How We Read: Close, Hyper, Machine

N. Katherine Hayles

The author is professor and director of graduate studies in the literature program at Duke University. A version of the article was presented at the 2010 ADE Summer Seminar East in Adelphi, Maryland.

THE evidence is mounting: people in general, and young people in particular, are doing more screen reading of digital materials than ever before. Meanwhile, the reading of print books and of literary genres (novels, plays, and poems) has been declining over the last twenty years. Worse, reading skills (as measured by the ability to identify themes, draw inferences, etc.) have been declining in junior high, high school, college, and even graduate schools for the same period. Two flagship reports from the National Endowment for the Arts, *Reading at Risk*, reporting the results of their own surveys, and *To Read or Not to Read*, drawing together other large-scale surveys, show that over a wide range of data-gathering instruments the results are consistent: people read less print, and they read print less well. This leads the NEA chairman, Dana Gioia, to suggest that the *correlation* between decreased literary reading and poorer reading ability is indeed a *causal* connection. The NEA argues (and I of course agree) that literary reading is a good in itself, insofar as it opens the portals of a rich literary heritage (see Griswold, McDonnell, and Wright for the continued high cultural value placed on reading). When decreased print reading, already a cultural concern, is linked with reading problems, it carries a double whammy.

Fortunately, the news is not all bad. A newer NEA report, *Reading on the Rise*, shows for the first time in more than two decades an uptick in novel reading (but not plays or poems), including among the digitally native young adult cohort (ages 18–24). The uptick may be a result of the Big Read initiative by the NEA and similar programs by other organizations; whatever the reason, it shows that print can still be an alluring medium. At the same time, reading scores among fourth and eighth graders remain flat, despite the No Child Left Behind initiative. Notwithstanding the complexities of the national picture, it seems clear that a critical nexus occurs in the juncture of digital reading (exponentially increasing among all but the oldest cohort) and print reading (downward trending with a slight uptick recently). The crucial questions are these: how to convert the increased digital reading into increased reading ability and how to make effective bridges between digital reading and the literacy traditionally associated with print.

Mark Bauerlein (a consultant on the *Reading at Risk* report), in the offensively titled *The Dumbest Generation: How the Digital Age Stupefies Young Americans and Jeopardizes Our Future*, makes no apology for linking the decline of reading skills directly to a decrease in print reading, issuing a stinging indictment to teachers, professors, and other mentors who think digital reading might encourage skills of its own. Not only is there no transfer between digital reading and print reading skills in his view, but digital reading does not even lead to strong *digital* reading skills (93–111). I found *The Dumbest Generation* intriguing and infuriating in equal measure. The book is valuable for its synthesis of a great deal of empirical evidence, going well beyond the 2009 NEA report in this regard; it is infuriating in its tendentious refusal

to admit any salutary effects from digital reading. As Bauerlein moves from the solid longitudinal data on the decline in print reading to the digital realm, the evidence becomes scantier and the anecdotes more frequent, with examples obviously weighted toward showing the inanity of online chats, blogs, and *Facebook* entries. It would, of course, be equally possible to harvest examples showing the depth, profundity, and brilliance of online discourse, so Bauerlein's argument here fails to persuade. The two earlier NEA reports (*Reading at Risk*; *To Read*) suffer from their own problems; their data do not clearly distinguish between print and digital reading, and they fail to measure how much digital reading is going on or its effects on reading abilities (Kirschenbaum). Nevertheless, despite these limitations and distortions, few readers are likely to come away unconvinced that there is something like a national crisis in reading and that it is especially acute with teen and young adult readers.

At this point, scholars in literary studies should be jumping on their desks and waving their hands in the air, saying "Hey! Look at us! We know how to read *really* well, and we know how to teach students to read. There's a national crisis in reading? We can help." Yet there is little evidence that the profession of literary studies has made a significant difference in the national picture, including on the college level, where reading abilities continue to decline even into graduate school. This is strange. The inability to address the crisis successfully no doubt has multiple causes, but one in particular strikes me as vitally important. While literary studies continues to teach close reading to students, it does less well in exploiting the trend toward the digital. Students read incessantly in digital media and write in it as well, but only infrequently are they encouraged to do so in literature classes or in environments that encourage the transfer of print reading abilities to digital and vice versa. The two tracks, print and digital, run side by side, but messages from either track do not leap across to the other side.

Close Reading and Disciplinary Identity

To explore why this should be so and open possibilities for synergistic interactions, I begin by revisiting that sacred icon of literary studies, close reading. When literary studies expanded its purview in the 1970s and 1980s, it turned to reading many different kinds of "texts," from Donald Duck to fashion clothing, television programs to prison architecture (see Scholes). This expansion into diverse textual realms meant that literature was no longer the de facto center of the field. Faced with the loss of this traditional center, literary scholars found a replacement in close reading, the one thing virtually all literary scholars know how to do well and agree is important. Close reading then assumed a preeminent role as the essence of the disciplinary identity.

Jane Gallop undoubtedly speaks for many when she writes, "I would argue that the most valuable thing English ever had to offer was the very thing that made us a discipline, that transformed us from cultured gentlemen into a profession [i.e., close reading]. . . . Close reading—learned through practice with literary texts, learned in literature classes—is a widely applicable skill, of real value to students as well as to scholars in other disciplines" (15). Barbara Johnson, in her well-known essay "Teaching Deconstructively," goes further: "This [close reading] is the only teaching that can properly be called literary; anything else is history of ideas, biography, psychology,

ethics, or bad philosophy" (140). For Gallop, Johnson, and many others, close reading not only assures the professionalism of the profession but also makes literary studies an important asset to the culture. As such, close reading justifies the discipline's continued existence in the academy, including the monies spent to support literature faculty and departments. More broadly, close reading in this view constitutes the major part of the cultural capital that literary studies relies on to prove its worth to society.

