CHAPTER 4

NEUROSCIENCE OF READING: DEVELOPING EXPERTISE IN READING AND WRITING

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In the opening of *The Shallows: What the Internet Is Doing to Our Brains*, author Nicholas Carr (2011) invokes the film *2001: A Space Odyssey*, describing astronaut Dave's dismantling of Hal's brain, and Hal's complaint that his mind is going. Carr says he himself feels this way, feels that his mind is going as a by-product of the time he spends online. In the discussion that follows, Carr specifically talks about what is happening to his reading and his ability to pay attention to text for an extended period of time. A similar description arises in a more recent book, *A Deadly Wandering* (Richtel, 2014), reporting on a fatal traffic accident in Utah that happened while a young man was texting while driving. The point of these publications is that we are increasingly distracted, increasingly unable to pay attention to anything for an extended period of time. This research explores the impact of online behavior on attention and distraction when we interact with texts; understanding these and other findings with respect to reading from a cognitive perspective has useful implications for the teaching and learning of writing.

This chapter will first discuss the relevance of reading research for writing; Ellen Carillo's (2015) work shows that the two have been separated far too long even though most scholars and writing teachers agree that they are related processes. Both processes suffer when we are distracted, particularly as we try to learn new skills. According to a Pew study done in 2012 surveying high school advanced placement teachers and those who participated in the National Writing Project, almost 90% of teachers see students' distraction by technology as a problem in terms of their reading, research and writing (Purcell et al., 2012). Then, the chapter will discuss key studies on reading which reveal the cognitive and psycholinguistic features of the process. This material includes, among others, Stanislas Dehaene's (2009) report showing how the brain works during reading along with studies using MRI and fMRI to reveal the kinds of cognitive processing people engage in during reading. Work by Yellowlees Douglas (2015)

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and Naomi Baron (2015), supports Dehaene's findings. Additional research comes from the use of eye-tracking technology to see what readers actually do with text. Particularly revealing studies show how students read in the course of peer review. Work by Chris Anson and Robert Schwegler (2012) shows what students do when they read for peer review. The findings of eye tracking show that a good deal of reading goes on in writing and responding to others, but it is not very good reading. Daniel Keller's (2014) recent book explores the relevance of this kind of cognitively based research for reading, writing, and overall literacy development.

Finally, the implications for writing will be considered; a definition of academic critical literacy and a model of expert reading that addresses the problems revealed by brain research together lead to useful insights about the teaching and learning of writing. My own case studies suggest that expert readers have particular kinds of awareness of text structure, context and language as well as skills in analysis, synthesis, evaluation and application that they bring to bear on their reading and by extension on their writing. Only when novice writers think and respond like these expert readers can they move toward becoming critically literate, expert writers.

RECONNECTING READING AND WRITING

I have been banging a drum for the last decade or so about the relevance of reading for the teaching and learning of writing. In a number of presentations and publications (including a co-edited book with the same title as this section; see Horning & Kraemer, 2013), I have been arguing that we cannot improve students' performance in writing without paying attention to their reading. A steadily growing pile of reports (ACT, 2015, among others) makes clear that students coming to college have problems with the kind of careful reading of extended nonfiction prose that most college courses require These problems are not improving, nor are they being addressed as directly as it seems to me they should be. The implications of these problems are abundantly clear from the highly regarded Citation Project study of students' use of sources in their writing (Jamieson & Howard, 2012). Other scholars see the same problems and needs; American University linguist Naomi Baron (2015), for example, points out that if college faculty and society more generally want students to be voting intelligently and participating fully in our society, they will need to be able to focus on reading, especially extended nonfiction prose (p. 168). Recently, it appears that writing teachers are starting to pay attention to my drumbeat: Keller (2014) and Carillo (2015) offer detailed discussions of the role of reading in composition theory and pedagogy. These scholars' insights are relevant because they make

clear why and how reading is relevant for a more cognitively based approach to the teaching and learning of writing.

