

COGNITIVE PROCESSING OF NEWS AS A FUNCTION OF STRUCTURE:
A COMPARISON BETWEEN INVERTED PYRAMID AND CHRONOLOGY

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A COMPARISON BETWEEN INVERTED PYRAMID AND CHRONOLOGY

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To Raphael and Eugenio

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A COMPARISON BETWEEN INVERTED PYRAMID AND CHRONOLOGY

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ABSTRACT

Little has changed in how written news is structured, even as the newspaper industry changes dramatically. One of the most entrenched news routines, the inverted pyramid, continues to persist in both print and online news. This dissertation explored the cognitive processing and subjective evaluation of written news when structured either as an inverted pyramid or a chronological presentation. It also explored how the structure of written news affects men and women differently in terms of cognition and evaluation. Four different news stories were manipulated so that there was an inverted pyramid and chronological version of each. In a 2 (Structure) x 2 (Story) x (Sex) mixed design, participants read two inverted pyramid and two chronological news stories, each on a different topic. Dependent measures included availability of cognitive resources while reading, cued recall, recognition accuracy, text comprehension, and reading enjoyment. Secondary task reaction times (STRTs), which measure attention and use of cognitive resources, were slower for chronological stories, possibly because they require more construction of meaning than inverted pyramid stories. No differences emerged for the memory and enjoyment measures, and a marginally significant difference favoring the inverted pyramid structure was observed on the text comprehension measure. Women had slower reaction times than men across stories, but a significant interaction showed their use of cognitive resources was less affected by variations in story structure.

CHAPTER 1

Introduction: Story structure as a routine

The advent of the Internet has changed journalism, and some grim studies predict that if the current trends in readership decline continue, hard-copy newspapers will disappear by 2040 (e.g., Meyer, 2004). But has that made news stories easier to understand and enjoy? This dissertation explores the cognitive processing and subjective evaluation of text structures that are routinely used in news writing, both print and online. Even though written news is bound to reach audiences more often through a computer screen than paper, with already 67 million unique visitors to newspaper Web sites just in January 2008 (Newspaper Web Sites Attract Record Audiences in First Quarter, April 14, 2008), little has changed in how journalists report and write stories. One of the most entrenched news routines, and a hallmark of American journalism, is the inverted pyramid: a way of structuring news stories with the most important element at the top, followed by the second most important element, and so forth. It continues to persist not only in print, but also in online news, as Web sites are often “merely aggregating journalistic work that originated in a newspaper” (Alterman, March 31, 2008, p. 49). Popular partisan blogs, such as the Huffington Post (www.huffingtonpost.com) and the Drudge Report (www.drudgereport.com) feature many traditional Associated Press stories written as inverted pyramids. Some argue that today’s 24/7 information cycle has given wings to the century-old form of news writing: “Frequently misdiagnosed as dying, the inverted pyramid has more lives than a cat -- perhaps because the more people try to speed up the dissemination of information, the more valuable the inverted pyramid becomes” (Brooks et al., 2005, p. 143).

The other common structure in written news is the chronological story, which lists facts in the order in which they occurred. It is loosely similar to what in fiction writing

would be referred to as a “narrative,” which includes distinct characters (e.g. *Ways With Words*, 1993), is “organized in knowledge structures that can be anticipated by the audience” (Graesser, Golding, & Long, 1991, p. 174), contains “affect patterns” (p. 175), and offers a moral lesson or point of view (Graesser, Golding, & Long, 1991). Britton et al. (1983) define narrativity simply as the extent to which a passage describes “a sequence of events occurring in time” (p. 40), which is equivalent to chronology, and exposition as a style of writing describing “static events and relationships” (p. 40). Studies of text comprehension have classified narratives as appropriate for fiction, poetry, short stories, and expository structures as the style of instruction materials. Both inverted pyramid and chronological styles can be viewed as ways to organize text, which requires “logical connections among ideas as well as subordination of some ideas to others” (Meyer & Rice, 1984, p. 319). The purpose of narrative texts is to entertain, while the purpose of expository texts is to inform (Weaver & Kintsch, 1991).

But a story built upon chronology does not have to be entertaining or contain distinct characters, affect patterns and a point of view. At least two experiments (Lang, 1989; *Ways with Words*, 1993) have shown that virtually any news story can be re-written into a chronology. Such a rewrite seems to improve memory for information contained in the story (Lang, 1989) and reading enjoyment (*Ways with Words*, 1993). Other studies reviewed throughout this proposal also suggest that a chronological presentation may be the most effective way of conveying written news. This is supported by research showing that reading is not out of fashion: Modern readers continue to read avidly and more than ever before, but their interest has shifted from daily print news to magazines, books (Schoenbach & Bergen, 1998), weeklies, and alternative newspapers (Thurlow & Milo, 1993).

This dissertation explores how readers cognitively process news when the

information is structured either as an inverted pyramid or a chronological presentation. Comparisons between expository structures, of which the inverted pyramid is one type, and chronological structures have consistently shown that expository texts create difficulties in generating inferences and hence are more difficult to comprehend than chronological stories (e.g., Olson, 1985). But is that the case in news? If so, such a finding would call into question the historical dominance of the inverted pyramid.

The inverted pyramid is a story structure more than a century old. It was in the late 19th century that “reporters came to share a common world of work; they also shared common ideas about how to conduct their work” (Schudson, 1978, p. 70). The inverted pyramid became a nearly universal formula of news writing by the turn of the 20th century, replacing a more chronological, opinionated and indirect style (Brooks et al., 2005, p. 144). That change is most often attributed to the invention of the telegraph, which came into use in the 1840s and gained importance as an information transmittal device (rather unreliable in its first years and decades of use) during the Civil War. Because of the uncertainty and expenses associated with the use of the telegraph, newspaper reporters received instructions to begin with the most important information (Brooks et al, p. 144). Other social changes that occurred in the first half of the 19th century: the advent of the penny press, with its coverage of news about the lives of ordinary people, the egalitarianism of the 1830s and 1840s, and the economic interests involved in reaching those who could only read a little bit (Schudson, 1978, p. 14-57) may have contributed to the rise of this new form of story organization.

Pottker (2003) argued that although there are various explanations for the inverted pyramid, such as government controls of information and competition between publishers, they are inaccurate because they are tied to the Civil War era. In reality, it was only at the end of 19th century that the inverted pyramid became commonplace. In a

content analysis of the *New York Times* and the *New York Herald* on a randomly selected day in 1855, 1875, 1895 and 1920, Pottker found the inverted pyramid began to appear regularly only after the Civil War and at the very end of the century, and the emergence of this new form of story organization coincided with the increasing use of illustrations and headlines. Pottker's findings are consistent with Schudson's observations on the emergence of machine-like reporting and leads that answered the "who", "what", "when", "where", "why" and "how" questions only late in the 19th century (Schudson, 1978, p 77-87). In the early 20th century, the inverted pyramid formula began to spread to other parts of the world, however slowly; for instance, in Europe the events leading to World War I were still reported in chronological order (Pottker, 2003). Nowadays, for reasons that remain relatively unexplored, the inverted pyramid remains much less common in European journalism than it is in the United States.

Around the time when the inverted pyramid was coming into existence, a journalistic form built exclusively on compelling narratives and imagery also began to emerge. The so-called literary journalism, which entails presenting facts and real-life observations in the suspense-ridden manner of a novel or a short story, appeared around the time of the Civil War and continued to develop throughout the rest of the 19th century (for a review, see Hartsock, 1999). Many journalists (e.g. Mark Twain) began their careers writing short stories and other prose (Lepore, 2002). The form came in the spotlight again in the 1960s as "New Journalism" (a term originally coined in the late 19th century), and has begun to gain new momentum since the early 1990s under various names, including "narrative journalism" and "creative nonfiction" (Abrahamson, 2006). But although literary journalism as a vivid and compelling form of storytelling does not predate the inverted pyramid, chronological presentations of news, in which the key facts rarely appeared in the beginning, were the norm before the telegraph came into use

(Stapler, 1985). Narratives (oral or written) are, in fact, a “truly universal aspect of the human race” (Lacey, 2000, p. 6), starting with the Epic of Gilgamesh as the world’s oldest known narrative dating back to 2000 BC (p. 78).

Not every news story is presented as a typical inverted pyramid; Gans (1979) describes a slightly different formula in his study of evening news and newsmagazines: Each story has a lead, or a “hooker,” designed to grab the attention of the audience; this is followed by a narrative, or a “body,” that documents or illustrates the lead; finally, the story ends with a “closer,” which reinforces or debunks the lead (p. 161-162). This format reinforces symbols and is designed as a “morality play” of sorts, according to Gans (p. 162). Such a story, evidently, could not be automatically cut from the bottom; however, news events are still cast to fit a routine form that excludes personal analysis and/or diversions that are not immediately relevant, even if they have contextual or historical significance. The readers are left to connect the dots or move on, while journalists cling to the belief that their job is to offer strictly factual and concise stories.

The idea for this dissertation emerged from a number of personal journalistic experiences suggesting that the quality standards of reporters and editors for news differ from the quality standards of readers. Many of those differences have been subject of research and are outlined in more detail in Chapter 3. News writing conventions seem to be an important part of that divide between the standards of journalists and readers. But readership studies indicate that many factors other than just story structure may be necessary to enhance comprehension and enjoyment of written news.

For example, one interesting fact that emerged from the readership literature is the so-called “gender gap,” which refers to the fact that fewer women than men read news. This is the secondary focus of this dissertation. The “gender gap” phenomenon has come into play only in the last 30 years, and it is present despite significant evidence that

women have a biological advantage in language processing, including reading. It would be easy to dismiss that shift as simply another symptom of the time-limited lifestyle that women have experienced since entering the workforce while continuing to be responsible for many childcare and household maintenance duties (Einsidel & Tully, 1981). But various studies and data suggest a need for alternative explanations. It does not seem that women simply have no time for news: According to a recent dataset, more women than men watch the nightly network and local TV news (The News Gender Gap, 2004, July 9). Another study found that women dislike print news because they see newspapers as carriers of a “male personality” and irrelevant to their lives (McGrath, 1993, p. 103). Because the inverted pyramid can be classified as a masculine style of communication due to its lack of context and details (Wood, 2007), it is worth testing through experimental quantitative research whether sex differences in written news consumption might be a function of story structure.

This dissertation explores the above questions within the context of media psychology. Decades of research have shown that people have limited capacity for processing information (e.g., Lang, 2000; Cowan, 2001; Miller, 1956), and various readability indexes and self-report inventories have long suggested that news stories can be taxing for audiences. But it is only in the last 20-25 years that research on the structure and presentation of news has begun to incorporate psychological theories. How do story structures affect cognitive resource allocation, memory, and comprehension? Do people enjoy reading some story structures more than others? And how do sex differences interact with story structures? Five variables seem relevant to the effects of story structure on cognitive processing: availability of cognitive resources; recall and recognition, because they are direct memory measures and show the outcome of this cognitive processing; text comprehension, because it is indicative of a potential mismatch

between story structures and sense-making strategies in the cognitive processing of text; and reading enjoyment, because it is related to motivation and attention for reading. The literature suggests some of those variables are likely correlated. For instance, according to Britton and colleagues (1978; 1979; 1982), comprehension and engagement in reading lead to less availability of cognitive resources. Answering the research questions posed here would have practical implications for the news industry by providing additional theoretical support for the need to emphasize chronological structures over the traditional inverted pyramid. Although time has proven news routines extremely difficult to change, the deepening readership crisis suggests an inevitable shift in the focus of journalism training and newsroom operations. Abandoning the inverted pyramid in favor of more easily comprehensible structures might be an important part of that shift.

The following three chapters explore the literature that is relevant to these research questions. Chapter 2 contains the literature review, which consists of three subsections. The first one outlines a theoretical framework that emphasizes a limited capacity approach to cognitive processing, along with a discourse-based model useful for the text comprehension variable in this study. The second one explores the evidence on reading enjoyment elicited by different story structures. The third one delves into the so-called “gender gap” in news reading against the backdrop of a solid body of literature about the female advantage in language processing. Chapter 3 outlines the research method, an experiment that employs measures of resource allocation, cognitive performance, and subjective evaluation. Results are presented in Chapter 4, followed by discussion and conclusions in Chapter 5.

CHAPTER 2

Literature

2.1. Our limited capacity for processing information

This dissertation explores the effects of writing style on four dependent variables:

1) Available cognitive resources, defined as “resources allocated minus resources required” (Lang et al., 2007, p. 319) and operationalized through the use of secondary task reaction time; 2) Memory, operationalized as cued recall and recognition accuracy; 3) Text comprehension, operationalized through a sentence verification task; and 4) Reading enjoyment, operationalized through a single-question self-report. Those variables require a combination of theories to set the foundation for the experimental tests to follow. Available resources and memory are discussed in the context of Cowan’s (2001) view of working memory as limited by a central capacity. One specific theoretical framework grounding this research is Lang’s limited capacity model of motivated mediated message processing (LC4MP; 2000, 2006), a useful framework because it offers insight into how different features of media affect cognition and emotion. The text comprehension hypotheses are tested within the context of the “construction-integration” model (Kintsch, 1988). This discourse-based approach, which takes into account the limited capacity of the human brain to process information and views comprehension as drawing inferences and fitting them in with previous knowledge, are the theoretical basis for the Sentence Verification Technique (SVT) task that is used to measure comprehension. This dissertation does not directly build upon contemporary limited effects models, but it recognizes that media messages influence some audiences more than others, in certain circumstances more than in others, and that there is an interaction between audiences, messages, and social environment (e.g., Bandura, 1986, 1994). The

emphasis here, however, is on individual-level variables of information processing; hence, the review of the theories relevant to this dissertation begins with a summary of the existing psychological knowledge on attention and memory. This is followed by a review of LC4MP and of the construction-integration model.

Attention

Attention refers to the voluntary or involuntary selection of items from the environment (Baars & Gage, 2007). It is highly relevant to the cognitive processing of news, since it has been argued that lack of attention is at the core of the lack of memory and understanding for news, which in turn leads to decreasing readership. For instance, Meyer (2004) suggests that the mountains of information available through the Internet lead to “an overload on the ability of the audience to receive and consider the messages” (p. 8). Broadbent’s (1957) early view of attention was that it operates as a pipeline, starting with sensory information that is attentionally filtered before entering the cognitive realm. The typical metaphor for attention is “spotlight” (Baars & Gage, 2007). Because of limited capacity, people cannot attend to everything in the environment. What is attended to is the product of various selection processes. Many studies have shown that performance suffers when attention is divided (e.g., Cowan et al., 2005; Saults & Cowan, 2007; Cowan, 2001). This concept of divided attention is at the core of the secondary task technique used in measuring cognitive capacity. The more cognitive resources are used up by a primary task, the more the reaction to a secondary task is delayed: a principle that Britton and colleagues (1978) suggested can be easily demonstrated by asking a colleague to multiply 37 by 8 while walking along a long hallway; the multiplication would lead the person to slow down or stop walking. What is attended to has an impact on what is retained in memory, a topic reviewed briefly in the following section.

Memory

Memory is the cognitive process of creating a mental record of the past, both distant and immediate (for a recent summary, see Baars & Gage, 2007). Questions addressed in memory research include types of memory (e.g., short-term versus long-term; episodic versus semantic; declarative versus procedural, etc.), and how information is selected and retained. The findings suggest two categories of content-based memory: (1) episodic (autobiographic, unique memory of personal experiences), found to contain a large yet limited amount of information (about 1 billion bits); and (2) semantic (knowledge shared with others, often viewed as the collective residue of multiple episodic traces), found so far to be unlimited. As a general rule of thumb, research has found that conscious types of memory (declarative, working) are of limited capacity. No capacity limit has been shown so far for unconscious types of memory, e.g., procedural information such as how to ride a bike, or the ability to maintain the lexicon of one or more languages (Baars & Gage, 2007). Lexicon in linguistics refers not just to the knowledge of a list of words, but also to their appropriate usage in idiomatic phrases and the skillful application of the rules of syntax and phonology (Marantz, 1997). Those findings are also reflected in Lang's LC4MP model (2000; 2006), which emphasizes limited capacity for encoding and storage of new information but not for the content of semantic memory.

Research on working memory is especially relevant to the limitations and overloads that occur in human information processing. For instance, a typical way to load working memory in psychological research is the so-called n-back task, which requires study participants to keep in mind a number of items and their order but also continue to notice new elements (e.g., Smith & Jonides, 1998). In a sense, the challenge of the n-back

task is similar to the challenge posed by a story written in the inverted pyramid style. The inverted pyramid also requires readers to remember a lot of elements ordered by presumed importance before being able to draw inferences.

Cowan (2001) defined working memory as the set of mental processes holding limited information in service of cognition. An earlier widely accepted model of working memory was coined by Baddeley and Hitch (1974). It consists of three elements: central executive, phonological loop (for rehearsal of auditory, including verbal information) and visuospatial sketchpad (for rehearsal of visual information). After information passes through sensory stores and the attention buffer, it can be held in the phonological loop and the visuospatial sketchpad. The initial view that those two elements are completely separate has been revised in recent years due to evidence that overload of one of the rehearsal/storage elements affects (limits) the capacity of the other one. This has led to the suggestion of a limited-capacity overlap between the two, called focus of attention (Cowan, 2001) or episodic buffer (Baddeley, 2000). Much of cognitive research has been devoted to the boundaries of the limited capacity of working memory, starting with a seminal study by Miller (1956), which showed that most people can hold seven items in their immediate memory, plus or minus two. Later studies, however, suggested that Miller may have underestimated the importance of chunking (“gluing” several items together in a meaningful unit, as in the letter string FBI, for example). For instance, Cowan (2001) found that, without having the option to chunk, most people can hold between three and five items in working memory. Using a different research setup than Miller and Cowan, Sperling (1960) showed that, out of an array of 12 items, people remember about four.

