

Proprioception And Literacy

In the

Digital Realm

by

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A Thesis

Submitted to the University at Albany, State University of New York

In Partial Fulfillment of

The Requirements for the Degree of

Master of Arts

The College of Arts & Sciences

Department of English

2014

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Abstract:

Drawing on research in the fields of neuroscience, reading cognition, and the history of writing, the author explores the condition of reading today. Rather than accepting the apocalyptic pronouncements that the Internet is “dumbing down” current readers, the author argues for a more nuanced understanding of the effects of digital media. He argues that the literacies needed for the new digital realm are not new, but are literacies developed over thousands of years. The author argues for the need of more education and instruction in the use of digital media, and that the digital realm requires new proprioceptive (spatial awareness) abilities to navigate.

Introduction

Recently my family bought my 87-year-old grandmother an eReader for her birthday. She is a voracious reader and avid crossword-puzzler and devours books at an amazing rate. The idea was to get her an eReader in order to make more books more easily accessible without her having to leaving the house. This didn't work quite as planned. Unfortunately, she can't access the books on her eReader, because she doesn't know how to use the functions. Once the book was open on her screen, she had no problem progressing through it, right and left arrows pointing back and forth in the book. However, if she accidentally gets to the device's home screen, she is lost. She couldn't figure out how to download books, and even looked at me quizzically when I said, "download." The icons and symbols and signs that make the device work are as foreign to her as Chinese characters. She had to be taught how to use the device in order to read the books that are on it. In fact, everyone must be taught how to read on different media and in different ways.

This conflict of literacies isn't new to the digital realm. In the 1940s John Wilson tried to teach non-literate Africans about the hazards of standing water (They are mosquito breeding grounds) by using film. He soon discovered that the task was not as simple as he had anticipated. The Africans were not able to "read" the movies the way Wilson wanted them to. Whereas a movie-literate person takes in the whole picture on the screen and then focuses on the important parts, a non-movie literate person looks at the screen as they would a text, element by element. When an actor walked off the screen, the Africans were distracted, wondering what happened to him. The movie-literate person understands that there is no more need

for the actor, but the non-literate had to see him take a “natural turn” around a corner or down the street. The African villagers had to be educated in how to watch a movie. They needed to be taught how to “read” the movies (Wilson 7-14).

These stories illustrate the need to educate people on how to use a technology, to make them *literate* in the use of it. This can seem a bit counter-intuitive to those who grew up watching movies or navigating computers, but can be frustratingly complicated to the uninitiated. Computers may seem intuitive to those who have used them, but in order to use them properly the user must develop a form of literacy. This may be called digital-literacy, or cyber-awareness, or computer competency, but no matter what it is called, it is the development of skills needed to navigate the digital world, a world that is increasingly becoming important in our lives. The computer makes use of and alters old forms of literacy in new ways.

Computers have created a new mental landscape that requires new proprioceptive abilities to traverse this landscape, abilities which require the users to be able to not only read words, but to recognize icons and to navigate the landscape as well. They need to understand the functions of the icons displayed, what the buttons on the device do, and how the information is organized on the World Wide Web. They must understand the use of the scroll bar on the side of the webpage, and the back and forth buttons on the web browser. The user must learn how to use a search engine and what a website address is. Once the desired text is found, the reader must learn to distinguish between the text of the document and the advertisements and website content buttons. Reading on computers requires different motor functions, different reading abilities and different competencies.

It is important to understand how the digital realm is affecting readers because educators are just beginning to teach the children who were born post web 2.0. The difference between a child currently learning to read, and how her teachers learned to read is the difference between a card catalogue and Google; punch card computing and the systematic web; pencils and iPads; the telephone and video chatting. It is a much different world today than it was thirty years ago, and the way the newer generations are interacting with the written word is different than the generations before. Where once there were letters, now there is text messaging, instant and accessible. In order to interpret these texts properly, the reader needs instruction on *how* to interpret the text, whether it is a text message, a book or a webpage.

Another reason it is important to recognize the differences between computer-based reading and text-based is because of the “digital divide,” the growing gap between those who have access to computers, and those who do not have access; namely the underprivileged poor (“Digital Divide”). A recent study by the PEW research institute found that about 20% of Americans don’t have Internet access at home. Some of these are older Americans some are people whom have chosen to not subscribe to Internet services because they feel they have no use for it. The figure that is important to take notice of is that 46% of households that make less than \$30,000 a year don’t have access at home, although some of those people have access on their smartphones (Robertson). This is a significant number of people. The children of those households are losing out on learning how to read in this new

digital world; they are not getting the experience of the digital realm and will therefore have a harder time competing in the digitally-driven job market.

They are missing out on Facebook and Twitter and online games and YouTube, and they are missing out on the great information resources that these social media forms provide. Twitter can warn populations of storms and hurricanes faster than any TV or radio channel. YouTube is one of the greatest storehouses of information freely accessible. Want to know how to play the doboro? YouTube it. Need to know how to change the RAM on an iMac? YouTube it. Tutorials abound on YouTube, and some of them are as complex as how to rebuild an engine. 20% of the population is missing out on one of the most useful verbs to come along in the past century: “to Google,” to plug a logical sequence of words into a search engine and to have the answer appear somewhere below it. It is sometimes hidden among lies, misdirections, and near misses, but it is usually there. Those without computers at home can’t simply “Google it” or “YouTube it,” and they may face the social stigma for not ‘liking’ their peers’ Facebook comments. And yet these are not the most important interactions these children are missing out on. It is the ease of government forms online, applications to jobs, easily figured out directions and warnings of natural disasters. And there is something more that they are missing out on: learning how to navigate the Web; physically learning how to use a mouse and how to go between webpages and how to assess judgment on the Internet. They are illiterate in this new reading on computers. They don’t know the meanings of icons that have meaning to most of us, the back and forth buttons on web browsers, the house that means “homepage,” or even what a homepage is.

They are missing out on the proprioception of digital life: The digital-spatial awareness. Internet navigation, and even computer navigation is a learned skill. In order to run a desktop computer, one needs to know how to use a mouse and how to interpret the icons that are used. The user must understand that where her arm moves the mouse corresponds to where the cursor is on the screen. It is not a natural ability, but a learned one. The concept immediately is an easy one to grasp, but a difficult one to master. Actually knowing where the cursor is at any time can be a difficult task for even the very computer-literate, forcing us to move the cursor around frantically trying to see any sign of movement across the screen.

There is also the digital proprioception of learning where things are on the computer, and how they are connected. There is no physical model to look at to understand it in a physical sense. The user must learn where files are stored, and how to get to programs that are on the computer. Each computer is slightly different, having different filing conventions depending on the user's decisions or place preferences. Files may be contained within files within files, ad nauseam. These may only be ways to interact with the computer, and not ways that it affects reading, but if one does not know how to open a book, one cannot read the book. If a child doesn't know how to begin to access information in a digital form, then she can't possibly read anything in that form. Their literacy does not develop. Educators need to understand these differences in order to best teach the students of today how to read and how to navigate this new digital realm.

Reading and Writing

The Oxford English Dictionary explains that the word “reading” comes from the Old English word “Raedan,” and defines it as, “To consider, interpret, discern,” and also, “To guess, make out, or tell by conjecture.” Reading is an act of guessing. In order to guess correctly, we educate ourselves in conventions that we have agreed upon, including the phonetic alphabet, icons, and symbols. It is important to note that reading is not simply learning how to use the alphabet, but rather learning how to recognize signs. This not only includes letter signs, symbols such as the ampersand (&) and the at sign (@), but also the back and forth buttons on web browsers and the power buttons on electronic devices. The literacy needed today is a mixing of literacies from across centuries. Readers now need to understand iconography like the writers of cuneiform, in addition to being able to read the phonetic alphabet.

Writing is a remarkable feat of human ingenuity. It is a technology written on technologies with technologies; and yet it is an art form, stylized and expressive. It is hard to think of it as a technology because it is an ancient one, and one that has been only slightly altered in thousands of years. Since the ancient Egyptians were writing in hieroglyphics we have been writing with ink on paper-like papyrus. There were other mediums, such as clay and stone, but for most of human history ink was the tool of the scribe. That is, until recently. Today we write on computers and read on computers and transfer these works through computers and everyone can be a scribe and author and editor and publisher. The computer has become the pen, the ink, the book, the printing press, and the library. It has become the radio, the

television, and the newspaper. It has completely changed the way we interact with the written word and with each other; we are only just beginning to understand its implications. We must understand these changes in order to find the good and the bad in them, and the best way to go about this is to look at the changes in writing throughout history, and to see how they compare to how we read to day.

Reading and writing are so often lumped together that it is easy to forget that they are not the same thing, just as listening is different from speaking. According to Steven Fischer, "Writing prioritizes sound, as the spoken word must be transformed or deconstructed into representative sign(s). Reading, however, prioritizes meaning" (11). Writing is the process of transcoding sounds to symbols; reading is the process of deciphering those symbols, not back toward sounds, but toward concepts. In writing, the aim is to mimic speech patterns, representing phonetic units by means of marks on a page (letters). Experienced readers use a "whole word approach," they have no need to sound most words out. The part of consciousness that "speaks" is quieted, allowing the reader to take in the word at its level of meaning. The word becomes the sign (Fischer 337-339). Put simply: to the reader the word is the symbol of the meaning; to the writer, the letter is the symbol of the sound.

The symbol changes shapes depending on the medium used, and therefore affects the message itself. They utilize different forms of construction, different shapes and sizes, and have different restrictions. Books are limited by size; a ten thousand-page book is impractical to carry around. A computer-based text is not limited by space, but rather by battery power. A book can only produce words and

pictures; a computer-based text can include sounds and video. By observing the differences of reading and writing on different technologies, we can begin to understand how we as human beings interact with the written word. We can then begin to try and consciously mold the media to our desires. We can create the space we want to, and we can educate future generations on how to best use it.

