



The Reading Matrix © 2014
Volume 14, Number 1, April 2014

It's NOT New; It's NOT Different: The Psycholinguistics of Digital Literacy

Alice S. Horning
Oakland University

ABSTRACT

Teachers of reading and writing have been getting a lot of criticism recently, mostly derived from studies showing that students and the population at large lack essential literacy skills to be successful. The move to multimodal literacy only complicates the problems already present. While some new skills are needed in order to engage in successful multimodal composing, for website design or other activities on the web, students must first be prepared with the critical foundational literacy that derives from working with printed texts. By examining the underlying psycholinguistic processing abilities and text features people need for effective web literacy, the consistencies between these two sites of literacy emerge. The commonalities suggest that multimodal composing must rely on print-based skills. After defining and connecting critical and multimodal literacy to the foundational literacy of print, this discussion, though focused on reading, explores the ways that readers respond to both print and digital texts with direct implications for composing. A brief look at three different websites will demonstrate that the psycholinguistic processing abilities and the distinctive features of texts that make literacy possible, with a few additions for digital forms, are used for all reading and writing.

INTRODUCTION

Teachers of reading and writing have been getting a lot of criticism from a variety of sources of late. For instance, studies by the U.S. Department of Education (2006) and others have shown that students and the population at large lack essential literacy skills to be successful at home, at work and in society. The move to multimodal literacy only complicates the problems already present; both theory and practical application are needed to address the need for faster, more efficient and more effective literacy skills in both print and digital venues. While some new skills are needed in order to engage in successful multimodal composing, for website design or other activities on the web, students must first be prepared with the critical foundational literacy that derives from working with printed texts. If our collective goal is critical literacy on both pages and screens, teachers should be helping students to develop, build and adapt foundational, print-based writing and reading skills to the new and developing hybridized digital situation. By examining the underlying psycholinguistic processing abilities and text features people need for effective web literacy, the consistencies between these two sites of literacy emerge. The

commonalities suggest that multimodal composing must rely on print-based skills (Horning, 2012).

A full understanding of the psycholinguistics of literacy entails, first, a definition of critical literacy that applies to both print and digital forms. Then, multimodal literacy must be connected to the foundational literacy of print. While the discussion of this connection focuses on reading, understanding the ways that readers respond to both print and digital texts has direct implications for composing. A brief look at three different websites will demonstrate that the psycholinguistic processing abilities and the distinctive features of texts that make literacy possible are used for all reading and writing; only two additional processing mechanisms and a few different features are needed specifically for digital texts that appear as typical websites (i.e., not ebooks and other simulations of traditional texts).

Defining Critical Literacy

Defining critical literacy is not easy. If we define our humanity, in part, by our ability with language (Pinker, 1994, p. 17), a further definition is that critical literacy, on the printed page and on the web, is the most sophisticated aspect of current human linguistic ability (Horning, 2012, p. 135f.). Humans develop this amazing ability by relying on seven key processing mechanisms that operate on the distinctive features in language (Horning, 2012, pp. 100-134). These processing mechanisms and features have evolved over time to make it possible for human beings to be critically literate. I want to propose the following definition for critical literacy, which includes current technology:

Critical literacy is best defined as the psycholinguistic processes of getting meaning from or putting meaning into print and/or sound, images, and movement, on a page or screen, used for the purposes of analysis, synthesis, evaluation and creation; these processes develop through formal schooling and beyond it, at home and at work, in childhood and across the lifespan and are essential to human functioning in contemporary society.

The need for every human being to develop critical literacy is urgent everywhere, in schools and colleges and beyond them in the United States and also around the world. In general, this goal has not been achieved (see U.S. Department of Education, 2006; Murray, Kirsch & Jenkins, 1997; results on the international test of the Programme for International Student Assessment (PISA) given in 40 countries provide further evidence for this claim as discussed by Ripley, 2013, pp. 15-25). The growing use of the Internet, because of the amount of information now available everywhere, makes that need even more urgent.

My proposed definition addresses both the reading side and the writing side of the literacy equation. Analysis, synthesis and evaluation are the reading side while creation is the writing or composing side. My view of critical literacy also addresses the broader issue of the context of literate activity, as discussed by such scholars as Street (2001), Kress (2003) and Selfe (1999). Work in the digital environment will entail the use of seven basic psycholinguistic abilities that humans have (Goodman, 1996; Pinker, 1994; Smith, 2004), plus two new ones, bricolage and juxtaposition. Bricolage concerns the assembly of a page or screen from varied parts and juxtaposition concerns the placement of those parts for specific purposes (Burbules, 1998, p. 107). Perceiving and producing multimodal texts requires these abilities, but they are an extension, built on other aspects of psycholinguistic processing humans have and use with print as Burbules and other scholars point out. The abilities humans have that make literacy possible

operate on the features of text to be discussed below. And while there are certainly new features (image, sound, movement, and link), these too build on other features used in printed texts. Before looking at the processing abilities and distinctive features of pages and screens, the claim that the foundational literacy of print provides the basis for multimodal composing warrants exploration.