All this literature supports the view that cognition is limited by default; this is only one element of a more general evolutionary perspective on the psychological

processing of media, which suggests that because the human brain adapted to processing environmental stimuli crucial to survival and procreation, it is likely to utilize similar heuristics in processing modern media (Sherry, 2004; Shoemaker, 1996; Lee & Jung, 2005). The specific memory limitations outlined above can be extended to suggest, for instance, that messages requiring people to hold more than several items in their working memory will seriously tax their cognitive resources, limit what they can transfer into long-term memory, and cause them some subjective discomfort due to the amount of mental work involved. Media effects scholars have borrowed heavily from the cognitive psychology literature to develop information processing models that help explain the effects of mediated content on cognition. The limited capacity model of motivated mediated message processing (LC4MP; Lang, 2006), the topic of the following section, is an example of such a theoretical framework.

LC4MP: Testing available resources and memory

Lang's LC4MP (2006) reflects much of the research on cognition reviewed above and is about understanding "how the content and structure of messages interact with a viewer's information-processing system to determine which parts and how much of a communication message is remembered" (p 46, 66). The model includes three stages of cognitive processing: encoding, storage, and retrieval, which are "continuous and iterative" and for the most part occur simultaneously. It is the allocation of both controlled (goal-directed, intentional, conscious) and automatic (unintentional, unconscious) resources that eventually determines the extent to which a message is comprehended and may lead to some degree of learning. Lang specifically distinguishes between automatic and controlled processes in the encoding stage, when information is perceived. In that stage, sensory input is taken in and bits of information are selected

based on the perceiver's goal (through both controlled and automatic processes) as well as the structure and content of the message (through automatic processes). In the end, the encoded message is "an idiosyncratic representation of the message that is constructed by the viewer" in the working or activated memory (Lang, 2000, p. 49).

The second subprocess, storage, refers to the keeping of mental representations of selected bits of the sensory input in sensory stores of working memory, for example, in the visuospatial sketchpad or the phonological loop (as in Baddeley and Hitch's model of working memory, for instance). Associations are built between new and old mental representations, and which bits make it into storage depends on the memory networks that become activated. Retrieval, the final subprocess, refers to searching associative memory network for relevant knowledge in order to comprehend and store new information. It is both "an outcome associated with learning the content of a message" and "an ongoing process during message reception" (Lang, 2000, p. 50). Because Lang assumes that resources are allocated from a single pool, all of what is available can be used for just one of the processes or distributed in various proportions among encoding, storage, and retrieval. Messages may not be thoroughly processed either because the recipient chooses to allocate fewer resources than necessary or because a message requires more than the available resources.

The LC4MP discusses those three cognitive subprocesses in the context of television viewing. It does not directly address the cognitive processing of reading, which has gone largely unexplored in mass communication research. The model has been used mostly as a framework for the cognitive processing of video and audio messages, which are also used as examples in Lang's articles (2000; 2006). However, the LC4MP is highly relevant to questions about the cognitive processing of text proposed here because it successfully incorporates and builds upon a number of earlier theories on attention and

memory, some of which have been used in educational psychology and reading research. For instance, the notion that previous knowledge allows readers to make inferences from new text (Kintsch & van Dijk, 1978; Kintsch, 1988) is very similar to the retrieval stage in Lang's model.

All this suggests that there is no reason to avoid using the LC4MP in studying reading. As the next section shows, the cognitive challenges of processing of text can be assessed indirectly by dividing attention and measuring reaction time to a secondary task.

Available resources during reading

Reading is a mental challenge, perhaps the most difficult of various types of language processing. According to Kutas et al. (2007), language is “a mapping between physical inputs/outputs, in the form of written, spoken, or signed signals, and experiences, memories and knowledge stored in long-term memory” (p. 560). In that sense, reading can be defined as mapping between inputs/outputs from written signals and what is stored in long-term memory. One way to explore how reading different story structures puts a load on human cognition is through the concept of “available resources,” an amount equal to resources allocated minus resources required (Lang et al., 2007). A typical way to measure available resources is through secondary task reaction time (STRT). While people are watching a message (primary task), they are also asked to press a button as soon as they hear an audio tone. Most STRT research has been done using video messages as stimuli, specifically in measuring encoding. At least one study has used it in evaluating writing processes (Piolat et al., 2001). Assuming that cognitive resources come from one central pool and all stimuli (visual or auditory) compete for those resources (Morey & Cowan, 2005; Sauls & Cowan, 2007), STRTs seem to be appropriate to studies of any cognitive workload, including reading.

Secondary task reaction time (STRT) has been used, if seldom, in some text comprehension studies. Britton and colleagues (1983) measured cognitive capacity through a secondary task technique with two kinds of probes, auditory and tactile, during reading of text in six experiments. They compared narratives and expository texts, which can be considered loosely similar, respectively, to the chronological and inverted pyramid structures as defined earlier. The findings were somewhat counterintuitive: Slower reaction times were found for narratives than for expository texts, suggesting that more cognitive resources were used while reading narrative text than while reading expository texts. Britton et al. (1983) argued that the slower STRTs are due to the fact that readers are more absorbed. In other words, “narrative passages produce more meaning because schemata for narrative texts are more familiar, more frequently encountered, and easier to comprehend than schemata for expository texts” (p.39); when more meaning is produced, more cognitive capacity is filled. Interestingly, Britton et al. found no support for the hypothesis that texts that are difficult to comprehend induced “problem solving cognitive operations that filled capacity” (Britton et al., 1983, p. 39).

This is consistent with earlier studies by the same group, showing that readers were slower to respond to a secondary task when reading relatively easy to comprehend (as measured by a Cloze test) text than they were when reading more difficult text (Britton, Westbrook, & Holdrege, 1978; Britton, Holdrege, Curry, & Westbrook, 1979). Recall rates were similar both for easy and difficult passages, suggesting that both had been read. Furthermore, total cognitive capacity usage, a concept that takes into account not only STRTs but also the amount of time it takes to read a passage (calculated by multiplying the number of seconds it took to read a passage by the average reaction time in milliseconds) turned out to be greater for difficult than for easy passages. This led Britton et al. (1978) to conclude that, due to “frequent breakdowns” in “word recognition

and grammatical calculations” (p. 589) in reading difficult passages, working memory is temporarily emptied, leaving capacity available for the secondary task. Text generating more discourse level meaning, defined as “the meaning conveyed by the integrated sentences of the text as a unit” (p. 263), has also been found to elicit slower STRTs than a paragraph consisting of sentences that are meaningful on their own but unrelated to adjacent sentences, unless unified by a title (Britton, Holdrege, Curry, & Westbrook, 1979). Prior knowledge has also been found to fill cognitive capacity, with readers showing slower STRTs during the reading of texts for which they had background knowledge than for texts on relatively unfamiliar topics and issues (Britton & Teaser, 1982). Furthermore, Britton et al. (1983) found that text mentioning people fills more cognitive capacity than text about inanimate objects; and passages from children’s literature fill more capacity than adult literature. Those findings suggest that in reading, STRT may be more than a measure of available cognitive resources at encoding, and perhaps also reflect capacity related to retrieval.

Britton’s approach to STRT is very different from Lang’s paradigm, which views STRT as a measure of resources (available or remaining) at encoding and significantly influenced by features eliciting orienting responses, such as scene changes. As such visual changes are of lesser significance in text, Britton and his colleagues argue reaction times reflect access to long-term memory and construction of new associations. “If an expert happens to have an extremely large amount of activated prior knowledge for a particular task, the knowledge will presumably use a correspondingly large amount of capacity” (Britton & Teaser, 1982, p. 423). Readers have also shown slower STRTs while reading sentences judged “important in the content structure of a passage,” suggesting that such sentences require more effort to process and relate to the context (Britton, Muth, & Glynn, 1986). All this evidence comes in support of the so-called

comprehensibility hypothesis, which states that “cognitive capacity is filled during reading by the meaning that is produced in the reader’s cognitive system” (Britton et al., 1983, p. 41), with meaning being defined as “large amount of cognitive content besides the text itself” (p. 41). That may include memories of related information, schemata, affect, and cognitive elaborations. In the example used by Britton, a psychologist would generate a lot of additional cognitive content while reading a scholarly paper on a topic in psychology but very little while reading a professional paper on plant pathology.

With the exception of the studies by Britton and colleagues, the issue of cognitive capacity usage in reading remains largely unexplored. The research line has been continued to some degree in research on aging; for instance, Tun (1989) replicated Britton’s STRT findings in comparing narrative versus expository texts among younger readers but not among older readers. However, the STRT research in reading is indirectly related to much other literature. For instance, the view that chronological stories lead to more reading absorption (indicated by the slower STRTs during reading) is reminiscent of some research in journalism, such as Schramm’s 1947 finding that feature stories (which are often chronological) “hold” readers better than inverted pyramid stories. It is also consistent with research showing that narratives, such as folktales (loosely similar to the chronological structure as defined in this dissertation), possibly due to the absorption they induce, are read more quickly than information-conveying structures, such as encyclopedia articles (Graesser, Golding, & Long, 1991). The findings by Britton and colleagues indicating faster STRTs in reading non-narratives are also consistent with research showing that more complex audio and video messages (with more changes in scene or topic and containing more information) elicit faster STRTs (Lang et al., 2006; Lang et al., 2007; Bolls & Lang, 2003). Thus, the following hypothesis emerges:

H1: Chronologically structured stories will lead to slower secondary task

reaction times (STRTs) than will inverted pyramid stories.

Hypothesis 1 is also indirectly derived from readership research suggesting that inverted pyramid stories are more likely to lead to disengagement, especially after reading the lead and the first few paragraphs (e.g., Shoemaker, 1996; Graber, 1984; Green, 1979). Some authors (e.g., Graber) have interpreted this “giving up” as a time efficiency approach (the readers got what they wanted and they are moving on) rather than disengagement. One reason for such disinvolvement may be that inverted pyramid stories require more work: Readers have to understand and memorize the gist as summarized by the writer rather than constructing their own “whole” of the text, which is a necessary step on the comprehension process (Kintsch, 1988). They also have to constantly access long-term memory to contextualize new bits of information (Lang, 1989) and make more inferences due to a shortage of causal connections (Green, 1979).

Based on the above literature, inverted pyramid stories can also be expected to lead to less knowledge gain and poorer memory, which is what Lang (1989) found in an exploratory study of television stories. This might be because of the disinvolvement issue, and because inverted pyramid stories are more likely to present a cognitive challenge, thus limiting cognitive resources, than are chronologically structured stories. Two measures that are useful here are recognition memory and cued recall, which are negatively affected under cognitive overload (e.g. Lang, Bolls, Potter, & Kawahara, 1999). Recognition, the most sensitive memory test, has been used as a measure of message encoding performance (e.g., Lang et al., 2007) and of episodic memory strength, which is related to semantic competency (e.g., Robertson & Kohler, 2007). Cued recall has been used as a measure of storage (Haarmann, Davelaar, & Usher, 2003), as it reflects associations between newly encoded information and already existing knowledge. Hypothesis 1 already suggested that chronological stories will absorb more

cognitive capacity, measured through secondary task reaction time (STRT), than will inverted pyramid stories. The findings in some of the existing literature (e.g. Tun, 1989) are that narrative texts (loosely similar to chronologically structured stories, as defined here) lead to better recall than expository texts, a category that includes the inverted pyramid structure. Further testing the effect of story structure on encoding and storage requires a measurement of how well people can recognize and recall details from each story:

H2a: Recognition memory of content in chronologically structured news stories will be more accurate than recognition memory of content from inverted pyramid stories.

H2b: Cued recall of items in chronologically structured news stories will be greater than cued recall of items in inverted pyramid news stories.

These hypotheses are consistent with Lang's (1989) finding that chronologically structured broadcast news stories elicited more accurate recall than traditionally structured inverted-pyramid stories. Comparing the information processing of inverted pyramid stories versus chronologically structured stories within the theoretical framework of the LC4MP has the potential to enrich Lang's model and provide further support for it by extending it to a new medium, text (print or online). There is one more dependent variable, comprehension, which is closely related to memory but nevertheless requires a separate theoretical framework. This is the purpose of the following section.

“Construction-integration” and comprehension

Comprehension, while impossible without attention and memory, has usually been discussed within the realm of linguistics. One approach to understanding text comprehension is the “construction-integration” (CI) model (Kintsch & van Dijk, 1978),

which is highly applicable to this dissertation because it fits well with models of cognition that emphasize limited cognitive capacity. Comprehension in that model is viewed as a “cyclical process constrained by limitations of working memory” (p. 363). It occurs in three stages: the elements of a text are organized into a coherent whole; the gist of the text is subtracted from that whole; and finally, new texts are generated from “memorial consequences.” Just like in the LC4MP, many complex processes linking general to particular and vice versa occur as part of the model, either simultaneously or in a sequence. Just like in the Baddeley and Hitch model of working memory (1974), in the CI model cognitive processing of text goes two ways: Bottom-up signifies sensory input and top-down is about the effect of memory and knowledge components (Kintsch, 2005). Those directional processes interact and produce “fluent comprehension.”

Comprehension in this model is closely linked to memory, because it is viewed as “constructing a representation of a discourse upon which various computations can be performed” (Kintsch, 1988). Computations are defined in the sense of answering questions, recollection, summarizing, etc., of the text. According to the CI model, the reader makes a lot of parallel inferences, or linkages, based on the text; however, many of those inferences become deactivated in the process of reading and integration of knowledge. There are several steps: “(a) Forming the concepts and propositions directly corresponding to the linguistic input; (b) elaborating each of these elements by selecting a small number of its most closely associated neighbors from the general knowledge net; (c) inferring certain additional propositions; and (d) assigning connection strengths to all pairs of elements that have been created” (Kintsch, 1988).

Prior knowledge is crucial to this process, because it can sometimes change the learning outcome from reading a text (Kintsch, 1988; Yochum, 1991). For instance, McNamara and Kintsch (1996) found that high-knowledge readers learned more from

low-coherence text, where they had to do a lot of their inferencing on their own, while low-knowledge readers learned more from high-coherence texts. Furthermore, prior knowledge has been found to affect reading time across text structures, with sentences toward the beginning of a story or holding a relatively high level of importance taking longer to read than sentences later in the story or of less importance, likely due to the need for context in which to integrate meaning (Cirilo & Foss, 1980). “High-level” sentences, according to the same study, also generate better recall.

If a combination of words does not make sense (in Kintsch’s example, if it is about lawyers sending defendants to prison), then the knowledge net in the second step of the process contributes nothing; however, readers still elaborate associatively on each word separately. A text is comprehensible when it is coherent, and van Dijk (1983) lists several coherence strategies used by journalists: specification or the use of “general toward particular” flow of information; conditional and temporal relations among the denoted facts; generalizations or summarizations based on a local or a current event; contrast or denial when events are compared to expectations; and deletion of irrelevant detail. Lack of familiarity with the topic means the text will be processed in small chunks (in that sense the short paragraphs of the inverted pyramid formula seem to be an appropriate choice). And, if a “crucial piece of information fails to arrive, the working memory will be quickly overloaded and incomprehension will result” (Kintsch & van Dijk, 1978, p. 372).

This process of generating inferences is very similar to what Graber (1984) calls fitting new information into one’s personal “schemas,” or cognitive structures that contain knowledge and opinions about specific topics or people. Schemas can sometimes change if contradictory information overwhelms them. For the most part, however, people deconstruct and pigeonhole the news, which explains the inaccuracies and

misinterpretations that emerge in recall. In other words, “people are apt to distill information into true or false meanings and inferences, and store only the distillation” (Graber, 1984, p. 127). In that sense, audiences “re-narrate” news stories, categorize the issues and the players, categorize what is important, and draw inferences for the future. The need to generate inferences and “memorial consequences” from a semantic situation is also in line with the findings of Bransford and Franks (1971; Bransford, Barclay, & Franks, 1972) showing that linguistic ideas are “abstracted” and “constructed,” and that people are more likely to (often falsely) recognize sentences that express “all the semantic information characteristic of the complete ideas acquired during acquisition” (Bransford & Franks, 1972, p. 348).

The CI model seems useful in explaining the cognitive processing of news stories featuring topics that most readers are not familiar with, such as foreign affairs and obscure governmental proceedings. But do people actually read stories on topics they know nothing about? Yes and no. Graber (1984) found that, on average, people read about 67 percent of the stories in the newspaper (p. 82). Many of their choices were determined by the personal relevance that stories carried for them, and, to a lesser degree, by prominence cues supplied by the media and cues from the social environment (conversations among friends and family). Further support for this notion is provided by the uses and gratifications approach to media effects (Blumler & Katz, 1974), which argues that people consume media to gratify specific needs. Yet another wide body of literature (agenda setting; McCombs & Shaw, 1972) suggests that people at least sometimes read news on topics they have no personal familiarity with (e.g., a foreign war, federal politics). Those so-called “unobtrusive” issues are the realm of so-called agenda-setting effects, and audiences are more likely to be influenced by the media in perceiving unobtrusive issues than obtrusive as important.