A critical factor in this new digital landscape is that in order to read and write the reader needs to be able to navigate this landscape, which is different than the act of reading or writing in a physical book. Writing with a pen involves two physical components: perceptual, learning how to shape a letter; and motor, learning “the trajectory producing the letters’ shape (Vintner 147). In order to learn how to write, one must learn to recognize the shapes, and then how to draw them. This relies on proprioception (the ability for the body to know where it is in space). In order to learn this takes practice and consistency, shown by the fact that children learning how to write are able to recognize the letters that form their own name before they learn to recognize other letters (148). In this changed digital landscape typing doesn’t require any forming of letters, and clicking a mouse doesn’t require precision. The letters don’t have a trajectory, but are rather positions on the keyboard. They are barely different movements that navigate the digital world more than they do the physical one. Navigating and creating texts in the digital world therefore requires much different proprioceptive behaviors. “As the page becomes immaterial, so is the self depicted as immaterial” (Muri 238). The reader’s interaction with the object she is reading goes from corporeal to ethereal, from body to mind, from crafting letters to typing them out. This does not create the “post

human cyborg” that Sadie Plant describes, which is, “more or less directly connected to your central nervous system; more or less hooked up to its own abstraction” (qtd in Muri 233). Readers are not becoming one with the machine, but are simply interacting with it in a new way. One example of this is that the reader is learning to recognize icons as functions that perform tasks on computers.

Reading on a computer reflects the past experiences of the user, and if that user does not have a past experience with computers or the digital realm, then their reading of the text would be different than that of one who is digitally literate. Wolfgang Iser believed that the true meaning of a text does not exist in the author’s mind, but rather in the mind of the reader through the interplay between the text and the reader, and the implications for reading in the digital world are staggering. He called this “the virtual dimension,” and says that it “is not the text itself, nor is it the imagination of the reader: it is the coming together of text and imagination.” He believed that the way a reader experiences a text is reflected by a combination their own disposition, by their life experiences, and all of the texts that they have ever read (Iser 1005). We must learn to read in different ways. Take for example Stanley Fish’s classroom experiment. In 1967 he put on a blackboard a list of names of that his class would be studying. When that class left he drew a frame around the names, and above wrote: “p. 43.” The next class he taught was an English class in which they had been studying religious poems. Fish told his students that the list of names was a poem similar to those they had been studying. The class then proceeded to dissect the list as though it were a poem (Fish 323). Fish claims to have reconstructed the experiment several times to the same effect: the students were able to deconstruct

the list of names as though it were a poem even when they were told the truth, that it was an assignment (Fish 327). Fish says: “It requires just as much work to see this as an assignment as it does to see it as a poem” (Fish 329). Obviously, it was not a poem, and any interpretation to that end is wrong, but that did not stop his classes from doing it. Even when the student knows the truth they are still able to dissect the text as though it were a poem. Once the students were taught how to read a text like a poem, they were even able to read lists as though they were poems. In order to interpret something the reader must be taught *how* to interpret it, and once this is done, the reader is able to do so.

This is possible because the brain does not simply dissect sentences into words and punctuation, but into ideas and concepts. Words do not exist in our brains independently, but are entirely dependent on every use of the word we have ever heard or read- our understanding of what that word actually means. Our brains don’t work in a direct one-to-one correspondence with the word; the word does not exist as a Platonic ideal, but rather more like a spider web where the word causes a reaction to spread throughout the strands of the brain. When talking about the word “tree,” what comes to mind “draws on all the symbolic context” associated with it, every tree we can remember. There is no “perfect” tree that exists in our mind from which we interpret every other tree. Every word we use relies on the fact that our brains associate it with the concept it signifies and the real trees we have seen (Lacan 1135). A palm tree and a weeping willow are both trees, although they don’t look particularly similar. We are able to think of them both as trees because our brains are spiderweb-like, and the utterance of the word is like a fly landing on a

single strand, sending ripples throughout the web. When we see the willow or the palm, we think of it as a “tree,” because we are told that is what it is, then we file it away under that heading, so that the next time we hear “tree,” palms and willows are in the mental-web directory alongside oaks and birches. Jacques Lacan called this “reference back” (Lacan 1141).

With print came an increase in the amount of texts available, which is in effect other people’s thoughts laid out bare on the page. As literacy increased, and access increased, the inner cross-referencing that goes on inside the reader grew. The number of texts the reader was able to “reference back” to increased. The more books a reader reads, the more the reader internalizes other people’s thoughts. Readers are affected by every text they have ever read and they compare it to what has come before. Iser says:

Whatever we have read sinks into our memory and is foreshortened. It may later be evoked again and set against a different background with the result that the reader is enabled to develop hitherto unforeseeable connections. (1004)

Readers can’t help but be affected by the texts that they have read before. The more texts they have read, the more the reading has changed their perception. By making texts widely available, the printing press forever altered the human mind by providing more catalysts of change. When people began to read more books, they had more frequent experience in the mental world created in the interaction between a text and the reader. They were mastering the art of reading through practice. Today, the “World Wide Web” is a giant, evolving text that we navigate through, and return to again and again. It constantly changes, but so do we as we work through it.

In order to properly use digital texts we must learn how to read them; our “reference back” must not only include word usage, but icon usage in the form of internet navigation and computer functions. Fortunately, this is not something that we need to create from scratch. Our reference back includes every time we have interacted with computers and grows with each use. The reader is already equipped with the tools needed to read in this new way because the digital realm relies on already established forms of literacy, and uses them in new ways. Our idea of “tree” now extends into pictorial and photographic representations, just as our understanding of “home” has extended to the homepage on a web browser.

Mediums Across Millennia

In order to understand why these changes are occurring in the way we read, we must look at the way we have read in the past and how the changes affected the world. Paper and ink may have been used since Ancient Egypt, but there was also an abundance of different mediums and modes of communicating, all with different types and quantities of people reading. For most of human history the select few could read and write, but that changed with the invention of the printing press, which significantly lowered the cost of books and made the dissemination of information easier. The technology changed the course of human history, just as the Internet is doing today.

To understand how writing started, we must understand what reading meant to ancient people. It is possible to read books and letters, but it is also possible read animal tracks, omens, signs and facial expressions. The idea of reading as

deciphering letters is perhaps the most modern of these ideas. Before that, our ancient ancestors needed to read the world around them. They had to read the signs in the swirling waters of a pond to find fish, they had to read the signs written on the trees to know when they would fruit, they had to read the expressions of animals to know when they should be hunted, and when they themselves were the hunted. These basic, hunter-gatherer acts of reading did not fade away as literacy began to take shape, but existed together with them, and survive today. Spend enough time outside and one can learn how to predict the weather, to read the signs. Dark clouds mean rain. Heavy winds mean a change in the weather. Learning to read one thing does not mean forgetting how to read another. Reading in the digital realm does not mean forgetting to read in the paper world.

Before our modern phonetic alphabet even began to take shape, there were other types of man-made sign systems. There were notches on sticks and knots in ropes to remember quantities, and there were coins, which represented sums. The earliest examples of writing were clay tokens representing livestock and goods. These began to create basic neural pathways that would form the basis for our current understanding of reading (Carr 52). Ancient peoples living at that time could “read” the tokens, and understand that they represented something else: livestock. In order to do this required the development of new neural pathways, connecting the visual cortex of the brain with a nearby sense-making area of the brain. A form of literacy was developed. Parents taught children how to ‘read’ the tokens, how to understand what they were intended to represent (Carr 57). They had to learn to associate the symbol with what it represents, the map for the territory. This isn’t

very different from what we still do today, paying with paper money for tangible goods. The money and the tokens represent something and it is our mental leaps that make the connection. This is also the basis for words, each word representing a concept. The word “cattle” represents the animal as much as the clay tokens did.

The importance of these first steps towards our modern writing system is that it transferred the aural sounds to a visual space. Concepts as represented by sounds (words), could now be seen. McLuhan observed that, “Writing is a visual enclosure of non-visual spaces and senses. It is, therefore, an abstraction of the visual from the ordinary senses interplay” (McLuhan “G. Galaxy” 43). The letters and symbols we use for communicating through writing are not inherent. The “A” doesn’t sound like an “A” because of its inherent value, but rather because as a society we have decided on the sound. It is a tool used to represent the sound. This wasn’t exactly writing, as we know it today, but it was the humble beginnings, the framework that would one day forge reading. Writing couldn’t exist until there were agreement symbols used by many people (Jean 12). These early signs were so localized that they weren’t truly a form of writing; they had to be codified, agreed upon by more than a select few in order to truly develop. If only one person knows what the symbol means, he is the only person that can read it. If only a family knows what the sign signifies, it is a family secret. But once a village agrees upon the signs, it becomes public knowledge; the larger the village, the more useful the symbols. For the first time messages could be sent vast distances without alteration, records could be passed down through the generations. While we don’t have brain scans of these early readers and writers, we can assume that something was changing in

their synapses as they went from an oral society to a written one, just as our synapses are changing moving from a book-based culture to a cyber-based one. Our eyes began to do the work that our ears had done before. The utility of this is that once something is written, it exists in a more tangible form than something that is spoken. Speech is carried away immediately by time. Writing is (slightly) more permanent.

We have traces of this proto-writing from the temple site of Uruk, from the Sumer civilization in the form of lists of stacks of grain and heads of cattle, a more complex version of the tokens mentioned before (Jean 13). It is no coincidence that one of the earliest records we have was discovered at a temple, because for a long, long time writing was a skill practiced and maintained by religious institutions. This writing system utilized symbols, or 'pictograms' to represent ideas. A cow, for instance, was represented by the crude outline of a cow's head.

While this form of writing eventually gave way to the phonetic alphabet, we never really stopped using it. Take street signs for example. We rely on iconic symbols to represent ideas in a quick and succinct manor. The "Men's" and "Women's" room signs are good examples of this. We learn at a young age that the person with the triangular bottom represents a woman with a skirt. However, these types of signs also show the problems inherent in pictograms. Take for example these two pictures of a street sign taken in France (figure 1 and figure 2). With no knowledge of the French language, and no education of French street signs, these images have no meaning, though the icons may be familiar. Figure one in fact has

nothing to do with children, but is rather a sign that indicates no pedestrian activity.

The meaning to figure 2 is unknown.



Figure 1. Street sign of adult holding child's hand signifying a no-pedestrian section. Picture taken by author.



Figure 2. Street sign of dog and arrow. Meaning unknown. By author.