The work that is of interest here comes from a number of different fields. Besides work in composition studies mentioned previously, there is research in cognitive psychology and in neuroscience that is helpful. The two fields overlap to some degree, but Baron provides a particularly clear explanation of the difference between them:

> The mental workings of the brain are now studied in two allied fields: cognitive psychology and neuroscience. What is the difference? Simplistically, cognitive psychology studies the mental functioning of people (say, when you ask them to remember a list of words). Neuroscience looks either at what the brain is physically doing during those cognitive tasks or . . . how the brain changes as a result of practice. It is the same brain at work in cognitive and neuroimaging studies, regardless of how we measure its activity. (2015, p. 159)

The following discussion begins with the work in composition studies and then integrates findings of these other fields.

Keller's (2014) recent book, *Chasing Literacy,* is the earlier of two works from composition studies that connect reading and writing from a cognitive perspective. His study included case studies of nine high school students, with a follow-up focus on four in first-year college courses, and interviews with a teacher, a librarian and family members. He notes the need for more focus on reading but disputes the distraction problems. Using the concepts of acceleration and accumulation, Keller suggests that we can understand the online environment where so much reading and writing takes place as an entirely different venue (2014, pp. 166-167). Readers of all kinds (not just students) work with texts in distinct ways online, making use of what he calls "foraging." Foraging is a kind of reading to find sources and material of interest; he draws on the work of Duke University technology scholar and literary critic Katherine Hayles on deep and surface reading as the basis for this idea. One of the processes that takes place in the course of foraging is accumulation—the pile up of different kinds of materials as a by-product of the use of literacies from different kinds of sources, including traditional print, screens, sound, among others, and different forms of access—laptops, phones, tablets, and so forth. This concept is related to and draws on Brandt's work with vertical and horizontal literacy accumulation—vertical is different forms, formats, media; horizontal is different types of literacy that have developed over time, such as, traditional, digital, media, and the like.

A key difference in types of literacy, according to Keller, has to do with the

speed at which text is processed, his concept of acceleration. Here, Keller says the increasing numbers of materials require faster reading through skimming, scanning, and willingness and ability to switch between reader and writer roles through social media and other forms like blogs. But teachers need to watch out for "digital literacies tourism" (2014, p. 160). Students, especially if they don't read well, are too likely to engage in shallow review of too many resources in too many different forms. Deep reading is still essential. Therefore, slow and fast rhetorics need to be considered in teaching. Slower speeds can be useful for some things, and faster speeds can be useful for others. If the goal is deep exploration of a topic, common in academic material, then slower is a better choice. If the goal is attracting wide attention, then faster is better. Students can be made aware of these options (Carillo has specific recommendations for doing so, discussed below) and a theory of reading should include how the meaning of a text might be constructed under these different conditions.

Thus, in connecting reading and writing, Keller suggests that there might be what he calls "oscillating" in the course of foraging, varying reading "between different levels of depth and rates of speed" (2014, p. 166). Students engaged in research, according to his study, engage in both foraging and oscillating, as well as multi-tasking. In the latter, Keller makes a distinction between intentional and unintentional multitasking (2014, p. 167). Intentional multi-tasking is done by choice and with awareness of limits and choices being made. By contrast, unintentional multi-tasking is casual and when one is not really aware of the activity; this kind of multi-tasking is commonly unproductive as it entails much distraction. In his research, Keller observed all of these phenomena among the high school and first-year college students he followed. These findings show that reading, writing, technology and cognitive processing are related, so careful understanding of the relationships among them is essential.

Carillo (2015) agrees with Keller's findings, making the case for connecting reading and writing more explicitly in teaching composition. Her book reports a study done under the auspices of a Conference on College Composition and Communication (CCCC) Research Initiative grant in 2012 in which she did an online national survey of college faculty on reading in first-year writing. She had 100 self-selected participants gathered through the WPA listserv; of these participants, almost half also did a follow-up interview. The participants who were willing to do so also shared a link with students and through this process 93 students responded to a set of questions about their reading experiences in first-year writing and seven did a follow-up interview. The book warrants careful reading for its findings and for its discussion of the ways in which composition studies as a field has had what might fairly be described as a love-hate relationship with reading over many years.