Whether the topic is familiar or not, for best comprehension and long-term memory, the reader must be able to derive relevant “macropropositions” that place current events in context (for instance, “the Israelis again violated the cease-fire”). In that sense, differences in the comprehension of story structures may be related to the different ways in which such “macropropositions” are constructed. In the case of the inverted pyramid, a “macroproposition” is easily available; however, it is not derived by the reader but by the writer, who crafts the lead. In the case of a chronologically structured story, readers can derive their own “macropropositions” as they progress through the unfolding of events.

So why might chronologically structured stories be easier to process? As Lang’s LC4MP model (2000, 2006) suggests, a chronological presentation, or one rife with well-placed explanations, would leave available most of the readers’ existing cognitive resources for encoding and storage in memory, since fewer resources would be spent on retrieval of information from long-term memory (needed to facilitate storage). Similarly, in Kintsch’s construction-integration model (1988), comprehension requires creating a mental representation of the “whole” text, followed by subtracting the gist and then creating inferences for comprehension of future information on the same topic. When readers are faced with stories in which the gist has already been subtracted, they miss the entire first step in the comprehension process, the construction of a mental “whole” of the text. Graesser, Golding, & Long (1991) suggest that it is easier to comprehend and remember “*event sequences* that people in a culture directly enact or experience” (p. 172). DeSilva (2002, p. 47) suggests that “drama and suspense have to do with chronology.” Teske (2006) has even argued that there the relative ease of reconstruction of temporal orderings in the human brain has a neuropsychological basis:

The serial stream of conscious experience is likely to be a kind of virtual

temporality imposed upon a massively parallel stream of conflicting and continually revised events (p. 182).

Memory measures, including free recall, cued recall and recognition (in the form of multiple-choice questions), have been used to assess comprehension, but a measure that appears to be fairly specific to comprehension is performance on the Sentence Verification Technique (SVT). This is a measure of comprehension that requires participants to decide whether a test sentence means the same as a sentence encountered in the original text (for a review, see Durwin & Sherman, 2008). The essence of SVT (Royer, Hastings, & Hook, 1979; Royer, 2001) is that it forces one to engage in interpretation rather than just recollection of a linguistic message, and is considered a measure of paragraph-level rather than sentence-level comprehension (Durwin & Sherman, 2008). It is based on the theoretical assumptions of the CI model, specifically “that reading comprehension is a constructive process involving an interaction between incoming discourse (text or speech) and the reader or listener's prior knowledge” (Royer, 2001, p. 30). As a result, the meaning is preserved but not the exact words, which is in sync with the findings of Bransford and Franks (1971, 1972). Assuming that most readers lack sufficient prior knowledge on complex topics in the news, it is likely that they can better derive accurate interpretations (measured through SVT) from reading chronological rather than inverted pyramid texts. Thus, it follows that:

H3: Chronologically structured stories will lead to better Sentence Verification Technique scores than will inverted pyramid stories.

More indirect support for this hypothesis is offered in the next chapter, which outlines the emergence of the inverted pyramid as a news production rather than a news consumption convenience, and its shortcomings in terms of reading enjoyment in comparison with a chronological structure.

2.2. Text structure as a predictor of reading enjoyment

It can be said that journalists, their sources, and their audiences come together to form unique “discourse communities” (Killingsworth, 1992, p. 110). But there is also much disconnect among them. Routine features and approaches to news, of which the inverted pyramid is only one, are often disliked and misunderstood by readers. A slew of studies suggest the divide is wider than one can imagine. For instance, contrary to the assumption that local news is attractive to readers, news with a local byline are less likely to be read than news supplied by a wire service or a syndicate (McCombs, Mauro & Son, 1988). Using vivid personal cases in broadcast stories about disabilities and unemployment leads to less audience involvement and empathy than stories that only present statistics about the issue (Iyengar & Kinder, 1987). Direct quotes, a feature of news that is highly valued by reporters and editors, make little difference to comprehension and information retention (Weaver et al., 1974).

The inverted pyramid might be one important element of that disconnect between journalists and audiences. Although many find it to be “cluttered and confounding” (p. 11), it continues to be used in about 70 percent of newspaper stories (Retaining New Readers, November 5, 2001). A popular news writing textbook suggests the ratio is even higher, 80 percent for regular news stories and nearly 100 percent in niche markets, such as financial news (Brooks et al., 2005, p. 145). Chronological stories are rare, especially because they require gathering of details about what happened over a period of time and do not fit the demands of newsroom routines.

Consider the following example of a “news narrative with a narrative emphasis” (p. 196) from Brooks et al. (2008):

About five months ago, Cara Walker, 17, was lying in a hospital recovering from the spinal injury she received when she lost control of her car, rolled the vehicle and was thrown halfway through the side window.

Doctors weren't sure she would ever ride again. On Sunday, in a remarkable turnaround, Walker competed in the Midway Fall Classic Quarter Horse Show at the Midway Expo Center. The results were surprising.

Last July, Walker, a junior at Rock Bridge High School, was taking lunch break from riding in preparation for the Fort Worth Invitational, where she qualified in five events. Driving with three passengers on a back road near Moberly, she rolled her car at 50 mph where the paved road turned to gravel without warning. Walker was the only one not wearing a seat belt. Her head and upper body smashed through the side window.

Fortunately, she was still in her riding boots. Her spurs got caught on the bar under the seat, which Walker says may have saved her life.

At the time of the accident, Walker was nationally ranked in the trail-riding event.

Doctors fused her neck in surgery. During the next couple of weeks, she was able to shed her full upper-body cast. Walker returned home to her parents and twin sisters two days after the surgery, but her mother, Jane Walker, said doctors told her to stay away from her sport for a few months until she healed.

For Walker, the top all-around youth rider in Missouri and the president of the American Quarter Horse Youth Association, the four months following the accident was her first time away from riding.

After returning home, she worked to regain strength and mobility from the accident that initially left her right side paralyzed. She walked short distances. Going to the mailbox at the end of the driveway wore her out, her mother recalls.

Walker had to work almost every muscle in her body back into shape. After the accident, the family brought her 10-year-old quarter horse to their barn in Columbia. That motivated Walker to at first walk to the barn and then to start caring for the horse and eventually ride again.

Sunday, the rehabilitation was complete. With ramrod posture and strict horse control, she won first place in the horsemanship class (p. 196).

The above story, however, is a textbook case that was modified to provide an example of chronological writing. The published article (Tully, 2006, November 27) was cast in a more traditional mold and did not wait until the last paragraph to deliver the news that the injured rider had won first place. Rather, the punch line came early, in the third paragraph, following a background graph introducing the teenager and her riding achievements. This is just one example suggesting the degree to which the inverted pyramid, which requires less effort to report and write than a chronological story (Brooks

et al., 2008), has remained unchanged due to the pressure of news routines. As Breed (1955) observed more than 50 years ago, media staffers learn “by osmosis” (p. 328) to craft the news in accordance with “professional norms” (p. 327) and subtle, covert policies dictated by superiors. Tuchman (1978) and Gans (1979) found that reporters pigeonhole news according to preset frames. The use of known story forms such as “the fire” or “the lost child” prompts reporters not only to choose how to write but also what questions to ask of their sources (Tuchman, p. 103). Gans even compared journalistic work to an “assembly line” (p. 165). The next section outlines the unfavorable perceptions that readers have of such an approach to news writing.

Criticism of the inverted pyramid

Some of the literature suggests the inverted pyramid scores quite low on readers’ enjoyment and comprehension. It is certainly not the style used by the more popular print media of books and magazines. For example, Knobloch et al. (2004) have found that the common inverted pyramid style of news writing is less effective than other styles at maintaining reader interest. A field experiment at the *St. Petersburg Times*, partially organized and supported by the American Society of Newspaper Editors and the Poynter Institute for Media Studies, also found that readers, when presented with different versions of stories, preferred and learned best from narratives (defined in that study as chronological stories with beginning, middle and end, and featuring distinct characters). The modes that fared less well included the inverted pyramid, “point-of-view” presentation and “radical clarity” structure with detailed explanations (Ways With Words, 1993).

Readers also tend to understand more content from complex science stories written with Yaros’s (2006) explanatory structure-building (ESB) model than in the

inverted pyramid. The ESB is similar to a chronological presentation in that it builds up the presentation of a complex slowly, fact by fact, aiming to provide context and clarity. In a between-subjects experiment, undergraduate students were introduced to scientific information presented either in an inverted pyramid or ESB form. After controlling for scientific literacy, the study found that readers liked and understood the ESB story much better than the inverted pyramid one. Those who read the inverted stories, in fact, often appeared to fail to generate inferences (Yaros, 2006).

In the context of online news, Wise et al. (2007) also found that video clips attached to a story written in inverted pyramid style elicited greater heart rate deceleration during the first half of the video clip than video clips attached to a story written in narrative/chronological style, suggesting inverted pyramid stories require greater allocation of cognitive resources.

Because the inverted pyramid seems to be somewhat unnatural to the way people process information, it has been called the “perverted pyramid” (Fry, 1999, p. 24) and “one of the most unstable architectural forms the mind can conceive” (Fitzgerald, April 13, 1996, p. 72). It has been pinpointed as the reason behind the lack of memorable news story endings that “you can hear echoing in your head when you put the paper down” (DeSilva, 2002, p. 47).

The problem with the inverted pyramid, Green (1979) has argued, is that such a presentation is entirely organized around production convenience, allowing an editor to shorten a story from the bottom up, rather than around readers’ convenience. A linguist, Green was surprised upon perusing newspaper stories to discover that they contained fewer connectives (e.g., “as a result of,” “consequently,” “meanwhile,” “such as,” “however,” etc.) and more content redundancies than so-called “normal” English. Especially lacking in news stories were causal connectives, more so than temporal

connectives, most likely because reporters feared of being accused of personal interpretation. Green took as an example a story about student protests, rewrote it as if the reporter was telling it at home after work, and found that the “at-home” story was shorter, yet it contained twice as many connectives than the Associated Press version (Green, 1979).

Many journalists are aware that “the inverted pyramid allows for very little freedom of expression, that the formula is so narrow in scope that it is often dull” (Beasley, 1998, 83). It is also easier to write, because it allows for presentation of facts without necessarily having all the connections between them, while a chronologically structured piece takes more time and research (Beasley, 1998). Not surprisingly, studies have found that most newspaper readers read only the first few paragraphs of a story, unless the topic is of high personal or other relevance (Graber, 1984; Schramm, 1947). In that sense, the inverted pyramid can be seen as both a culprit (it delivers the scoop early on, causing the story to run out of steam) and a necessity (if we assume that readers cannot be expected to read the whole story). Graber (1984), for example, has argued that the inverted pyramid helps readers to fit new information into their already existing schemas (cognitive structures combining knowledge and opinions about people and topics). But she has also found that many readers have highly inaccurate memories of what they read in the news, and that only 18 percent of all newspaper stories are read in full. Graber’s study also found that most people had difficulty keeping up with a developing story if they had missed the first installments on the topic.

Those trends continue in the 21st century: A recent Poynter Institute study showed readers often drop midway when reading inverted pyramid stories (Brooks et al., 2005, p. 145). This reading disengagement may be related to the fact that the writer rather than the reader has decided what is important and in what order it should appear. This is

hardly conducive to reading enjoyment, which is predicted by choice and personal relevance of topic (Flowerday, Schraw, & Stevens). Cultural congruence is another predictor of reading enjoyment (Rickford, 2001), and the inverted pyramid is hardly congruent with the way people tell stories in everyday life. Although these findings come from the education literature, there is nothing that suggests their logic cannot be extended to the news domain. Furthermore, the inverted pyramid can be viewed as a private case of the so-called expository style of writing, which is intended “to convey information so that the reader might learn something” (Weaver & Kintsch, 1991, p. 230). Within that style, there are different text substructures. The inverted pyramid appears similar to the descriptive (grouping by association, Meyer & Freedle, 1984) substructure or the cause-and-effect substructure within expository writing, which have been found to be less memorable and enjoyable than other structures, such as the so-called contrast-compare structure (e.g., Yin-Kum, 1995; Meyer & Freedle, 1984).

Based on all this literature, it is hypothesized that:

H4: Chronologically structured stories will elicit more self-reported reading enjoyment than will inverted pyramid stories.

In short, the literature on story structures suggests that the inverted pyramid is a formulaic, cognitively burdensome way to present the content of a news story. Does this have anything to do with the fact that the news industry was initially created by men and for men? This is the topic of the next chapter, which focuses on the female language advantage and the paradoxical finding that fewer women than men read news.

2.3. Sex differences in reading

This section explores what some have called the “gender gap” in reading news.

Fewer women than men read news, but why is that? Biologically, women are better readers than men, as the following review shows. Is it possible that story structure acts as a moderating variable in the relationship between sex and reading ability? There are virtually no studies from the realm of the media psychology that have addressed the issue (although some sociological explanations have been suggested and are described in the literature review that follows). Why women are less keen than men on reading news is an important question for the news industry, which can benefit from any audience research during a time of a major shift in news delivery channels combined with increasing mistrust in media (Jones, 2004). But the question is also of theoretical significance, because it may indicate a potential limitation to the well supported finding that women have a biological advantage in language processing.

Despite the use of the term “gender gap,” the focus of this dissertation is really on sex differences in reading. The concept of gender is often used in social science research as synonymous with biological sex, but this dissertation contends that it is more accurate to define gender as “a social, symbolic construction that expresses the meanings a society confers on biological sex” (Wood, 2007, p. 318). Within the concept of gender, individuals can be classified as predominantly masculine or predominantly feminine. Many fall in the middle: They are “both masculine and feminine, both assertive and yielding, both instrumental and expressive, depending on the situational appropriateness of these various behaviors” (Bem, 1974, p. 155). Because of the complexities involved in defining and measuring gender as a continuous variable, this dissertation uses only sex as a dichotomous variable with two levels, male and female.

Some of the first readership studies using sex as a variable were conducted by the American Newspaper Publishers Association in the early 1940s (Sikes, 1942). A brief primer on readership studies published in *The Journal of Marketing* recommended that an

equal number of men and women be selected for each study, with stratified sampling to represent different occupational, class and racial groups. In those days, married women were still classified by the occupation of their husbands. In 1970, readership was still fairly evenly divided between the sexes: 78 percent of adult *women* and 77 percent of adult men were likely to read a daily newspaper. Twenty years later, only 64.5 percent of men and 60.5 percent of women read a daily newspaper (Fitzgerald, 1994). In 2004, the gender gap was still present: About 51 percent of men and 46 percent of women read a daily paper, according to data from the Newspaper Association of America. In the same dataset, the difference is especially striking for the 25-34 age group: About 42.2 percent of men and 29.8 percent of women in that category read daily newspapers (Mitchell, 2004).

USA Today, without citing a specific source of information, reported yet different and more alarming numbers: In 2004, 47 percent of men and 37 percent of women read newspapers (The News Gender Gap, 2004, July 9). The gap was, however, reversed for nightly network news (watched by 37 percent of women and 30 percent of men) and for local TV news (61 percent of women, 56 percent of men), according to the *USA Today* dataset. Gibbons (2003) reports that such a “gender” gap exists in nearly every country in the world, and suggests the explanation is at least partly in newspapers’ use of generalizations and stereotypes. But another explanation is also possible: As many women entered the workforce in the 1970s and 1980s, juggling career with childcare demands may have left them with less time to read. Einsidel and Tully (1981), for example, presented data from at least two readership studies showing that housewives were more likely to read a daily newspaper almost every day than were working women. However, surveys by Minnesota Opinion Research, Inc., found that readership among working women is just as high, if not often higher, than among those who stay at home

(McGrath, 1993). Some differences in content preference also emerged from at least one readership survey: While working women were more interested in consumer safety, health, environment, food, and wars, housewives preferred to read about crime, economics and science (Einsidel & Tully, 1981). Graber (1984, p. 74), on the other hand, suggested it is the mothers of small children (working women or not) who were the least interested in news and had the most difficulty with finding time to pay attention to news.

Research shows that men and women approach news content differently. Weaver and Mauro (1978), for example, found that men and women read some of the same news categories (from hard news to humor), but in different combinations. Women also tend to evaluate crime stories as more disturbing than do men (Ketterer, 2002). In processing broadcast news, women process pleasant stories more effectively than they process unpleasant stories. They are also drawn to stimuli that are moderately arousing as long as the stories deal with pleasant topics, while they tend to avoid unpleasant (Grabe & Kamhawi, 2006; Kamhawi & Grabe, 2008). By contrast, men are drawn to unpleasant stories more than they are drawn to pleasant stories (Kamhawi & Grabe, 2008). Given the predominance of negatively framed news, a phenomenon that Shoemaker (1996) suggests is meant to fulfill an evolutionary surveillance function, these differences offer another explanation for why women are less avid news readers than men.

In desperation about the continuing loss of female readership, some newspapers in the 1990s reintroduced women-only sections, which had been common in the 1950s before being deemed as too “patronizing” and replaced by lifestyle sections (Schmidt & Collins, 1993). Other strategies for attracting female readers have included efforts to increase the number of female sources quoted in news stories and to strengthen so-called “content for women” (Armstrong, 2006, p. 447-448), including coverage of education, health, homemaking, fashion, etc. Strong readership among women is often traced to

local news, especially when the community exhibits “emotional consensus” (McGrath, 1993, p. 101). Other studies have focused on women’s view of newspapers as carriers of masculinity. Freedman and Fico (2005) suggest it is the lack of female sources that discourages women to seek out news. When asked to personify a paper, female focus group participants typically responded that they imagined the newspaper as a man in his 50s or 60s, wearing a suit, or a “good old boy” drinking bourbon and driving a nice, big, all-American car (McGrath, 1993, p.102). Some women have also made comments to which editors responded by throwing “their hands in disgust” (p. 101): newspapers ruined their manicures, soiled their white couches or were simply too old-fashioned. Although the inverted pyramid never comes up as an issue in content preferences, it is the choppiness of print news that women seem to dislike:

Women are obsessed with the subtext, the meaning, the motive, the story behind the story. Women are interested in the constructive uses of information, not in being informed for the sake of being informed. They’re turned off by the endless stream of coverage that presents news as unconnected, inassimilable, static bits of information (Tina Brown, unpublished speech to the American Newspaper Publishers Association, May 1991, cited in McGrath, 1993, p. 105).