Figure 2 is clearly an icon of a dog, but the meaning beyond that is ambiguous. It could be pointing in the direction of the dog, or in the direction the dog should be going. Or, it could be a dog on a skateboard. Without being taught how to read these signs, they are not clear. These pictures illustrate that while icons are useful and still in use today, each one needs to be learned to be understood. One must learn what each symbol means on its own. Contrast this with our modern alphabet, where you must learn only 26 letters, and you can make any word, sentence, or instruction, and you can see that while icons are useful for quick reading, they are hindered by the need to learn them all individually.

Computers are using this old technology of the icon in order to represent companies and functions and actions, capitalizing on its space efficiency, and on the human mind's ability to recognize them. But the signs must be learned, including the navigation arrows and the "home" button. They seem simple, but they use inexact symbols to represent ideas. The arrows that represent going back to a previously viewed webpage points to the left of the screen, but the actual webpage isn't physically to the left, neither is the next webpage to the right. They are simply convenient conventions. Over time, stylized writing systems began forming leaving iconography behind and becoming more abstract, but the icons never truly disappeared.

By 2900 B.C. the curves in the writing system disappeared giving way to straight lines. This is because the stylus on clay method was not suitable for curves, but did allow for straight lines and triangular wedges. This is where the term "cuneiform" comes from: the Latin 'cuneus' for "wedge" (Jean 15). While still

retaining within its form the icons they originally represented, the symbols began to move beyond icons because of the limitations of clay. The distance between the visual space on the page, and the world it represented was widening. They were more abstract, and started looking less and less like the things they represented.

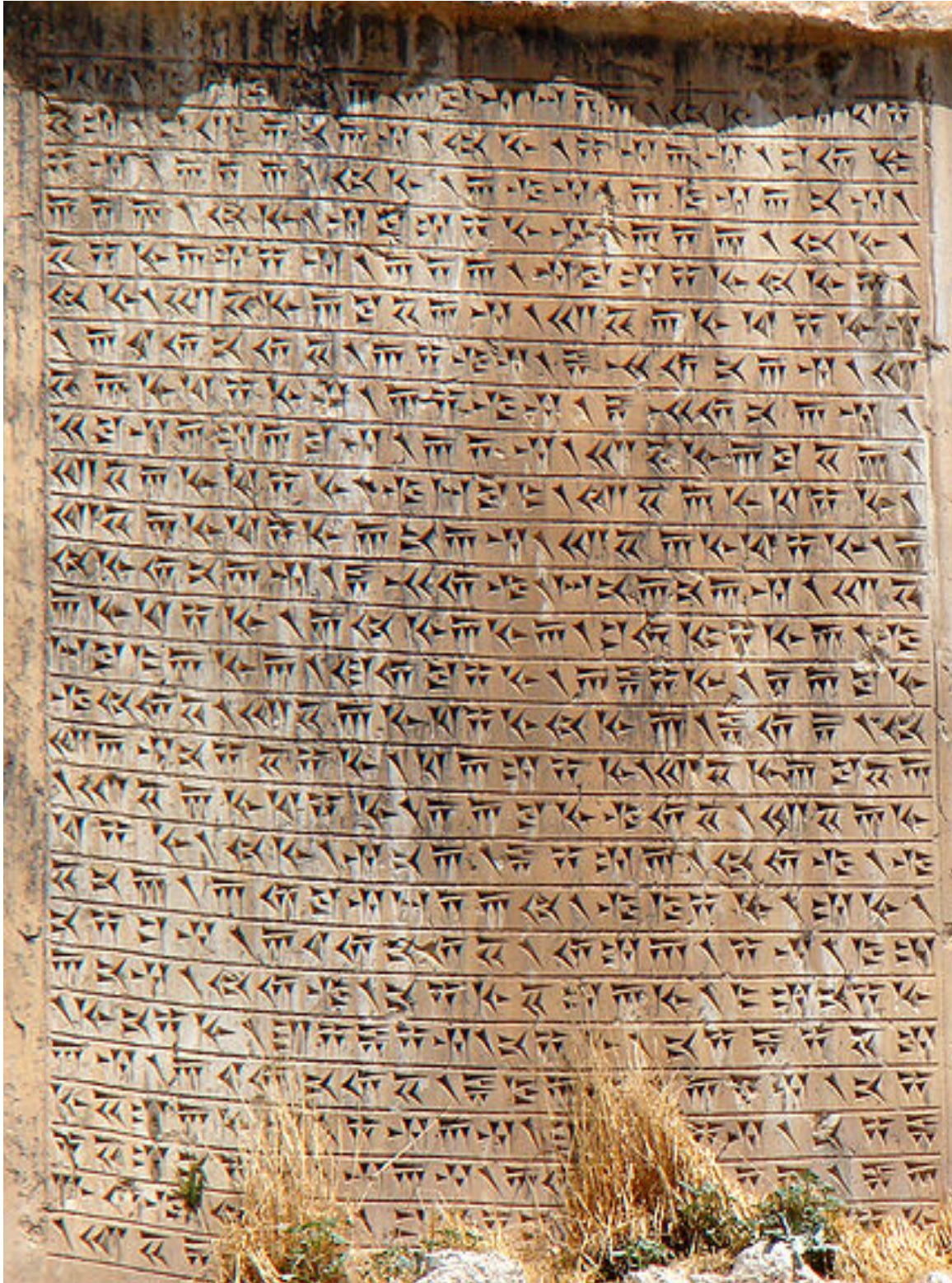


Figure 3. Cuneiform engraving of a message from King Xerxes. Wikimedia Commons.
By Bjørn Christian Tørrissen

Looking at these ancient clay tablets, it is easy to see that the motions needed to write on them are much different than the motions needed to write with ink. It is also apparent that the ability to read these tablets would have been slow and laborious; as the symbols were so packed together it is difficult to separate them visually. In these clay tablets we get the first sense of how the technology of the time influenced the writing method. Looking at the tablet above, one can see how difficult it would be to make these signs with ink, but with a wedge shaped stylus, they would be simple movements.

Over the centuries, cuneiform began not only to accumulate thousands of pictorial signs, but also those signs began to take on new meanings. A sign for a human foot grew to mean a foot, or “to walk,” “to move,” or even “to stand up,” depending on how it was used. This system was complex, and in order to learn it scribes needed “sign lists,” a type of dictionary that was intended to help young scribes learn all the meanings of all the signs. Because of its complexity, it became a highly specialized task (Jean 16). This intensive, lifelong practice of learning to draw and interpret signs must have produced a culture within the scribal community that would contemplate and experiment. His or her task would become more complex with each new thought or concept. Importing sheep into a culture that only had cattle would mean that the scribe would have to create a new sign for sheep. In order for a sign to work there had to be agreement between scribes. This is paralleled in learning how to navigate the Web today. Each individual sign, such as navigation buttons or the symbol for Facebook, has to be learned in order to use it properly.

Cuneiform was a much different system than our modern alphabet, and uses a different type of reading. Cuneiform was still simply a representation of things, not sounds like our modern alphabet. It wasn't until the scribes began to use those symbols to represent sounds that we began to move towards a phonetic alphabet. They would combine pictures of things to represent the sound those words meant, like "using drawings of a 'car' and a 'pet'" to represent a carpet." This is called a rebus, and it means that the signs should be read phonetically, as opposed to symbolically (Jean 16). The complexity of this meant that someone would have to learn all the symbols, how to pronounce the words they represented, and then how to string them together. They had to know when to read the sign as an icon, and when to read it as a rebus-- a complex mental task that harkens back to the original meaning of the word "to read" ... "to guess." Raedan. The complexity of this system would mean that it would take years to learn and a lifetime to master.

As the writing systems began to shift and change form, we can imagine that the way they were read changed form as well, as different writing systems utilize different parts of the brain when read. While the Mesopotamians were writing in a rebus form of cuneiform, around the world other forms of writing were beginning to form. In Egypt, hieroglyphics were being created, and in China they were working on their own pictographic writing system (Jean 45). Modern Chinese is a direct descendent of this pictographic writing system, but one that incorporates phonetic elements in each character that guide the pronunciation. Looking at the brain patterns of people reading Chinese characters, researchers have seen an "extensive activation of visual regions in the occipital areas, a physiological correlative of the

cortical 'space' needed for acquiring thousands of Chinese characters" (Wolf & Barzillai 34). This is much different than the brain scans of readers of phonetic alphabets, like English, where there was increased activity in the temporal and parietal regions of the brain, parts closely associated with sounds (Wolf & Barzillai 34). Although modern Chinese is a complex and complicated system, and very different from the iconographies of ancient cuneiform, we can use it to see that these differences affect different parts of the brain, and that it suggests, then, that cuneiform and the phonetic alphabet would also affect different parts of the brain.

It is believed that hieroglyphics, dating to the third millennium B.C., was the first 'true' writing form. It is because it used three types of signs: "Pictograms-stylized drawing that represent objects or beings... phonograms-the same or different forms used to represent sounds; and determinatives- signs used to indicate which category of objects or beings is in question" (Jean 28). Part of the reason for these differences is that while in Mesopotamia there was an abundance of clay, in Egypt there was an abundance of papyrus. So, instead of inscribing on clay, the Egyptian hieroglyphics were printed on paper-like papyrus using reed styluses and ink. This allowed for greater variety of lines, curved and straight, but no indentations like cuneiform (Jean 41). The medium affected the writing style; they had more freedom to develop a wider range of signs because the medium allowed it.

Over time this led to the phonetic alphabet, the importance of which is that the alphabet opened up the system to allow for a large amount of variation and customization, making it uniquely adaptable. The limitations of the scripts cuneiform, hieroglyphics, and Chinese, is that they required the scribe to memorize

thousands of characters, which took a lot of time to master. The Phoenicians created the phonetic alphabet, which spread over the Mediterranean, reaching Greece around 800 B.C. The Phoenician signs represented sounds, which meant that any word could be written, more or less precisely, with only a finite number of signs (Jean 52). It limited the number of signs that the scribes needed to recognize. All alphabets, including our own, can trace their lineage to the Phoenician alphabet (Jean 60). The phonetic alphabet was one of the most important revolutions in writing because it was versatile and adaptable. Sometimes signs were borrowed into a language that had no relation to the original sound, but the idea that each sign had its own sound is what made it unique. This had the effect of increased dissemination of writing, as the scribe no longer needed to remember those hundreds of signs, but only needed to remember around thirty (Jean 52).

