

WRITING: CULTURALLY AND COGNITIVELY DISTRIBUTED

1. INTRODUCTION

Today, fewer Americans belong to bowling leagues than previously, but more Americans report that they go bowling. Putnam (2000) cites this as evidence that the growth of individualism in the late 20th century has led to the decline in some types of collective social activities. Cronin (2004), however, does not believe this metaphor applies to all areas of public space. Specifically, he believes that scholars and researchers are more collaborative than ever, their published work providing evidence of heavy collaboration. In fact, collaborative papers have become so much of a common practice that the “lone wolf scholar may soon feature on the endangered species list” (Cronin, 2003).

Scholarly collaboration, however, is a relatively new phenomenon. Independent scientific research was much more common before the 20th century, although recent evidence has suggested that even Albert Einstein collaborated with his first wife, Mileva Mariac (Mileva's Story, 2003). The emergence of widespread collaboration in the mid-to-late 20th century was largely driven by efficient communication technology (telephone, postal mail, and e-mail) and information access (inexpensive air travel, shared libraries, and the internet). Furthermore, collaboration serves to reduce individual workload, while maximizing societal benefit. For example, with a team of scientists working on an exceedingly large problem such as sequencing of the human genome, individual cognitive effort remains manageable, but incremental effort provides an expedient solution. In fact, the projected 15-year Human Genome Project was completed two years early due to an internationally distributed effort (About the Human Genome Project, 2006), advantageously allowing researchers to apply the results towards additional endeavors ahead of schedule.

Collaboration, as the coordination of activities among two or more individuals, exemplifies a distributed cognitive process. In the United States alone, more than 200 principal investigators were conducting research for the Human Genome Project (About the Human Genome Project, 2006). In addition to this social organization of workload, scientists sequencing the human genome were applying learned knowledge to manipulate laboratory instruments for solving complex problems. Furthermore, since the project lasted thirteen years, research was continually building upon previous work. Consequently, the human genome project illustrates the distribution of cognition between individuals, between internal knowledge and external artifacts, and through time.

While collaboration may be a clear example of distributed cognition, almost by definition, other everyday tasks may still be considered predominantly solitary activities. After briefly reviewing the theory of distributed cognition, I attempt to discuss *WRITING* as another exemplary, albeit overlooked, distributed cognitive process.

2. DISTRIBUTED COGNITION

The theory of distributed cognition provides a structured framework for explaining all domains of cognitive phenomena. Traditionally, cognitive scientists thought that cognitive processes, such as memory, decision making, inference, reasoning, and learning, were properties of isolated individuals. Yet this account overlooks a number of observed phenomena suggesting that context influences cognition. Beach (1993) conducted a series of experiments illustrating how structures in the environment influence cognitive tasks. He found that expert bartenders fail to mix drinks correctly when provided with uniform glassware, whereas novices are unaffected by the substitution. In the process of learning to mix drinks, bartenders manipulate the working environment to simplify the cognitive load. Consequently, expert bartenders rely on the memory store from the environment, the distinctively shaped glassware, to recall drink orders. This example precisely illustrates the role of context in cognition, where *CONTEXT* is “a wide dynamical process of which cognition of the individual is only a part” (Hutchins, 1995, p.xiii).

Thus, the distributed model extends the boundary of the unit of analysis beyond isolated neural processes to include the larger socio-cultural context in which the individual is situated. In this way, *DISTRIBUTED COGNITION* is the behavior emergent from a dynamic interaction between one or more individual actors and elements of the environment. This model does not claim that internalized knowledge is absent, but rather that cognitive processes may also be distributed among individuals (through social interactions), between internal and external structure (with material artifacts and the environment), and through time (Hutchins, 1995).

2.1 SOCIAL INTERACTIONS

By distributing the workload among several individuals in a group, the greater social system produces coordinated, intelligent behavior that any single individual is unable to generate alone. Hutchins (1995) illustrates this by describing the process of Navy

PILOTAGGE, or navigation near land. The physical layout of the ship and the physical limitations of the human body necessitate distributing activities among the navigation team to assure successful entry to port. Minimally, workload must be divided between two men standing on the wings of the ship (to sight and measure landmarks) and two men on the navigation deck (to record and calculate ship location.). The fix cycle begins when an officer on deck announces three landmarks that need to be measured. Upon hearing the request, the wing operators divvy up the task, and measure and report back the landmark bearings. With this information, the officers calculate the ship's current position, heading, and speed, and are able to determine which set of landmarks should be used for the next fix. This cycle continues until the ship is safely docked (Hutchins, 1995). Consequently, no single individual is responsible for the navigation of the ship, nor could a single individual conceivably navigate the ship alone. Rather, the complex process of navigation emerges from a social distribution of physical and cognitive workload among individual actors.