The Psycholinguistics of Critical Literacy

Other scholars have made clear not only that reading and writing must go hand-in-hand, but also, their studies validate the need to incorporate new technologies, seeing them as essential to literacy in all venues. For example, University of Connecticut reading scholar Donald Leu and his colleagues offer a definition of new literacies very close to the one I have proposed:

The new literacies of the Internet and other ICTs [information and communication technologies] include the skills, strategies, and dispositions necessary to successfully use and adapt to the rapidly changing information and communication technologies and contexts that continuously emerge in our world and influence all areas of our personal and professional lives. These new literacies allow us to use the Internet and other ICTs to identify important questions, locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others. (Leu, Kinzer, Coiro, & Cammack, 2004, p. 1572)

Leu et al.'s (2004) definition addresses not only reading and writing but also printed and digital environments. The need for this kind of literacy has recently become the focus of various organizations such as Educause and the Educational Testing Service (which has lately begun offering a test of information literacy that addresses some aspects of critical literacy) as well as of accrediting bodies across the country (Foster, 2007, p. A38). Leu et al. make a further point about integration of reading and writing in digital forms developing from print-based abilities as they discuss “foundational literacies” and their role in helping students develop skills in the digital age:

It is essential, however, to keep in mind that the new literacies... almost always build on foundational literacies rather than replace them. Foundational literacies include those traditional elements of literacy that have defined almost all our previous efforts in both research and practice. These include skill sets such as phonemic awareness, word recognition, decoding knowledge, vocabulary knowledge, comprehension, inferential reasoning, the writing process, spelling, response to literature, and others required for the literacies of the book and other printed material. Foundational literacies will continue to be important within the new literacies of the Internet and other ICTs. In fact, it could be argued that they will become even more essential because reading and writing become more important in an information age. (pp. 1590-1591)

This view of “foundational literacies” arising from the printed page as a source runs counter to the view that digital forms are increasingly supplanting the page. Leu et al. point out, though, that the fundamental skills that provide the base for all reading and writing come from printed material. Whether the print array appears on paper or on a screen is of little consequence because the underlying skills needed to process written text are the same regardless of the venue. There is considerable psycholinguistic evidence to support Leu et al.'s observations and claims.

Print-based reading, integrated with writing, is the basis for any and all work in our increasingly digital world.

This claim applies to older digital “immigrants” as described by educational theorist Mark Prensky (2001), and to the younger digital “natives” now in school. Leu’s work shows clearly that even those digital “native” students in our classrooms must develop foundational literacy with printed material as the basis for working with digital materials of all kinds. This foundational literacy relies on seven main kinds of psycholinguistic processing mechanisms, all of which are essential to reading and writing: identification, categorization, discrimination, prediction and limited short-term memory. In addition, students developing critical literacy must be able to capitalize on the linguistic phenomena of syntax and redundancy to have the full set of processing abilities that critical literacy demands, along with the additional processing abilities specific to the web, bricolage and juxtaposition.

The first of these capacities, then, is the human ability to recognize and/or identify letters, words and other written forms, such as punctuation. Recognition, in psycholinguistic terms, includes both *remembering*, that is, “conscious recollection of seeing the item previously” (Knowlton, 1998, p. 254), and *knowing*, that is, “recognition in the absence of such recollections” (Knowlton, 1998, p. 254). These general abilities apply not only to letters and words but also to meanings in written language processing. Identification makes it possible for us to look at ‘A’ and ‘a’ and ‘A’ and label all of them as letter ‘A’. Identification refers specifically to the ability to name the letters, words or other written forms.

Some experts might challenge the importance of the first of these mechanisms, identification or recognition, to literacy. One of the great debates in the teaching of reading and writing concerns whether it is necessary for readers and writers to identify, that is, to label, letters and words at all; this issue plays out in arguments over phonics vs. “whole language” approaches to teaching reading, for example. Although Frank Smith (2004), author of one of the definitive textbooks on the nature of the reading process and now in its sixth edition, argues that letter and word identification are not necessary to reading. He does concede, however, that when a reader cannot get meaning directly, there is the possibility of mediated letter or word identification, sometimes using phonics or other strategies. Smith may be stretching his argument to make a point about the direct identification of meaning. Even so, identification does play a role, albeit limited, in literacy.

A second processing mechanism is the ability to categorize a range of possible shapes as belonging to the same group. Categorization is not the same as identification, which specifically refers to labeling ability. When psycholinguist Kenneth Goodman (1996) talks about these abilities, he separates them into an ability to judge things that look similar to one another as different (labeling) and things that look different as the same (categorizing). Goodman’s view concurs with that of Smith, who points out that identifying letters or words is not that hard, as it entails only labeling. Putting items into a category is more complex since it entails knowing the features of the category. Identification, Smith (2004) says, is not necessary in order to be able to categorize or discriminate between categories. By using the sets of features, both processes are possible. He further suggests that the exact feature list is not essential to either identification or categorization, suggesting that the features may well be intuitions. In any case, he contends that the ability to name (i.e., to identify) and the ability to group like items together (i.e., to categorize) are basic tools of human thinking ability that make critical literacy possible.