The innovation of the phonetic alphabet is that it helped to turn language into a tangible thing. Written words that could be held, felt and changed. By writing words down they become fixed, part of the tangible world, as opposed to ethereal, impossible to pin down, as they are in the auditory form. Marshall McLuhan points out that, "The interiorization of the technology of the phonetic alphabet translates man from the magical world of the ear to the neutral visual world" (McLuhan "G. Galaxy" 18). By writing words down, they are placed into a fixed medium, solidifying their existence and meaning. "Print... translated the dialogue of shared discourse into packaged information, a portable commodity" (McLuhan "G. Galaxy" 164). This meant that the thoughts of great thinkers could be sent far and wide, spreading their influence as far as the alphabet and language could carry it.

Of course, not everybody in Greece was impressed by the new technology of writing. Plato famously said in his play Phaedrus: "If the Egyptians learn to write, it will implant forgetfulness in their souls: they will cease to exercise memory because they rely on that which is written, calling things to remembrance no longer within themselves, but by means of external marks" (Hackforth 157). Plato was worried about the movement of an auditory culture to a written one, thinking that writing would in effect make people dumber because they no longer had to remember everything. Despite his objections, writing proliferated and its benefits far outweighed the fact that it "implant[s] forgetfulness" (157). But Gregory Crane retorted, "writing constitutes artificial memory and extends the range of human intelligence" (Crane). He argues that writing created the commodity of information. Words written did not create wisdom, but rather knowledge.

The phonetic alphabet invariably changed the human mind forever. It allowed for aural information to become visual. One could listen with an eye, or speak with a hand. McLuhan writes:

The dominant organ of sensory and social orientation in pre-alphabet societies was the ear- "hearing was believing." The phonetic alphabet forced the magic world of the ear to yield to the neutral world of the eye. Man was given an eye for an ear. (McLuhan "Medium" 45)

We were able to transfer meaning from sound to sight, but in order to do this, a great leap in mental awareness had to be made. The basis for the phonetic alphabet is the phoneme, the "irreducible meaningless 'bit' of sound, which is 'translated' by a meaningless sign. The phoneme is the smallest 'sound unit' of speech, and it has no relation to concepts or semantic meaning" (McLuhan "Laws" 14). Sounds were represented by signs, allowing the eye to function as the ear does by internal

vocalization. The reader's inner voice speaks the sounds to the reader's inner ear. As readers become more adept, their inner voice gets quieter, but the phonetic alphabet allows them to sound out unfamiliar words, giving them an inner ear to listen to the inner voice.

The conquering Romans helped to spread the alphabet throughout their empire, bringing it to new peoples with different languages. The effectiveness of the phonetic alphabet proved itself with its ability to adapt to these new languages, time and time again. The alphabet was also adapted for the mediums used by the various peoples. From Greece the alphabet spread across the Mediterranean Sea to Rome, where it was adapted and changed to become two separate alphabets. Here we see can see the medium changed the Alphabet. There existed two forms, the uppercase and the lowercase. The lowercase, rounded versions of the letters, was primarily used for writing on wax tablets and papyrus. The uppercase, the straight form of the letters, was used for carving into stone. Here, at the same point in time, we can definitively see the effect that the writing medium has on the formation of the letters. The uppercase letters were straight because of the difficulty of carving curved lines into stone (Jean 62). Or take for example the runes of the Germanic people. They took the alphabet and adapted it to their unique needs. While Egypt had an abundance of papyrus, making writing with brushes easy, and the Mesopotamians had an abundance of clay, making writing with a stylus easy, the Germanic tribes had an abundance of wood; this led to the development of runes and the unique shapes that they would become. We know that at least half of the early runes can be traced to the Roman alphabet, and that their shapes were altered

for use on wood. (Zender 4:8:18). A stick or a large piece of wood would be shaved to make a flat, clean surface, and then the runes would be carved into it using a knife (Zender 4:13:13). The medium of wood presented a problem for straight adaptation, though. The Roman letters had perpendicular lines, like the crossing of the “T” at a right angle, but this wouldn’t work on wood because the grains would be confused for the letters. So, in order to distinguish the knife marks from the marks in the wood, letters became angular. The medium of wood affected not only affected the style of the alphabet, but also made necessary different proprioceptive abilities. Carving letters with a knife requires more delicacy and attention than writing with ink and paper.

The primary reason parchment was used instead of papyrus or wood was because it did not soak up the ink as other mediums did. This meant that the colors would stay vibrant and preserve their original colors. Unfortunately, parchment was expensive to produce because it was made from animal skins treated and tied together. Another great innovation of parchment was its toughness. It allowed the use of the goose quill to be used, something that had more versatility than the brushes used for writing on paper or papyrus. The goose quill could be cut into different shapes and sizes, depending on the desired affect the scribe wanted to produce (Jean 81-82). The different mediums also show how the medium affected dissemination. While the parchment was expensive and labor intensive to make, wood was abundant. This meant that anyone could pick up a stick, inscribe a message with a simple knife, and send it on its way. The masses had the tools to write (Zender 11, 5:11:23). Contrarily, the expense of writing on parchment meant

that only the few, affluent, would have the resources to write. This kept writing in the domain of the scribe, and out of the hands of the common people. The medium affects dissemination. Unlike the wooden runes, the parchment manuscripts were far too expensive to produce. And yet despite these high costs, the utility of the parchment still helped to disseminate knowledge. Civilizations could organize. Complex orders could be sent across great distances, instructions followed to the letter. Armies could be organized, orders followed. Advanced ideas could be meticulously crafted and sent across great distances (McLuhan "Medium" 48).

The inherent toughness of the parchment, and the use of quills, allowed for more decorative manuscripts to be produced. While the runes were the marks of the common people, parchment and manuscript culture was the domain of the rich and educated. The parchment, together with the goose feather quill, allowed for vibrant colors, a wide range of scripts, and the ability to decorate the page with intricate designs. The difference between the two writing systems is a class distinction. Sticks are plentiful and easily found, making it the perfect medium for the masses. It was easy for a writer to pick a stick up off the ground, carve a quick message onto it, and send it on its way. Once the message was read, the stick could be used for as a fuel source, they could burn the message (Zender 11, 5:11:23). Parchment on the other hand was made from animal skins and took time and effort to create. The difference between the mediums meant that they would be used for differently. Parchments, being expensive, would have been crafted more patiently and used illustrated more lavishly than the more fickle wood.

During the middle ages reading and writing were considered different types of literacy. Because the use of quills was so difficult, many people never truly learned to write, but could read (Clanchy 234). So while there was the literacy of reading, there also existed the literacy of writing, and a third kind of literacy that was still in existence from times past: the reading of signs and symbols. On the borders of many manuscripts exist pictures of animals, monsters, and people. They are not, however, simply decorative. Those that read the manuscripts understood that the decorations meant something; they were notations adding meaning to the page. Take, for instance, this event Clanchy describes:

In 1291 Roger [of Pilkington] was granted a royal charter, which is most exceptional in being ornamented on all four sides with animals, birds and trees.... The ornament is descriptive, as it shows the flora and fauna which Roger will encounter when enjoying the hunting rights granted by the charter... As real animals and birds frame the words of the charter, so real rights are conveyed by its text. (294)

Pope Gregory the Great had just allowed the use of images in worship because he said that it allowed the illiterate to “read by seeing on walls in churches what they were unable to read in books” (Clanchy 192). In the medieval mind, words and images existed together, complementing and helping each other and serving different purposes. This mixing of symbols and words is something that still proliferates today on the Internet, using symbols to represent ideas and functions. Just as medieval man considered the birds on the edges of the charter to have meaning, so too does the modern reader understand the icons on the outer edge of the web browser to have meaning. The difference is that the pictures on the edge of Roger of Pilkington’s charter enhanced the meaning, while the icons on web

browsers have meaning unto themselves; web icons are navigation aids, charter pictures were informational aids.

Whereas today we learn to read and write at the same time, one skill augmenting the other, in the Middle Ages they would learn to first read, and then to write (Chartier 157). Their idea of literacy included a division between reading and writing, where our society views them as inseparable. To further complicate our ideas of literacy, during this time most people were reading out loud, whether alone or in a common room. The ability to read silently to oneself came about over centuries of practice. To the medieval mind, the concept of reading a book would not only incorporate reading the book oneself, but also having the book read aloud to them. Slowly, over the course of hundreds of years, different groups of people began to master silent reading. First were the monastic copyists, followed by the university scholars in the twelfth century. Later the aristocracy mastered the skill. This makes sense, as the copyists were reading the most, followed by scholars, and then the aristocracy. The more practice people had reading, the better they got at it, and the more they were able to internalize. By the fifteenth century most people were silently reading (Chartier 164). By the time of the invention of the printing press, the world was poised for a massive change. The greater amount of time a person spent reading, the better they got at it. They became quicker as their inner voice quieted down. Practice on the Internet can be viewed in the same way, the more experience people have with it, the better they are at using it.

Due to the expense of the medium, parchment, and the skill required for writing on it, there were very few people who could actually afford books. This

changed with the invention of Johann Gutenberg's printing press. It was not the first use of moveable characters, the Chinese were using it since the 11th century, but it was the first to mechanize printing (Jean 93). The effect of the Gutenberg press cannot be overstated, for it changed the landscape of the written word forever. From 500 B.C. until this invention, writing was primarily the domain of the scribe (McLuhan "G. Galaxy" 74). Now, it had become the product of the machinist. It significantly reduced the labor involved with creating books, thus reducing the cost, therefore allowing the greater dissemination of books, and in turn raising the literacy rates. Again, we see that the technology used affects dissemination. Gutenberg had used the medium of paper, much cheaper than vellum, for his printing press, thus adding to the overall cost efficiency (Jean 95). In manuscript culture the amount of books that a person had was limited, and so the readers would labor over the few books they had at length. Print made the cost of books drop, people were able to buy more books, and they began to read for pleasure. As the fifteenth century gave way to the sixteenth, the amount of books people had increased dramatically. The average merchant went from four to ten books, the average physician from twenty six to sixty two books, and the average textile trader from one book to four (Chartier 165). This sudden influx of written materials into the home had a profound effect on those that were reading.