Literary scholars generally think they know what is meant by *close reading*, but, looked at more closely, it proves not so easy to define or exemplify. Jonathan Culler, quoting Peter Middleton, observes that "close reading is our contemporary term for a heterogeneous and largely unorganized set of practices and assumptions" (20). John Guillory is more specific when he historicizes close reading, arguing that "close reading is a modern academic practice with an inaugural moment, a period of development, and now perhaps a period of decline" ("Close Reading" 8). He locates its prologue in the work of I. A. Richards, noting that Richards contrasted close reading with the media explosion of his day, television. If that McLuhanesque view of media is prologue, then digital technologies, Guillory suggests, may be launching the epilogue. Citing my work on hyperattention (more on that shortly), Guillory sets up a dichotomy between the close reading recognizable to most literary scholars—detailed and precise attention to rhetoric, style, language choice, and so forth through a word-by-word examination of a text's linguistic techniques—to the digital world of fast reading and sporadic sampling. In this he anticipates the close versus digital reading flagrantly on display in Bauerlein's book.

Amid the heterogeneity of close reading techniques, perhaps the dominant one in recent years has been what Stephen Best and Sharon Marcus call "symptomatic reading." In a special issue of *Representations*, Best and Marcus launch a frontal assault on symptomatic reading as it was inaugurated by Fredric Jameson's immensely influential *The Political Unconscious*. For Jameson, with his motto "Always historicize," the text is an alibi for ideological formations that are subtextual. The heroic task of the critic is to wrench a text's ideology into the light, "massy and dripping," as Jameson puts it (245; qtd. in Crane 92), so that it can be unveiled and resisted (see Crane for a close analysis of Jameson's metaphors). The trace of symptomatic reading may be detected in Johnson: listing textual features that merit special attention for close reading, she includes such constructions as "ambiguous words," "undecidable syntax," and "incompatibilities between what a text says and what it does" (141–42). Most if not all these foci are exactly the places where scholars doing symptomatic reading would look for evidence of a text's subsurface ideology.

After more than two decades of symptomatic reading, however, many literary scholars are not finding it a productive practice, perhaps because (like many deconstructive readings) its results have begun to seem formulaic, leading to predictable conclusions rather than compelling insights. In a paraphrase of Gilles Deleuze and Félix Guattari's famous remark, "We are tired of trees," the *Representations* special issue declared, We are tired of symptomatic reading. The issue's contributors are not the only ones who feel this way. In panel after panel at the conference sponsored by the National Humanities Center in spring 2010, entitled "The State and Stakes of Literary Studies," presenters expressed similar views and urged a variety of other

reading modes, including "surface reading," in which the text is examined not for hidden clues but its overt messages; reading aimed at appreciation and articulation of the text's aesthetic value; and a variety of other reading strategies focusing on affect, pleasure, and cultural value.

Digital and Print Literacies

If one chapter of close reading is drawing to an end, what new possibilities are arising? Given the increase in digital reading, obvious sites for new kinds of reading techniques, pedagogical strategies, and initiatives are the interactions between digital and print literacies. Literary studies has been slow to address these possibilities, however, because it continues to view close reading of print texts as the field's essence. As long as this belief holds sway, digital reading will at best be seen as peripheral to our concerns, pushed to the margins as not "really" reading or at least not compelling or interesting reading. Young people, who vote with their feet in college, are marching in another direction—the digital direction. No doubt those who already read well will take classes based on close reading and benefit from them, but what about others whose print-reading skills are not as highly developed? To reach them, we must start close to where they are, rather than where we imagine or hope they might be. As David Laurence observes, "good teachers deliberately focus on what the reader can do, make sure that both teacher and student recognize and acknowledge it, and use it as a platform of success from which to build" (4).

This principle was codified by the Belarusian psychologist L. S. Vygotsky in the 1930s as the "zone of proximal development." In *Mind in Society: The Development of Higher Psychological Processes*, he defined this zone as "[t]he distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (86). The concept implies that if the distance is too great between what one wants someone else to learn and where instruction begins, the teaching will not be effective. Imagine, for example, trying to explain *Hamlet* to a three-year-old (an endless string of "Why?" would no doubt result, the all-purpose response of young children to the mysterious workings of the adult world). More recent work on "scaffolding" (Robertson, Fluck, and Webb) and Ron Tinsley and Kimberly Lebak on the "zone of reflective capacity" extends the idea and amplifies it with specific learning strategies. These authors agree that for learning to occur, the distance between instruction and available skills must be capable of being bridged, either through direct instruction or, as Vygotsky notes, through working with "more capable" peers. Bauerlein instances many responses from young people as they encounter difficult print texts to the effect the works are "boring" or not worth the trouble. How can we convey to such students the deep engagement we feel with challenging literary texts? I argue that we cannot do this effectively if our teaching does not take place in the zone of proximal development, that is, if we are focused exclusively on print close reading. Before opinion solidifies behind new versions of close reading, I want to argue for a disciplinary shift to a broader sense of reading strategies and their interrelation.

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In 1999, James Sosnoski presciently introduced the concept of hyperreading, which he defined as "reader-directed, screen-based, computer-assisted reading" (167). Examples include search queries (as in a *Google* search), filtering by keywords, skimming, hyperlinking, "pecking" (pulling out a few items from a longer text), and fragmenting (163–72). Updating his model, we may add juxtaposing, as when several open windows allow one to read across several texts, and scanning, as when one reads rapidly through a blog to identify items of interest. There is considerable evidence that hyperreading differs significantly from typical print reading, and moreover that hyperreading stimulates different brain functions than print reading.

