated. 2001. <<http://browserwatch.internet.com/stats/stats.html>>.
- Ramparasad, J. "Information Graphics in Newspapers," Newspaper Research Journal, 12.4 (1991): 92-103.
- Reigeluth, Charles M., Instructional Theories in Action: Lessons Illustrating Selected Theories and Models. Hillsdale: L. Erlbaum Associates, 1987.
- Rieber, L.P., Tzeng, S., Tribble, K., and Chu, G. "Feedback and Elaboration within a Computer-Based Simulation: A Dual Coding Perspective," American Educational Research Association Annual Meeting. New York, New York. April 1996.
- Rigny, J.W. and Lutz, K.A. "Effect of Graphic Analogies of Concepts in Chemistry on Learning and Attitude," Journal of Educational Psychology, 68 (1976): 305-311.
- Robinson, John P. and Levy, Mark R. The Main Source: Learning From Television News, Beverly Hills: Sage. 1986.
- Rogers, Everett M. Diffusion of Innovations. New York: Free Press. 1995.

- Sadoski, Mark. "An Exploratory Study of the Relationship Between Reported Imagery and the Comprehension and Recall of a Story," *Reading Research Quarterly*, 19 (1983): 110-123.
- Sadoski, Mark, Paivio, Allan, and Goetz, Ernest T. "A Critique of Schema Theory in Reading and a Dual Coding Alternative," *Reading Research Quarterly*, 26 (1991): 463-468.
- Salomon, Gavriel. *Interaction of Media, Cognition, and Learning*. Hillsdale: L Erlbaum Associates, 1994.
- Scott, Randall K. and Goff, David H., "How Excitation from Prior Programming Affects Television News Recall," *Journalism Quarterly*, 69.4 (1992): 615-620.
- Sentius Corporation. "Guide to Online Publishing for Reading Comprehension – Section II," Sentius Corporation. 1997. <<http://www.sentius.com/>>.
- Senzig, Don, *CYHISTCommunity Memory: Discussion List on the History of Cyberspace*, Posted Message. 7 Nov. 1998.
- Simpson, Timothy J., "Message into the Medium: An Extension of Dual Coding Hypothesis," *Proc. of International Visual Literacy Association*, 12-16 October 1994 :255-263.
- Sims, Roderick C. "Engagement, Control and Learner: A Theoretical Appraisal of Interactivity," Australian Society for Computers in Learning in Tertiary Education Conference, Adelaide, 1996.
- Smith, Douglas, and Alexander, Robert. *Fumbling the Future: How Xerox Invented, Then Ignored the First Personal Computer*. New York: Morrow, 1988: 89.
- Snow, R., "Aptitude-Treatment Interaction as a Framework for Research on Individual Differences in Learning," eds: Ackerman, P., Sternberg, R.J., Glaser, R. *Learning and Individual Differences* New York: W.H. Freeman, 1989.

Stark, Pegie and Garcia, Mario. Eyes on the News, St. Petersburg: Poynter Institute of Media Studies, (1991).

Straubhaar, Joseph, and LaRose, Robert. Communications Media in the Information Society, Updated Edition. Belmont: Wadsworth, 1997.

Tappendorf, Sean. "ARPANET and Beyond," The World-Wide Web Virtual Library: The Internet Studies Page. 1995. Asia Pacific Research Online. <<http://www.ciolek.com/WWWVLPages/QltyPages/NetStudies.html/>>.

Theys, Mitchell. "My Home Page." Purdue University. 1998. <http://garage.ecn.purdue.edu/~theys/stuff/misc/comp_hist/>.

Tolley, B. Stuart. "Newspaper Effectiveness: The Data," Journal of Advertising Research, 31, Feb./March 1991: 12.

Treichler, D.G. "Are You Missing the Boat in Training Aid?" Film and A-V Communication, (1967): 14-16.

Tulving, Endel and Donaldson, Wayne. "Episodic and Semantic Memory." Organization of Memory. New York: Academic Press, 1972.

"TV News Viewership Declines: The Internet News Audience Goes Ordinary." Pew Research Center for the People and the Press. 2001. <<http://www.people-press.org/mediarpt.htm/>>.

"TV Viewership Falls: Fall Off Greater for Younger Adults and Computer Users," Pew Research Center for the People and the Press. 18 March 2001. The Pew Foundation. <<http://www.people-press.org/mediarpt.html/>>.

"U.S. Has 33% Share of Internet Users Worldwide Year-End 2000 According to the Computer Industry Almanac." Computer Industry Almanac. Computer Industry Almanac Inc. 2001 <<http://www.c-i-a.com/>>.

Vonder Haar, Steven. "AOL Slows Growth as Membership Churns," Inter@ctive Week, 20 May 1996: 15.

Walma van der Molen, Juliette H. and van der Voort, Tom H.A. "The Impact of Television, Print and Audio on Children's Recall of the News: A Study of Three Alternative Explanations for the Dual Coding Hypothesis." Human Communication Research. 26.1 (2000): 3-26.

Wearden, Stanley T., Fidler, Roger, Schierhorn, Ann B., and Shierhorn, Carl. "Portrait vs. Landscape: Potential Users' Preferences for Screen Orientation," Association for Education in Journalism and Mass Communication Annual Convention, New Orleans, 1998.

Weber, D. and Harnish, J.D. "Visual Imagery for Words: The Hebb Test." Journal of Experimental Psychology, 54, (1974): 409-414.

Webster's New World Dictionary of American English, 3rd College Edition, ed.: Neufeldt, Victoria, New York: Prentice Hall, 1994, 271.

Wertheimer, Max, Productive Thinking, New York: Harper & Row, 1959.

Wilson, Brent and Cole, Peggy. "A Critical Review of Elaboration Theory." Educational Technology Research and Development. 40 (1992): 63-69.

Windowsmedia.com, Microsoft Corporation. 2001.
<<http://www.windowsmedia.com/>>.

Wolfe, Mark R. "The Wired Lot: Lifestyle Innovation Diffusion and Industrial Networking in the Rise of San Francisco's Multimedia Gulch." Urban Affairs Review, May (1999): 707-728.

Worden, Aileen, Walker, Neff, Bharat, Krishna and Hudson, Scott. "Making Computers Easier for Older Adults to Use: Area Cursors and Sticky Icons." CHI '97, Atlanta, Georgia, 22-27 March 1997.

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