The above findings are somewhat perplexing given research suggesting that women are better readers than men regardless of genre or story structure. This holds across cultures: In a study of 199,000 adolescents in 43 countries, including the United States, Chiu and McBride-Chang (2006) found girls outscored their male classmates on reading achievement in every country, although about 42 percent of this so-called “gender effect” was mediated by reading enjoyment. Hedges and Nowell (1995), in a secondary analysis of six large datasets, found American females were slightly better than males in reading comprehension (mean differences, Cohen’s *d*, of about 0.1-0.2) and substantially better in writing skills (mean difference of about 0.6). About 7 out of 10 girls outperform the average boy in writing performance, and about 3 out of 5 girls

outperform the average boy in reading skills; but that does not imply that girls are better at all tasks involving language. For instance, boys show better achievement in solving word problems (Geary, 1998). Women, however, outperform men at immediate and delayed verbal recall of text, including semantic clustering (Kramer et al., 2006) and overall confidence of verbal skills (Ackerman et al., 2001).

Biologically speaking, women's advantage in reading might be due to the fact that most of them process language in both hemispheres, while most men process language predominantly in the left hemisphere (e.g., Shaywitz & Shaywitz, 1995; Shaywitz, 1996; Pizzamiglio et al., 1985). Another hypothesis is that women have higher density of neurons in the primary site for speech processing (Witelson et al., 1995; 2005), increased grey matter volume in areas hypothesized to be involved in language processing (Good et al., 2001), and larger subregions of the corpus callosum, which connects the two brain hemispheres (McGlone, 1980; Allen et al. 1981). Baxter et al. (2003) suggested that both an interhemispheric and an intrahemispheric model of sex differences in language were supported by the results, and that the two models "may not be mutually exclusive."

Based on these sex differences in language processing, I expect that for all stories women will experience better comprehension, show more engagement, and have more available resources than men. Secondary task reaction time (STRT) is used here as a measure of cognitive resource availability. Recognition is also used as a measure of encoding performance, and cued recall as a measure of storage. The Sentence Verification Technique (SVT), described earlier, which forces interpretation rather than just recall, is used to create a task measuring text comprehension. This can be expressed in the following hypotheses:

H5a: For all stories, women on average will show slower secondary task reaction times (STRTs) than men.

This is because women, as more proficient readers with better comprehension and memory, are more likely to be engaged with construction of meaning while reading. This direction was chosen for consistency with the comprehensibility hypothesis, which is also behind H1 in this study. On the other hand, according to standard STRT theory, which views STRTs as a measure of remaining resources (total minus allocated), women's reaction times should be faster than men's.

H5b: For all stories, women on average will show better recognition memory than men.

H5c: For all stories, women on average will show better cued recall than men.

H5d: For all stories, women on average will score better on the Sentence Verification Technique task than will men.

At the same time, the inverted pyramid, because of its directness, parsimony, and polarized approach to presenting an issue (with two or more sides), exemplifies a masculine style of communication. For instance, Fiske (1987) has argued that most traditional television news stories are structured to provide a point of narrative closure that approximates that of a masculine fictional narrative. By contrast, a feminine style of communication is more likely to be built around examples, contextual details, elements of tentativeness, and avoidance of conflict (Wood, 2007, p. 126-130). The literature on masculine and feminine styles of communication comes from the fields of critical studies and from experimental psychology studies focused on gender traits; but there is no experimental research that firmly establishes a connection between the inverted pyramid in news and masculine styles of communication. This dissertation extends those ideas to the study of story structures in news. Specifically in the field of journalism, at least one quantitative study has found a relationship between sex and journalistic writing style.

Ruffner and Burgoon (1981) found that female journalists tend to use longer sentences, more total words and more modification (adjectives and adverbs) than male journalists.

A view of the inverted pyramid as a masculine style of communication is not necessarily contradicting the massive literature on an overall female advantage in reading; rather, it can be seen as specifying limitations to this general advantage. Thus, several more hypotheses emerge:

H6a: There will be an interaction between sex and story structure, such that the mean secondary task reaction time (STRT) for women during reading of chronological stories will be greater (slower) than the mean STRT for women during reading of inverted pyramid stories and the mean STRTs for all men.

H6b: There will be an interaction between sex and story structure, such that women's mean recognition for chronological stories will be greater than women's mean recognition for inverted pyramid stories and all of the recognition means for men.

H6c: There will be an interaction between sex and story structure, such that women's mean cued recall for chronological stories will be greater than women's mean cued recall for inverted pyramid stories and all of the cued recall means for men.

H6d: There will be an interaction between sex and story structure, such that women's mean Sentence Verification Technique (SVT) score for chronological stories will be greater than women's mean SVT score for inverted pyramid stories and all of the SVT means for men.

The hypotheses from this and the previous chapter were tested through an experiment in which participants read four stories each and answered questions measuring their comprehension, recall, and enjoyment of each story. The availability of

cognitive resources was measured through secondary task reaction time (STRT), with audio probes occurring randomly during the process of reading.

CHAPTER 3

Research Method: Experiment

Design

The experiment used a 2 (Structure) x 2 (Story) x 2 (Sex) mixed design. The two levels of structure were inverted pyramid and chronological. Story was a repetition factor. An inverted pyramid and a chronological version were written for each of four stories (two about health and two about science and technology), with the possible combinations of writing style and story counterbalanced across all subjects, such that each participant read two inverted pyramid and two chronological stories. The sex factor was between subjects with two levels, male and female. The following design, in which “IP” stands for “inverted pyramid” and “Ch” for “chronological, was used:

Condition 1: IP₁ Ch₂ IP₃ Ch₄

Condition 2: Ch₁ IP₂ Ch₃ IP₄

Condition 3: IP₃ Ch₄ IP₁ Ch₂

Condition 4: Ch₃ IP₄ Ch₁ IP₂

Participants

Fifty-eight participants, 88% of them students at a large Midwestern university, were recruited. Some received extra credit for participation in the study. Others chose to receive \$10 for participation. Power analysis suggested that a repeated measures, within-subjects ANOVA with two factors and two repetitions per factor, which were used for testing hypotheses 1 through 4, required a sample size of 34 to achieve power of .80 (assuming that alpha is set at .05 and we are seeking a moderate effect size of .25). The same sample was required for repeated measures ANOVA for within-between interaction (same power, number of groups, repetition and level of alpha), which were used to test hypotheses 6a-d. Because .25 was considered a liberal estimate of effect size in this

study, a larger sample was recruited. For the fifth set of hypotheses, an independent-sample t-test with power of .80 required at least 64 participants per group, or a total of 128, which was beyond the resources available to conduct this study.

Factors

The main independent variable was story structure, operationalized in two levels: chronological and inverted pyramid model. A chronological story presents most of the facts in the temporal order in which they occurred. By contrast, as mentioned in an earlier definition, an inverted pyramid story places the most important news at the top, followed by the next most important element, and so on. Since there can be variations to the inverted pyramid structure (Gans, 1979), this structure was limited for the purposes of this dissertation by using only stories with 5-W leads (answering the questions, Who? What? Where? When? Why?), consistent with the definition of inverted pyramid used by Schramm (1947). Eleven volunteers participated in a pretest that asked them to assess the manipulation by answering two questions for each of the stories: “On a scale of 1 to 5, how would you rate this story for conformity with the inverted pyramid style of writing?” and “On a scale of 1 to 5, how would you rate this story for conformity with a chronologically structured style of writing?” To test whether “chunking” the stories in three parts would affect reading enjoyment, the pretest also presented some stories in three chunks of 100 words each, and other stories as “whole” articles, with all 300 words presented on the screen at once. The results suggested that there were no significant differences in reading enjoyment, and that the volunteers (graduate students in journalism and strategic communication) rated some of the manipulations as both consistent with an inverted pyramid and a chronological structure. As a result, the manipulations were revised to remove any chronological portions within inverted pyramid stories. Three newspaper editors with significant journalistic experience were also asked to assess the

manipulation of the four stories and rate the different versions for conformance with the practical standards of news writing. They suggested changes that were incorporated in the manipulations to make the differences between the two versions as extreme as possible.

Stimuli

Four news stories were manipulated in such a way as to create an inverted pyramid and a chronological version, for a total of eight messages. The original stories were published in various newspapers (for a list of sources, see Appendix B). Each story was approximately 300 words in length. The manipulation aimed at creating two versions as identical as possible by reshuffling paragraphs and only minor changes in wording to add necessary transitions, in approach similar to the one Lang (1989) applied to broadcast news stories. The inverted pyramid and chronological versions for each story were presented with identical headlines and decks (sub-headlines) conveying the gist of the story. For the purposes of experimental control, the chronologically structured story was not edited to fit newspaper routines (there was no hook in the lead). The two versions of each story had approximately the same Flesh ease of reading scores (a measure of reading difficulty that is available through a function of Microsoft Word), contained equal number of sentences and concepts, and differed only in the news writing style. For an example of the manipulation, please see Appendix A.

Dependent variables

Secondary task reaction times (STRTs). As outlined by Lang et al. (2007), an audio STRT probe (250 milliseconds, 1,000 Hz) was inserted at three randomly selected points in each message with one probe occurring in each third of the messages. Participants, while reading news stories (primary task), were asked to click the “Enter” key as soon as they heard an auditory signal (secondary task). To create markers for the audio probes, each story was presented in three installments, one installment per screen.

Participants were asked to press a button to move on to the next installment.

The probes were inserted at random times, which were selected through sets of random numbers returned by a research Web site called www.randomizer.org. To ensure consistency within each condition, the times when the audio probes occurred were the same for a specific story version (for example, a tone always occurred at second six of the second chunk of the chronological version of Article 2). The random selection of the probe locations within the different installments made the probes unpredictable for the viewer, which was important to ensure the validity of the STRT measure. Each probe occurred no less than 5 and no more than 11 seconds after each participant had clicked “Continue” to begin reading a specific story chunk, each consisting of approximately 100 words. A reaction time answer was recorded if the participant pressed the key with less than 2 seconds from hearing the tone. The upper limit of 11 seconds for the occurrence of an audio probe was selected to ensure that the tone occurred while participants were still reading, and that they were going to continue to read for at least 2 more seconds after pressing “Enter” to react to the tone. (Pretesting showed that pressing “Continue” to move on to the next installment within less than 2 seconds from when the tone sounded caused the experimental software to skip the audio probe in the next installment.)

Recall. Memory data were collected starting with cued recall in the form of open-ended questions. For each story, there were five open-ended questions, including one asking about the gist of the story. For an example, please see Appendix B.

Recognition. Recognition memory data were collected through a task consisting of multiple-choice questions. One of them asked about the gist of the story and offered a correct answer along with three other plausible options. For each story, there were five questions, with four possible choices for each. For an example, please see Appendix C.

Comprehension. This was measured using the Sentence Verification Technique, a

long-standing measure of both reading and listening comprehension that originated in educational psychology. A 12-item test was constructed for each story. Following the Royer, Hastings, and Hook (1979) setup for SVT, participants were asked to rate as either “new” or “old” four types of sentences: 1) original, or a verbatim repetition of a sentence as it appeared in the text; 2) paraphrase, or a sentence in which as many as possible words are changed from the original without changing the meaning; 3) meaning change, or a sentence in which at least word has been replaced in the original in such a way that a new meaning is created; 4) distracter, or a sentence consistent with the general theme of the paragraph but not related to any of the original sentences. Royer (2001) suggests that SVT tests (targeted mostly as K-12 students) should be designed in such a way that questions pertaining to the first half of a passage should appear first in the test. However, to avoid any confounding influence due to the different order of paragraphs in the inverted pyramid version and the chronological version, and given that all participants were adults with presumably more reading and comprehension experience than K-12 students, all sentences were presented randomly without any restriction on the order. Marking original and paraphrase sentences as “old,” and change-of-meaning and distracter sentences as “new” was considered correct. For an example, please see Appendix D.

Enjoyment. Enjoyment was measured through the question, “How much did you enjoy reading the text?” with a six-point scale ranging from “not at all” to “very much” as used by Knobloch et al. (2004, p. 275). The rating on this question was added to an enjoyment index created from factor analysis of ratings on 12 items: mysterious, informative, boring, exciting, enigmatic, calming, gripping, sound, uninteresting, secretive, thrilling, and objective, on a scale of 1 to 6 (Knobloch et al., 2004), for a total of 13 questions after each story. This scale also reflects measurement of suspense and

curiosity, which are related to enjoyment, but may not necessarily load on the same factor in the subsequent analysis. For the enjoyment measure, please see Appendix E.

Covariates

Pretest scores for interest and prior knowledge on each specific story topic were collected, with the intention of using them as covariates in the analyses stage and/or exploration for potential moderating effects in the relationship between story type and comprehension. For an example, please see Appendix F.

Procedure

Each participant entered the laboratory, provided informed consent, and sat down at a computer terminal with a 15-inch monitor, where the experimenter explained the reading and secondary task. First, participants completed a brief pretest measuring their interest and prior knowledge on the topic of each story they were about to read. Participants were instructed to read a short news story and listen for audio tones from the computer. They were told to read each paragraph completely before clicking on “Continue” to move on to the next one and instructed to regard reading as their main task, since they would later answer questions about the text. Reading times for each paragraph, measured as the time between the moment when a participant pressed a button to start reading and the moment when he or she pressed the button to move on to the next paragraph, were collected via the experimental software, MediaLab.

The participants were asked to click “Enter” as quickly as possible after they heard an audio tone. A practice trial was conducted, in which each participant read a story similar in length to the experimental stimuli (please see the practice story in Appendix A). The practice trial contained three randomly embedded audio tones, one in each third of the message and occurring no earlier than 5 seconds after a participant had pressed a button to start reading or move on to a new paragraph. Data collection began

when participants indicated that they understood the procedure and had no further questions. Stimulus presentation began with instructions appearing on the monitor, followed by the first story. Participants read the story, followed by a single-item measure of enjoyment and the SVT. This process was repeated until all four stories were completed.

After completing all four stories, participants took part in an unrelated distracter task, consisting of the Bem Sex Role Inventory (Bem, 1974), a 60-item instrument on which participants were asked to rate their self-perceived performance on a number of personality traits (e.g., decisive, ambitious, shy, etc.) on a scale of 1 to 5. This inventory (please see Appendix G) is used to measure gender (masculinity, femininity) as a continuous variable. Measures of gender are not variables in this study, but the data were collected for exploratory analysis in future research. When participants had completed the distracter task, a cued recall test consisting of five questions for each of the four stories appeared on the screen. The questions for each story appeared within the same block, but their order was randomized within that block. The blocks of questions were also randomized. This was followed by a recognition test consisting of five multiple-choice questions for each of the four stories, also randomized in the same fashion as the cued recall questions.

CHAPTER 4

Results

Data cleaning and reduction

The original sample contained 58 people (28 men and 30 women). In the secondary task reaction time (STRT) dataset, two subjects were removed from the start for persistent timeouts (reaction times exceeding 2 seconds). The remaining missing data (timeouts) in 11 cells (1.6% of the remaining 672 cells) were replaced with the mean for the respective column and row. This was considered an appropriate procedure because fewer than 5 percent of data points were missing randomly, and because the group mean is a more sensible replacement than the overall mean (Tabachnik & Fidell, 2006). After that, values outside two times the interquartile range beyond the 25th and 75th quartiles were flagged as outliers, which Lang et al. (2006) recommended as “preferable to replacements based on standard deviations because the outliers themselves go into the computation of the standard deviation” (p. 378). Coincidentally, this process also identified 11 outliers (1.6%). Additional analysis showed that most (8) of those outliers were concentrated within the reaction times of three more subjects, who were then removed from the dataset. The remaining three outliers (.4%) were replaced with the maximum/minimum allowable value. The final dataset contained 53 participants, 24 men and 29 women.

In the Sentence Verification Technique dataset, the data for one subject (who after the experiment reported misunderstanding the directions for this task) was removed from the start of the analysis. The nonparametric sensitivity measure A' and the nonparametric criterion bias measure B'' were calculated from formulas using the rates of hits and false

alarms, with alternative formulas used for cases of below-chance performance (Aaronson & Watts, 1987; D. Aaronson, personal communication, August 1, 2008). For all analyses yielding significant interactions, Tukey HSD post-hoc tests were computed to determine which of the interaction means in the pairwise comparisons were significantly different from one another.

In the reading enjoyment dataset, average values were computed for each of the 13 questions, which came from the inventory used by Knobloch et al. (2004). In a factor analysis (varimax rotation, PCA extraction), those loaded on three factors with eigenvalues greater than 1. The three factors cumulatively explained 70% of the variance. An index was constructed based on the first factor, which explained 36% of the variance and reduced the number of items from 13 to seven (including the answers to the questions about whether each story was enjoyable, mysterious, exciting, engaging, relaxing, gripping, and thrilling). The items were highly related (Cronbach's alpha = .861). However, the index was not used in the final analysis, because it appeared to be a measure more of the suspense and excitement elicited by stories rather than reading enjoyment.

Reading times were also collected for future analysis.