Yet another processing ability is discrimination. It is the ability to perceive two items (such as letters or words in this case) as the same as or different from each other. Discrimination

does not require either identification or categorization, but is a separate kind of ability. It is not necessary to be able to identify (i.e., label) two items in order to discriminate between them (Kucer, 2014, pp. 111-139). It is also not necessary to categorize two items in order to discriminate between them. This ability is important in a number of different kinds of cognitive processing, including literacy. It is discrimination that allows us to see the difference between ‘b’ and ‘d’ and between ‘p’ and ‘q’—essentially all the same combination of a circle and a bar, distinguished by the position of the bar (left, right, up or down). We distinguish these four through our discrimination ability.

These first three processing mechanisms are basic abilities we have with language that support literacy. For letters, words, and texts, readers must be able to identify or recognize what they are looking at, whether it is letters, words or ideas; readers must know when items that look different are really the same, i.e., to categorize, say, upper and lower case ‘a’ as ‘A’ or two sonnets with similar rhyme schemes, or two texts on the same side of an issue; and finally, readers must be able to say that items that look the same or nearly the same are different, such as ‘E’ and ‘F’ or between sonnets and odes or between speeches of opposing political candidates. We apply these processing mechanisms to both receptive and productive forms of literacy and will need them as much or more as literacy evolves and moves to digital formats.

A further essential cognitive ability is the ability to predict. We predict or make guesses about what is to come in a text based on our prior knowledge of the world and to some extent, our knowledge of language. Prediction relies chiefly on our knowledge of the world and how it works. Psycholinguists describe this knowledge using the concept of a schema, a set of facts, examples and attitudes regarding any particular part of our world. We have schemas for many different kinds of experiences. The mention of a child’s birthday party, for example, brings many facts, examples and attitudes immediately to mind: cake, ice cream, presents, pin-the-tail-on-the-donkey, singing “Happy Birthday,” exuberant kids, and so on. Prediction is a powerful mechanism because it allows us to create expectations (Kucer, 2014, pp. 134-37; Dehaene, 2009, pp. 11-51).

In written language, there are similar schemas, some of which are indicated by mere phrases. When we read “Once upon a time,” we almost invariably begin thinking about adventures in medieval Europe, of boy meets girl, boy gets girl, boy loses girl, boy gets girl again, and ending with “they lived happily ever after,” with a possible dragon or troll thrown in for good measure. As another example, scholars in science respond predictably to headings like these: Review of the Literature, Methods, Results, Discussion, Conclusion. Prediction draws on prior knowledge of both the world and the language of the text.

A fifth general cognitive processing mechanism that plays a key role in critical literacy is the mind’s capacity to store a limited amount of information in short-term memory. This limit is well established at the “magical number seven” give or take two items, as reported by psycholinguist George Miller (1956) in a landmark study more than fifty years ago. Miller’s research showed clearly that humans can hold about seven unrelated items in short-term memory before they are lost. Short term memory interacts with long-term memory and the two work together in an essential way to facilitate efficiency in normal, fluent reading (Kucer, 2014, pp. 121-24).

Human beings, then, have these five processing abilities that have evolved over time to make literacy possible: identification, categorization and discrimination along with prediction ability and the constraining capacity of short-term memory. Though it may seem odd to include a constraint with abilities, the constraint does play a key role in processing, and must be

considered as part of the capacities that make reading and writing do-able. All of these processing mechanisms play a role in literacy as they make it possible for human beings to produce and comprehend written language on pages or screens. The mechanisms discussed thus far are general processing abilities. These general processing mechanisms work together with two kinds of linguistic ability—again fairly basic in nature—to make critical literacy possible.

The first of these linguistic processing abilities is the general cluster of syntactic ability, usually discussed early in basic linguistics texts (Fromkin, Rodman & Hyams, 2011). Syntactic ability entails a number of interrelated phenomena: knowledge of sentence rules that allows us to judge their grammaticality and acceptability; productive use of a small set of these rules that allows us to create an infinite number of possible sentences; recognition of the arbitrary relationship of symbols and meanings that allows us to adapt language to any need that might arise; disconnection of language from context that allows us to discuss matters unrelated to the immediate context.

In general, these syntactic abilities make it possible for literate people to produce and comprehend written language using this core set of language rules. We use our knowledge of these rules for instance when we read poetry, where the rules may be broken for artistic purposes. We use productivity when we generate new texts in written form. We use the arbitrary connection of symbol and meaning when we make up or recognize new words, such as for new products or new phenomena in the world. We use the arbitrariness of symbols to read or write about people and events happening around the corner or around the world or in imaginary worlds, again, on both pages and screens.

The production and interpretation of language also depends on another linguistic system in addition to syntax. This second linguistic system Smith (2004) calls redundancy—the information overlap built into language that insures that the message sent is the message received—pervades printed and digital written language from the configurations of letters to the overall structure of a text. It plays a role in our ability to recognize various aspects of written language, and without it, the connection of readers and writers through a text would be much more difficult. The work of cognitive scientist Stanislas Dehaene (2009), including careful studies of readers' processing using CT, MRI and PET scanning, shows that readers use both the visual display and letter-sound relationships as part of this information overlap (pp. 104-109).