One such impact was the cultivation of a new inner life for people. The ease of access and affordability of texts, in addition to the newfound ability to read silently, led to a new interaction between the text and the reader. For the first time people had practice interacting alone with a text. This was due not only to the wider

availability of books, but also to its clean visual style. The letters on the page were uniform, meaning that the reader no longer had to guess at what letter the scribe was trying to create. Reading became easier, which meant that it sped up. Once it is faster to read silently than to speak the words, it becomes a hindrance to read out loud. Thus reading became an individual endeavor, and the interaction between the reader and the text was able to mature.

As the voice became more silent, the brain had to absorb the information entirely visually. The text now came in more so through the eyes, and not as much through the ear. Marshall McLuhan said that “With print the eye speeded up, and the voice quiets down” (McLuhan “G Galaxy” 43). The masses began to cultivate an inner life for themselves. The ability to read “liberated the individual from the old mediators, freed him or her from the control of the group” (Chartier 157). They could read what they wanted, when they wanted. They didn’t have to be in agreement with those around them, they could read silently to themselves, pursuing text that interested them, paying no mind to the people around them. They were able to pursue individual endeavors. With the advent of writing came the ability to not only transfer thoughts through space and time, but also to put into tangible form those thoughts. This new inner life of reading, and outer life of writing, created an extension of our idea of self. The writer’s thoughts were splayed out on the page, to be read, and reread by any who could see it and knew how to read. The reader could scrutinize it and ponder over it; the writer could rewrite drafts and to organize thoughts; arguments and agreements could be meticulously designed. Not only were the thoughts of great minds broadcast to the world, but also those great thoughts

were organized, brooded over and reworked. Individuals began to interact with people from across great distances and through time.

Print also had the effect of standardizing the language. Before the advent of print, spelling was subject to the desires and accents of those writing it because it was a purely phonetic representation. It was print, with its ability to produce and reproduce exact copies that began to standardize it. It had started before Gutenberg, and it took hundreds of years to accomplish, but it would never have worked without the printing press. It was book publishers pushing for English language dictionaries that were the main agents of standardization, though it took them a long time to actually affect the change. Samuel Johnson compiled his work, "Dictionary of the English Language," in 1755 at the behest of his book-publishing friend, Robert Dodsley. Dodsley also pushed another client, Robert Lowth, to publish his "Short introduction to English Grammar" in 1762. Lowth had written the book for his son, but it was the printer that had pushed for it to be given to the public (Van Ostade 242). It was with print that standardization of spelling and grammar really took off, for print made bad grammar possible (McLuhan "G. Galaxy" 231). Spelling, grammar, and punctuation rules are constructs of written language, perpetuated by the development of print. We do not use commas in spoken language, but rather the comma is a device we use to clarify thoughts and to represent pauses in speech. Punctuation began as Roman oratory aid, marking the length of pauses. Will Caxton, one of England's first printers, used the slash (/) in place of the period, and even up until the end of the 18th century punctuation acted more as a visual aid for oratory than an aid for reading silently (Nordquist).

Likewise, “proper” spelling is simply something that society has agreed upon over a long time. Printers perpetuated it because standardizing words made the process quicker and easier (Kemmer). The medium of print affected the visual representation of words, helping to standardize the visual signifiers of the language.

Print codified the language to such a degree, albeit over hundreds of years, that it we still retain the spellings to words in an older form of English today. Around the 1500s, and continuing over hundreds of years, there occurred a massive change in the spoken English language: The Great Vowel Shift, where the sounds of vowels changed forms. Vowels that were made in one part of the mouth, shifted to another part, changing the sounds of most words (Menzer). Some letters also stopped being pronounced in words, such as the “K” in “knight,” and the “G” in “gnat.” Because this happened at the same time as the printing press was gaining influence and standardization was happening, modern English retained some unusual spellings. The technology of the printing press forever affected the way we read because it began to standardize an older form of the language. We read Modern English using spelling standards of Middle English (Kemmer). The medium affected the message.

This does not mean that the spellings are arbitrary. In fact, the odd spellings and silent letters help the mind to determine which meaning of the word is meant. Take for instance the homophones: “there,” “their,” and “they’re.” They are all spoken the same, but the fact that they are written differently means that the reader can learn to distinguish which term is meant. Because reading is a different process from writing, the mind of the fluent reader does not convert the word to sound, and

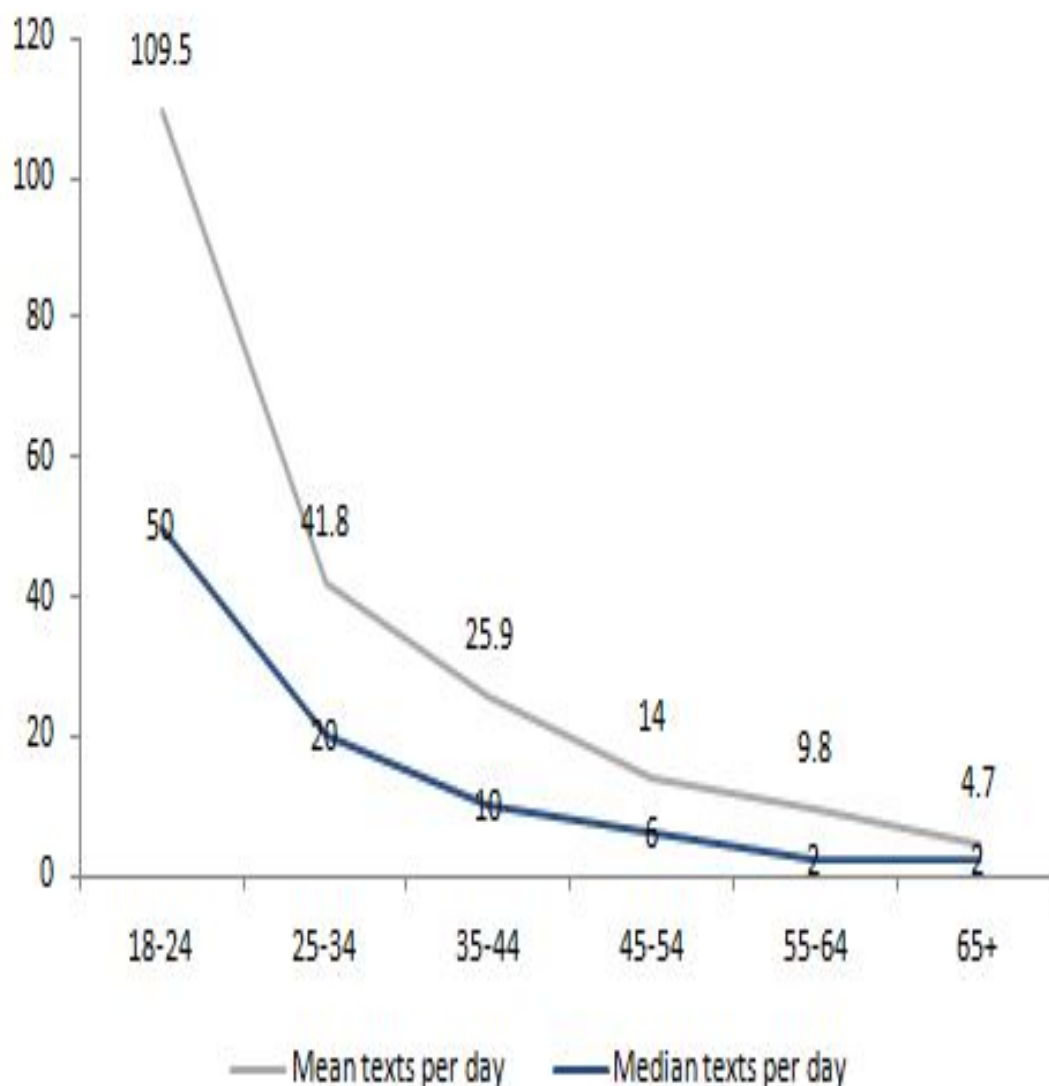
then to meaning, but rather converts the word directly to meaning (Fischer 334-335). Print allowed for greater speed in transferring the writer's thoughts to the reader's mind.

The State of Reading Today

Today, reading and writing are not just a way to communicate across great distances as letters once were, nor to keep our finances in order as in the use of the clay tokens. They are one of the primary ways we interact with the world around us. Street signs tell us where to go and when to stop; emails tell us what to do at work; newspapers tell us about the world around us; text messages keep us in touch with family and friends; the list goes on. Text messaging represents one of the largest percentages of reading matter today. Where once the main form of long distance communication was the domain of the voice, the phone call, today it is changing into the domain of the eye, the text message. A study by the PEW research institute found that while only 31% of people using cell phones in 2011 preferred text messaging to voice calls, the younger subjects interviewed definitely preferred it (Smith 1). This shows that the preferred means of communication is changing due to the technology we are using. Figure 4 below shows that the younger groups are using text messages more than phone calls, meaning they are writing to each other more often than they are talking to each other

Number of texts sent/received per day, by age group

Based on adults who use text messaging on their cell phones



Source: The Pew Research Center's Internet & American Life Project, April 26 – May 22, 2011 Spring Tracking Survey. n=2,277 adult internet users ages 18 and older, including 755 cell phone interviews. Interviews were conducted in English and Spanish.

Figure 4. Texts sent and received by age groups. From Smith (section 2)

The younger people are, the more they prefer texting to voice calls. People 18-24 are texting twice as much as the next age group up, the 25-34 year olds. With each ten-year age group the number of texts halves. It is clear that technology is changing our personal interactions. Messaging, e-mail, Facebook and Twitter have changed our means of communication forever. The total implications will not be measurable for years to come, but it is clear that the younger generations are interacting more through sight than they are through voice.

Not only are children reading more through text messaging than older generations, but also the prevalence of the Internet is making what they want to read more accessible, as shown in the studies of children reading video game sites. The increase in availability of more traditional sources is also causing the number of people reading books to increase as well. The graph below, by Gallup Surveys, shows the percentage of people reading books has increased dramatically in the last fifty years (Madrigal). We are reading now more than ever before, and in a variety of mediums. Again, the existence of one form of literacy does not exclude other forms. Reading more text messages does not mean we are reading less novels. In fact, figures 4 and 5 show that the amount of reading being done is greater for younger age groups than for older ones.