Hypotheses

Hypothesis 1 predicted that chronologically structured stories would lead to larger (slower) secondary task reaction times (STRTs) than would inverted pyramid stories. It was tested by a 2 (Structure) x 2 (Story) x 3 (STRT Repetition) repeated measures ANOVA on STRTs, with sex and condition as between-subject factors. Support for Hypothesis 1 was demonstrated by a significant main effect of Story Structure

($F_{(1,44)}=3.92$, $p=.05$, $\eta^2_{\text{part}}=.08$), with the chronological stories eliciting larger (slower) STRTs than the inverted pyramid stories (Table 1).

Table 1. Effect of story structure on secondary task reaction times (STRT)

Structure	Means (ms.)	Std. dev.	Power
Inv. pyramid	396.4	121.13	.49
Chronology	412.7	122.89	.49

Hypothesis 2a predicted that recognition memory of content in chronologically structured news stories would be more accurate than recognition memory of content from inverted pyramid stories. It was tested by a 2 (Structure) x 2 (Story) repeated measures ANOVA on recognition data, with sex and condition as between-subject factors. Pretest data were not taken into account, since a correlation analysis showed that they correlated significantly with answers on other pretest questions but not with the posttest recognition and cued recall scores. The main effect of Structure was not significant ($F_{(1,50)}=.01$, $p=.94$, $\eta^2_{\text{part}}<.01$). Hypothesis 2a was not supported.

Table 2. Effect of story structure on recognition

Structure	Means	Std. dev.	Power
Inv. pyramid	.82	.17	.07
Chronology	.81	.19	.07

Hypothesis 2b predicted that cued recall of items in chronologically structured news stories would be greater than cued recall of items in inverted pyramid news stories. It was tested by a 2 (Structure) x 2 (Story) repeated measures ANOVA on cued recall data, with sex and condition as between-subject factors. There was no significant main effect for Structure ($(F_{(1,50)}=1.32, p=.26, \eta^2_{\text{part}}=.03)$). Hypothesis 2b was not supported.

Table 3. Effect of story structure on cued recall.

Structure	Means	Std. dev.	Power
Inv. pyramid	.57	.25	.20
Chronology	.54	.29	.20

Hypothesis 3 predicted that chronologically structured stories would lead to better Sentence Verification Technique scores than would inverted pyramid stories. It was tested by a 2 (Structure) x 2 (Story) repeated measures ANOVA on SVT data, calculated as percent correct answers, with sex and condition as between-subject variables. The main effect of Story Structure on SVT data approached significance, ($F_{(1,49)}=3.20, p=.08, \eta^2_{\text{part}}=.06$), but this effect was opposite the hypothesized direction such that inverted pyramid stories elicited higher SVT scores than chronological stories did.

Table 4. Effect of structure on text comprehension scores

Structure	Means	Std. dev.	Power
Inv.	.66	.13	.45

pyramid			
Chronology	.64	.11	.45

Signal detection theory was employed to calculate not only the percent correct answers but also criterion bias and sensitivity, as has been done in the original article on SVT by Royer, Hastings and Hook (1979). The signal in the case of sentence verification is the meaning, which means that, unlike the case of audio recognition, some nonverbatim sentences can be recognized correctly as signals as long as they preserve the meaning. However, instead of calculating the parametric measures d' and β as Royer, Hastings and Hook (1979) did, the nonparametric A' and B'' were calculated, as they are more appropriate to analyses in the field of communication (Shapiro, 1994). Sensitivity (A') was computed for each of the four conditions (two inverted pyramid stories and two chronological stories). Criterion bias (B'') was also computed for each of the four conditions. The main effect of Story Structure on sensitivity approached significance, ($F_{(1,49)}=2.91, p=.09, \eta^2_{part}=.06$), such that sensitivity was higher for inverted pyramid stories than for chronological stories (Table 5). There was no main effect of Story Structure on criterion bias ($F_{(1,49)}=.15, p=.7, \eta^2_{part}<.01$).

Table 5. Effect of story structure on sensitivity (A')

Structure	Means	Std. dev.	Power
Inv. pyramid	.73	.18	.39
Chronology	.69	.11	.39

Table 6. Effect of story structure on criterion bias (B'')

Structure	Means	Std. dev.	Power
Inv. pyramid	-.12	.36	.07
Chronology	-.10	.41	.07

Hypothesis 4 predicted that chronologically structured stories would elicit more self-reported reading enjoyment than would inverted pyramid stories. It was tested by a 2 (Structure) x 2 (Story) repeated measures ANOVA on reading enjoyment data, with sex and condition as between-subject variables. This hypothesis was not supported, as there was no main effect for the single-question self-report ($F_{(1,50)}=1.92$, $p=.17$, $\eta^2_{\text{part}}=.04$).

Table 7. Effect of structure on reading enjoyment

Structure	Means	Std. dev.	Power
Inv. pyramid	3.62	.8	.26
Chronology	3.46	.77	.26

Although not hypothesized, there was a significant interaction between Story Structure and Sex ($F_{(1,50)}=4.05$, $p=.05$, $\eta^2_{\text{part}}=.08$), based on the single-question self-report. However, a Tukey HSD post-hoc test showed that none of the interaction means were significantly different from one another.

Hypothesis 5a predicted that for all stories, women on average would show slower secondary task reaction times (STRTs) than men. The hypothesis was tested by

submitting STRT data for all stories to an independent-sample t-test, with female and male participants designated as the two groups. The difference approached significance ($t_{51}=-1.4$, one-tailed $p = .08$, mean difference= -43.39), with the mean STRT for men across stories lower (faster) than for women (Table 8). The results reflect underpowered tests for this particular set of hypotheses.

Table 8. Sex differences in secondary task reaction times (STRTs) during reading.

Sex	Means	Std. dev.	Power
Male	384.3	109.8	.43
Female	427.7	114.29	.43

Hypothesis 5b predicted that for all stories, women on average would show better recognition memory than men. The hypothesis was tested by submitting all the recognition data (scores on multiple-choice questionnaires) for all stories to an independent-sample t-test, with female and male participants designated as the two groups. The hypothesis was not supported ($t_{56}=-.49$, $p=.31$, mean difference = $-.02$).

Table 9. Lack of sex differences in recognition

Sex	Means	Std. dev.	Power
Male	.80	.15	.13
Female	.82	.13	.13

Hypothesis 5c predicted that for all stories, women on average would show better

cued recall than men. The hypothesis was tested by submitting the cued recall data (scores on open-ended-question inventories) for all stories to an independent-sample t-test, with female and male participants designated as the two groups. The hypothesis was not supported ($t_{56}=.03$, $p=.49$, mean difference $<.01$).

Table 10. Lack of sex differences in cued recall.

Structure	Means	Std. dev.	Power
Male	3.45	.8	.05
Female	3.46	.77	.05

Hypothesis 5d predicted that for all stories, women on average would score better on the Sentence Verification Technique task than will men. The hypothesis was tested by submitting the SVT data (as percent correct answers) for all stories to an independent-sample t-test, with female and male participants designated as the two groups. The results only approached significance ($t_{55}=-1.24$, $p=.11$, mean difference $=-.03$), with women's comprehension score higher than men's comprehension score (Table 9).

Table 9. Sex differences in text comprehension (SVT)

Sex	Means	Std. dev.	Power
Male	.64	.08	.44
Female	.67	.07	.44

For the sensitivity measure A' , the results also approached significance ($t_{55}=-$

1.43, one-tailed $p=.08$, mean difference $=-.04$), with women demonstrating higher sensitivity than men (Table 10).

Table 10. Sex differences in sensitivity (A')

Sex	Means	Std. dev.	Power
Male	.74	.09	.5
Female	.69	.13	.5

For the criterion bias B'', there was a significant difference between the sexes ($t_{55}=1.89$, $p=.03$, mean difference $=.16$), such that women showed a lower (more liberal) criterion bias than men (Table 11).

Table 11. Sex differences in criterion bias (B'')

Sex	Means	Std. dev.	Power
Male	-.02	.29	.77
Female	.18	.34	.77

Hypothesis 6a predicted that there would be an interaction between sex and story structure, such that the mean STRT for women during reading of chronological stories would be greater (slower) than the mean STRT for women during reading of inverted pyramid stories and the mean STRTs for all men. This hypothesis was tested by submitting the data to a 2 (Structure) x 2 (Story) x 3 (STRT Repetition) repeated measures ANOVA on STRTs, with sex and condition as between-subject factors. The

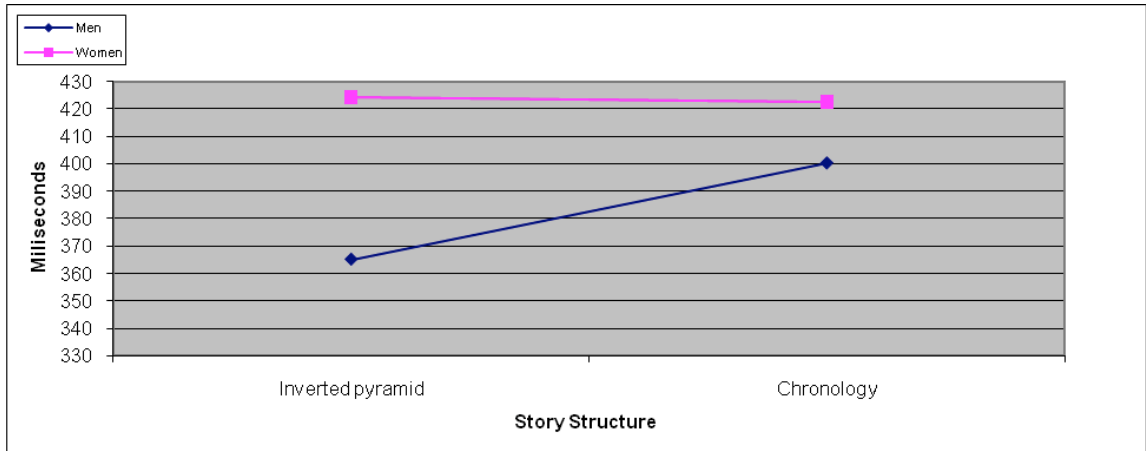
Story Structure x Sex interaction was significant, ($F_{(1,45)}=5.23$, $p=.03$, $\eta^2_{part}=.10$) but the hypothesis was only partially supported. As predicted, women’s STRT means for the two structures were both significantly greater (slower) than men’s STRT mean for inverted pyramid stories (Table 12).

Table 12: Effect of story structure and sex on secondary task reaction times (STRT):

Structure	Male Means (ms.)	Std. dev.	Female Means (ms.)	Std. dev.	Power
Inv. pyramid	365.14	180.92	427.67	161.13	.61
Chronology	400.29	183.53	425.20	163.47	.61

However, the women’s STRT means for the two structures did not significantly differ from one another, and they were not significantly different from the men’s mean for chronological stories, according to a Tukey HSD post-hoc test (Figure 1). According to Baron and Kenny (1986), the significant interaction between two dichotomous variables (in this case, structure and sex) means that sex is a moderator, a variable that affects the strength or the existence of the relationship between story structure and available cognitive resources (of which secondary task reaction time/STRT is the operational measure).

Fig. 1: Structure x Sex interaction for STRTs:



Hypothesis 6b predicted that there would be an interaction between sex and story structure, such that women’s mean recognition for chronological stories would be greater than women’s mean recognition for inverted pyramid stories and all of the recognition means for men. It was tested by submitting the data to a 2 (Structure) x 2 (Story) repeated measures ANOVA, with sex and condition as between-subject variables. There was no significant interaction ($F_{(1,50)}=.5, p=.48, \eta^2_{\text{part}}=.01$). This hypothesis was not supported.

Table 13: Effect of story structure and sex on recognition

Structure	Male Means	Std. dev.	Female Means	Std. dev.	Power
Inv. pyramid	.80	.24	.83	.23	.15
Chronology	.82	.27	.80	.26	.15

Hypothesis 6c predicted that there would be an interaction between sex and story structure, such that women’s mean cued recall for chronological stories would be greater than women’s mean cued recall for inverted pyramid stories and all of the cued recall means for men. It was tested by submitting the data to a 2 (Structure) by 2 (Story) repeated measures ANOVA, sex and condition as between-subject variables. There was

no significant interaction ($F_{(1,50)}=0.03$, $p=.86$, $\eta^2_{\text{part}}<.01$). H6c was not supported.

Table 14: Effect of story structure and sex on cued recall

Structure	Male Means	Std. dev.	Female Means	Std. dev.	Power
Inv. pyramid	.62	.34	.53	.33	.05
Chronology	.56	.43	.54	.40	.05

Hypothesis 6d predicted an interaction between sex and story structure, such that women’s mean Sentence Verification Technique (SVT) score for chronological stories would be greater than women’s mean SVT score for inverted pyramid stories and all of the SVT means for men. It was tested by submitting the data to a 2 (Structure) by 2 (Story) repeated measures ANOVA, with sex and condition as between-subject variables. There was no significant interaction ($F_{(1,49)}=1.83$, $p=.18$, $\eta^2_{\text{part}}=.04$). This hypothesis was not supported.

Table 15: Effect of story structure and sex on text comprehension (SVT scores):

Structure	Male Means	Std. dev.	Female Means	Std. dev.	Power
Inv. pyramid	.66	.17	.70	.16	.30
Chronology	.61	.14	.66	.13	.30

There were also no significant interactions between Structure and Sex for the sensitivity measure A’ ($F_{(1,49)}=.94$, $p=.34$, $\eta^2_{\text{part}}=.02$) and the criterion bias measure B’’

($F_{(1,49)}=.19$, $p=.7$, $\eta^2_{\text{part}}<.01$).

Table 16: Effect of story structure and sex on sensitivity (A')

Structure	Male Mean s	Std. dev.	Female Means	Std. dev.	Power
Inv. pyramid	.72	.22	.75	.20	.16
Chronology	.66	.21	.73	.19	.16

Table 17: Effect of story structure and sex on criterion bias (B'')

Structure	Male Mean s	Std. dev.	Female Means	Std. dev.	Power
Inv. pyramid	-.04	.52	-.19	.49	.07
Chronology	-.04	.60	-.15	.56	.07

CHAPTER 5

Discussion

This dissertation explored how the structure of news stories affected readers' allocation of cognitive resources, memory, comprehension, and reading enjoyment in the context of the limited capacity model of mediated message processing and the construction-integration model of text comprehension. Clearly, cognitive resources available during reading varied as a function of the story structure, inverted pyramid or chronological. Participants had faster secondary task reaction times (STRTs) for inverted pyramid than for chronological stories, which is consistent with reading research by Britton and colleagues (1978; 1979; 1982), as well as media effects research showing that more complex audio and video messages (with more changes in scene or topic and containing more information) elicit faster STRTs (Lang et al., 2006; Lang et al., 2007; Bolls & Lang, 2003). The two structures did not elicit significantly different recognition, cued recall, and reading enjoyment, as originally hypothesized. Text comprehension scores were marginally different for inverted pyramid stories and chronological stories, but in a direction opposite than the one hypothesized, with inverted pyramid stories eliciting higher comprehension. In the set of hypotheses regarding sex differences in reading, there were marginally significant differences between men and women, such that women had slower STRTs and higher comprehension scores than men. However, there were no significant differences between the sexes in terms of recognition, cued recall, and reading enjoyment. There was also a significant interaction between Sex and Story Structure, as hypothesized, but no significant Sex interactions in the recognition, cued

recall and text comprehension datasets. Those results will be discussed in light of their theoretical and practical implications, both for the general issue of cognitive capacity use in processing different text structures and the more specific question about sex differences in reading those structures.

Theoretical implications

These data may help synthesize the literatures from reading comprehension and media effects to advance knowledge of both the cognitive processes reflected by STRTs and the effects that media features have on these processes. From the reading comprehension literature, Britton has argued that slower STRTs indicate heavier use of the cognitive capacity “by the meaning that is produced in the reader’s cognitive system” (Britton et al., 1983, p. 41). In that framework, simple messages produce slower STRTs, possibly because they allow more room for internal construction of meaning. By contrast, the media effects literature contains what Lang et al. (2006) call “standard STRT theory” (p. 370). This perspective views STRTs as a measure of remaining resources (total resources available minus resources allocated to a message), such that simple messages should result in faster STRTs than more complex messages. Reeves and Thorson (1986) summarize the traditional media effects view of STRTs this way: “If substantial effort is devoted to viewing, then responses to the signal take longer; if viewing is relatively easy, then responses are quicker” (p. 345). But like Britton, they also found that simple messages (with fewer visual changes and linguistic propositions) elicited slower STRTs than complex messages. To explain those counterintuitive results, a more sophisticated theory emerged, suggesting that STRTs are a measure of available resources, which equal resources allocated to a message minus resources required to

process that message (Lang, 2006).

This study replicated Britton's findings (including the lack of significant differences in recall between the two structures), and so one simple way to explain the findings is in light of Britton's comprehensibility hypothesis, which suggests that difficult texts elicit faster reaction times due to the temporary emptying of working memory because of "frequent breakdowns" that leave available capacity for the secondary task (Britton et al., 1978, p. 589). This is consistent with Lang's view of STRTs as a measure of available resources. In that context, the findings of this study can be interpreted as providing additional support for the comprehensibility hypothesis and perhaps for the view of STRTs as measuring available resources. This is because chronological stories, which were hypothesized to be the simpler messages, elicited slower STRTs, which cannot be explained with the traditional STRT paradigm. Such an interpretation also suggests that inverted pyramid stories are indeed more difficult to process, a finding consistent with the evidence and arguments in the literature.