Providing sufficient redundancy while writing, or interpreting redundancy while reading is a skill effective readers and writers have obviously mastered. But linguists have not yet been as successful in describing what these rules are or how they operate as they have been in describing, for example, the rules of syntax. To complicate matters further, redundancy operates at all the different levels of language, from the forms of letters to the construction of sentences to the structure of paragraphs to the overall development of the whole text. Despite its complex nature, the ability to tap into various kinds of psycholinguistic redundancy is a seventh key processing ability of human beings that plays a key role in critical literacy. The common sense idea is that redundancy is a negative characteristic of language, mere repetition; however, from a psycholinguistic perspective, redundancy constitutes an essential feature of language because it insures that the message sent by one person is the same as the message received by another. Redundancy operates largely below our conscious awareness like the other cognitive processing mechanisms, but in its absence, communication is difficult, if not impossible.

Finally, there are two more processing mechanisms, bricolage and juxtaposition, needed for critical literacy on both pages and screens; these are not often discussed, but are additional to the seven processing capacities essential for literacy, all of which have their basis in print.

Bricolage is a term drawn from art, referring to an ability to put together parts (Burbules, 1998). Burbules (1998) defines bricolage as “*assembling* texts from pieces that can be represented in multiple relations to one another” (p. 107). The second mechanism needed is juxtaposition, the placing of items close to one another for comparison or contrast (Burbules, 1998). In foregrounding the visual, a web page asks readers to see images as they are arrayed, next to each other for various specific purposes. Part of the point is for readers to see, notice, and attend to how the various pieces of a web page are related to each other by their position on the screen (Burbules, 1998).

In the examples below, it will be clear that multimodal texts require both of these processing mechanisms. Web pages make use of not only alphabetic text and images as does traditional print, but may also include sound, movement, links and other features presented in ways that entail the use of bricolage and juxtaposition. Students need both to be aware of the processing strategies they are using and the rationale for the designers’ choices of particular items in a particular layout. Just as students learn to be aware of rhetorical strategies for print writing like appeals to ethos, pathos and logos, teachers can and should help students develop an awareness of the choices designers have made about what elements to choose and how to arrange them. Here again, reliance on foundational skills can provide a base for helping students use skills they already have for print in their work with multimodal texts.

These processing mechanisms and linguistic abilities help account for how critical literacy is possible. Without the abilities of identification, categorization, discrimination, prediction and short-term memory, limited though it is, no literacy on pages or screens would be possible. Without the ability to use syntax and redundancy in language, reading and writing would also be impossible. Without an awareness of and the ability to use bricolage and juxtaposition, multimodal composing would not be successful. So these are essential human abilities that provide the basis for critical literacy; they operate on the written and digital forms of language to allow people to analyze, synthesize, evaluate and create alphabetic texts, web sites, social networking connections and so on. To do so, the processing mechanisms and linguistic abilities work with the distinctive features for letters, words, sentences, texts, images, sounds, movement and links that are similar to the well-established phonological distinctive features.

Defining the Distinctive Features

The distinctive features appear consistently in writing and reading whether the text is on paper or appears in some hybrid form on a screen, supported by pictures, sound and movement. The abilities described by critical literacy are possible because of the distinctive features of language at four levels, coupled with the distinctive features of web pages or sites. Like the phonological distinctive features that help us produce and perceive spoken language, they make selective use of redundancy; they help to insure that readers and writers understand one another. These features appear in the orthography and graphology, a sort of rudimentary level of literacy, in the morphology and meanings of written language at a basic level, in the sentence patterns, discourse forms or genres at an intermediate level, and in the rhetorical modes and argument strategies of written text at the most advanced level (Horning, 2012, pp. 119-34). Alongside these four levels of features, there are the specialized features of the web. Critical literacy entails the ability to perceive and produce the distinctive features at each level, on pages or screens.

Smith's (2004) generic definition of a distinctive feature makes a good starting point for the description of the full range of features in written forms. A distinctive feature is generically defined by Smith as follows:

...it is a property of visual information that can be used to differentiate some visual configurations from others—a “significant difference.” A distinctive feature must be common to more than one object or event; otherwise, it could not be used to put more than one into the same category, [sic] it would be all one needs to know. But, on the other hand, if the feature were present in all objects or events, then we could not use it to segregate them into different categories; it would not be “distinctive.” In other words, a feature, if detected, permits the elimination of some of the alternative categories in which a stimulus might be allocated. (p. 115)

Though he intended for this description to apply chiefly to letter identification in reading, Smith's description works well not only for rudimentary orthography, but also for the basic, intermediate and advanced features.

The orthographic distinctive features at a rudimentary level include not only the components of written characters for both perception and production, but also the key features of graphology, the study of the written symbols of language. The geometric elements of print might include these: circle, square, triangle, vertical, horizontal, open, closed, diagonal, curve, positionality and sequencing. This set is similar to that proposed by psychologists Sadoski and Paivio (2001).