For the purposes of this discussion, though, what is useful from Carillo's study is her claim that students need to learn more about reading from a metacognitive perspective in first-year writing in order to take their knowledge of reading with them to the rest of their courses and into their professional lives. Carillo argues for a cognitively based approach to reading to achieve the goal of academic critical literacy I will set later in this discussion. Reviewing research in cognitive psychology, Carillo explains that transfer of learning occurs when students "recognize and generalize" information or practices from a course or experience to other contexts (2015, p. 105). Moreover, students must be made aware of their recognition and generalization to make transfer happen (Carillo, 2015, p. 107). If one of the goals of first-year writing is to connect reading and writing in ways that support and encourage transfer, this work relies on the metacognitive features that connect these processes.

Carillo ultimately proposes "mindful reading," She defines this phrase in a way that makes its metacognitive connection clear:

> I use the term "mindful" to underscore the metacognitive basis of this frame wherein students become *knowledgeable, deliberate,* and *reflective* about *how* they read and the demands that contexts place on their reading. . . . The term "mindful," when modifying reading, describes a particular stance on the part of the reader, one that is characterized by intentional awareness of and attention to the present moment, its context and one's perspective. (2015, pp. 117-118)

This approach could fairly be described as a "reading about reading" approach, particularly because Carillo invokes Doug Downs and Elizabeth Wardle's "writing about writing" approach. She steps carefully away from recommending a particular reading strategy or advocating rhetorical, close or any other angle on reading. Instead, she is in favor of any approach that makes students think about their reading and make conscious choices in their own strategies; in this view, she supports the needs for awareness advocated by Keller. It should also be clear that like Keller, Carillo has built on studies of cognitive processes to propose "mindful reading." "Mindful reading" is moreover entirely consistent with my observations of expert readers to be discussed below.

UNDERSTANDING READING

While both Keller and Carillo draw on cognitive and metacognitive work to advocate for the connection of reading to writing, a more direct argument is offered by University of Florida hypertext scholar and professor of management

communication, Yellowlees Douglas in *The Reader's Brain: How Neuroscience Can Make You a Better Writer* (2015). Much of the research she cites is also discussed in a *New York Times* best-selling book, *Reading in the Brain* by French cognitive scientist Stanislas Dehaene (2009); Douglas herself also refers to this book. Dehaene's work is commonly referenced in almost all recent publications on reading because he synthesizes the insights gained from neuroscience, cognitive psychology, education, linguistics, and various other fields to explain the reading process. While he does talk about writing, Dehaene's focus is chiefly on reading, so his work provides a research-based backdrop to the more recent work of Douglas and others focused on reading-writing connections. References to Dehaene's work appear here only as relevant for this reason.

Turning to Douglas (2015), then, she quickly reviews the main features of research on the reading process to offer five key principles for good writing that are based in the findings of neuroscience: Clarity, Continuity, Coherence, Concision, and Cadence (p. 9). Douglas explains reading's key features, its speed (word recognition takes place in tiny fractions of seconds), its use of prediction (by relying on schemas or sets of expectations derived largely from prior knowledge), and its complexity (reflected in readers' use of inference), all features revealed by neurological research using MRIs, PET scans and the like. Dehaene's book covers much of the same ground but goes a bit further by claiming, based on fMRI studies, that there is one area in the brain devoted to reading, which he calls the brain's "letterbox" (2009, pp. 74-78). Drawing on Dehaene's and others' research findings, Douglas (2015) advises concrete word choice, standard sentence patterns and connections and predictable overall structure to create effective writing (p. 28). Citing neuroscientific research on the lexical, syntactic and inferential processing that happens in reading (2015, p. 34), Douglas makes these specific suggestions to support Clarity in writing: using active voice, action verbs, and concrete subjects and objects, and structuring sentences so that subjects and verbs appear together and at the start of sentences.