Do you happen to be reading any books or novels at present? (% answering yes)

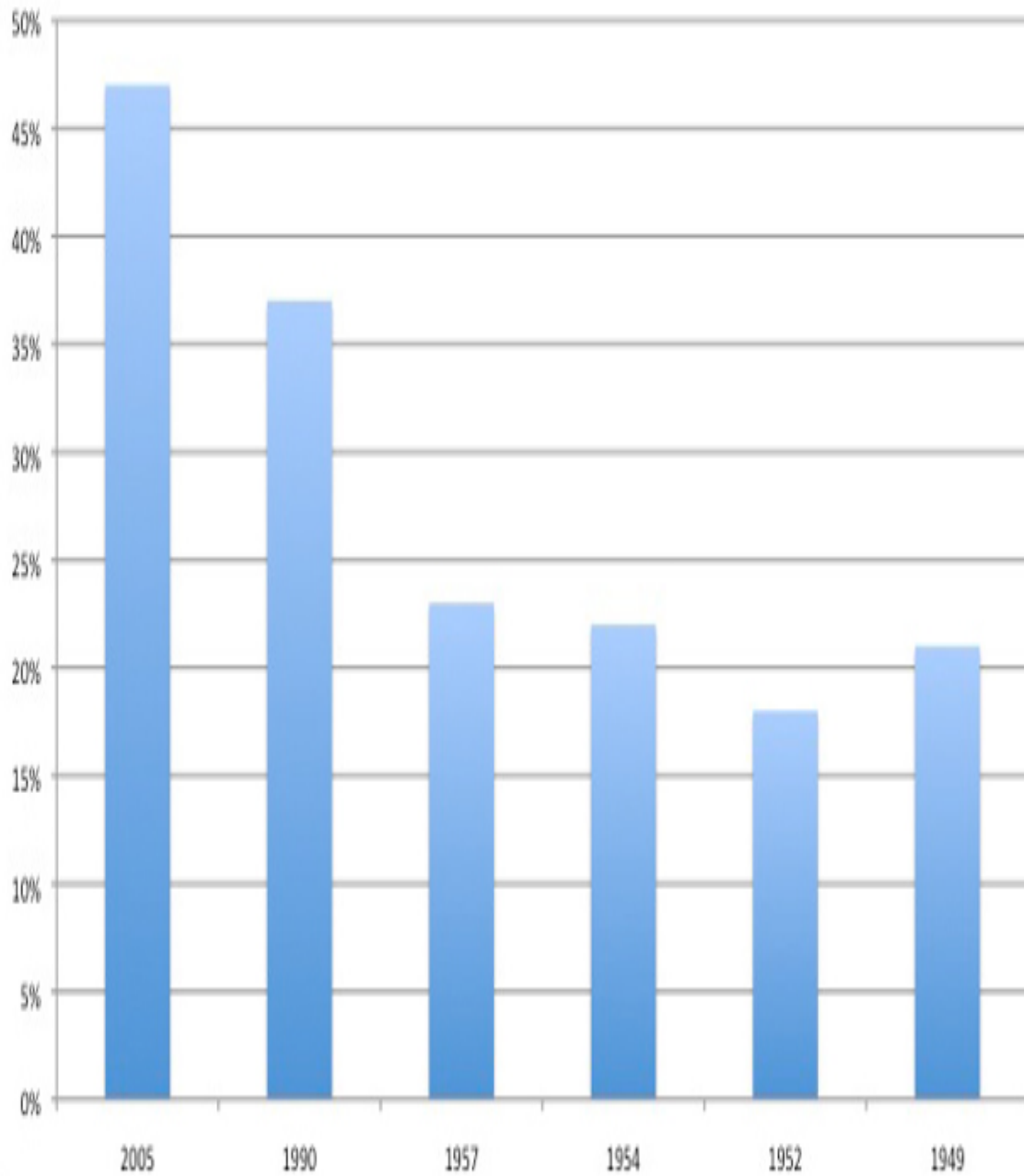


Figure 5. Percent of people surveyed who are reading books. By David Moore.

Reported in Madrigal.

With the Internet reading no longer means simply reading books or codices or scrolls. The format has changed. It is reading text messages and novels and websites and magazines and listening to audiobooks and using Twitter and Facebook and Instagram. These formats require readers to interact in both new and old ways with the text. Readers not only need to know how to navigate physical books, but to also navigate the internet, to ignore the clutter of advertisements and navigation bars and to focus on the desired text. The online reader must decide what on the screen is part of the text they are focusing on, and what they must ignore. They must also learn when to pay attention to certain elements, such as the navigation bar, and when to utilize them. In order to access the information available the user needs to understand the icons used to represent portals into this world, the symbols that represent Internet browsers and functions. This may not seem like a complex idea, but the problem is that many of these icons are skeuomorphs. This is a feature of a new technology that mimics an older one, or in the case of computing, “an element of a graphical interface that mimics a physical object” (“skeuomorph”). This is illustrated by the file and save icons on the computer. The problem is that these icons represent objects that many children today have never seen. Most computers today don’t even have an input for a floppy disk, and yet that is the image that represents saving in most programs. The file folder, a way to group documents on a computer, is usually represented by the icon of a folder from a filing cabinet. Even the phone icon on smart phones represents the receiver from rotary phone. To those of us who remember floppy disks and folders and rotary phones the icons seem simple, but by looking at it the way future

generations would, you can begin to understand that it is a form of literacy that must be learned. Just like the street signs, each icon must be learned individually. Too often we think of literacy as merely being able to read the phonetic alphabet, but it is so much more than that. In order to live in today's digital society we not only need to develop new digital literacies, but also to utilize literacies that have been developed over thousands of years.

Even something as simple as the way we write affects our brains in ways we are just beginning to understand today. In 2012 Dr. Karin James of Indiana University did a study on children who did not yet know how to write. He separated them into three groups; one group learned their letters by tracing them, another by tracing them with a dotted line, and the third by typing them out. James found that for the latter "the activation was significantly weaker." Dr. James believes that it might be the inherent messiness of the child's letter that helps her to learn it. The different messy forms of the letter created ingrain the child with the memory of what that letter is. Practice creating the letter helped the child remember the letter (Konnikova). In a similar study Dr. Virginia Berninger of the University of Washington showed that printing, cursive, and typing all show separate brain patterns. When Dr. Berninger asked her subjects to write an essay, she found that those who wrote by hand consistently had produced more words, did it quicker, and expressed more ideas than those who composed on keyboards. (Konnikova).

Writing letters helps students to learn them but once they are learned, is it not quicker to type? The click of the keyboard is as quick as the slight press of a finger. Writing requires more movement, more precision, and more stylization and

produces more mistakes, more variety, and more inflection. In order to read computer text one needs to know of the Platonic ideal form of the letter. Even though there are different fonts, there is a basic ideal, a basic idea of what the letter should look like. In order to read hand-written script one must be able to recognize all of the ugly and beautiful and incomprehensible real life versions of that letter. The reader must be able to guess at which platonic ideal the letter is trying to imitate. The slight variants in shape and size that make every letter of every word of a hand written note unique: the combination of upper and lowercase letters, the larger lowercase letters and the smaller uppercases; the slight, barely visible dashes that mean possessive or plural; The “P”s that look lie “R”s and the “h”s that look like “L”s; the combination of print and cursive, sometimes in the same word. Readers must learn to interpret those wonderfully time saving non-phonetic symbols like: \$,#,@ and &. They must be able to decipher chicken scratches and blotches of ink. In order to read handwriting the reader must learn to decipher the sloppy glyphs of another human. They must imagine their hand on the pen of the writer and guess at what they were trying to do. They must ignore stray blotches and scratches and the slight curve of a pencil that changes the thickness of letters.

In addition to enabling a new proprioception, the digital world also encourages traditional reading. A games researcher at the University of Wisconsin-Madison, Constance Steinkuehler, recently did a study to see if video games could influence the reading abilities of children. She asked struggling readers of middle and high school age to pick a video game topic, and then she picked texts from video game sites for them to read. She found that the students were not only able to read

the sites, but that they were able to understand the language. She says that this is because they are motivated, and if they don't understand a word or phrase, they will put effort into trying to figure it out (Thompson 48). A similar study by a literacy researcher, Hannah Gerber, found that students read only ten minutes a day in English class, but spend seventy minutes at home reading video game sites. The web articles in both of these studies were difficult and challenging for the age groups, but the kids devoured them (Thomas 48). This illustrates the importance of access. Children need motivation to read, just as we all do. Children are no exception. They will read if they believe that it will help them or entertain them, and that's exactly what these websites do. Without access to what they want to read, the children encapsulated in the digital divide are not getting as much reading practice, and they are not getting the practice of moving along in the text of a webpage, which is inherently different from moving through a physical text.

Of course, we have to reflect on the negative aspects of digital reading as well. Norway's Stavanger University recently did a study in which they found that people were significantly less likely to remember when an event happened in a story if they read it on a kindle as opposed to a printed copy. The researchers gave 50 readers the same short, mystery story, and then tested them on aspects of the story such as characters, settings and objects. The readers of printed texts were much more likely to remember. The researchers said that the "tactile feedback" of the book aids in memory (Flood). Every sentence in a book has a physical space in the book... it is a certain distance from the top or bottom, a certain distance from the

left or right side. It has a physical depth, too, measured by page numbers; the higher the number, the deeper down inside the book.

When reading we create “structure maps,” a “mental representation of the physical structural form of the text and, crucially, a mapping between physical structure and meaningful context” (Payne & Reader 462). It is a mental representation of the text, a map of where things are on the page and within the book. The difficulty of creating a structure map of a digital text is that there is no physical object to assist in memory. When looking for a passage in a physical book, the location on the page aids in finding it. On digital texts there is no such aid. By changing the font or the size of the screen, the text may change physical position, and by scrolling down the location moves up the screen. Another problem with structure maps of online texts is the hyperlink. While the printed page is linear, starting from the top left of the top page and moving down the page (in English), and then down the book, the hyperlinked document goes in many directions at once.