At a second, basic level, drawing on Smith's (2004) generic definition, the distinctive features address words and meanings. Word recognition features might include length, frequency, consistency with letter/sound sequential constraints for the language, and grammatical markers (plural, past tense, possessive, etc.), among others. Then there would have to be yet another set of distinctive features for meaning. These claims follow, again, Smith's (2004) general proposals in *Understanding Reading* and are supported by the neurolinguistic studies reported by Dehaene (2009, pp. 88-93). The meaning features would be more complex, but still essentially at a basic level. Semantic feature theory as proposed by some linguists (Reeves, Hirsh-Pasek, & Golinkoff, 1998) offers the major meaning features; the idea of semantic features has evolved over time through the work of linguists, cognitive psychologists and others, as discussed by Bernd-Olaf Küppers et al. (2013). Feature theories capture such key characteristics of words as components of meaning, such as human and animate and perhaps also such gender markers as male and female where relevant. As in graphology, we do not have a definitive list of what all the features are, but we do have an intuitive sense of them. In terms of syntax, we have a list of what might be features, the classic parts of speech: nouns, verbs, adjectives, adverbs, prepositions, conjunctions, articles, interjections. Notice that this is a fairly standard list of eight categories, within the short-term processing limit of seven plus or minus two items.

Beyond these first two sets of features, I propose that there is a third, intermediate level, again hinging on features of print, for both perception (reading) and production (writing). The features here might be, for documents and sites, such arrays as tables, charts, graphs, diagrams, forms, and maps, and for prose, the various genres of text, including prose, poetry, drama, newspaper articles or editorials, textbook-type materials or basic legal texts like warranty statements. For both reading and writing purposes, language users must recognize these distinctive forms as distinctive, though again, not necessarily in a conscious way.

Finally, at the advanced level, the features of digital or traditional printed texts may include both the rhetorical modes such as description, narration and exemplification and the forms of argumentation, such as inductive or deductive argument. The forms and features might vary from language to language and culture to culture as contrastive rhetoricians have pointed out (Kaplan, 1966). The most sophisticated features are used to perceive and produce the various rhetorical modes for evaluation or creation. These various rhetorical modes and arguments occur in both written and digital forms, giving rise to recent discussions of visual literacy or visual rhetoric.

The processing mechanisms, including the less obvious bricolage and juxtaposition abilities, operate on these four levels of distinctive features and also, in the digital environment, on the distinctive features of web pages and sites. Web pages and sites, as will be clear in the illustrations to follow, entail all these distinctive features and some different ones: image, sound, movement and link. While many printed books have had pictures for a long time, and some children's books have sound or other interactive features (think *Pat the Bunny* (Kunhardt, 1968) and the like), the images, sounds, and animation to be found on the screen are all considerably more sophisticated and complex as the following examples will demonstrate. The one further feature that may be the most distinctive characteristic of the web is the presence of links that allow readers to move from one page or site to another. All of us, but especially students who live, work and participate in our increasingly digital, interconnected world must become more adept as readers and writers because of the increasing speed and quantity of material coming at all of us in both print and digital forms. Achieving this goal, and using the processing mechanisms, linguistic abilities and distinctive features effectively on both pages and screens begins with and builds upon foundational literacy with printed text. A recent study by a librarian (Harris, 2011) as well as a study by a Microsoft researcher on young people's use of social media (Boyd, 2014, pp. 180-197) support this claim.

Critical literacy skills of analysis, synthesis, evaluation and creation will call for some new abilities including the additional processing mechanisms of bricolage and juxtaposition and the additional distinctive features of image, sound, movement, and link. These will challenge human literate capacity because they require "hyperreading." Hyperreading entails the ability to read and to work with hypertext, i.e. text with these other features, in particular ways described by University of Illinois professor of educational policy Nicholas Burbules (1998). Links, as Burbules points out, are especially important because, as he says, "The usage and placement of links is one of the central ways in which the tacit assumptions and values of the designer/author are manifested in a hypertext - yet they are rarely considered as such" (p. 104). Moreover, Burbules points out that links not only shape readers' responses but also are set up as going in only one direction, despite the ability to return to an earlier page or site.