Drawing on research on cognitive load, or the amount of information being presented in a text, Douglas points out the potential for cognitive overload if the writer does not help readers through the use of principles of continuity (2015, pp. 63-64). Writers who build continuity into their writing help readers make the predictions on which comprehension is built (Douglas, 2015, p. 66). The principle of cognitive overload was established unequivocally, as she points out, in a study of information processing by George Miller (1956), "The Magical Number Seven, Plus or Minus Two." Miller's work, frequently cited and replicated a number of times, shows that we can manage and recall somewhere between five and nine unrelated pieces of information in short-term memory. So, Douglas concludes, writers need to help readers avoid cognitive overload and

make appropriate predictions through techniques including placing important information at the ends of sentences, paragraphs or articles, using transitional words and phrases, making use of consistent grammatical subjects, and presenting unfamiliar information after known material (2015, p. 84).

To make the case for coherence as an essential feature of good writing, Douglas gives a quick overview of competing theories of how readers make sense of text: a top-down view that suggests readers rely on schemas (i.e., prior knowledge and expectations), a bottom-up view that readers use the visual array of the text itself as their primary resource for getting meaning, or an interactive view that is a complex combination of the two. Regardless of the preferred view, writers need to help readers see how the parts of a text fit together (Douglas, 2015, pp. 85-91). To do so, writers should provide strong introductions to the whole text and also within the paragraphs of the text to guide readers through their ideas. A thesis at the end of the opening helps readers set up their expectations (consciously or not) for the rest of the text, while benefitting from the "recency effect" that the most recent information stays with readers most effectively (Douglas, 2015, p. 112). Similarly, conclusions help readers to review key ideas, and research says that readers remember best information they encounter more than once (Douglas, 2015, pp. 115-116).

Continuity and Coherence are important for another reason that has to do with cognitive processing in reading. In discussing attention issues, computer scientist and author Cal Newport argues for the focused attention needed to do what he calls "deep work" (2016, p. 3), work done with full attention that is free of distractions, electronic or otherwise. Studies Newport cites point to the problem of "attention residue" (2016, p. 41; cf. Leroy, 2009), which shows up as a by-product of multi-tasking and is one of the many reasons multi-tasking is a poor work strategy. When switching from one task to another, attention tends to stay behind, so a person is thinking about task A even after switching to task B. When writers provide a text that has the features of Continuity and Coherence, these characteristics make it easier for readers to stay focused on the developing ideas and argument without getting distracted.

Douglas offers a number of suggestions for her fourth C, Concision, without spending much time on the psycholinguistics of reading, other than to say that short common words are easier to understand and remember than longer less-common ones according to research (2015, p. 140). Otherwise, Concision requires avoiding repetitive phrasing and hemming and hawing in the text. Turning back to the work of Dehaene, it is clear that much repetition is unnecessary because in normal reading relatively little information is taken from the printed page. Readers generally only see a small sampling of what is in the visual display, as the eyes move from fixation point to fixation point in jumping

movements called saccades (Dehaene, 2009, pp. 13-18). In terms of physical processing, readers can only see what is at the fixation point as the periphery is blurry even if vision is fine. Moreover, the eyes are moving so quickly between fixations that readers are effectively blind. Given that there is so little sampling from the visual array going on anyway, repetition is clearly not needed if writers want to help readers get meaning from their text.

But with the discussion of his last C, Cadence, Douglas returns to research on the mental processing required in reading and the resulting advice for writers that arises from it. With respect to Cadence, then, Douglas discusses research showing that when reading, the brain makes use of areas involved in speaking and listening as well as those involved in seeing (2015, pp. 150-151). Other work discussed by Dehaene in the context of dyslexia supports these findings; Dehaene shows that people with dyslexia have problems with phonological processing (2009, pp. 235-261). Strategies for treating dyslexia that improve letter-sound relationships or the processing of sounds help children learn to read and improve their reading (Dehaene, 2009, pp. 258-261). In addition, the findings of recent PET scan research (Douglas, 2015, p. 150) confirm much earlier claims made in a famous article entitled "Reading is Not Strictly Visual" by Paul Kolers (1968). The oral and aural areas turn out to be neurologically connected and to have been wired to work together by the demands of reading and writing through the brain's ability to learn and change, its neuroplasticity (Douglas, 2015, pp. 148-155). It's the latter ability that helps to account for why when people lose one ability, such as vision, their hearing improves as the brain learns to compensate for lost input. Recommendations for writers to vary sentence structure and length and to begin a list with the shortest items and end with the longest arise from these findings (Douglas, 2015, pp. 155-160). And finally, Douglas advocates reading well-written material when writing because, though limited, some research shows that what writers read affects their ability to write with all five of the C characteristics, but especially Cadence (2015, pp. 161-162).