2.2 MATERIAL ARTIFACTS & THE ENVIRONMENT

Furthermore, many cognitive tasks are facilitated by tools and structures in the environment. Modern, Western navigation relies heavily on material artifacts. Through years of accumulated knowledge, individuals have imposed structure and meaning upon tools, such as the three-scale nomogram, to ease the burden of complex mental calculations (Hutchins, 1995, p.148). As a result, in place of error-prone algebraic computations of distance, rate, and time, the nomogram facilitates the calculation through pattern matching and simple manipulations of the tool. Micronesian navigation, on the other hand, relies heavily on structures in the environment (e.g., islands and stars) to reduce the cognitive load on individuals. Imagining the passage of islands underneath given stars provides amazingly accurate information about canoe location and speed (Hutchins, 1995, Chapter 2). In this way, Micronesian navigators coordinate internal knowledge (a large amount of memorized information) with knowledge externalized to the structures in the environment (location and movement of the islands relative to the stars), as a way to facilitate computation-heavy navigational tasks. Within this system, resulting behavior is thereby cognitively distributed between individuals and elements in the environment.

2.3 DISTRIBUTION THROUGH TIME

Finally, cognition may be distributed through time, as current events are informed by the results of previous actions. Since navigation requires coordinated activity between a group of individuals and a number of complex calculations, it is nearly impossible to sail along a pre-defined route. As future actions are inevitably constrained by earlier events, the location of the previous position fix will determine which landmarks to select for the next fix (Hutchins, 1995, Chapter 1). Consequently, individuals do not need to memorize an onerous list of landmarks necessary for navigating to port. Rather, officers can make online decisions about landmarks to use for the next fix based on information from the immediate fix. In this way, cognition is distributed through time.

Accordingly, the theory of distributed cognition provides a dynamic account of actions and events emerging from within the broader social and cultural system. As a result, cognitive scientists no longer believe cognition to be a property of individual actors. Instead, intelligent human behavior is mediated by interactions between individuals, between internal knowledge and external artifacts, and between past and future events. In the remainder of the paper, I apply this theory to a case study of single-author scholarly writing. While exploring a domain traditionally considered to be an isolated activity, I discover both the culturally and the cognitively distributed practices influencing the writing process.

3. CASE STUDY

Several studies have explored writing as a cognitive process (Flower & Hayes, 1981; Bracewell, Frederiksen & Frederiksen, 1982; Bereiter & Scardamalia, 1987). However, the majority of this literature limited discussion to the text production aspects of writing, defining “the writer’s behaviour in terms of internal mental processes with little explicit regard for the artefacts used for the task and the environment within which these behaviours take place” (O’Hara, Taylor, Newman & Sellen, 2002). A few researchers have used the theory of distributed cognition to describe collaborative writing (Syverson, 1994; Rogers & Ellis, 1994), and at least two have applied it to single-author writing (O’Hara, Taylor, Newman & Sellen, 2002; Cronin, 2004). To further explore the individual writing process as an instance of culturally-guided distributed cognition, I conducted a case study of the evolution of a paper written by a single individual (PR).

For a literature course, PR was instructed to consider the consequences of war

photography by comparing images of death from Franny Nudelman's Civil War book, *JOHN BROWN'S BODY: SLAVERY, VIOLENCE, AND THE CULTURE OF WAR* (2004), to another book she had read in class. PR found striking parallels between themes from Nudelman's photography and Stephen Crane's *THE RED BADGE OF COURAGE* (2004), where the main character, Henry Flemming, finds purpose in war after observing the death of a friend. An informant interview (PR, Personal interview, 2006) and analysis of the evolution of the essay revealed that, throughout the assignment, PR engaged in a cognitively distributed system: through social interactions during idea formation, through external material artifacts during text creation, and through the passage of time during editing.

3.1 IDEA FORMATION & SOCIAL INTERACTIONS

The writing process begins with an idea. However, formulating the idea requires obtaining information and subsequently manipulating that information to create an argument. For this article, PR acquired background knowledge through two main texts, Nudelman's *JOHN BROWN'S BODY* and Crane's *THE RED BADGE OF COURAGE*. Although these books were required class assignments, before PR formulated her essay thesis the class had only discussed themes and implications from *JOHN BROWN'S BODY*. Thus, PR was required to coordinate knowledge obtained from independently reviewing *THE RED BADGE OF COURAGE* with ideas generated from class discussion. This nicely illustrates a distributed cognitive process where certain ideas were fostered by social interactions in class, with instructors and fellow classmates, while others required internal development.