For example, Jakob Nielsen's consulting team, which advises companies and others on effective Web design, does usability research by asking test subjects to deliver running verbal commentaries as they encounter Web pages. Their reactions are recorded by a (human) tester; at the same time, eye-tracking equipment records their eye movements. The research shows that Web pages are typically read in an F pattern (Nielsen, "F-Shaped"). A person reads the first two or three lines across the page, but as the eye travels down the screen, the scanned length gets smaller, and, by the time the bottom of the page is reached, the eye is traveling in a vertical line aligned with the left margin. (Therefore the worst location for important information on a Web page is on the bottom right corner.) In Bauerlein's view, this research confirms that digital reading is sloppy in the extreme; Bauerlein would no doubt appreciate Woody Allen's quip, "I took a speed reading course and was able to read *War and Peace* in twenty minutes. It involves Russia" (qtd. in Dehaene 18). Nevertheless, other research not cited by Bauerlein indicates that this and similar strategies work well to identify pages of interest and to distinguish them from pages with little or no relevance to the topic at hand (Sillence, Briggs, Harris, and Fishwick).

As a strategic response to an information-intensive environment, hyperreading is not without precedent. John Guillory, in "How Scholars Read," notes that "[t]he fact of quantity is an intractable empirical given that must be managed by a determined method if analysis or interpretation is to be undertaken" (13). He is not talking here about digital reading but about archival research that requires a scholar to move through a great deal of material quickly to find the relevant texts or passages. He identifies two techniques in particular, scanning (looking for a particular keyword, image, or other textual feature) and skimming (trying to get the gist quickly). He also mentions the book wheel, a physical device invented in the Renaissance to cope with the information explosion when the number of books increased exponentially with the advent of print. Resembling a five-foot-high Ferris wheel, the book wheel held several books on different shelves and could be spun around to make different texts accessible, in a predigital print version of hyperreading.

In contemporary digital environments, the information explosion of the Web has again made an exponentially greater number of texts available, dwarfing the previous amount of print materials by several orders of magnitude. In digital environments, hyperreading has become a necessity. It enables a reader quickly to construct landscapes of associated research fields and subfields; it shows ranges of possibilities; it identifies texts and passages most relevant to a given query; and it easily juxtaposes many different texts and passages. *Google* searches and keyword filters are now as

much part of the scholar's tool kit as hyperreading itself. Yet hyperreading may not sit easily alongside close reading. Recent studies indicate that hyperreading not only requires different reading strategies than close reading but also may be involved with changes in brain architecture that makes close reading more difficult to achieve.

Much of this evidence is summarized by Nicholas Carr in *The Shallows: What the Internet Is Doing to Our Brains*. More judicious than Bauerlein, he readily admits that Web reading has enormously increased the scope of information available, from global politics to scholarly debates. He worries, however, that hyperreading leads to changes in brain function that make sustained concentration more difficult, leaving us in a constant state of distraction in which no problem can be explored for very long before our need for continuous stimulation kicks in and we check e-mail, scan blogs, message someone, or check our RSS feeds. The situation is reminiscent of Kurt Vonnegut's satirical short story "Harrison Bergeron," in which the pursuit of equality has led to a society that imposes handicaps on anyone with exceptional talents. The handsome, intelligent eponymous protagonist must among other handicaps wear eyeglasses that give him headaches; other brainiacs have radio transmitters implanted in their ears, which emit shrieking sounds two or three times every minute, interrupting their thoughts and preventing sustained concentration. The final satirical punch comes in framing the story from the perspective of Bergeron's parents, Hazel and George, who see their son on TV when he proclaims his anti-handicap manifesto (with fatal results for him), but, hampered by their own handicaps, they cannot concentrate enough to remember it.

The story's publication in 1961 should give us a clue that a media-induced state of distraction is not a new phenomenon. Walter Benjamin, in "The Work of Art in the Age of Mechanical Reproduction" (1968), wrote about the ability of mass entertainment forms such as cinema to make distracted viewing into a habit (as opposed to the contemplative viewing of a single work of art). Even though distraction, as Jonathan Crary (2001) has shown, has been a social concern since the late 1800s, there are some new features of Web reading that make it a powerful practice for rewiring the brain (see Greenfield for a summary). Among these are hyperlinks that draw attention away from the linear flow of an article, very short forms such as tweets that encourage distracted forms of reading, small habitual actions such as clicking and navigating that increase the cognitive load, and, most pervasively, the enormous amount of material to be read, leading to the desire to skim everything because there is way too much material to pay close attention to anything for very long.

Reading on the Web

What evidence indicates that these Web-specific effects are making distraction a contemporary cultural condition? Several studies have shown that, contrary to the claims of early hypertext enthusiasts such as George Landow, hyperlinks tend to degrade comprehension rather than enhance it. The following studies, cited by Carr in *The Shallows*, demonstrate the trend. Erping Zhu, coordinator of instructional development at the Center for Research on Learning and Teaching at the University of Michigan, had test subjects read the same online passage but varied the number

of links. As the number of links increased, comprehension declined, as measured by writing a summary and completing a multiple-choice test. Similar results were found by two Canadian scholars, David S. Miall and Teresa Dobson, who asked seventy people to read Elizabeth Bowen's short story "The Demon Lover." One group read it in a linear version, and a second group with links. The first group outperformed the second on comprehension and grasp of the story's plot; it also reported liking the story more than the second group. We may object that a print story would of course be best understood in a printlike linear mode; other evidence, however, indicates that a similar pattern obtains for digital-born material. D. S. Niederhauser, R. E. Reynolds, D. J. Salmen, and P. Skolmoski had test subjects read two online articles, one arguing that "knowledge is objective," and the other that "knowledge is relative." Each article had links allowing readers to click between them. The researchers found that those who used the links, far from gaining a richer sense of the merits and limitations of the two positions, understood them less well than readers who chose to read the two in linear fashion. Comparable evidence was found in a review of thirty-eight experiments on hypertext reading by Diana DeStefano and Jo-Anne LeFevre, psychologists with the Centre for Applied Cognitive Research at Canada's Carleton University. Carr summarizes their results, explaining that in general the evidence did not support the claim that hypertext led to "an enriched experience of the text" (qtd. in Carr 129). One of their conclusions was that "increased demands of decision-making and visual processing in hypertext impaired reading performance," especially in relation to "traditional print presentation" (qtd. in Carr 129).