However, going by the standard STRT paradigm, the findings can also be interpreted to mean that chronological stories elicited slower reaction times because they were simply more difficult to understand. There are two possible reasons for that. First, the chronological stories failed to deliver a mental representation early on, which is an important factor toward comprehension and memory (Branford & Franks, 1971). Second, there was a mismatch between the hard-news headline and the opening of the chronological stories, which may have presented a problem to comprehension. This will be discussed further in the limitations section.

Going back to the definition of STRTs as "a covert measure of attention" (Lang,

2006, p. 370) and the vast body of literature that connects attention to memory, it is somewhat surprising that there were no significant differences between chronological and inverted pyramid stories in terms of accuracy of recall and recognition. That raises some interesting questions. If forgetting of content from inverted pyramid and chronological stories occurs at similar rates, could it be happening for different reasons? It may be that chronological text, because it is so engaging and because of the nature of the medium, encourage readers to construct their own meaning to the point of forgetting some of the actual content. Reeves and Thorson (1986) argued it is exactly the construction of meaning that slows down STRTs for simple and engaging messages. On the other hand, as Lang (1989) has argued, inverted pyramid stories require so much access to long-term memory that this interferes with the processes of encoding and storage, which are indexed by recognition and cued recall. The findings supporting the null hypothesis on recognition and recall measures in this study will be discussed below in conjunction with the significant results on STRTs.

Most of the analysis in this study is based on research that has used audiovisual rather than written messages. The following paragraphs will attempt to flesh out some tentative interpretation that has much to do with the differences between cognitive processing of text and broadcast messages. Some cues to this issue can be found in the main theoretical framework for this study, the LC4MP, which Lang (2006) contends is “meant to be applicable to all contents, all media, and all goals” (p. S58). However, each medium “has its own set of perceptual channels, temporal constraints, learned signals, and orienting eliciting structural features (p. S66). Thus, the LC4MP recognizes the distinction between channels involving sensory perception, such as video and audio, and

channels that rely on cognitive elaboration, such as text. Most media psychology research so far has focused on sensory perception, resulting in theories that may not necessarily be applicable to messages that elicit internal cognitive elaboration. Since reading and viewing are fundamentally different, it is likely that they involve different mechanisms of cognitive processing.

For example, decades of psycho physiological research have shown that messages that rely on sensory perception from the environment (listening to detect a tone, watching a video) tend to elicit heart rate deceleration as resources are allocated to encoding the message, while messages that require performance of complex cognitive tasks (such as learning and applying the rules of a card game or performing mental arithmetic) elicit heart rate acceleration as resources are allocated to encoding the message (Lacey & Lacey, 1974, in Orbits et al.; Cacioppo, 1979). If the same mechanisms apply to reading as another cognitive effortful activity, encoding written text likely consumes many more cognitive resources than the encoding of broadcast messages. Future research could extend those psychophysiological differences into an exploration of differences in attention and use of cognitive capacity between text and broadcast messages. An interesting question that emerges at the operational level, for instance, is whether STRTs for written messages would be larger (slower) than STRTs for broadcast messages, perhaps indicating that more meaning is constructed while reading than during viewing and listening.

Other factors also underscore the differences between processing text and processing audiovisual stimuli. For instance, television messages are “temporally demanding” (Lang, 2006, p. S67); viewers “cannot back up and “re-view” material that

was poorly understood or incompletely perceived” (Lang, 1989, p. 4), leading to a loss of information not encoded at exposure. Print messages, on the other hand, allow readers to continue to encode the information for as long as they want. In that sense, readers have more control than viewers. This element of control may be important in terms of fortification or expansion of the cognitive process during reading. Wise and Reeves (2007), in a study that allowed some participants to control the appearance of images on a computer screen, have argued that “the ability to actively control when something appears is fundamentally different than passively viewing something that is externally controlled” (p. 564). Although the Wise and Reeves study used different stimuli and procedure than this dissertation, their findings about control can be extended to reading as an activity that allows for greater ability to self-pace the allocation of resources than do externally delivered video and audio messages. And this self-pacing is part of a bigger picture: Reading is an individual cognitive activity, which is learned as part of human socialization but is not necessary for survival from the standpoint of evolutionary theory. While humans have employed spoken language for a long time as a way to bond and escape danger, reading appeared only about 5400 years ago (Dehaene, 2005). Reading and arithmetic can be regarded as “cultural acquisitions... far too recent to have exerted any evolutionary pressure on brain evolution” (p. 133). In that sense, reading is different from processing video messages also because text does not employ the same cognitive mechanisms as face-to-face verbal and nonverbal communication.

In the context of all these differences between reading and viewing, it would not be surprising if STRTs and other operational measures used in media psychology require a new interpretation when subjects are engaged in the more effortful process of

constructing a message internally than when they are being delivered the message via video/audio. Lang has argued that chronological broadcast news stories lead to better recall and recognition because they are processed as episodic knowledge and require less access to semantic memory (facts and general knowledge about the world) than do inverted pyramid stories, whose comprehension requires some previous knowledge on the topic. Furthermore, speaking from an evolutionary standpoint, the human brain likely has adapted for chronological processing (Teske, 2006). We rarely tell stories in an inverted pyramid form; as Green (1979) noted, a reporter coming home after covering a civil rights demonstration is likely to tell the story at the dinner table in a much different (way than the way he or she wrote the news story. However, this study found no significant differences between chronological and inverted pyramid stories in terms of the accuracy of recognition and cued recall, suggesting that writing style affected neither encoding, indexed in the LC4MP by recognition, nor storage, indexed by cued recall (Lang, 2000, 2006). Going back to the earlier question about the interpretation of these findings in light of reading as an intense meaning-construction activity, the results may mean different things. It is possible that the lack of temporal demands in processing print messages and the availability of more control minimize the differences that one should expect in recognition and cued recall between inverted pyramid stories and chronological stories.

Another possible interpretation is that text requires so much more cognitive work than video and audio that story structure makes relatively little difference in terms of encoding and storage. If that is indeed the case, these results raise the question of whether written text can be processed without constant access to semantic memory in

order to recognize symbols, words and grammatical structures and create meaning out of them. Many of the cued recall answers offered evidence that subjects were making associations with previous knowledge, no matter whether they read the inverted pyramid or the chronological version of a given message. Some interpreted a story about chimpanzees in a language study as adding to the controversy of the “intelligent design” debate. One participant wrote that “some people are unhappy” with the appearance of four apes on the social network Facebook; another said “some people still refuse to make the connection” that “chimps are genetically closer to humans.” In a story about serotonin in the brain, some participants jumped to big-picture conclusions, such that raising serotonin levels of serotonin “could lead to a more complacent and happier society in which there is less conflict.” While anecdotal, these observations may suggest that the stories activated participants’ existing schemas, sometimes to the point of creating false memories about the content of the stories they just read. It would be interesting to explore further whether written messages elicit more associations with previous knowledge and activate existing schemas more than do audiovisual messages that rely on sensory input from the environment.

These findings also open the door for speculation about similarities between transitions in written messages and cuts and edits in broadcast stories. Inverted pyramid stories, which have more abrupt transitions in subject than chronological stories, can be viewed as similar to broadcast stories that contain a lot of cuts (changes from one visual scene to a completely new visual scene). Chronological stories can be viewed as similar to stories with more edits (defined as shots from one camera to another within the same visual scene). Thus, the results in this study are consistent with the results of Lang et al.

(2006), who found that stories containing edits elicited slower reaction times than did stories containing cuts. One possible explanation is that cuts or abrupt transitions elicit orienting responses, which are automatic attention responses to changes in the environment. Predictability “should lessen the value of automaticity” at least for stimuli controlled by each participant (Wise & Reeves, 2007, p. 552). Chronological stories, which arguably evolve predictably, are less likely to elicit orienting responses. This, in turn, would cause few automatic resources to get allocated to the message and also lead to fewer available resources, after the message consumes a certain amount of required resources for processing. Under the available resources paradigm, this would be reflected in slower STRTs. On the other hand, the inverted pyramid delivers novelty elements in an order of decreasing importance, and each paragraph contains an element of surprise, at least in the first half of the story. The orienting responses might increase the resources allocated to a message. Presuming that resources required remain constant, in the paradigm of STRTs as a measure of available resources, this should allow for more available resources and speed up the reaction time. It is difficult to know how much support there is for such an explanation, given that few research studies have attempted to explore orienting responses elicited by text. Furthermore, as Lang et al. (2006) have noted, such results do not clearly support an interpretation of STRTs as either available or remaining resources.

Despite the lack of significant differences in recall in recognition, subjects showed marginally better text comprehension (SVT scores) and higher sensitivity (A') for inverted pyramid stories. In the context of signal detection theory, the higher sensitivity suggests that the inverted pyramid stories were stimuli of somewhat higher

intensity and with a stronger signal than the chronological stories (Fox, 2004; Shapiro, 1994). Along with the lack of a significant difference in reading enjoyment between the inverted pyramid and chronological stories, this suggests that inverted pyramid stories did not pose the kind of a cognitive challenge that hindered comprehension and felt unpleasant to participants. But the SVT results from this study do not necessarily imply that inverted pyramid stories are easier to comprehend than chronological stories. Instead, they may mean that participants had difficulty making sense of the chronological stories because they were chunked, forcing participants to engage in frequent cognitive wrap-ups without sufficient information. It is also possible that the hard-news headline that preceded the first chunk of each story delivered what in the construction-integration model of text comprehension is called a macroproposition, or gist of the story (Kintsch & van Dijk, 1978). In light of that gist, readers might have had difficulty integrating the first few paragraphs of the chronological structures as needed for comprehension (Myers et al., 2000).

Sex differences in processing text

The unknowns in interpreting many of the findings so far are also present when considering the results from testing the hypotheses about sex differences. For example, the finding that women's reading STRTs are slower than men's can mean different things. Those have to be considered in light of women's linguistic advantages, which include better verbal memory (Kramer et al., 2006), text comprehension (Hedges & Nowell, 1995), better ability to recover linguistic performance after brain damage (Shaywitz & Shaywitz, 1995), and somewhat earlier advances in language acquisition (Schachter et al., 1978). Women's STRTs might be slower because they are more

engaged while reading and busier than men in constructing meaning from text. From the standpoint of the comprehensibility hypothesis, this means they have fewer available resources to deal with the secondary task. In that explanation, women should spend a lot of cognitive resources on reading. On the other hand, women's STRTs might be slower because reading is relatively effortless to them to the point that they allocate very few resources to this process, and thus have very few left to react to the secondary task. Such an explanation is plausible, given that a preliminary analysis of the reading times dataset indicated the main effect for sex approached significance ($F_{(1,50)} = 3.76$, $p = .06$, $\eta^2_{\text{part}} = .07$), such that women across stories read faster than men. Under either option, the standard STRT theory cannot explain women's slower STRTs in light of the female linguistic advantage. However, it is also possible that women's slower STRTs during reading are simply an example of a female disadvantage in reaction time, observed by Pesta et al. (2008).

The finding that story structure makes more difference to men than to women (men had significantly slower STRTs for chronological stories than for inverted pyramid stories, while women's means were nearly identical) poses a challenge to the view that a masculine style of communication is direct and parsimonious (Wood, 2007). If slower STRTs indeed indicate ease of processing, as in the comprehensibility hypothesis, and more available resources, as in Lang's (2006) proposed paradigm, then men had an easier time and/or more available cognitive resources when processing chronologies. In the realm of speculation, this may be due to an evolved male ability to process action as it develops in time, which may have been advantageous for hunting and defending the family. Perhaps one example of that is that men enjoy action films more than do women

(Peterson & Pang, 2006). On the other hand, if faster STRTs indicate ease of processing, then men did better at cognitively processing inverted pyramid messages, as predicted. Along with the finding that inverted pyramid stories elicited marginally higher comprehension than chronological, men's faster STRTs lend support to the possibility that less effort was needed for comprehension of the inverted pyramid stories, at least for men, and that there was therefore more capacity remaining to complete the STRT task in that condition (a simple limited resources account). This would be somewhat surprising, however, given the interaction between Sex and Structure in the reading enjoyment dataset, which indicated that women liked inverted pyramid stories more than they liked chronological stories.

The finding that women had lower (more liberal) criterion bias (B'') than men, indicating that women were more likely to try maximize hits at the risk of scoring some false alarms (Shapiro, 1994) is somewhat surprising, given the large body of literature suggesting that women are more averse to risk than men (for a review and meta-analysis, see Byrnes, Miller, & Schafer, 1999). The results, however, are in line with research that found men and women are not different in their risk attitudes when it comes to hypothetical risk decisions at the individual level, but the socially expected differences only emerge when they are placed in groups (Ronay & Kim, 2006). A potential psychological explanation is that women tend to score lower than men on autonomy (Gorski & Young, 2002; Clark, Steer, Beck, & Ross, 1995) and higher than men on sociotropy and interdependence (Clark, Steer, Beck, & Ross, 1995; Sato & McCann, 1998). It is possible that women's tendency to please others, which is part of the concepts of sociotropy and interdependent, may be behind their willingness to take higher

hypothetical risk by scoring more false alarms.

Practical implications

The findings of this study inform the debate about how to make print and online news more attractive and readable. Somewhat surprisingly, they imply that the inverted pyramid structure is perhaps not as “perverted” (Fry, 1999, p. 24) as suggested in much of the literature. Although much evidence has accumulated against the inverted pyramid, it is worth considering that it may turn out to be a superior form of communicating written messages, after all. The marginally higher text comprehension and sensitivity (A’) for inverted pyramid stories also add to the proposition that the inverted pyramid structure may not be so inadequate. Interpretation of the results regarding allocation of cognitive resources, of course, depends on which STRT theory is applicable to the findings. This is hard to determine without additional research on cognitive resources employing written instead of broadcast messages.

Another practical implication is that the frequent use of the inverted pyramid structure in print and online news does not seem to present a problem for female readers. This suggests that other explanations need to be explored for the so-called “gender gap” in news readership. In fact, under Britton’s comprehensibility hypothesis for cognitive processing of text, it hardly made any difference to women what story structure they were reading. This is consistent with findings from the *St. Petersburg Times* field experiment, which compared four different story structures (among those, inverted pyramid stories and narratives) and suggested that women are less picky than men when it comes to writing styles (Ways With Words, 1993). The results of this dissertation lend no support to the proposition that women avoid written news because they represent a masculine

style of communication. In that context, the argument that the readership “gender gap” is related to the increased load on women since they entered the workforce but continue to be responsible for much of childcare and household chores (Einsidel & Tully, 1981) now appears more credible. This does not contradict findings that women watch more TV news than men do (The News Gender Gap, 2004, July 9). As mentioned earlier in the theoretical implications, video and audio messages are less cognitively effortful to process than text; they also allow viewers and listeners to divide their attention to some degree while conducting other business at home or at work.

The lack of corroboration for many of the hypothesized relationships may also lend support to the view that media are increasingly shaping human thought, and so it is hard to find cognitive processing mechanisms that have not already been influenced by various media messages. Carr (July/August 2008) speculates that the Internet has changed the way people process news, making it increasingly difficult to read long articles and increasingly easier to process a “swiftly moving stream of particles” (p. 57). In the context of much research indicating development of new neurons (neurogenesis) and plasticity of the human brain in adulthood (Drapeau & Abrous, 2008; Thompson et al., 2008; Fallon, Irvine, & Shepherd, 2008), it is perhaps not so absurd to consider that after decades of feeding inverted pyramid stories to news consumers, it might be best to just stick with tradition and continue to do so.

Limitations

The aforementioned theoretical and practical implications of this research must be tempered by some limitations. The stories that were used were ones in which the chronological order of events was somewhat arbitrary, manipulated for the sake of

experimental control in such a way that the chronological stories contained exactly the same information as inverted pyramid stories but in different order. Stories in which the chronological order is important and conveys a causal chain of events may have produced different results, but as mentioned earlier, such news stories are extremely rare and difficult to find. Usually, they also contain distinct characters; this makes them more fitting of the definition of narratives rather than simple chronological accounts.

Another limitation is that the tests for the fifth set of hypotheses, which addressed sex differences in reading, were underpowered. Running more experimental subjects, which is one of the most pressing directions for future research, is likely to bring about statistically significant results. Furthermore, nearly 80% of the subjects were journalism and strategic communication students. The rest were students majoring in other disciplines or working adults. While the experimental method by its very nature limits the influence of individual differences on the results, it is worth noting that journalism and communication students, as well as most other college students, are consistently trained to understand and present information in an inverted fashion, by a subjective order of importance. It is important to note also that subjects in this study did not have as much control as readers in the real world, because they read each story in three chunks without the option of going back to a previous screen. This was done for the sake of experimental control to ensure that each of the three audio probes per message occurred in a different third of the story. What this might mean for the results is that they cannot be generalized for all readers and all circumstances. Perhaps the results could be considered most applicable to well-educated, young populations reading chunked stories, as is often the case with online news. The pretest for this study showed there was no significant main effect of chunking in terms of reading enjoyment, but there appeared to be a

significance-approaching interaction between chunking and story structure, such that subjects liked the best “whole” (presented on one screen) chronological stories and “chunked” (presented in installments) inverted pyramid stories. Only 11 volunteers participated in the pretest; even so, the effect of chunking approached significance for inverted pyramid stories, with chunked stories being liked more (two-tailed $p < .17$). It is likely that a well-powered study with a bigger sample could show if there is indeed such an interaction between chunking and structure. This has an important practical implication for online news (usually chunked), suggesting that the inverted pyramid might be a more adequate structure when writing for the Web.