In fact, PR engaged in additional social interactions outside of the classroom, as well. Since she enjoys sharing her thoughts with friends, she further consolidated her ideas by talking with a roommate. This served an important purpose in idea formulation, for PR had already combined information from class discussions and from an independent reading of *THE RED BADGE OF COURAGE*. Her new internal representation relied on an additional social iteration to become fully integrated. In this way, conversations with her roommate served to ultimately formulate her thesis.

These social interactions all occurred before PR actually began writing the paper. However, invisible in this process are the cultural practices that guided PR's internal thoughts. Humans are very social beings. In fact, some believe that modern man out-

survived the Neanderthals due to well-developed organizational and communication skills (Hoffecker, 1999). In Western culture, social interactions form the core of family, political, commercial, and community life. Furthermore, the Western educational environment defines a structure for culturally-acceptable socialization and thinking, involving reading books, participating in class discussions, and independently creating and documenting ideas on paper. That PR was even able to generate an idea for her article stemmed from years of experience participating in these socially-motivated, educational activities. In this respect, well-established, and often overlooked, cultural practices directly inform the idea formation process involved in writing a scholarly article.

3.2 TEXT CREATION & MATERIAL ARTIFACTS

Following idea formation, PR began the text creation process. She started by writing a basic outline on a piece of paper, and proceeded to type a complete first draft with a text editing program. During composition, she referenced one online source (dictionary.com) and cited quotations from both Nudelman's and Crane's books. Although somewhat simplified in description, this process involved a complex interaction between internal knowledge, technological artifacts, and source materials.

Text creation was only partially informed by information in her head. Even after generating some internal knowledge about her essay thesis, she stated that "before I draft, I'll just kind of jot down a bunch of random notes, just to keep it clear so I don't lose it" (PR, Personal Interview, 2006). This quote illustrates the power of external representations in facilitating cognitive workload. PR may believe the outline is just "a bunch of random notes," but, in fact, it can be referenced later as a cognitive aid. Such material artifacts help both to organize ("to keep it clear") and recall ("so I don't lose it") her ideas, thereby reducing the internal cognitive burden of text composition.

Technological artifacts also shaped the cognitive properties of the writing task. For example, the physical act of text creation required employing a keyboard to create textual representations of words in a software program. Encountering typed text on the computer screen undoubtedly altered the task of writing, as current textual output can lead to new conceptual or grammatical insights. Furthermore, the text editing program prescribed default layouts, fonts, and formatting for displaying prose in an electronic domain. The computer monitor provided a graphical user interface for viewing output from the text editing

program, although limited monitor size reduced text visibility. However, the cognitive consequences of only having access to a portion of the document at any given time are somewhat uncertain. Several investigators (Duchnicky & Kolers, 1983; Elkerton & Williges, 1984; Neal & Darnell, 1984) have reported little difference in text processing and editing for full page compared to partial page displays; while others (Dillon, Richardson & McKnight, 1990) have concluded that text interaction and comprehension is improved by larger screens, although with an expected upper limit on ideal display size. Regardless, it seems likely that these technologies, allowing PR to record, act, and react to her visually displayed words and thoughts, fundamentally altered the cognitive properties of the text composition process.

Source materials served as another influence on cognition in this distributed system. PR knowledgeably browsed the internet to find an official definition of 'war' from dictionary.com. Although the dictionary was online, it served as a replacement for the physical artifact (e.g., the Oxford English Dictionary), or for laboriously defining the word herself. She also referenced two original sources (Nudelman's and Crane's books), however commenting that she "referred...mainly [to]...the pictures that were in [Nudelman's] book...because that was sort of the core of the paper" (PR, Personal Interview, 2006). Annotations in the book margins and notes from class further allowed PR to quickly locate excerpts for quotation, without requiring her to memorize the occasional passage. Such annotations and notes served as additional material artifacts, or cognitive pointers to relevant information, thereby offloading cognitive workload to an external structure. Cognitive offloading is common in many activities, and is especially pervasive throughout the process of writing due to the heavy cognitive demands of the task. In fact, Adler et al. (1998) and Sellen & Harper (1997) observed that a significant portion of the text composition process, up to 90% of total writing time, is spent reading and referencing source materials.