Why should hypertext and Web reading in general lead to poorer comprehension? The answer, Carr believes, lies in the relation of working memory (i.e., the contents of consciousness) to long-term memory. Material is held in working memory for only a few minutes, and the capacity of working memory is severely limited. For a simple example, I think of the cell-phone directory function that allows me to get phone numbers, which are given orally (there is an option to have a text message sent of the number, but for this the company charges an additional fee, and being of a frugal disposition, I don't go for that option). I find that if I repeat the numbers out loud several times so they occupy working memory to the exclusion of other things, I can retain them long enough to punch the number. For retention of more complex matters, the contents of working memory must be transferred to long-term memory, preferably with repetitions to facilitate the integration of the new material with existing knowledge schemas. The small distractions involved with hypertext and Web reading—clicking on links, navigating a page, scrolling down or up, and so on—increase the cognitive load on working memory and thereby reduce the amount of new material it can hold. With linear reading, by contrast, the cognitive load is at a minimum, precisely because eye movements are more routine and fewer decisions need to be made about how to read the material and in what order. Hence the transfer to long-term memory happens more efficiently, especially when readers reread passages and pause to reflect on them as they go along.

Supplementing this research are other studies showing that small habitual actions, repeated over and over, are extraordinarily effective in creating new neural pathways. Carr recounts the story told by Norman Doidge in *The Brain That Changes Itself* of

an accident victim, Michael Bernstein, who had a stroke that damaged his brain's right side, rendering his left hand and leg crippled (30–31). He entered an experimental therapy program that had him performing routine tasks with his left arm and leg over and over, such as washing a window and tracing alphabet letters. "The repeated actions," Carr reports, "were a means of coaxing his neurons and synapses to form new circuits that would take over the functions once carried out by the circuits in the damaged area in his brain" (30). Eventually, Bernstein was able to regain most of the functionality of his unresponsive limbs. We may remember in *The Karate Kid* film (1984) when Daniel LaRusso (Ralph Macchio) is made to do the same repetitive tasks over and over again by his kung fu teacher, Mr. Miagi (Pat Morita). In contemporary neurological terms, Mr. Miagi is retraining the young man's neural circuits so he can master the essentials of kung fu movements.

These results are consistent with a large body of research on the impact of (print) reading on brain function. In a study cited by the French neurophysiologist Stanislas Dehaene, a world-renowned expert in this area, researchers sought out siblings from poor Portuguese families that had followed the traditional custom of having an elder sister stay home and watch the infant children while her younger sister went to school. Raised in the same family, the sisters could be assumed to have grown up in very similar environments, thus serving as a way to control other variables. Using as test subjects six pairs of illiterate-literate sisters, researchers found that literacy had strengthened the ability to understand the phonemic structure of language. Functional magnetic resonance (fMRI) scans showed pronounced differences in the anterior insula, adjacent to Broca's area (a part of the brain associated with language use). "The literate brain," Dehaene summarizes, "obviously engages many more left hemispheric resources than the illiterate brain, even when we only *listen* to speech. . . . The macroscopic finding implies a massive increase in the exchange of information across the two hemispheres" (209).

Equally intriguing is Dehaene's "neural recycling" hypothesis, which suggests that reading repurposes existing brain circuits that evolved independently of reading (because literacy is a mere eye blink in our evolutionary history, it did not play a role in shaping the genetics of our Pleistocene brains but rather affects us epigenetically through environmental factors). Crucial in this regard is an area he calls the brain's "letterbox," located in the left occipito-temporal region at the back of the brain. This area, fMRI data show, is responsible for letter and phonemic recognition, transmitting its results to other distant areas through fiber bundles. He further argues that brain architecture imposes significant constraints on the physical shapes that will be easily legible to us. He draws on research demonstrating that 115 of the world's diverse writing systems (alphabetical and ideographic) use visual symbols consisting mostly of three strokes (plus or minus one). Moreover, the geometry of these strokes mirrors in their distribution the geometry of shapes in the natural environment. The idea, then, is that our writing systems evolved in the context of our ability to recognize natural shapes and that scribal experimentation used this correspondence to craft writing systems that would most effectively repurpose existing neural circuitry. Dehaene thus envisions "a massive selection process: over time, scribes developed increasingly efficient notations that fitted the organization of our brains. In brief,

our cortex did not specifically evolve for writing. Rather, writing evolved to fit the cortex" (171).

Current evidence suggests that we are now in a new phase of the dance between epigenetic changes in brain function and the evolution of new reading and writing modalities on the Web. Think, for example, of the F pattern of Web reading that the Nielsen research revealed. Canny Web designers use this information to craft Web pages, and reading such pages further intensifies this mode of reading. How quickly neural circuits may be repurposed by digital reading is suggested by Gary Small's experiments at the University of California, Los Angeles, on the effects of Web reading on brain functionality. Small and his colleagues were looking for digitally naive subjects; they recruited three volunteers in their fifties and sixties who had never performed *Google* searches (Small and Vorgan 15–17). This group was first tested with fMRI brain scans, wearing goggles onto which were projected Web pages. Their scans differed significantly from another group of comparable age and background who were Web savvy. Then the naive group was asked to search the Internet for an hour a day for five days. When retested, their brain scans showed measurable differences in some brain areas, which the experimenters attributed to new neural pathways catalyzed by Web searching. Citing this study among others, Carr concludes that "[k]nowing what we know today, if you were to set out to invent a medium that would rewire our mental circuits as quickly and thoroughly as possible, you would probably end up designing something that looks and works a lot like the Internet" (116).