The unification of reading and writing advocated by all of these scholars draws on other research in cognitive psychology that supports this approach. Going back to Newport's *Deep Work* (2016) discussion, he cites the work of psychologist K. Anders Ericsson on the importance of practice of a certain kind. Ericsson's research is one of the sources used by Malcolm Gladwell (2008) and others in advocating 10,000 hours of practice to develop expertise in any area. To achieve expertise, and use it in deep work requires deliberate practice, that is, practice of the skill that is done with full, focused attention. Such practice benefits from coaching where the coach provides specific feedback on how to focus attention. Newport summarizes these characteristics of deliberate practice as follows:

> Its core components are usually identified as follows: (1) your attention is focused tightly on a specific skill you're trying to improve or an idea you're trying to master; (2) you receive feedback so you can correct your approach to keep your attention exactly where it's most productive. . . . The first component . . . emphasizes that deliberate practice cannot exist alongside distraction, and that it instead requires uninterrupted concentration. (2016, p. 35)

Brain research, Newport (2016) goes on to point out, shows that deliberate practice and focused attention produce physical changes in the brain such that the connections between brain cells are supported and effectively glued together by a substance called myelin (p. 36). When reading and writing are done together with good feedback from a teacher, and when there is focused attention of the kind described here, students are on their way to developing expertise.

THE ROLE OF THE EYES IN READING

Although the psycholinguistic and cognitive research on reading demonstrates clearly that the eyes do relatively little in the reading process, there are nevertheless important insights about reading to be gained from how the eyes work while readers look at a text. This research makes use of devices that track eye movements during reading of texts of various kinds, on paper or on a screen. Eye tracking allows researchers to see where readers look and for how long in these activities. Some of the work that has been done relates to how readers use information from a website, but the work that is of particular interest here explores students' peer reviews.

A quick look at the research on websites shows that eye movements follow clear patterns. Jakob Nielsen (2006), for example, focuses on the design of websites for commercial use. He has looked at Web usability, finding that readers typically follow an F-shaped pattern that has led to a fairly standard design for most websites. Joyce Locke Carter (2012), a former chair of CCCC, has analyzed the eye movements of readers of letter of application to a graduate program. Her findings show that expert readers are distracted by errors, but also pay close attention when writers use key words reflecting their identification with the program to which they are applying. Eye tracking, then, appears to shed some light on the cognitive processes of readers.

This technology has allowed those interested in the teaching and learning of writing to see what happens in peer review. Two reports provide useful insights into students' reading of one another's work. The first by Eric Paulson, Jonathan

Alexander, and Sonya Armstrong (2007) used eye tracking to see how 15 students reviewed an essay written by another student. The readers looked at errors initially and much more closely than they looked at organization, rhetorical features, and other global matters; their comments and feedback to the writer reflected their eye-tracking results. Paulson and his colleagues concluded that peer review might be more effective if readers are told to attend to errors first and then to move to more global issues, a very different strategy than most teachers use. It's also worth noting that Carter found a similar pattern among expert readers of application letters as discussed above.