Again, important cultural practices drive this interaction. PR used a modern computer and text-editing program to create an electronic representation of her ideas. The cognitive process of text creation was shaped by previous experience with computers, typing skills, and automatic grammar and spell-checking functionality in the software program. Individuals using a typewriter or composing documents by hand would have a vastly different cognitive experience, requiring an additional suite of tools and information (e.g., accurate knowledge of English spelling and grammar, a dictionary instead of internet access, and knowledge of a different medium for writing). In addition, annotating text and taking

notes in class is a product of the Western educational system. Without such practices, PR would have had fewer material artifacts for referencing, and a greater demand on internal cognitive processes during the text creation phase. This illustrates that through cultural institutions, individuals learn to “sculpt and exploit the environment in ways that transform and simplify the task that confronts [them]” (Clark, 2001, p.141).

3.3 TEXT EDITING & DISTRIBUTION THROUGH TIME

For some individuals, editing may be indistinguishable from text creation; however, for this assignment, PR's writing process concluded with a distinct text editing phase. One day after she composed the first draft, she printed the electronic copy onto paper. As she re-read the essay, she used a pen to write editing suggestions in the margins. Finally, she revised and updated the electronic document based on her hand-written comments. While the editing stage involved interactions with material artifacts (e.g., annotations), as well, it additionally demonstrated how the cognitive process of writing is distributed through time.

Reviewing PR's interview statements and document modifications revealed that she edited primarily for content, not for grammar. She described this as, “I generally...come up with other points” while editing, “realiz[ing], oh, this is an entire other section that I need to add” (PR, Personal Interview, 2006). Furthermore, most of her hand-written editing comments included content-driven suggestions such as *WATCH THESIS, ADD IN SPECIFIC PICTURE, TALK ABOUT BRUTALITY OF DEATH?*, and *?QUOTE?*. She only occasionally inserted a note about changing word order or sentence grammar, although even then corrections often did not appear in the final document. For example, she used a black pen to add an apostrophe to *WAR'S* in *WAR'S TRUTH*, but the small ink mark against the printed black text must have been overlooked when she was completing the final draft (see Figure 1). In another case, she edited *CHARACTERS* by drawing several lines through the word and writing *CHARACTER'S* nearby (see Figure 2). This annotation was much more salient on the document print-out than the earlier apostrophe, but was similarly absent in the final paper. As hand-written notes become material artifacts, intended to reduce the mental workload, they could serve to limit the need for perfect knowledge of English grammar and punctuation. However, more importantly, they facilitate broader cognitive tasks, such as concept integration and thesis development, alleviating the burden of internal representations by serving as pointers to relevant information. A likely explanation for these

omissions, then, is that PR was heavily focused on content editing and simply neglected minor grammatical errors.

now accepted war's truth.

FIGURE 1.

characters
characters role in the war

FIGURE 2.

FIGURES 1 & 2. THESE HAND-WRITTEN CORRECTIONS WERE OMITTED DURING EDITING OF THE FINAL DOCUMENT.

Furthermore, the text editing phase of the writing process is distributed through time. As mentioned earlier, simply encountering words previously typed on the computer screen changes future linguistic and conceptual decisions. On a larger scale, the creation of a coherent essay is inevitably reduced into temporal stages. The first phase involves initial text generation. Subsequently, the draft is reviewed and annotated, reflecting intended future document modifications. Finally, the draft is revised. This process is entirely dependent on previous cognitive output, for PR cannot edit a manuscript she has not yet written, and cannot anticipate future modifications before she has composed an initial draft. As a result, cognitive workload remains manageable. Since text created in the past will determine subsequent revisions, PR can write in stages, not worrying about creating a perfect composition in the first draft. Although PR completes this process only once, many authors iterate through several such cycles during the writing process.

Cultural practices similarly drive the text editing phase. This process would be quite different if PR had not worked with both computers (hardware and software) and with pen-and-paper technology to edit her essay. PR may have benefited from instantaneously viewing her words as she typed, but may have been limited by the reduced screen size. Similarly, printing a paper copy of the manuscript and annotating by hand altered the structure of the editing task by providing additional access to her ideas in a different medium. The benefits and drawbacks of the editing process would simply differ for individuals employing different techniques. Although computer technology is obviously a cultural product, so is the use of paper. In Nepal, for example, individuals advertise by spray painting permanent messages onto large boulders rather than by posting paper fliers. Thus, the writing medium is highly culturally-dependent, and can certainly influence cognitive processes.

Furthermore, the temporal distribution of writing is, again, directed by cultural institutions. The Western educational system largely instructed PR in how to create an essay.