How valid is this conclusion? Although Carr's book is replete with many different kinds of studies, we should be cautious about taking his conclusions at face value. For example, in the fMRI study done by Small and his colleagues, many factors might skew the results. I don't know if you have had a brain scan, but I have. As Small mentions, brain scans require that you be shoved into a tube just big enough to accommodate your supine body but not big enough for you to turn over. When the scan begins, supercooled powerful electromagnets generate a strong magnetic field, which, combined with a radio frequency emitter, allows minute changes in blood oxygen levels in the brain to be detected and measured. When the radio frequency emitter begins pulsing, it sounds as though a jackhammer is ripping up pavement next to your ear. These are hardly typical conditions for Web reading. In addition, there is considerable evidence that fMRI scans, valuable as they are, are also subject to a number of interpretive errors and erroneous conclusions (Sanders). Neural activity is not measured directly by fMRI scans (as a microelectrode might, for example). Rather, the most widely used kind of fMRI, BOLD (blood-oxygen-level dependent), measures tiny changes in oxygenated blood as a correlate for brain activity. BOLD research assumes that hardworking neurons require increased flows of oxygen-rich blood and that protons in hemoglobin molecules carrying oxygen respond differently to magnetic fields than protons in oxygen-depleted blood. These differences are tabulated and then statistically transformed into colored images, with different colors showing high levels of oxygen-rich compared with oxygen-depleted blood.

The chain of assumptions that led Small, for example, to conclude that brain function changed as a result of *Google* searches can go wrong in several different ways (see Sanders for a summary of these criticisms). First, researchers assume that the

correlation between activity in a given brain area is *caused* by a particular stimulus; however, most areas of the brain respond similarly to several different kinds of stimuli, so another stimulus could be activating the change rather than the targeted one. Second, fMRI data sets typically have a lot of noise, and if the experiment is not repeated, the observed phenomenon may be a chimera rather than a genuine result (in Small's case, the experiment was repeated later with eighteen additional volunteers). Because the data sets are large and unwieldy, researchers may resort to using sophisticated statistical software packages they do not entirely understand. Finally, they may be using a circular methodology in which the hypothesis affects how the data is seen (an effect called nonindependence). When one group of researchers went back through fMRI research that had been published in the premier journals *Nature*, *Science*, *Nature Neuroscience*, *Neuron*, and the *Journal of Neuroscience*, it found interpretive errors resulting from nonindependence in forty-two percent of the papers (Sanders).

Relying on summaries of research in books such as Carr's creates additional hazards. I mentioned earlier a review of hypertext experiments (DeStefano and LeFevre) cited by Carr, which he uses to buttress his claim that hypertext reading is not as good as linear reading. Consulting the review itself reveals that Carr has tilted the evidence to support his view. The authors state, for example, that "[t]here may be cases in which enrichment or complexity of the hypertext experience is more desirable than maximizing comprehension and ease of navigation," remarking that this may be especially true for students who already read well. They argue not for abandoning hypertext but rather for "good hypertext design" that takes cognitive load into account "to ensure hypermedia provide *at least as good* a learning environment as more traditional text" (1636; emphasis added). Having read through most of Carr's primary sources, I can testify that he is generally conscientious in reporting research results; nevertheless, the example illustrates the unsurprising fact that reading someone else's synthesis does not give as detailed or precise a picture as reading the primary sources themselves.

The Importance of Anecdotal Evidence

Faced with these complexities, what is a humanist to do? Obviously, few scholars in the humanities have the time—or the expertise—to backtrack through cited studies and evaluate them for correctness and replicability. In my view, these studies may be suggestive indicators but should be subject to the same kind of careful scrutiny we train our students to use with Web research (reliability of sources, consensus among many different researchers, etc.). Perhaps our most valuable yardstick for evaluating these results, however, is our own experience. We know how we react to intensive Web reading, and we know through repeated interactions with our students how they are likely to read, write, and think as they grapple with print and Web materials. As teachers (and parents), we make daily observations that either confirm or disconfirm what we read in the scientific literature. The scientific research is valuable and should not be ignored, but our experiences are also valuable and can tell us a great deal about the advantages and disadvantages of hyperreading compared with close reading, as well as the long-term effects of engaging in either or both of these reading strategies.

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Anecdotal evidence hooked me on this topic five years ago, when I was a Phi Beta Scholar for a year and in that capacity visited many different types of colleges and universities. Everywhere I went, I heard teachers reporting similar stories: "I can't get my students to read long novels anymore, so I've taken to assigning short stories"; "My students won't read long books, so now I assign chapters and excerpts." I hypothesized then that a shift in cognitive modes is taking place, from the deep attention characteristic of humanistic inquiry to the hyperattention characteristic of someone scanning Web pages (Hayles, "Hyper and Deep Attention"). I further argued that the shift in cognitive modes is more pronounced the younger the age cohort. Drawing from anecdotal evidence as well as such surveys as the Kaiser Foundation's *Gen M* report (Roberts, Foehr, and Rideout), I suggested that the shift toward hyperattention is now noticeable with college students. Since then, the trend has become even more apparent, and the flood of surveys, books, and articles on the topic of distraction is now so pervasive as to be, well, distracting.