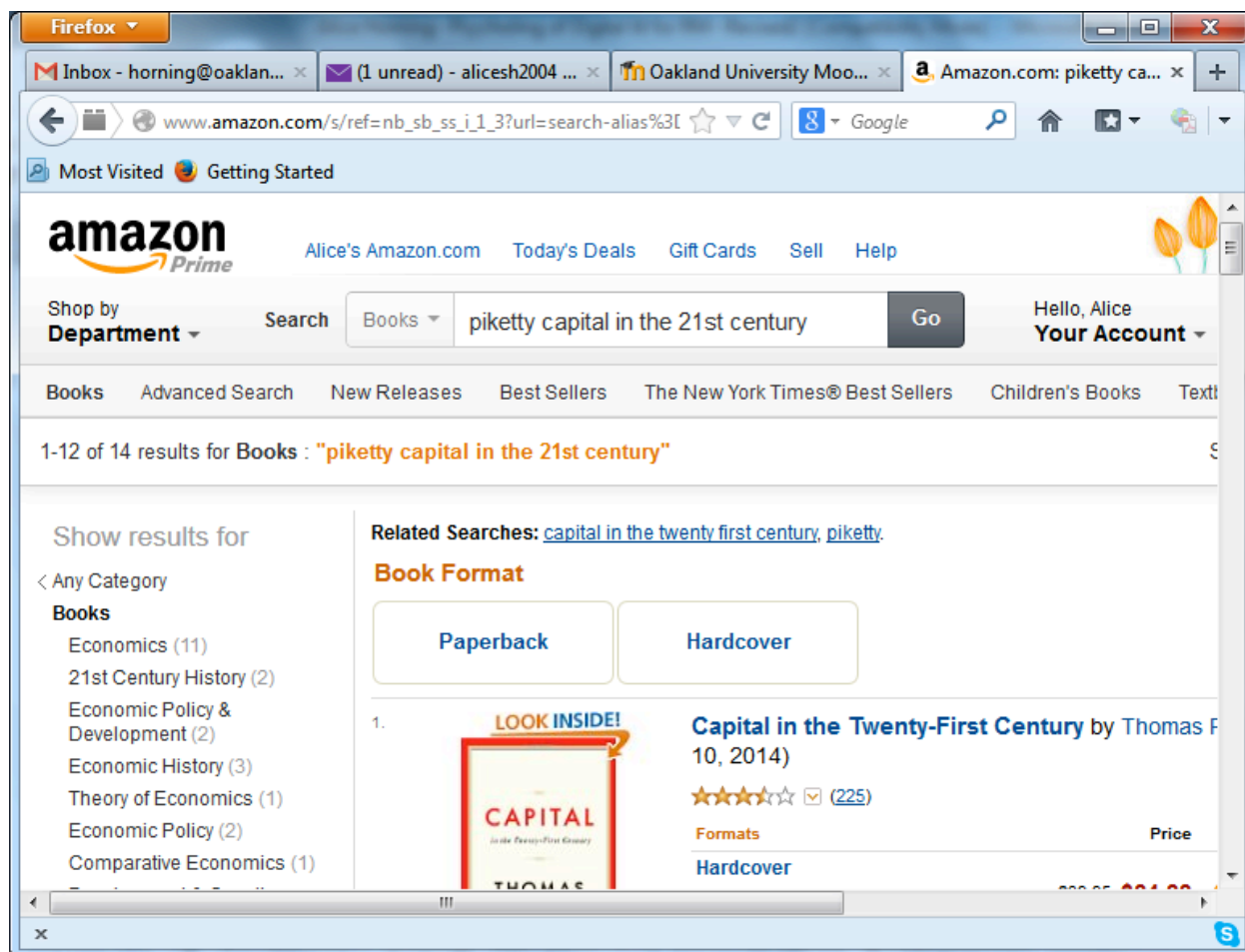
Hyperreading on screens calls for the ability to draw on the processing mechanisms used for printed text and the additional abilities with bricolage and juxtaposition described above. It requires familiarity with the distinctive features of print as well as the ability to manipulate and respond to the new features: images, sounds, movement, and links. Hyperreading is no less important or relevant despite the more recent move of many young people to social media platforms like Facebook and Youtube. After 7 years of research on teens' use of social media, including 166 interviews with young people across the country, Boyd (2014) makes clear that young people need to continue to develop critical literacy skills to evaluate what they find and read online. The skills needed for both traditional reading and digital work entail analysis, synthesis, evaluation and careful application or use; these skills are needed by all readers,

whether the text appears on paper or a screen and whether it is an original document (such as the Declaration of Independence) or a silly cat video on Youtube.

Web Testing

These processing mechanisms and features appear on readily available websites on the Internet. The processing abilities on pages and screens that I have described are ones that will be used by both our digital “native” students who have grown up in a computer-based society and the rest of us, digital “immigrants.” The relevance of this distinction as support for the argument presented here is provided by English professor and *Chronicle of Higher Education* columnist James Lang (2007). It should be clear that both natives and immigrants need critical literacy skills that draw on the processing abilities human beings have that make literacy possible. While the multimodal environment for reading and writing draws on two additional digital processing mechanisms which operate on several additional distinctive features beyond those needed for print, the core abilities and features are the same in both venues. As these abilities continue to evolve, the debate about the positive and negative impact of the on-going changes will also continue. On the one hand, scholars like Katherine Hayles (2012) of the University of North Carolina contend that the forms of written language are changing in positive ways, while others like journalist Nicholas Carr (2010) suggest that we are losing our minds as a by-product of the impact of technology. Still others, like Arizona State University professor James Paul Gee (2003) point out how video games have a positive effect on language development and critical thinking abilities. All agree that print and reading will continue to be central to people’s lives online and off and require the same set of critical literacy skills.

To confirm the accuracy of my claim here a quick foray onto the web is in order. The popular shopping site Amazon.com offers a good starting point. A look at this page reveals that the processing mechanisms are all in use as readers look to see what books, movies, music and other items are available. There is text, which requires the same reading skills as printed material, and then static/stationary images and possibly movement and sound, in specific juxtaposition. The page that appears in the screen shot below shows the title of a new book; clicking it allows the reader to see a few pages of the contents. In addition, there are links, some of which go to reviews by readers or listeners of the material under consideration, and there again, the skills needed are those reading skills foundational to print mediums. While conscious awareness of juxtaposition and bricolage or the other processing mechanisms may or may not be present for users, they provide the basis for reading and using this site. The layout of the page follows Nielsen and Pernice’s (2010) findings about the F-shape of typical reading patterns for web pages. The readers of the site may well be jumping around among links, looking at an image of a book’s cover, reading other readers’ reviews, perhaps listening to an author talk about or read from the book, and adding their own reviews or comments on a book or recording, and so forth. To cope with the sheer volume of input, to be able to make use of critical skills of analysis, synthesis, evaluation and application, users must rely on print-based processing mechanisms and the distinctive features I have described.