In elementary school, students are taught how to read and write, transferring ideas in their heads to words on a piece of paper. Through the years, students are required to write longer compositions, and are slowly advised on how to divide the writing task into distinct phases (e.g., first draft, second draft, final draft). Feedback from teachers, parents, and peers helps students craft a unique working and writing style. In fact, this instructional process continues to shape the nature of an individual's writing even after formal education is complete. Therefore, it is even impossible to discuss a temporally distributed writing practice without acknowledging the underlying cultural influences.

In addition, I wonder if PR's failure to notice and correct grammatical mistakes is a consequence of Western education. Throughout my own (private school) education, I was never formally instructed on English grammar. However, my parents observed this and provided some instruction at home; although as a native English speaker, it is shocking that I was never formally taught English grammar. I fear that children whose parents are less knowledgeable or conscientiousness than mine might not ever learn proper grammar, unless our educational system reforms some of its instructional priorities.

4. CONCLUSION

Although scholarly writing may appear to be a solitary activity at times, it is a highly distributed cognitive process. Analyzing the evolution of PR's literature paper revealed three distinct writing stages: idea formation, text creation, and text editing. Each of these phases required cognitively taxing activities which PR coordinated through social interactions, through material artifacts, and through time. As a result, PR exploited her environment in a culturally informed and culturally acceptable way, to produce a written composition.

Although I only analyzed a single instance of independent writing, the distributed framework can be applied to all types of writing. Distributed cognition drives single-author, cooperative, and collaborative writing; it similarly guides one-line text messages, law briefings, software development, and comic strips. Even in writing this article, I observe the distributed nature of my writing process. Not only did I reference PR's source materials, drafts, annotations, and notes, I also read additional books and papers as evidenced by the citation list. I made use of other artifacts (e.g., search engine, spell-checker, pen-and-paper), I discussed my ideas with friends and colleagues, and I spent several weeks writing, editing, and rewriting. While I am sole credited author on this paper, my information, my ideas, and

even my writing style were shaped by many additional material, cultural, and social factors.

In fact, distributed cognition always describes behavior emerging from a socio-cultural system. Well-established cultural practices are largely invisible, but should not be overlooked. Even with single-author writing, the distributed processes involved are heavily determined by cultural influences.

If it is indeed the case that culture informs the nature of text composition, what is inherently human about writing and what is simply culturally-mediated? Individuals have been formally documenting language at least from the time of the scribes in ancient Egypt (3000 B.C.), and were thinking and speaking long before that. Today, the cognitive properties of the writing task may differ by country, as local cultures accept different social conventions and technologies. However, has the writing process been fundamentally changed by such cultural institutions, or do cultural practices simply facilitate and expedite the cognitive processes involved? I believe these questions can be addressed by recognizing that writing itself is a cultural convention.

As such, there is nothing inherently human about writing. Just about every individual can speak a language, but according to the Federal Ministry for Economic Cooperation and Development, 862 million adults are illiterate worldwide (Education in Developing Countries, 2006). Historically, other local cultural practices (e.g., remembering where to hunt for food; tracking the contents and sales of goods) may have led to its development, but writing is fundamentally a cultural phenomenon. Consequently, the nature of the writing process could be markedly different across cultures and customs. To further this argument, I have attempted to discuss the culturally-guided and cognitively distributed influences on this process in the Western world.

However, one glaring omission in my account so far is the role of language, another highly variable, cultural convention. Conceivably language may have the ultimate (invisible) influence on the way individuals think, speak, and write. In ideogram-based languages, such as Chinese, characters represent distinct concepts, each with its own meaning (e.g., the characters for *CHINA*, 中国, mean 'center of the world'). It is plausible that writing these characters causes a visceral reaction in people, arousing feelings of patriotism and loyalty, and possibly even affects the nature or tone of the subsequent composition. Speakers of alphabet-based languages, on the other hand, may not experience such profound emotional states when writing, if individual characters and phonemes are not intrinsically meaningful.

Thus, in addition to the cultural practices mentioned previously, language may similarly influence the nature of the writing process.

Accepting that writing is a learned cultural convention, now well supported by other cultural practices (e.g. the educational system, social interactions, material artifacts, technology), what societal implications does this have? In fact, a better understanding of the processes involved in writing will help guide educational and instructional methods, and may inform the design of better tools for impaired individuals (e.g., audio interfaces as cognitive aids for the blind). Although reading and writing are still underdeveloped practices in many parts of the world, striving to fully understand the distributed and culturally-influenced cognitive processes involved remains a valuable exercise, if only in hoping that one day this knowledge will result in an acknowledgment and acceptance of cultural differences worldwide.

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