Several significant interactions between Structure and Story (coded as topic) emerged in the results, suggesting that the choice of two very different story subjects (health and science/technology) may have been a limitation to this experiment. In future research, it would be more reasonable to limit topic variance by presenting two or more messages from the same domain. This was done by Yaros (2006), who used only stories about science, and Lang (1989), who used only stories related to law enforcement. Admittedly, restricting the topic limits the generalizability of the results; on the other hand, it increases reliability and makes for an easier interpretation of the results.

Another limitation may be that participants were instructed to read everything completely before moving on to the next chunk and, as a result, were paying relatively high levels of attention. It is also possible that this is why the predicted results about memory accuracy did not surface. Lang (1989) argued that the effects of chronology are strongest when people are paying low levels of attention, because they are “the ones most likely to be helped by the ability to process the newscast primarily in episodic memory” (p. 13).

Also, as mentioned earlier (p. 60), the hard-news headline that delivered the gist might have made for a difficult interpretation of the opening of chronological stories, which hardly made any reference to the gist until the middle or the end of the story. As Bransford and Franks (1971) have argued, the early acquisition of a complete idea makes for easier comprehension of further information; but if the information that arrives does not match the already acquired complete idea, it may not be recognized and retained. Having a mental representation seems to be of importance for integration in general; for example, experiments using mismatching captions and photos suggest that people integrate pictures and sentences by “comparing sentence constituents with mental representations of the corresponding picture parts” (Knoeferle & Crocker, 2005, p. 6). In that sense, using feature type headlines (e.g., The Net of Apes, Brain Games, etc.) matching both versions of each story might have been a better choice for this study.

Finally, although order was assigned randomly, no steps were taken to ensure that an equal number of males and females were present in each condition (order). Some condition interactions that occurred could have potentially been eliminated if an equal number of males and females were in each condition, which might have also further boosted the observed sex differences.

Directions for future research

The cognitive mechanisms involved in the processing of text are still poorly understood, partly because reading poses a challenge to experimental control due to individual differences in reading speed. The reading times per chunk of about 100 words in this study varied from 8 seconds to more than a minute. This makes it difficult to measure cognitive resources through a secondary task, given that each subject is likely be

at a different place in the text when a probe occurs. One simple option to elaborate on the results of this study is to extend the analysis to reading times. Although a preliminary analysis showed there was no significant difference between inverted pyramid stories and chronological stories in terms of reading time per chunk ($F_{(1,50)} = .79, p = .38, \eta^2_{\text{part}} = .02$), it is worth to also calculate what Britton et al. (1978) call “total cognitive capacity usage” (p. 584), calculated by multiplying the reading time for each chunk by the STRT recorded for that chunk. Britton et al. (1978) argue that “this measure weights the average capacity usage by the span of time over which that capacity is being used, and it reflects the total amount of capacity used in reading the entire passage” (p. 584), and it should be greater for difficult than for easier passages.

Beyond the secondary analysis of data from this study, varying the experimental settings in a number of studies could incrementally increase scientific knowledge about the use of cognitive resources in reading. One option is to make print messages temporally demanding, like broadcast stories, by showing them on a computer screen for a preset and limited period of time (for example, 20 seconds for 100 words). Another option, which increases experimental control in terms of following where a subject is in the process of reading, is to shorten the chunks presented on the screen by instructing participants to press “Continue” in order to move on to the next sentence or the next paragraph. Exploring the effects of chunking news stories on memory and construction of meaning could extend some of the existing research about frequent cognitive wrap-ups that occur when reading a text in installments (Just & Carpenter, 1980; Rowell & Moss, 1990). Yet another option is to present only whole stories on the screen to limit any effects due to chunking. While such mode of presentation may not be the best in terms of

experimental control over the occurrence of audio probes and measuring STRT, it is closer to real-world reading experience and thus may yield more significant difference in measuring recall and recognition.

A very promising route would be to test some of the propositions and interpretations discussed here by employing physiological measures. Heart rate and heart rate variability could be useful in determining whether inverted pyramid stories lead to disengagements, as suggested in some of the literature (Graber, 1984; Brooks et al, 2005). Skin conductance could be used to measure arousal, which is likely to occur during reading of chronological stories if they are indeed more engaging.

Another possible extension of the comparison between the inverted pyramid and chronological presentations is to explore the effect of story structure on news credibility. A complex concept, credibility extends beyond trust, accuracy and fairness, and into the realm of “likeability” (Meyer, 1988). Structures that are easier to process and/or perceived as more likeable may be also viewed as more credible. Pinpointing such differences would also have practical implications to the news industry in resolving its current credibility crisis. While the current study found no significant differences in reading enjoyment between story structures, the results could change with the use of a different inventory that contains more of the elements that come into play in the construction of credibility. To extend this into another direction, it might be of even greater significance to the news industry to compare how chunked stories compare to whole stories in terms of credibility, especially in light of some findings that online news and blogs score as more credible than print news (Johnson & Kaye, 2004; Johnson & Kaye, 1998).

In regard to continuing the exploration of sex differences in reading, a possible route would be to use as stimuli stories about people and stories about inanimate objects. It is likely that women would employ more cognitive resources than men would in reading stories about people because women tend to be more socially interdependent and less autonomous than men (Clark et al., 1995).

Conclusion

Much of the psychological research on cognitive processing of media has focused on broadcast messages, which deliver external video or audio stimuli. It is possible that understanding reading, an internal construction process, requires new theories that are very different from the ones that can explain and predict external messages. Reading, for one thing, involves much more meaning construction, imagination and effortful work than passive exposure. It makes intuitive sense that we react more slowly when we are absorbed in a process. There is much anecdotal evidence that people reading an interesting book tend to lose sense of time and to ignore external stimuli. Unfortunately, both remaining resources and available resources, potentially indexed by STRTs, are only indirect ways to estimate resources required to process a message, which would be the ideal operational measure for comparing messages in media research. It is worth considering a simple view of STRTs as a measure of resources remaining (total resources minus resources allocated), with the caveat that more resources are allocated to engaging messages rather than to what we might call cognitively unattractive messages. It may not be the standard STRT theory that needs to be revisited, but the subjective dichotomy of complex versus simple messages. But even more importantly, it is perhaps worth reconsidering the interpretation of many measures traditionally used in media research in

order to reflect some significant differences between the relatively effortful processing of text and the relatively effortless processing of sensory input from the environment.

APPENDICES

APPENDIX A: Stimuli (same headline and deck for the two versions)

Practice story (same for all conditions)

Headline: Study Shows Problems With Olympic-Style Tests

Deck: Danish lab questions the accuracy of common urine measure

Athletes who want to cheat by injecting themselves with a performance-enhancing drug that boosts their blood cell count can do so with little risk of getting caught, a new study indicates, possibly exposing another flaw in what is regarded as the world's toughest anti-doping program.

A urine test that is supposed to detect the drug, and that will be used in the Tour de France next month and in the Olympics in August, is likely to miss it, the study says. The substance, recombinant human erythropoietin, known as EPO, speed up production of oxygen-carrying red blood cells. And with more blood cells, endurance athletes like cyclists and distance runners can perform better.

EPO is banned by the World Anti-Doping Agency, an international group that promotes and coordinates efforts to stop doping in sports and whose program is followed by the International Olympic Committee. The agency defends its EPO test and questioned the latest study.

Although athletes have said EPO is in widespread use, few have tested positive. Most of the athletes who have been linked to doping in recent years have been caught not through drug testing, but rather through criminal investigations.

The study, to be published Thursday in the online edition of the Journal of Applied Physiology, was conducted last year by a renowned lab in Denmark, the

Copenhagen Muscle Research Center. The investigators gave eight young men EPO and collected urine samples on multiple occasions before, during and after the men were doping.

A lab found some samples positive and a few others suspicious. A suspicious result does not bring sanctions for doping. The lab also declared a sample positive, although the man had stopped taking the drug and it should have been gone from his urine. His previous urine sample, obtained when he was taking EPO, was negative in this lab's test.

"The paper certainly is an eye-opener," said Don Catlin, the chief executive of Anti-Doping Research, a nonprofit group in Los Angeles. "It's quite remarkable."

Article 1: Book scanning

inverted pyramid

Headline: Microsoft losing Internet search competition to Google

Deck: Gates' company gives up book scanning and cuts support to digital archives

Microsoft said Friday that it was ending a project to scan millions of books and scholarly articles and make them available on the Web, a sign that it is retrenching in some areas of Internet search in the face of competition from Google, the industry leader.

The announcement comes two days after Microsoft said it would focus its Internet search efforts on certain areas where it sees an opportunity to compete against Google. The company unveiled a program offering rebates to users who buy items that they find using the company's search engine.

"It makes you wonder what else is likely to go," said Danny Sullivan, editor in chief of the blog Search Engine Land. Early adopters are now likely to turn to Google

with increasing frequency, he said.

Microsoft's decision leaves the Internet Archive, the nonprofit digital archive paid by Microsoft to scan books, looking for new sources of support. Several major libraries had chosen to work with the Internet Archive rather than with Google.

"We're disappointed," said Brewster Kahle, chairman of the Internet Archive, which has been scanning about 1,000 books each day and has money to keep the project "going for a while."

Some libraries that work with the Internet Archive and Microsoft said they planned to continue their book-scanning projects.

"We certainly expect to go on with this," said Carole Moore, chief librarian at the University of Toronto.

Microsoft acknowledged that commercial considerations played a part in its decision to end the program.

Microsoft and Google have been scanning older books that have fallen into the public domain, as well as copyright-protected books under agreements with some publishers.

Microsoft said it had digitized 750,000 books and indexed 80 million journal articles. Google said it had scanned more than a million books. It plans to scan 15 million in the next decade.

chronologically structured

Headline: Microsoft losing Internet search competition to Google

Deck: Gates' company gives up book scanning and cuts support to digital archives

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public domain, as well as copyright-protected books under agreements with some publishers.

Microsoft said it had digitized 750,000 books and indexed 80 million journal articles. Google said it had scanned more than a million books. It plans to scan 15 million in the next decade.

On Wednesday, Microsoft said it would focus its Internet search efforts on certain areas where it sees an opportunity to compete against Google. The company unveiled a program offering rebates to users who buy items that they find using the company's search engine.

Two days later, Microsoft said it was ending a project to scan millions of books and scholarly articles and make them available on the Web, a sign that it is retrenching in some areas of Internet search in the face of competition from Google, the industry leader.

Microsoft acknowledged that commercial considerations played a part in its decision to end the program.

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Article 2: Facebook chimps

inverted pyramid

Headline: Apes join Facebook

Deck: Prodigious chimp named Albert is the first to chat online using sign language and touch screen

Albert, 20, became the first ape to join Facebook, the largest online social network, last month. Soon after he joined, three other chimps, named Mr. Jones, Sheena, and Britney, followed suit.

Scientists from The University of Northern Oregon announced that the four apes can communicate using more than 1,000 symbols adapted to the most popular features of the online social network. With the help of a touch screen and special software that recognizes American Sign Language, they can chat online, write text messages, and even upload profile pictures.

Albert’s gang has become very popular among Facebook’s users. Although sociologists and anthropologists have used social networks as empirical research tools, Facebook will now provide a new platform for biologists to observe the social skills of chimpanzees, said John F. Marlowe, chief researcher for the project.

The results from the Facebook study can be interpreted to show that chimps have

a brain designed for language and can use it to produce symbols that build their communicative repertoire, Marlowe said. His new challenge now is to train Albert in the use of even more sophisticated social networks, such as Palabea.

The scientists have spent the last two years training Albert and his comrades, all of the Pan troglodytes species, to acquire language skills necessary for their online social life.

Previous studies have revealed that chimpanzees and humans use the same brain regions to communicate verbally and non-verbally. Robin Dunbar, a British professor of anthropology and biology, even argues that chimps should be considered human due to their biological proximity to people.

Albert, born on May 31, 1988, in Knoxville, Tenn., is a prodigious exemplar of our closest genetic relative. He was named in a humorous salute to Albert Einstein. Since his acquisition by the Yorke's National Primate Research Center at Northern Oregon, he has participated in more than 200 studies.

“Albert was raised in a human-like setting and taught sign language as if he were a human child,” Marlowe said. “He has developed more complex language skills than any other language-learning chimps before.”

chronologically structured

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Article 3: Serotonin

inverted pyramid

Headline: Serotonin changes perceptions of fairness

Deck: Experiment finds that people with lower levels of serotonin are more likely to reject unfair offers

Levels of a brain chemical known as serotonin govern the way people react to unfair offers when they play the game of life, a new study indicates.

The study, conducted at the University of Cambridge in England, had people play the Ultimate Game, which has one player proposing a way to split a pot of money. If the other player accepts, both get paid. If the player refuses, neither gets a payment. The researchers had some players make deliberately unfair offers: "I get 80 percent, you get 20 percent." Players with artificially lowered serotonin levels were more likely to reject an unfair offer.

Serotonin levels have that effect, because the chemical affects the prefrontal region of the brain, said study author Molly J. Crockett, a doctoral student at the University of Cambridge.

"Down-rating the emotional response makes it more unlikely that an unfair offer

will be accepted," Crockett said.

Participants in the study fasted overnight. On the experiment day, some took a pill with all the amino acids but tryptophan. This would have been converted to serotonin, involved in emotional control. The lack of tryptophan lowered their serotonin levels.

Lower serotonin levels mean more resentment. Conversely, higher serotonin levels would make it easier to live in an imperfect world.

Prescription medications such as modern antidepressants raise serotonin levels. The same is true of the psychedelic drug Ecstasy, "a quick serotonin enhancer," said Matthew Lieberman, an associate professor of psychology at the University of California.

A proposed experiment would have people play the Ultimate Game inside a magnetic resonance imaging machine to see how the brain responds to fair and unfair offers as serotonin levels change, said Lieberman.

Scientists have known for a long time that serotonin is a brain chemical that carries messages between neurons. Expression of anger has been found to depend on variations in a gene governing the receptors for serotonin in brain cells.

chronologically structured

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Levels of serotonin govern the way people react to unfair offers when they play the game of life, the new study indicates. Lower serotonin levels mean more resentment. Conversely, higher serotonin levels would make it easier to live in an imperfect world.

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offers as serotonin levels change, said Lieberman.

Article 4: Tomatoes against cancer

inverted pyramid

Headline: Ketchup may slow down prostate cancer

Deck: University of Missouri researchers find sugar, not antioxidants, make tomatoes cancer-fighters

Processed tomato powder and paste, found in everything from chips to frozen pizza, can help fight cancer.

Three University of Missouri researchers have discovered evidence that links a sugar in dehydrated tomato products to slowing down prostate cancer. After testing different substances, they stumbled upon a sugar known as Fru-His and tested it on four groups of rats injected with chemicals causing prostate cancer.

The results were encouraging: Only 10 percent of rats fed a mixture of tomato paste and pure Fru-His developed tumors.

The newly found evidence warrants a clinical trial in humans, but hundreds of other sugars in tomatoes should also be tested, said Valeri Mossine, assistant professor of biochemistry and a primary investigator. The best effect likely comes from a synergy with lycopene, an antioxidant that gives a bright red color and is found in healthy prostate tissue.

"If a tumor grows rapidly, no diet will help, but prostate cancer usually happens in old age and few patients die from it," Mossine said. "For those reasons, cancer prevention through food ingredients is really attractive."

Mossine and two fellow MU researchers received a grant to test modified sugars in processed tomatoes. Mossine said this required a leap of faith.

"The idea was you needed something toxic to kill cancer cells," he said. "We had to get through this psychological barrier."

For decades, epidemiologists have known that people living in the Mediterranean have lower rates of prostate cancer than the rest of the world. This was credited to diets rich in tomato products. At first, scientists thought tomatoes were healthy because of lycopene.

But in 2003, University of Illinois researchers showed that in rats, lycopene is only slightly better than nothing at preventing prostate cancer deaths. Rats receiving tomato powder had a higher survival rate.

chronologically structured

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tomato powder had a higher survival rate.

That's where Valeri Mossine, assistant professor of biochemistry at the University of Missouri, and two fellow MU researchers came in. They received a grant to test modified sugars in processed tomatoes. Mossine said this required a leap of faith.

"The idea was you needed something toxic to kill cancer cells," he said. "We had to get through this psychological barrier."

After testing different substances, they stumbled upon a sugar known as Fru-His and tested it on four groups of rats injected with chemicals causing prostate cancer.

The results were encouraging: Only 10 percent of rats fed a mixture of tomato paste and pure Fru-His developed tumors.

The three University of Missouri researchers found evidence that links a sugar in dehydrated tomato products to slowing down prostate cancer. Processed tomato powder and paste, found in everything from chips to frozen pizza, can help fight cancer.

"If a tumor grows rapidly, no diet will help, but prostate cancer usually happens in old age and few patients die from it," said Mossine. "For those reasons, cancer prevention through food ingredients is really attractive."

The evidence warrants a clinical trial in humans, but hundreds of other sugars in tomatoes should also be tested, Mossine said. The best effect likely comes from a synergy with lycopene.

Appendix B

Sources of edited articles:

Book scanning: Microsoft Will Shut Down Book Search Program (2008, May 24). *The New York Times*.

Facebook chimps: Chimps discover Facebook to find new friends! (2008, May 10).

www.cyberchimps.org; Chimpanzees hit by Facebook bug (2008, June 7), *Times of India*.

Serotonin: Serotonin Levels Determine Sense of Fairness (2008, June 5). *The Washington Post*.

Tomatoes against cancer: MU study illuminates tomato benefit (2008, May 30). *The Columbia Daily Tribune*.