Carr points out that hyperlinks are:

a variation on the textual allusions, citations and footnotes that have long been common elements of documents. But their effect on us as we read is not the same at all. Links don't just point us to related or supplemental works; they propel us towards them. They encourage us to dip in and out of a series of texts rather than devote sustained attention to any one of them. (90)

Creating structure maps from multiple, online, hyperlinked texts is something that must be learned, and we are just beginning to research it. These structure maps not only help the reader to remember where something is on a page, but also to help them make judgments about diverse and possibly contradictory information. The Internet has created a form of reading that encourages reading

multiple texts in an interweaving fashion, jumping from one text to the next (Payne 462-463). This does not inhibit the creation of the structure map, but simply changes its form. Payne and Reader's study shows strong evidence that "readers of multiple on-line texts on the same topic spontaneously construct and remember a useful representation of the location of information within and between documents—a structure map" (473). The problem with these structure maps is that they are not as deep and critically read as text-based structure maps. But, they don't have to be because the information is coming from multiple sources. The online structure map includes opposite viewpoints, differing opinions and multiple authors. Reading what one person writes means seeing only one viewpoint, whereas surfing through hyperlinks means reading a multiplicity of viewpoints. What is lost depth is made up for in breadth.

Structure maps are different for every kind of medium ever used. The structure map of a scroll would be very different from the structure map of a book. In a book the location corresponds to the page, but there are no pages in the scroll, simply a top and a bottom, a left and right. So the structure map of a scroll would mean that the reader thinks of the place within the text in reference to how far down the scroll it is, and how close to the left or right margin. The structure maps of online texts are reliant upon the reader's proprioception of the digital world. The ability to pinpoint the location in the digital realm relies more on imagination than tactile feedback, something that can take a lot of getting used to. The eye is taking on more responsibility just as it did with the first alphabet. We now have an eye for an

ear, as in the alphabet, and also an eye for a hand, taking the place of tactile feedback.

Maryanne Wolf and Mirit Barzillai propose that reading online hinders deep reading. They define “deep reading” as, “the array of sophisticated processes that propel comprehension and that include inferential and deductive reasoning, analogical skills, critical analysis, reflection and insight” (33), and say that it is a skill that takes years to develop; that as children learn to read they need to use more brain regions than adults need to. As the child gets better at reading, “the original route changes to a set of pathways that are streamlined for decoding and that can now incorporate ever more sophisticated semantic and syntactic processes” (34). Once these streamlined pathways are created, the reader can then begin to focus on the meaning in the text, the ideas, stories, and information presented (33). While the Internet offers a plethora of information, it is necessary to be able to assess the value of it. This demands critical examination and self-monitoring skills (Wolf & Barzillai 35). This is a different type of reading than is necessary for physical books. In an interview, Wolf explained:

Our brain makes a new circuit for whatever is new to it, and reading is very new indeed, you see in eye movement research that skimming is the new reading. The human brain is in fact adapting almost too well to the particular attributes or characteristics of Internet reading.... What we are after is a discerning *bi-literate* brain. A child who knows when to allocate attention to those deep-reading processes, and when simply to play and move from one interesting thing after another (Lehrer 4:20).

They claim that we need to learn how to find, skim, and assess value, while at the same time maintain our ability of deep, critical readings of texts. While this is a good way to think about this new way of reading, it is limited in its perspective. The difference

between Internet reading and reading in the physical form is more than just hyperlinks and paragraphs. The Internet is an entire landscape that needs to be traversed. It is text and music and pictures and movies and forms to be filled out. Skimming is necessary in online texts because it is not all the “Text,” “the main body of matter in a manuscript, book, newspaper, etc., as distinguished from notes, appendixes, headings, illustrations, etc.” (Dictionar.com). There are advertisements and links to other pages on the website and links to share the text across social media sites and pop up advertisements. The structure map of online texts includes images and words and sounds and it is multiple texts on one screen that need to be navigated. Skimming is necessary to navigate the clutter.

By monitoring the brainwaves of people as they surf the Internet, scientists have been able to see that new neural pathways are formed. A professor of psychiatry at UCLA named Gary Small looked at the brain scans of people as they searched the Internet. Half of them were “computer-savvy” and half of them were not. What he found was that the computer-savvy people had increased activity in a part of their brain called the “dorsolateral prefrontal cortex,” while the others had minimal activity there. After five days, however, the “internet-naïve” began to show activity where there was once nothing (Carr 121). The part of our brain associated with language, visual processing, and memory is activated when reading a book, while the prefrontal cortex, the part of our brain associated with decision making and puzzle solving, is active when we read online (Carr 122). Reading online is akin to creating the text, piecing it together like a puzzle from multiple, disjointed sources. Just as Iser pointed out about printed texts, the digital text is created by the

interaction between the reader and the words on the screen. The internet, however, requires more work, more puzzle solving than traditional forms.

Part of the reason we read online texts in this way is because of the way our eyes move across the page. They do not move slowly, concisely across the page, but rather move in little jumps and starts, called “saccades.” Our eyes are scanning the page at a different rate than our brains are, but they work together in order to figure out the meaning of the text (Carr 134). This is part of the reason that the brain skips over spelling errors and missing letters. Our animal brains were not meant to read; it is not a natural skill, but again, a learned one. What this means is that we scan online texts in an “F” shape. We read the first two sentences on a webpage, and then scan our eyes down the left side, drawing the letter “F” (Carr 134). This scanning of the page means that we do not engage in the text, but rather we assess judgment of it. Carr points out that “natural state of the human brain... is one of distractedness” (63). Is that so different from bouncing from one webpage to the next?

A common diagnosis today is ADD, Attention Deficit Disorder, but future generations may call us tunnel visioned. AAD: Attention Abundance Disorder. We spend too much time focused on our TV sets and reading a single book. We suffer from a biological drive to pull in as much information from the world around us as we can, but sustained attention to one task limits this. Carr points out,

“Our fast paced reflexive shifts in focus were once crucial to our survival.... For most of human history, the normal path of human thought was anything but linear. To read a book was to practice an unnatural process of thought, one that demanded sustained, unbroken attention to a single, static object” (64).

But this didn't just appear with writing. Sustained attention predated reading. Hunters and craftsmen and fishermen all had to sit still and maintain focus for hours at a time in order to achieve their goal. Their gaze might shift and their thoughts wander, but they stayed focused on a task until it was completed, whether it was building a boat or stalking a deer (65). But Carr seems to worry that our internet-savvy, divided attention, will limit human development in some way. He believes that this new era of distractedness brought on by the Internet will cause future generations to lack the skills we have acquired over the thousands of years of learning to read and write. His attitude seems quite apocalyptic. As this paper has shown, technology constantly changes how we read and write, but civilization keeps moving onward, and new literacies do not push out old ones. Change is inexorable.

To lament the passing of time is a practice in futility. Fear that technology will ruin culture fails to recognize past trends. Communication, and language in particular are fluid, changing things. The linguist David Crystal explains:

Writing introduced a graphological dimension to English, with all that this involved in terms of spelling, punctuation, and styles of handwriting. Print added another dimension to written language, in the form of typography and graphic design.... The telegraph added new written styles, such as 'telegrams'.... In the late twentieth century, the mobile phone, with its space restricted screen, motivated the development of a further written variety, based on linguistic abbreviations, in the form of text-messaging. (401)

Technology changes the way we communicate with each other, but it does not take the place of our communication abilities. Take, for example, the new type of discourse created by the Internet: it changes the traditional back and forth of conversation, known as 'the adjacent pair:' question and response. Due to the temporal nature of texting or instant messaging, conversations have a different flow,

especially in a chat room where the simultaneous conversations are happening all at once. The discourse moves forward and back, answering one question, and then going back to another. This is because in the time it takes to read and respond to one question, other responses or questions can pop up quickly (403). It is a difficult format to get used to, and requires practice in being able to figure out, to guess, which pairs of sentences go together. The reader needs to be taught how to read in this new way, to figure out which pairs go together.

The James study shows that there is an inherent difference between the types of writing and while we can't quite quantify it, as writers of pen and ink we can begin to understand the mental differences. The raw forward motion of pen and ink on paper makes it a less definitive medium than typing on a computer. The writer moves forward, erasing with difficulty or simply leaving mistakes alone, or crossing them out making the paper an ugly mess of half starts and stops. Typing on a computer, in contrast is much easier to manipulate. The typist can go backwards and forwards, erase with ease, edit, and change format or font, cut and paste, all without leaving a smudge on the screen. Pen and paper are immediately permanent. Computer writing is only as permanent as the protection against mechanical failure and the decision to not press that 'backspace' button, deleting with the same ease as creating. The writer does not have to rub into the paper with an eraser and then blow away the particles of rubber, nor do they have to paint whiteout onto the page, and blow on it until it is dry. The writer simply moves their pinky to the backspace key. When a person writes with a pencil on a piece of paper, they are using physical movements in order to change the physical world around

them. They use kinetic energy, make movements with their muscles and create indentations onto paper, leaving behind a smear of ink or graphite. The effect is that the writer has now changed the physical world right in front of him, changed the landscape of the piece of paper, easily and readily perceivable. Now contrast this with the change affected by the typing of a sentence onto a computer. What motions are being made? What physical effect does this have on the world? No longer is each letter created with a series of specific motions, but rather a position punched out on a keyboard, each letter only differing in their place in space. Two very different proprioceptive behaviors.

Of course, there are physical changes created in digital texts, albeit ones that are not as easily perceivable. Every time someone types out something onto a keyboard, tiny changes occur inside the computer. And if the sentence is put onto the web then tiny changes are made onto servers perhaps thousands of miles away. These are actual physical changes, but there are also changes in this other, digital world of the mind, the World Wide Web.

This paper is not concerned with the tiny electrical changes that occur, because they are not easily perceivable to the average user, but rather it explores the changes to this new space that's been created. The Internet isn't exactly physical, though it is composed of physical aspects. It is a space created by humans and is only malleable by humans. The Internet is a combination of words, music, and pictures, and yet it does not occupy the "real" world. It is ethereal, abstract. A world of the mind. The Internet is a world of symbols: arrows representing the turning of a page, boxes representing files, the outline of an envelope representing email. These

are not actual things, but icons that represent functions, and the shared acknowledgement of their meaning gives them power. Folders on a computer are also icons of the thing they represent, a place to put 'papers.' But these folders are mental pathways, representations of a physical space, following the route of a predetermined logic. Navigating these pathways is as much a skill of spatial awareness as throwing a baseball. One must understand where the ball will go, see it in the mind's eye, before they throw it. The paths of a computer are visual representations of mental ideas of electronic transfers. Receptacles or organizational devices such as folders and applications are the way computer programmers have presented the inner functions of the computer to the user; they rely on the same type of mental activity as thinking about throwing a baseball. Indeed, studies have shown that our mental-spatial awareness is improving due to these activities in our digital lives. We are able to "rotate objects in our minds better than we used to be able to" (Carr 141), because humans are getting more and more practice interacting with this new digital realm. We are becoming more digitally literate, better at navigating this realm.