For me, the topic is much more than the latest research fad, because it hits me where I live: the college classroom. As a literary scholar, I deeply believe in the importance of writing and reading, so any large-scale change in how young people read and write is bound to capture my attention. In my work on hyperattention (published just when the topic was beginning to appear on the national radar), I argued that deep and hyperattention each have distinctive advantages. Deep attention is essential for coping with complex phenomena such as mathematical theorems, challenging literary works, and complex musical compositions; hyperattention is useful for its flexibility in switching between different information streams, its quick grasp of the gist of material, and its ability to move rapidly among and between different kinds of texts.[1] As contemporary environments become more information intensive, it is no surprise that hyperattention (and its associated reading strategy, hyperreading) is growing and that deep attention (and its correlated reading strategy, close reading) is diminishing, particularly among young adults and teens. The problem, as I see it, lies not in hyperattention/hyperreading as such, but rather in the challenges the situation presents for parents and educators to ensure that deep attention and close reading continue to be vibrant components of our reading cultures and interact synergistically with the kind of Web and hyperreading in which our young people are increasingly immersed.

Yet hyper- and close reading are not the whole story. I earlier referred to Sosnoski's definition of hyperreading as "computer-assisted." More precisely, it is computer-assisted human reading. The formulation alerts us to a third component of contemporary reading practices: human-assisted computer reading, that is, computer algorithms used to analyze patterns in large textual corpora where size makes human reading of the entirety impossible. Machine reading ranges from algorithms for word-frequency counts to more sophisticated programs that find and compare phrases, identify topic clusters, and are capable of learning. Given the scope, pervasiveness, and sophistication of contemporary programs used to parse texts, it seems to me quite reasonable to say that machines can read. One could, of course, restrict "read" to human beings, arguing that reading implies comprehension and that machines calculate but do not comprehend. However, some human readers (beginners, for example) may also read with minimum or no comprehension. Moreover, the

line between (human) interpretation and (machine) pattern recognition is a porous boundary, with each interacting with the other. Hypotheses about meaning help shape the design of computer algorithms, and the results of algorithmic analyses refine, extend, and occasionally challenge intuitions about meaning that formed the starting point for algorithmic design. Putting human reading in a leakproof container and isolating machine reading in another makes it difficult to see these interactions and understand their complex synergies. Given these considerations, saying computers cannot read is from my point of view merely species chauvinism.

In a field like literary studies, misunderstandings of the efficacy and importance of machine reading are commonplace. Even such a perceptive critic as Culler falls back on caricature when, in writing about close reading, he suggests, "It may be especially important to reflect on the varieties of close reading and even to propose explicit models, in an age where electronic resources make it possible to do literary research without reading at all: find all the instances of the words *beg* and *beggar* in novels by two different authors and write up your conclusions" (24). In other words, close reading is the garlic that will ward off the vampire of machine reading. The anxiety here is palpable, nowhere more so than in his final phrase ("write up your conclusions"), which implies that drawing conclusions from machine analysis is a mechanical exercise devoid of creativity, insight, or literary value. Even Guillory, a brilliant theorist and close reader, while acknowledging that machine reading is a useful "prosthesis for the cognitive skill of scanning," concludes that "the gap in cognitive level between the keyword search and interpretation is for the present immeasurable" ("How" 13). There are two misapprehensions here: that keyword searches exhaust the repertoire of machine reading and that the gap between analysis and interpretation yawns so wide as to form an unbridgeable chasm rather than a dynamic interaction.

Given these misconceptions, explicit recapitulation of the value of machine reading is useful. Although it may be used with a single text and reveal interesting patterns, its more customary use is in analyzing large corpora too vast to be read by a single person. Preeminent in this regard is the work of Franco Moretti, who uses the term "distant reading," an obvious counterpoise to close reading (*Graphs*). Careful reading of his work reveals that this construction lumps together human and machine reading; both count as "distant" if the scale is large. I think it is useful to distinguish between human and machine reading because the two situations (one done by a human assisted by machines, the other done by computer algorithms assisted by humans) have different functionalities, limitations, and possibilities. Hyperreading may not be useful for large corpora, and machine algorithms have limited interpretive capabilities.

If we look carefully at Moretti's methodology, we see how firmly it refutes the misunderstandings referred to above. His algorithmic analysis is usually employed to pose questions. Why are the lifetimes of many different genres limited to about thirty years (*Graphs*)? Why do British novels in the mid–eighteenth century use many words in a title and then, within a few decades, change so that titles are no more than three or four words long ("Style")? How to explain changes in narrative conventions such as free indirect discourse when the novel moves from Britain to British colonies (*Graphs*)? I find Moretti's work intriguing for the patterns he

uncovers, but I am flat out delighted by the ingenious explanations he devises to account for them. So far beyond the mechanical exercises Culler imagines are these explanations that I would not hesitate to call many of them brilliant. When the explanations fail to persuade (as Moretti candidly confesses is sometimes the case even for him), the patterns nevertheless stand revealed as entry points for interpretations advanced by other scholars who find them interesting.

I now turn to explore the interrelations between the components of an expanded repertoire of reading strategies that includes close, hyper, and machine reading. The overlaps between them are as revealing as the differences. Close and hyperreading operate synergistically when hyperreading is used to identify passages or to home in on a few texts of interest, whereupon close reading takes over. As Guillory observed, skimming and scanning here alternate with in-depth reading and interpretation ("How"). Hyperreading overlaps with machine reading in identifying patterns. This might be done in the context of a *Google* keyword search, for example when one notices that most of the work on a given topic has been done by X, or it might be done when machine analysis confirms a pattern already detected by hyper (or close) reading. Indeed, skimming, scanning, and pattern identification are likely to occur with all three reading strategies; their prevalence in one or another is a matter of scale and emphasis rather than clear-cut boundary.

Since patterns have now entered the discussion, we may wonder what a pattern is. This is not a trivial question, largely because of the various ways in which patterns become manifest. Patterns in large data sets may be so subtle that only sophisticated statistical analysis can reveal them; complex patterns may nevertheless be apprehended quickly and easily when columns of numbers are translated into visual forms, as with fMRI scans. Verbal patterns may be discerned through the close reading of a single textual passage or grasped through hyperreading of an entire text or many texts. An anecdote may be useful in clarifying the nature of pattern. I once took a pottery class, and the instructor asked each participant to make several objects that would constitute a series. The series might, for example, consist of vases with the same shapes but different sizes, or it might be vases of the same size in which the shapes underwent a consistent set of deformations. The example shows that differences are as important as similarities, for they keep a pattern from being merely a series of identical items. I therefore propose the following definition: a pattern consists of regularities that appear through a series of related differences and similarities.