Yahoo.com, a different kind of site, offers an alternative array of options, but these also rely chiefly on print-based literacy skills. There's news in the middle of the page, buttons to click for assorted categories of information, access to email, videos and other kinds of material. Across the top are the most common and often-used links: to email, sports, weather, entertainment, horoscopes and so forth. There is also a search box, not surprising since Yahoo is, among other things, a search engine. Along the left side of the screen, a kind of distinctive feature of web sites of this type, are more links to other kinds of information or material: games, jobs, personal ads, and so on. At the bottom of the screen are contact links to Yahoo itself: ways to report trouble with the site, to see jobs available working for Yahoo, its privacy policy and other items. How do users know which links to click? How do they read multiple links simultaneously? How can they manage all the input that comes from these many and varied options? How do they contribute via email, blogs or networking? Linguists (Crystal, 2006) and communication scholars (Danet & Herring, 2007) have analyzed these various aspects of web-based texts and make clear that all of these activities require foundational print-based literacy, even when what is being read or written is not necessarily continuous alphabetic text, like the label on a link or an IM message, with its low redundancy set of abbreviations, ranging from LOL (laugh out loud) to BRB (be right back)



A third sort of site on the Internet is the ubiquitous Wikipedia site. This site uses a different kind of software, allowing anyone with web access to read and write or edit any entry into this online encyclopedia. A typical Wikipedia entry features links, as illustrated in its self-description:

Wikipedia (IPA: /wɪkɪˈpiː.ə/ or /wɪkɪˈpiː.ə/) is a multilingual, web-based, free content encyclopedia project. Wikipedia is written collaboratively by volunteers from all around the world. With rare exceptions, its articles can be edited by anyone with access to the Internet, simply by clicking the *edit this page* link. The name Wikipedia is a portmanteau of the words *wiki* (a type of collaborative website) and *encyclopedia*. Since its creation in 2001, Wikipedia has grown rapidly into one of the largest reference Web sites.

In every article, links will guide you to associated articles, often with additional information. Anyone is welcome to add information, cross-references or citations, as long as they do so within Wikipedia's editing policies and to an appropriate standard. One need not fear accidentally damaging Wikipedia when adding or improving information, as other editors are always around to advise or correct obvious errors, and Wikipedia's software, known as MediaWiki, is carefully designed to allow easy reversal of editorial mistakes.

Because Wikipedia is an ongoing work to which, in principle, anybody can contribute, it differs from a paper-based reference source in important ways. In particular, older articles

tend to be more comprehensive and balanced, while newer articles may still contain significant misinformation, unencyclopedic content, or vandalism. Users need to be aware of this to obtain valid information and avoid misinformation that has been recently added and not yet removed. (See *Researching with Wikipedia* for more details.) However, unlike a paper reference source, Wikipedia is continually updated, with the creation or updating of articles on topical events within minutes or hours, rather than months or years for printed encyclopedias. (Wikipedia, 2011)

Notice that on this site, there are numerous links, but processing the material here calls for print-based reading and writing skills. To add content to any entry, a user must be able to read what appears in the entry, analyze, synthesize and evaluate it, and then add or make changes as appropriate. Thus, using Wikipedia as either a reader or a writer calls for the foundational literacy skills of print, first and foremost. Wikipedia may well be the best illustration of my claim that multimodal composing requires print-based foundational literacy as a pre-requisite. Contributors to Wikipedia can certainly make use of bricolage and juxtaposition, and will draw on the features of image, sound, movement and link, but will rely from the outset on the essential abilities drawn from print literacy.

If students are going to be asked to create their own web pages or sites, if they are going to assemble e-portfolios in individual courses and across their college careers, if they are going to engage in forms of multimodal composing that don't even exist yet, they are going to need a full set of skills. The psycholinguistic processing mechanisms provide the base for these skills and arise from work with printed texts. The distinctive features of text at the four major levels again appear in print and need to be a focal point of instruction. These points are not intended to suggest that students should be kept away from the web, but are intended to show that successful multimodal reading and writing can be achieved if students work with print and develop their abilities with printed texts first.

What should be clear from this little foray into the online world, albeit limited, is that digital pages and printed pages rely on the same set of underlying abilities. Human psycholinguistic processing abilities and linguistic abilities make reading and writing possible, whether in print or on screen. The “stuff” with which those abilities work, the distinctive features of language at all four levels appear in printed, alphabetic texts just as they do in the more visual venue of a website. And while there are new processing abilities and distinctive features in the new digital forms, the underlying and essential skills remain the same foundational skills that derive from print. For everyone, and for students especially, if our collective goal is critical literacy, it must begin with and remain centered on the foundational skills of reading and writing in print.

Alice Horning, Ph.D., teaches reading, writing and applied linguistics courses at Oakland University, a state university in Michigan. Her research focuses on the psycholinguistics of reading and writing. Her recent books include Reading, Writing and Digitizing: Understanding Literacy in the Electronic Age, published in 2012 by Cambridge Scholars Publishing, and a co-edited volume with Elizabeth Kraemer entitled Reconnecting Reading and Writing, published by Parlor Press and the WAC Clearinghouse (2013).