Building on these results, Anson and Schwegler (2012) also used eye tracking to observe students' work in peer review. In their report, they thoroughly explain how eye tracking works to reveal where readers look in a text and how the eyes move around on a page or screen; as they say, the current technology is "extremely accurate" in recording eye movements and processing (2012, p. 153). Eye tracking supports most of the points discussed above about the relatively small role of the visual display in the reading process according to Anson and Schwegler (2012, pp. 153-157). They also found, like Paulson et al. that different types of errors have different impacts on readers' understanding and attention, so that a hierarchy of errors might be created and discussed with students (2012, pp. 158-159). Anson and Schwegler suggest that there is great potential in this kind of work for understanding what is happening when students use sources in their writing, as studied by the Citation Project (Jamieson & Howard, 2012, p. 166) and other kinds of research on the intersection of reading and writing. The work on eye tracking, then, confirms a number of the features of cognitive processing discussed earlier in this chapter; it suggests that the teaching and learning of writing can benefit from a better understanding of reading.

INSIGHTS FROM EXPERT READERS

As noted at the outset, I have been making this case for the relevance of reading for writing for a number of years in various venues. My work with expert readers and writers provides some further support for my case. Although my research has involved a relatively small number of novice and expert writers, I believe that the data from my study provides good support. In my IRB-exempt project, I gathered data from eight novice readers and five experts, all reading both on paper and on screens, and all writing summary notes. The novices were all students at my university; the experts were people with graduate degrees who are academics or work with texts in closely related fields like editing or publishing. In the course of their reading, the participants provided a think-aloud protocol about what they were paying attention to and why in response to instructions to

read and summarize with the intention of using the material for a paper or other school assignment. For a baseline, I obtained all the participants' scores on the reading portion of the ACT; the novices had all taken it for college admission while the experts completed the reading section from a sample test I obtained from ACT.

Results from the experts show that they have three kinds of awareness and four skills for dealing with texts, whether on paper or on a screen. The first kind of awareness is meta-textual: experts see the overall organizational structure of a text, can separate main ideas from details and easily note when a writer is providing examples, description or comparison/contrast to expand an idea. The second awareness is meta-contextual, an awareness of the context of the text within its field, within its discipline or in the world at large: here, experts can relate the ideas presented to other ideas they know about in the field or subject area, or to historical events or other aspects of the larger domain of the text's topic. The third awareness is meta-linguistic, including attention to or knowledge of the language of the text such as definitions or specialized uses of particular words or phrases; genre-related linguistic features such as strategies for reporting research results might be included here. A key finding is that my novice readers showed almost no awareness of any kind in the reading I asked them to do.

Beyond these awarenesses, experts have four key skills that they bring to bear on all kinds of reading: analysis, synthesis, evaluation and application. These are easily defined, and found, albeit to a much more limited degree, among the novices as well. Analysis reflects the ability to take a text apart and see its sections as well as how the parts fit together. Synthesis is the ability to relate a text to other texts, observing similarities and differences, points of agreement between two or more texts and so forth. Evaluation focuses on these points: authority, accuracy, currency, relevancy, appropriateness and bias, a heuristic developed by faculty librarians at my institution (Lombardo, 2016). Many experts are able to evaluate materials almost unconsciously as it is such a regular part of their reading process while the novices need instruction and reinforcement for this skill. Finally, the application of information gained from reading to one's own purposes is again almost unconscious among experts, as so much of what they do entails using material they have read in their own work. In contrast to the experts who have all of these skills, the novices show some analysis, a bit of synthesis, but little ability to evaluate or apply.

This project (Horning, 2012) led me to propose the following definition of academic critical literacy:

> Academic 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 application; 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 a democratic society. (p. 41)

This definition reflects the skills noted among experts on which I believe they have built their awarenesses. That is, if readers have these skills, they will develop their awarenesses of text and become expert readers as well as writers. Setting a clear goal, it seems to me, can help teachers reconnect reading and writing so that novice students can move toward expertise in both.

MONDAY MORNING APPROACHES

All of this research points clearly to the kinds of work faculty members can and should do to help students improve their reading and thereby improve their writing. The work is needed not only in writing classes but also in every course and every discipline. Faculty should see that they can achieve their own goals or learning outcomes by helping students read better so that they can succeed in every course and in their professional lives. There are a variety of intensive and extensive strategies that build on the cognitive research discussed above that can be integrated in all kinds of courses to move students toward academic critical literacy. It's useful to distinguish between intensive strategies, which are about reading per se and extensive strategies that give students opportunities to practice and develop the skills cognitive science research suggests are essential to academic critical literacy.