Related to the idea of pattern is the question of meaning. Since entire books have been written on the subject, I will not attempt to define meaning but merely observe that wherever and however it occurs, meaning is sensitively dependent on context. The same sentence, uttered in two different contexts, may mean something entirely different in one compared with the other. Close reading typically occurs in a monolocal context (that is, with a single text). Here the context is quite rich, including the entire text and other texts connected with it through networks of allusions, citations, and iterative quotations. Hyperreading, by contrast, typically occurs in a multilocal context. Because many textual fragments are juxtaposed, context is truncated, often consisting of a single phrase or sentence, as in a *Google* search. In machine reading, the context may be limited to a few words or eliminated altogether, as in a word-

frequency list. Relatively context-poor, machine reading is enriched by context-rich close reading when close reading provides guidance for the construction of algorithms; Margaret Cohen points to this synergy when she observes that for computer programs to be designed, "the patterns still need to be observed [by close reading]" (59). On the other hand, machine reading may reveal patterns overlooked in close reading, a point Willard McCarty makes in relation to his work on personification in Ovid's *Metamorphosis* (53–72). The more the emphasis falls on pattern (as in machine reading), the more likely it is that context must be supplied from outside (by a human interpreter) to connect pattern with meaning; the more the emphasis falls on meaning (as in close reading), the more pattern assumes a subordinate role. In general, the different distributions between pattern, meaning, and context provide a way to think about interrelations between close, hyper, and machine reading.

The larger point is that close, hyper, and machine reading each have distinctive advantages and limitations; nevertheless, they also overlap and can be made to interact synergistically with one another. Maryanne Wolfe reaches a similar conclusion when, at the end of *Proust and the Squid*, she writes,

> We must teach our children to be bitextual or multitextual, able to read and analyze texts flexibly in different ways, with more deliberate instruction at every stage of development on the inferential, demanding aspects of any text. Teaching children to uncover the invisible world that resides in written words needs to be both explicit and part of a dialogue between learner and teacher, if we are to promote the processes that lead to fully formed expert reading in our citizenry. (226)

I agree wholeheartedly with the goal: the question is how, precisely, to accomplish it?

Synergies between Close, Hyper-, and Machine Reading

Starting from a traditional humanistic basis in literature, Alan Liu in the English department at the University of California, Santa Barbara, has been teaching undergraduate and graduate courses that he calls Literature+, which adopt as a pedagogical method the interdisciplinarity facilitated by digital media. He asks students "to choose a literary work and treat it according to one or more of the research paradigms prevalent in other fields of study," including visualization, storyboarding, simulation, and game design. Starting with close reading, he encourages students to compare it with methodologies in other fields, including the sciences and engineering. He also has constructed a "tool kit" on his Web site that includes links to software packages enabling students with little or no programming experience to create different modes of representation of literary texts, including tools for text analysis, visualization, mapping, and social-network diagramming. The approach is threefold: it offers students traditional literary training; it expands their sense of how they can use digital media to analyze literary texts; and it encourages them to connect literary methodologies with those of other fields they may be entering. It offers close reading not as an unquestioned good but as one methodology among several, with distinctive capabilities and limitations. Moreover, because decisions about how to encode and analyze texts using software programs require precise thinking about priorities, goals, and methodologies, it clarifies the assumptions that undergird close reading by translating them into algorithmic analysis.

An example of how the "Literature+" approach works in practice is the project entitled "*Romeo and Juliet*: A *Facebook* Tragedy" (Skura, Nierle, and Gin). Three students working collaboratively adapted Shakespeare's play to the *Facebook* model, creating maps of social networks using the Friend Wheel (naturally, the Montagues are all "friends" to each other, and so are the Capulets), filling out profiles for the characters (Romeo is interpreted as a depressive personality who has an obsessive attachment to his love object and who has corresponding preferences for music, films, and other cultural artifacts that express this sensibility), and having a fight break out on the message-board forum using a Group called The Streets of Verona. The Wall feature was used to incorporate dialogue in which characters speak directly to one another, and the Photos section allowed one character to comment on the attributes of another. The masque at which Romeo and Juliet meet became an Event, to which Capulet invited friends in his Friend Wheel. From a pedagogical point of view, the students were encouraged to use software with which they were familiar in unfamiliar ways, thus increasing their awareness of its implications. The exercise also required them to make interpretive judgments about which features of the play were most essential (since not everything could be included) and to be precise about interactions between relationships, events, and characters. Linking traditional literary reading skills with digital encoding and analysis, the "Literature+" approach strengthens the ability to understand complex literature at the same time it encourages students to think reflectively on digital capabilities. Here digital and print literacies mutually reinforce and extend each other.

Lev Manovich's "Cultural Analytics" is a series of projects that starts from the premise that algorithmic analyses of large data sets (up to several terabytes in size), originally developed for work in the sciences and social sciences, should be applied to cultural objects, including the analysis of real-time data flows. In many academic institutions, high-end computational facilities have programs that invite faculty members and graduate students in the arts and humanities to use them. For example, at the University of California, San Diego, where Manovich teaches, the Supercomputer Center sponsored a summer workshop in 2006, Cyberinfrastructure for the Humanities, Arts, and Social Sciences. At Duke University, where I teach, the Renaissance Computing Institute (RENCI) offers accounts to faculty members and students in the arts and humanities that allow them to use computationally intense analysis. In my experience, researchers at these kinds of facilities are delighted when humanists come to them with projects. Because their mission is to encourage widespread use across and among campuses and to foster collaborations among academic, government, corporate, and community stakeholders, they see humanistic inquiry and artistic creation as missing parts of the picture that enrich the mix. This opens the door to analysis of large cultural data sets such as visual images, media content, and geospatial mapping combined with various historical and cultural overlays.