APPENDIX C: Cued recall questionnaires

Please answer the following questions based on the stories you read earlier in this session. Please answer each question briefly, using only one or two sentences.

Article 1: Book scanning

What was the gist of the story?

What new decision did Microsoft announce on Friday?

Who is disappointed with this decision?

What are those who are disappointed going to do now?

How will Microsoft's competitor benefit from this decision?

Article 2: Facebook chimps

What was the gist of the story?

Who is Albert?

What special tools allow him to use Facebook?

What is the goal of the study involving Albert's gang?

How was Albert raised?

Article 3: Serotonin

What was the gist of the story?

What is the role of serotonin in the brain?

How did the study test for the effects of lowered serotonin?

How would a proposed future study tell us more about serotonin?

What substances affect the levels of serotonin in the brain?

Article 4: Tomatoes against cancer

What was the gist of the story?

Why did the study described in the story require a leap of faith?

What is lycopene?

What kind of substance did the study link to slowing down tumors?

In what products is this substance likely to be found?

APPENDIX D: Recognition questionnaires

Please answer the following questions based on the stories you read earlier in this session. Circle the letter that corresponds to what you believe is the right answer. There is only one right answer for each question.

Article 1: Book scanning

The gist of this story was that:

- a) Microsoft is a poorly managed company, unlike Google
- b) Google has scanned more scholarly articles than Microsoft
- c) Microsoft is retrenching by giving up its book scanning project
- d) Google is interested in offering support to digital archives

Microsoft's recent progress with expanding its search engine has included:

- a) Digitizing 750,000 books and indexing 80 million journal articles
- b) Digitizing 80 million journal articles and 750,000 books
- c) Offering fully copyrighted books for free on the Web
- d) Moving 100,000 digital books from the private to the public domain

Microsoft announced on Friday that:

- a) It will offer coupons to those who buy books through its search engine
- b) It will end a program to scan books and journal articles
- c) It will compete against book selling companies on Froogle
- d) It will buy copyright to 1,000 scholarly journals

The Internet Archive is:

- a) The book-scanning arm of Google
- b) A consortium of libraries, wanting library-only portals for digitized books
- c) A new competitor that poisoned the water for Microsoft and Google
- d) A book-scanning nonprofit that used to be funded by Microsoft

Book-loving early adopters are now:

- a) Going to turn to Microsoft's new rebate program
- b) Continue to use exclusively the Internet Archive
- c) Turn to Google for digitized books and articles
- d) Join the fight against offering copyrighted books on the Web

Article 2: Facebook chimps

What is the gist of the story?

- a) Chimpanzees have brains that are just as well developed as human brains
- b) Signs and touch-screens can allow most high-order animals to facebook
- c) Chimps joined Facebook as part of a study about apes' brains and language
- d) Scientists are looking to understand how chimps use their frontal brains

Who is Albert?

- a) The ring-leader of Albert's gang, a new Facebook application
- b) A chimp educated in a setting with several human children
- c) An Iowa ape that has participated in more than 300 communication studies
- d) A 20-year-old male chimp named after Albert Einstein

According to the story, the four participants in the University of Northern Oregon study can:

- a) Upload profile pictures, chat online, and send text messages
- b) Use more than 1,000 symbols to communicate with opposite-sex primates
- c) Speak with the primary investigator via American Sign Language
- d) Play online games via a touch-screen

Other than Albert, the members of Albert's gang include:

- a) John F. Marlowe and Pan Troglodytes
- b) Mr. Robin Dunbar, Palabea, and Shawna
- c) Britney, Sheena, and Mr. Jones
- d) Einstein, Barney, and Ms. Leena

Marlowe's new challenge now is:

- a) To get more Facebook users to join the cyber chimps application
- b) To find support for the theory that chimps should be considered human
- c) To ensure that experimental chimps are raised in a human-like setting
- d) To train Albert in the use of even more sophisticated social networks

Article 3: Serotonin

What is the gist of the story?

- a) A California researcher says antidepressants and Ecstasy make life easy
- b) A study found serotonin is linked to the way people react to unfair offers
- c) Fasting can lower serotonin levels and alter the processing of amino acids
- d) Because serotonin is linked to anger, we can learn from brain imaging

What is serotonin?

- a) A neurotransmitter that, when in excess, makes people more gullible
- b) A chemical that flows among neurons and is involved in emotional control
- c) An anger-inducing substance that can be lowered by antidepressants
- d) An essential amino acid, also called tryptophan

According to the story, what did the participants in the study have to do?

- a) Fast; then take a pill that raised their serotonin and play online games
- b) Fast; then play a game in which a poker player takes their money
- c) Fast; take a pill with or without tryptophan; then play the Ultimate Game
- d) Take an amino-acid pill; then fast and make unfair offers to others

What did the study find?

- a) Lower serotonin levels make it easier to live in an imperfect world

- b) Players with lowered serotonin were more likely to reject an unfair offer
- c) Serotonin levels affect mostly the dorsofrontal area of the brain
- d) Resentment is linked to emotional control when serotonin is low or absent

How would you describe the experiment that has been proposed as a follow-up?

- a) People will play the Ultimate Game while in a brain-imaging machine
- b) People will get a “serotonin enhancer” to lower their resentment of fasting
- c) A brain-imaging tool will project the Unfair Life game directly to neurons
- d) People on antidepressants will get Ecstasy to change their fairness views

Article 4: Tomatoes against cancer

The gist of the story was that:

- a) Mediterranean residents die of prostate cancer at very low rates
- b) Researchers found a sugar in processed tomatoes can slow down cancer
- c) It requires a leap of faith to ignore antioxidants as powerful cancer fighters
- d) Illinois and Missouri research teams are in competition

Lycopene is:

- a) An antioxidant that gives tomatoes their bright red color
- b) A sugar currently under the microscope as a potential cancer fighter
- c) A tomato powder used in artificially produced tomato paste
- d) An experimental method in which rats are divided in four groups

Until 2003, it was widely believed that:

- a) Only raw tomatoes contain cancer-fighting sugars
- b) It is lycopene that makes a tomato diet likely to slow down cancer
- c) Prostate cancer usually appears only in old age and kills very few people
- d) Only poisonous substances can be used to fight cancer

In the study described in the story, University of Missouri researchers found that:

- a) Rats fed a mixture of tomato paste and Fru-His showed the best results
- b) Hundreds of sugars in processed tomatoes act in synergy with lycopene
- c) Switching to a tomato diet requires getting over a psychological barrier
- d) Only 60 percent of people exposed to carcinogens develop cancer

The primary investigator in the University of Missouri study suggests the next step should be:

- a) Applying for a joint grant with University of Illinois researchers
- b) Exploring a synergy with the Mediterranean to study the tomato diet
- c) Informing corporations that produce tomato paste of the new findings
- d) A clinical trial in humans and testing of other sugars in tomatoes

APPENDIX E: Sentence Verification Technique

The following sentences were presented by the experimental software in a random order. Participants were asked to rate the sentences as old or new.

Article 1: Book scanning

Original (old)

Microsoft's decision leaves the Internet Archive, the nonprofit digital archive paid by Microsoft to scan books, looking for new sources of support.

Microsoft said it had digitized 750,000 books and indexed 80 million journal articles.

Some libraries that work with the Internet Archive and Microsoft said they planned to continue their book-scanning projects.

Meaning change (new)

Microsoft acknowledged that environmental considerations played a part in its decision to end the program.

Several major libraries had chosen to offer funding to the Internet Archive rather than to Google.

Microsoft said it was ending a project to buy millions of books and scholarly articles and make them available on the Web.

Paraphrase (old)

Danny Sullivan, editor in chief of the blog Search Engine Land, said that users who tend to be the first ones to adopt a new product or service will now likely choose Google when looking for scanned books and articles.

Microsoft and Google have been making digital copied of older books on which the copyright has expired, as well as copyright-protected ones, for which they have scanning deals with some publishers.

Carole Moore, chief librarian at the University of Toronto, said she certainly expects that her library will continue its book-scanning project.

Distracter (new)

Microsoft is a software company that has been gradually falling behind in the search-engine competition.

The University of Toronto library is willing to pay high price for digitized books, articles, and newspapers.

The blog Search Engine Land regularly features articles about the Internet Archive, despite warnings from Google that such exclusive coverage constitutes unfair competition.

Article 2: Facebook chimps

Original (old)

Scientists from The University of Northern Oregon have spent the last two years training Albert and his comrades, all of the Pan troglodytes species, to acquire language skills necessary for their online social life.

Although sociologists and anthropologists have used social networks as empirical research tools, Facebook will now provide a new platform for biologists to observe the social skills of chimpanzees, said Marlowe, chief researcher on the project.

Robin Dunbar, a British professor of anthropology and biology, even argues that chimps should be considered human due to their biological proximity to people.

Meaning change (new)

Albert, 20, became the first mate to join Facebook, the largest online social network, last month.

With the help of a touch screen and a special software that recognizes American Sign Language, they can pat others online, write text messages, and even upload profile pictures.

Albert's band has become very popular among Facebook's users.

Paraphrase (old)

Not long after Albert's profile appeared on Facebook, three other chimpanzees, Britney, Sheena, and Mr. Jones, joined as well.

The researchers said that the four primates can exchange information with others through the use of over 1,000 symbols adjusted to the most trendy features of the shared online net.

Marlowe said that the results from the study involving the presence of the four apes on Facebook can be construed to support the view that chimpanzees have brains with blueprint for language and can use it to produce symbols that expand their communicative gamut.

Distracter (new)

Facebook users are rattled about the presence of the chimps on their social network, proposing a ban of research conducted via the use of public online space.

Marlowe and Durban said several applications could use the apes' experience with online symbols.

Primates have been shown to have no problem with learning American Sign Language online but not if placed in human-like setting when too old.

*Article 3: Serotonin***Original (old)**

Lower serotonin levels mean more resentment.

Prescription medications such as modern antidepressants raise serotonin levels.

The researchers had some players make deliberately unfair offers: "I get 80 percent, you get 20 percent."

Meaning change (new)

The study had people play the Ultimate Game, which has one experimenter proposing a way to split a pot of money.

If a fair offer is refused, neither player in the Ultimate Game gets a payment.

Scientists have known for a long time that serotonin is a brain chemical that carries blood between neurons.

Paraphrase (old)

Matthew Lieberman, an associate professor of psychology at the University of California, said the psychedelic drug Ecstasy is "a quick serotonin enhancer."

Study author Molly J. Crockett, a PhD student at the University of Cambridge in England, said serotonin raises one's sensitivity to unfairness because of its influence on the brain's prefrontal area.

A new study indicates that available amounts of a brain substance called serotonin affect how humans respond to unfair propositions when they participate in the game of life, a new study indicates.

Distracter (new)

Molly Crockett, an assistant professor at the University of California, has suggested to her colleague Matthew Lieberman, a doctoral student at Oxford, the possibility of conducting a brain imaging study using the Ultimate Game of Life.

Serotonin, a brain substance found in some amino acids that convert into tryptophan, is usually lowered in people who fast or take anti-depressants.

Down-tracking emotional responses as a result of raised blood flow to serotonin-rich areas of the brain may lead some people to use “quick enhancers” to deal with unfair offers in life.

Article 4: Tomatoes against cancer

Original (old)

At first, scientists thought tomatoes were healthy because of lycopene, an antioxidant that gives a bright red color and is found in healthy prostate tissue.

For decades, epidemiologists have known that people living in the Mediterranean have lower rates of prostate cancer than the rest of the world.

Processed tomato powder or paste, found in everything from chips to frozen pizza, might turn out to be cancer fighters.

Meaning change (new)

After testing different substances, MU researchers stumbled upon chemicals causing prostate cancer and tested them on four groups of rats injected with a sugar known as Fru-His.

But in 2003, University of Illinois researchers showed that in rats nothing is only slightly better than lycopene at preventing prostate cancer deaths.

The evidence warrants a clinical trial in humans, but hundreds of other species should also be tested, Mossine said.

Paraphrase (old)

Valeri Mossine, a University of Missouri assistant professor of biochemistry, and two of his colleagues obtained funding to study altered sugars occurring in tomatoes that have been heated and made into various products.

Mossine said the dominant idea among researchers used to be that poisonous substances were needed to destroy tumor cells.

The results were heartening: Only one of ten rats that was given a mix of tomato paste and unadulterated Fru-His wound up with prostate cancer.

Distracter (new)

“It took a leap over a psychological barrier to start looking at a sugar like lycopene instead of all the antioxidants that people thought were in tomatoes,” said Mossine about the obstacles he and his colleagues overcame before getting on with the study.

Virtually one third of the rats in the study developed tumors prior to even ingesting the sugar that was the subject of the research.

Prior to the discovery that a tomato-rich diet may ward off deaths by prostate cancer, most grants went to study exploring the cancer-fighting effects of fructoid antioxidantss.

Appendix F: Reading enjoyment inventory

How much did you enjoy reading this text?

Not at all Very much

How mysterious was this story?

Not at all Very much

How informative was this story?

Not at all Very much

How boring was this story?

Not at all Very much

How exciting was this story?

Not at all Very much

How enigmatic was this story?

Not at all Very much

How calming was this story?

Not at all Very much

How gripping was this story?

Not at all Very much

How sound was this story?

Not at all Very much

How uninteresting was this story?

Not at all Very much

How secretive was this story?

Not at all Very much

How thrilling was this story?

Not at all Very much

How objective was this story?

Not at all Very much

APPENDIX G: Pretest

How would you evaluate your level of knowledge about current issues in health?

None Very high

How often do you pay attention to news stories about health issues?

Never All the time

How much do you know about the role of serotonin in the brain?

Nothing A great deal

How much do you know about the cancer-fighting benefits of tomatoes?

Nothing A great deal

How would you evaluate your level of knowledge about current issues in science/technology?

None Very high

How often do you pay attention to news stories about science/technology issues?

Never All the time

How much do you know about book scanning projects for the Internet?

Nothing A great deal

How much do you know about the studies involving primates and language?

Nothing A great deal

Appendix H: Distracter task (Bem Sex Role Inventory)

The Bem Sex Role Inventory asks participants to rate themselves on 60 characteristics using a 7-point scale. Twenty of the characteristics are considered indicators of femininity, 20 are considered indicators of masculinity, and 20 are considered neutral. Three scores are computed: a Masculinity score, a Femininity score, and an Androgyny score (which equals the absolute difference between the Masculinity and the Femininity scores).

How well do the following characteristics describe you?

Masculine items (heading not to be included in inventory given to subjects)

Acts as a leader

Never Always

or almost never or almost always

Aggressive

Never Always

or almost never or almost always

Ambitious

Never Always

or almost never or almost always

Analytical

Never Always

or almost never or almost always

Assertive

Never Always

or almost never or almost always

Athletic

Never Always

or almost never or almost always

Competitive

Never Always

or almost never or almost always

Defends own beliefs

Never Always

or almost never or almost always

Dominant

Never Always

or almost never or almost always

Forceful

Never Always

or almost never or almost always

Has leadership abilities

Never Always

or almost never or almost always

Independent

Never Always

or almost never or almost always

Individualistic

Never Always

or almost never or almost always

Makes decisions easily

Never Always

or almost never or almost always

Masculine

Never Always

or almost never or almost always

Self-reliant

Never Always

or almost never or almost always

Self-sufficient
Never Always
or almost never or almost always

Strong personality
Never Always
or almost never or almost always

Willing to take a stand
Never Always
or almost never or almost always

Willing to take risks
Never Always
or almost never or almost always

Feminine items (heading not to be included in inventory given to subjects)

Affectionate
Never Always
or almost never or almost always

Cheerful
Never Always
or almost never or almost always

Childlike
Never Always
or almost never or almost always

Compassionate
Never Always
or almost never or almost always

Does not use harsh language
Never Always
or almost never or almost always

Eager to soothe hurt feelings
Never Always
or almost never or almost always

Feminine
Never Always
or almost never or almost always

Flatterable
Never Always
or almost never or almost always

Gentle
Never Always
or almost never or almost always

Gullible
Never Always
or almost never or almost always

Loves children
Never Always
or almost never or almost always

Loyal
Never Always
or almost never or almost always

Sensitive to the needs of others
Never Always
or almost never or almost always

Shy
Never Always
or almost never or almost always

Soft spoken
Never Always
or almost never or almost always

Sympathetic
Never Always
or almost never or almost always

Tender
Never Always
or almost never or almost always

Understanding
Never Always
or almost never or almost always

Warm
Never Always
or almost never or almost always

Yielding
Never Always
or almost never or almost always

Neutral items (heading not to be included in inventory given to subjects)

Adaptable
Never Always
or almost never or almost always

Conceited
Never Always
or almost never or almost always

Conscientious
Never Always
or almost never or almost always

Conventional
Never Always
or almost never or almost always

Friendly
Never Always
or almost never or almost always

Happy
Never Always
or almost never or almost always

Helpful
Never Always
or almost never or almost always

Inefficient
Never Always
or almost never or almost always

Jealous
Never Always
or almost never or almost always

Likable
Never Always
or almost never or almost always

Moody
Never Always
or almost never or almost always

Reliable
Never Always
or almost never or almost always

Secretive
Never Always
or almost never or almost always

Sincere
Never Always
or almost never or almost always

Solemn
Never Always
or almost never or almost always

Tactful
Never Always
or almost never or almost always

Theatrical
Never Always
or almost never or almost always

Truthful
Never Always
or almost never or almost always

Unpredictable
Never Always
or almost never or almost always

Unsystematic
Never Always
or almost never or almost always

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