Some intensive strategies that can be helpful include talking to students about the reading process itself in the ways presented above. When readers understand how reading takes place, they can work on key features, such as building prior knowledge. If faculty members teach critical reading strategies, they send two messages: first, that critical reading is a key feature of success in courses, and second, that such reading is a learnable and transferable skill. One way to do this teaching is to read a portion of an assignment aloud to students and explain the thought process involved while moving through the text. Students are often surprised at the ways expert readers interact with a text. Two other techniques can move students toward more cognitively aware and critical reading: 25-word summaries (Bazerman, 1995), a tool for deeper analysis of any text, and reading guides (Herber, 1978) that can help students get not only key ideas and details, but move on to synthesis, evaluation and application. These approaches support

the development of academic critical literacy, building on what we know about the cognitive processing that takes place during reading. When students can read in these ways, they can help each other and themselves with their writing.

In addition to intensive strategies that focus on reading itself, students also need the kind of focused practice described in the research reviewed above. Like any skill, reading requires as much or more practice than shooting free throws or playing an instrument as we know from the work of Ericsson as discussed by Newport earlier in this chapter. Fostering opportunities for practice and focused feedback that supports the cognitive processes in reading includes having students read extended nonfiction prose. They might do so as part of a campus-wide reading program or common book but can also practice with discipline-specific materials faculty are likely to be assigning as part of regular course work. Faculty need to provide the guidance and feedback required to read these texts successfully. And faculty behavior can make a real difference, according to Linda Nilson, founding director of the Office of Teaching Effectiveness and Innovation (OTEI) at Clemson University. Nilson (2010) writes in the 3rd edition of *Teaching at Its Best* that faculty should resist the temptation to lecture on the content of assigned reading. It is much more effective to have students do something with what they have read, like write about it (!) on a discussion board, prepare a book review, or fill in some type of graphic organizer, and to make that work count 20% in the course grade (2010, pp. 211-222). A final approach entails connection to faculty librarians. The professional organization for college and university librarians has recently released a new *Framework for Information Literacy* (http://www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/ infolit/Framework_ILHE.pdf) that includes specific support for academic critical literacy in work with traditional and online texts. This valuable resource and the librarians who work with it can support reading development in every classroom drawing on the cognitive processing mechanisms discussed here. There are, it should be clear, quite a large number of cognitively based strategies any faculty member can use to improve students' reading, their critical literacy and their writing.

ONLY CONNECT OR RECONNECT

In drawing this chapter to a close, it is interesting to reflect backward from the definition of academic critical literacy as a goal to see how much of the research in cognitive psychology and neuroscience discussed here supports various elements of the definition. For example, the recent work of Keller and Carillo shows that reading and writing can and should be reconnected. Keller's work drawing on case studies with novices reveals the ways in which students' access

to texts and ways of interacting with them has changed in electronic venues; the need for these novice readers to understand how they are reading and why they might read differently for different purposes and situations makes clear some places where reading and writing go hand-in-hand. Carillo's goal of transfer through "mindful reading" offers a specific path to achieve both Keller's goal and my own in academic critical literacy. The work of Douglas, supported by neuroscientists and cognitive psychologists provides further backing for reconnecting reading and writing in ways that can help writers build Douglas' five C characteristics in their writing: Clarity, Continuity, Coherence, Concision and Cadence. My case studies with novices and experts show that expert readers build on their textual, contextual, and linguistic awareness through application of their skills in analysis, synthesis, evaluation, and application to demonstrate their expertise in reading and in those five Cs proposed by Douglas for writing. Classroom strategies can help move students toward the critical reading essential to effective writing. Cognitive and neuroscientific research has offered much not only to our understanding of expert reading and writing but also to a clear goal of academic critical literacy and some ways to achieve it.

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