An example is Manovich's analysis of *Time* magazine covers from 1923–89. As Manovich observes, ideal sites for cultural analytics are large data sets that are well structured and include metadata about date, publication venue, and so forth. The visualization tools that he uses allow the *Time* covers to be analyzed according to subject (for example, portraits versus other types of covers), color gradients, black-

and-white gradients, amount of white space, and in other ways. One feature is particularly useful for building bridges between close reading and machine analysis: the visualization tool allows the user both to see large-scale patterns and to zoom in to see a particular cover in detail, thus enabling analyses across multiple scale levels. Other examples include Manovich's analysis of one million manga pages using the Modrian software, sorted according to gray-scale values; another project analyzes scene lengths and gray scale values in classic black-and-white films. While large-scale data analyses are not new, their applications in the humanities and arts are still in their infancy, making cultural analytics a frontier of knowledge construction.

Of course, not everyone has access to computation-intensive facilities, including most parents and teachers at smaller colleges and universities. A small-scale example that anyone could implement will be helpful. In teaching an honors writing class, I juxtaposed Mary Shelley's *Frankenstein* with Shelley Jackson's *Patchwork Girl*, an electronic hypertext fiction written in proprietary *Storyspace* software. Since these were honors students, many of them had already read *Frankenstein* and were, moreover, practiced in close reading and literary analysis. When it came to digital reading, however, they were accustomed to the scanning and fast skimming typical of hyperreading; they therefore expected that it might take them, oh, half an hour to go through Jackson's text. They were shocked when I told them a reasonable time to spend with Jackson's text was about the time it would take them to read *Frankenstein*, say, ten hours or so. I divided them into teams and assigned a section of Jackson's text to each team, telling them that I wanted them to discover *all* the lexias (i.e., blocks of digital text) in their section and warning them that the *Storyspace* software allows certain lexias to be hidden until others are read. Finally, I asked them to diagram interrelations between lexias, drawing on all three views that the *Storyspace* software enables.

As a consequence, the students were not only required to read closely but also to analyze the narrative strategies Jackson uses to construct her text. Jackson focuses some of her textual sections on a narrator modeled on the female creature depicted in *Frankenstein*, when Victor, at the male creature's request, begins to assemble a female body as a companion to his first creation (Hayles, "Invention"). As Victor works, he begins to think about the two creatures mating and creating a race of such creatures. Stricken with sexual nausea, he tears up the female body while the male creature watches, howling, from the window; throws the pieces into a basket; and rows out onto a lake, where he dumps them. In her text Jackson reassembles and reanimates the female creature, playing with the idea of fragmentation as an inescapable condition not only for her narrator but for all human beings. The idea is reinforced by the visual form of the narrative, which (in the *Storyspace* map view) is visualized as a series of titled text blocks connected by webs of lines. Juxtaposing this text with *Frankenstein* encouraged discussions about narrative framing, transitions, strategies, and characterization. By the end the students, who already admired *Frankenstein* and were enthralled by Mary Shelley's narrative, were able to see that electronic literature might be comparably complex and would also repay close attention to its strategies, structure, form, rhetoric, and themes. Here already-existing print literacies were enlisted to promote and extend digital literacy.

These examples merely scratch the surface of what can be done to create productive interactions between close, hyper, and machine reading. Close and hyperreading are already part of a literary scholar's tool kit (although hyperreading may not be recognized or valued as such). Many good programs are now available for machine reading, such as *Wordle*, which creates word clouds to display word-frequency analysis, the advanced version of the *Hermetic Word Frequency Counter*, which has the ability to count words in multiple files and to count phrases as well as words, and other text-analysis tools available through the TAPoR text-analysis portal (http://digitalresearchtools.pbworks.com/Text+Analysis+Tools). Most of these programs are not difficult to use and provide the basis for wide-ranging experimentation by students and teachers alike. As Manovich says about cultural analytics and Moretti proclaims about distant reading, machine analysis opens the door to new kinds of discoveries that were not possible before and that can surprise and intrigue scholars accustomed to the delights of close reading.

What transformed disciplinary coherence might literary studies embrace? Here is a suggestion: literary studies teaches literacies across a range of media forms, including print and digital, and focuses on interpretation and analysis of patterns, meaning, and context through close, hyper-, and machine reading practices. Reading has always been constituted through complex and diverse practices. Now it is time to rethink what reading is and how it works in the rich mixtures of words and images, sounds and animations, graphics and letters that constitute the environments of twenty-first-century literacies.

Note

1. Researchers in the field of attention studies identify three major types of attention: controlled attention, capable of being focused through conscious effort; stimulus-driven attention, a mode of attentiveness involuntarily attracted by environmental events, such as a loud noise; and arousal, a general level of alertness (see Klingberg 21 for a summary). In these terms, deep attention is a subset of controlled attention, and hyperattention bridges controlled and stimulus-driven attention.

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Literary close reading and commentaries have extensive precedent in the exegesis of religious texts, and more broadly, hermeneutics of ancient works. For example, Pazand, a genre of middle Persian literature, refers to the Zend (literally: 'commentary'/'translation') texts that offer explanation and close reading of the Avesta, the sacred texts of Zoroastrianism.[1] The scriptural commentaries of the Talmud offer a commonly cited early predecessor to close reading.[2] In Islamic studies, the close reading of the Quran has flourished.Â "How We Read: Close, Hyper, Machine". ADE Bulletin. 152 (1). doi:10.1632/ade.152.0.