Email: horning@oakland.edu

REFERENCES

- Boyd, D. (2014). *It's complicated: The social lives of networked teens*. New Haven, CT: Yale University Press.
- Burbules, N. C. (1998). Rhetorics of the web: Hyperreading and critical literacy. In I. Snyder (Ed.), *Page to screen: Taking literacy into the electronic era* (pp. 102-122). London: Routledge.
- Carr, N. (2010). *The shallows: What the Internet is doing to our brains*. New York, NY: W.W. Norton.
- Crystal, D. (2006). *Language and the Internet*. (2nd ed.). Cambridge: Cambridge University Press.
- Danet, B., & Herring, S. C. (Eds.). (2007). *The multilingual Internet*. New York, NY: Oxford University Press.
- Dehaene, S. (2009). *Reading in the brain: The science and evolution of a human invention*. New York, NY: Viking.
- Foster, A. L. (2007). Information navigation 101. *The Chronicle of Higher Education*, A38-A40.
- Fromkin, V., Rodman, R., & Hyams, N. (2011). *An introduction to language* (9th ed.). Boston, MA: Wadsworth, Cengage Learning.
- Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York, NY: Palgrave Macmillan.
- Goodman, K. S. (1996). *On reading*. Portsmouth, NH: Heinemann.
- Harris, F. J. (2011). *I found it on the Internet: Coming of age online* (2nd ed.). Chicago, IL: American Library Association.
- Hayles, N. K. (2012). *How we think: Digital media and contemporary technogenesis*. Chicago, IL: University of Chicago Press.
- Horning, A. S. (2012). *Reading, writing and digitizing: Understanding literacy in the digital age*. Newcastle-Upon-Tyne, England: Cambridge Scholars Publishing.
- Kaplan, R. B. (1966). Cultural thought patterns in intercultural education. *Language Learning*, 16, 1-20.
- Knowlton, B. J. (1998). The relationship between remembering and knowing: A cognitive neuroscience perspective. *Acta Psychologica*, 98, 253-265.
- Kress, G. (2003). *Literacy in the new media age*. London: Routledge.
- Kucer, S. B. (2014). *Dimensions of literacy: A conceptual base for teaching reading and writing in school settings* (4th ed.). New York, NY: Routledge.
- Kunhardt, D. (1968). *Pat the bunny*. New York, NY: Golden Books.
- Küppers, B., Hahn, U. & Artmann, S. (Eds.). (2013). *Evolution of semantic systems*. Heidelberg: Springer-Verlag. DOI 10.1007/978-3-642-34997-3
- Lang, J. M. (2007, May 29). A brain and a book. *The Chronicle of Higher Education*, C2, C3.
- Leu, D. J., Kinzer, C. K., Coiro, J. L., & Cammack, D. W. (2004). Toward a theory of new literacies emerging from the internet and other information and communication technologies. In R. B. Ruddell & N. J. Unrau (Eds.), *Theoretical models and processes of reading* (5th ed.) (pp. 1570-1613). Newark, DE: International Reading Association.
- Miller, G. A. (1956). The magical number seven plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63, 81-92.

- Murray, T. S., Kirsch, I. S., & Jenkins, L. B. (1997). Adult literacy in OECD countries: Technical report on the first international adult literacy survey. *National Center for Education Statistics*. Retrieved from <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=98053>
- Nielsen, J., & Pernice, I. (2010). *Eyetracking web usability*. Berkeley, CA: New Riders/Peachpit/Pearson.
- Pinker, S. (1994). *The language instinct: How the mind creates language*. New York, NY: Harper Collins.
- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon* 9(5), 1-6. doi: [10.1108/10748120110424816](https://doi.org/10.1108/10748120110424816)
- Reeves, L. M., Hirsh-Pasek, K., & Golinkoff, R. M. (1998). Words and meaning: From primitives to complex organization. In J. Berko Gleason & N. Bernstein Ratner (Eds.), *Psycholinguistics (2nd ed.)* (pp.157-226). Fort Worth, TX: Harcourt College Publishers.
- Ripley, A. (2013). *The smartest kids in the world and how they got that way*. New York, NY: Simon & Schuster.
- Sadoski, M., & Paivio, A. (2001). *Imagery and text: A dual coding theory of reading and writing*. Mahwah, NJ: Erlbaum.
- Selfe, C. L. (1999). *Technology and literacy in the twenty-first century: The importance of paying attention*. Carbondale, IL: Southern Illinois University Press.
- Smith, F. (2004). *Understanding reading (6th ed.)*. Hillsdale, NJ: Erlbaum.
- Street, B. V. (Ed.). (2001). *Literacy and development: Ethnographic perspectives*. London: Routledge.
- U. S. Department of Education. (2006). National assessment of adult literacy: A first look at the literacy of America's adults in the 21st century. *National Center for Education Statistics*. Retrieved from http://nces.ed.gov/NAAL/PDF/2006470_1.PDF.
- Wikipedia. (2011). About Wikipedia. *Wikipedia*. Retrieved from <http://en.wikipedia.org/wiki/Wikipedia:About>