We are also creating our own digital realms. As Iser pointed out, each reader's interaction with the Internet is unique to him or her, creating his or her own interwoven text of webpages. This is not only because of the past experiences of the reader online, but also because of the portion of the greater text of the World Wide Web they have read. If McLuhan is right that all technology is an extension of man, and that electronic circuitry is the extension of mind (McLuhan, "Message" 26), then the Internet is a further extension, not of a single person's mind, but rather of

the collective consciousness. It is a virtual world, full with criminals and cops and business and entertainment, a constructed reality built to house all thoughts, all words, pictures, movies and interactions. And we navigate through this world as easily as we do the real one, but instead of physically moving around, we are mentally following the pathways that are created. We are navigating through both the text of our mind, and through the text of the digital reality.

Just as writing and then print helped to create a new inner life for readers, the Internet also has created a new life, only this new inner life is heavily connected to others. The Internet has ushered in McLuhan's "global village," and where once people congregated in village squares to exchange news and gossip, today we gather together alone in our houses. Our very interaction with the written word has changed; the literary hierarchy has been usurped (Muri 233). Muri writes:

The electronic environment has also destabilized a centuries-old system of inscribing and disseminating principles of critique, judgment, and morality through the stable and material texts sanctioned by our educational and religious institutions. The page is a tool for teaching, but in the electronic environment, anyone can be an author (233).

Facebook and Twitter have created ways to instantly publish any thought without the mediation of those that usually mediate grammar, the literary hierarchy: editors, publishers, grammarians, lexicographers, copy editors and booksellers (Crystal 404). Creating a blog is as easy as filling out forms online. One effect of this proliferation of publications is an "unprecedented degree of written public presence" of local and regional dialects (404). The majority of the written records over the past centuries consist of official documents such as court records, administrative records, academic writing, and newspapers (403), which are all

heavily edited and mediated. Outside of a few letters that have been preserved, it is difficult to find unmediated writings in the various archives (404). Text messages and emails are the unmediated texts of today, sent directly from the author to the reader with no outsider editing it for grammar or punctuation. As shown by figure 4, this represents a large portion of what people 18-24 are reading. Without the intermediation of these editors the literary hierarchy cannot dictate what is appropriate to write or how to write it. As more and more people are writing, and “publishing,” more varied forms of writing are disseminated. One effect is that bad grammar proliferates as the reader’s “reference back” is bogged down by all the grammatically incorrect text messages they have read. It is difficult to decide on the correct way to write something if the reader has seen it in multiple ways.

Conclusion

We are in a technological boom and our tools for reading and writing are changing yet again. It is clear to many people that it has had a profound effect on us; we know there is a difference in reading a novel and reading a webpage, we can feel it in our collective gut. Studies abound on this topic. We are studying our reading habits with brain scans, eye motion sensors, and questionnaires; we are compiling data and postulating theories and digging deep within ourselves to find out exactly how the act of reading is changing. And yet, all of the statistics and numbers and studies don’t mean anything if we don’t acknowledge that we are the ones affected. This isn’t a study of future or past generations. This is a study of modernity. These questions are a part of us, our world, our cognition. In order to educate future

generations we must understand these changes so that we can understand the differences between the generations. Schoolteachers must now teach digital literacy as well as reading literacy; and in order to develop these literacies children need to be exposed to the digital world, they need practice to develop digital proprioceptive abilities.

Now that we are in the digital era, our inner voice has been so quieted, that we are able to skip around webpages without consciously thinking about each letter and word. We have become so good at reading these webpages, our eyes so fast, that we are able to let the meanings glide over our conscious thought. We have become uniquely adept at skimming. This continued quieting of the inner voice has enabled us to pull out important parts of web pages without consciously deciphering each letter; we can ignore the advertisements and web functions along the edges.

Many people lament that the Internet is making us dumber, but this is myopic. Plato had the same quarrel with writing thousands of years ago. Despite his protests, the Greeks learned to write and they stopped relying on memory as much and the world went on, just as the world will go on despite the reliance on word processors' spell check. In fact, the world learned to write and stopped relying so much on memory and the world went on creating and inventing and producing. It did not halt the spread of knowledge, but rather helped it along. Memory wasn't pushed out altogether, though. It works in conjunction with reading to form structure maps and helps to develop the ability to write.

We alive today made the Internet. We inherited television, radio, and print, but we have created the Internet as it is. But so did the scribes of ancient Sumer and

the scribes of medieval manuscripts and the early users of the printing press. Their creation of iconographic signs didn't just contribute to the modern alphabet, but continue to be used in street signs and web browsers. The literacy of reading symbols on the edge manuscripts continues today in web icons. We still use fonts created by early printers. Reading today didn't just come about on its own, but rather owes an enormous debt to the innovations of the past. Internet reading wasn't invented by us, but was pieced together from older forms of literacy. The past mediums of the written word have all contributed to the way it is today. The rune-readers chose wood instead of stone for their engravings and it had to be adapted for that usage. The Greeks understood the failings of their medium, and so created an alphabet with two forms: one solid and lasting, one fluid and susceptible; uppercase for stone, lowercase for paper. Print brought about standardization, which eventually allowed for the inner voice to be silenced. All of these things together have helped create the digital world. All of them have left their stamp on our reading systems. Just because we have a phonetic alphabet doesn't mean we have no more need of icons.

We have taken what we have inherited, what we thought was useful, and we have applied it to this new technology. We have decided what is popular, what is important, what is deemed necessary to our lives. We have decided what is on the World Wide Web. We have created the icons, scrolling and the hyperlink. We have decided its form, its functions, its utility, and its popularity. We now have the power and knowledge to mold it to what we want it to be. By recognizing the need for digital proprioception, and learning to read icons, we will be prepared to educate

the next generations in the digital life we have created for them, just as past readers and writers have adapted to their systems and in turn molded it for us.

It is not a question of *if* technology is changing the way we read, but how. The creation of print allowed for mass dissemination, and therefore changed who was reading what forever. The creation of the telegraph allowed for near instant communication across the globe. The creation of the typewriter allowed people to bypass the messiness of handwriting. Progress is inexorable. Now the computer is changing the landscape of words and thoughts with the World Wide Web and, like earlier technologies of reading, writing, and dissemination, has developed new cognitive functions necessary for using it. Our digital proprioception is growing, the world of the mind expanding. The World Wide Web is a massive, evolving text that readers must navigate through. The fact that it is not a physical world means that users must use their imagination, their minds eye, in order to make sense of it. Our minds have to do the work that our hands used to; the tactile feedback of a book is replaced by mental understanding digital space: an eye for an ear and a mind for a hand.

Navigating this new digital realm requires puzzle-solving brain functions. We skim through parts, ignore other parts, and pay attention to what we deem important. This is the only way it can work; the amount of information on the Internet is simply too much. Where once people only had one book to pour over and ponder, today we have more at our fingertips than could be read in a thousand lifetimes. So we adapt. We read by skimming and we create shorter news articles.

We communicate more so by reading and writing today than ever before. With the advent of writing came the ability to transfer thoughts through space and time, to put into tangible form our own thoughts. With these abilities came an extension of the idea of self. We existed in the same world as the authors we read. As the availability of writing increased, and literacy increased, the inner-textuality within us increased. The more a reader reads, the more thoughts of other people are internalized. Today, with Facebook and Twitter and Google+ we are internalizing so many more thoughts of other people. This time, though, it is the thoughts of those around us, as opposed to authors long dead. Where once reading helped cultivate an inner life, today it has also helped create the global village. Where once the reader sat alone in her study, today she is also surrounded by others on the Internet, internalizing and responding to their thoughts.

This boom in correspondence means a greater increase in unmediated texts. No longer is the majority of reading done of edited and reworked texts, but of emails and text messages and Facebook posts. While those may be edited and reworked, the authors of digital correspondences usually don't have a third party check it for grammar and punctuation. Grammar purists may lament the "destruction of the written language," but it is not destruction. It is evolution; progress. These writings reflect the spoken language more than they have in centuries. The result is more variation, different styles and the exhibiting of regional dialects. Twitter forces people to think in 140 characters, making our interactions pithier and to the point. Emails make us rethink what we write because once the "send" button is clicked, that message is irretrievable. We are forced to mediate our own texts.

What will happen to the written word in the future? No one knows, but it will not be completely unrecognizable. It will have icons and logos and a phonetic alphabet. It will have scrolling and pages and uppercase and lowercase letters. It will, however, not be in the physical world; it will be digital pages and letters. Paper is already fading, though it will be around longer than any of us. Typing will get faster and writing will slow. Stop writing with a pen and the muscles atrophy, the letters become less precise. It will be quicker to type with thumbs, as many do while text messaging, than it will be to write in a sloppy longhand. Cursive is already fading, no longer a requirement in many schools. The effects of this will be seen when a generation signs their paychecks in a non-cursive script. It won't be a problem, though; they can just have it deposited directly into their bank accounts.

The ability to skim a webpage will continue to become faster. With greater dissemination comes a larger basis of texts with which to sift through, both on the Internet and within our own minds. Iser and Fischer point out that the meaning of a text exists between the reader and the text itself, this applies more so to the many choices available on the World Wide Web. We weave our own macro-text based on the many micro-texts available to us. Our new digital proprioceptive awareness will help us to create coherent structure maps from this vast evolving text. The written word will continue to influence us as we change it.

We are already moving away from interacting with computers using a mouse, moving more towards touch screens. The proprioception of a touch screen is different than that of a mouse, but the spatial awareness required to navigate the Web is the same. The larger the Web becomes, the more difficult it will be to

navigate it. Luckily our minds are malleable. We adapt to changes before we even realize we are adapting. Our digital proprioception will get better as the digital world expands.

We will continue to read in old ways as new forms emerge. Reading written symbols did not destroy reading signs in the wild, no more than reading online will destroy deep reading. We will simply develop more literacies. We will learn to read in different ways.

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