Learning to be Literate

Peter Smagorinsky

The University of Georgia

Department of Language and Literacy Education

College of Education

315 Aderhold Hall

Athens, GA 30602

Work phone: 706-542-4526

smago@uga.edu

Richard E. Mayer

University of California-Santa Barbara

Department of Psychological & Brain Sciences

Santa Barbara, CA 93106

805-893-2472

mayer@psych.ucsb.edu

Learning to Be Literate

Introduction

Among the defining features of an advanced modern society is widespread literacy in a print medium. And yet human beings invented writing systems only about 5,500 years ago, well after the human mind had fully evolved, suggesting that the human cognitive architecture could not have evolved specifically to enable reading and writing. Instead, the ability to read and write is based on general cognitive abilities that evolved to satisfy other purposes. For this reason, studies of literacy learning have general implications for all studies of cognition and learning. In this chapter, we review the large body of learning sciences research that examines the fundamental cognitive and social processes whereby people learn to read and write. We conclude by identifying several general implications for learning scientists.

The word *literacy* evolved from the Latin term *litteratus*, which means "being marked with letters." Thus a "literate person" is a person who can read and write text using letters. More recently, a broader and more expansive notion of a *literate performance* has been applied to fields and areas traditionally not focused solely on printed verbal texts: information literacy, media literacy (or mediacy), multimedia literacy, technological literacy, functional literacy, critical literacy, rhetorical literacy, arts literacy, ecological literacy, health literacy, statistical literacy, emotional literacy, computer literacy (or cyberacy), science literacy, mathematical literacy (or numeracy), visual literacy, digital literacy, infomedia literacy, moral literacy, dance literacy, ancient literacy, and countless other notions that refer to one's capabilities within a specific area

(Tuominen, Savolainen, & Talja, 2005). This more expansive conception of literacy further posits the need for *intermediality*, the synthesis of various literacies needed to navigate the complex 21st century world (Elleström, 2010).

In this chapter, we confine our attention to what follows from literacy's etymological origins, considering what is involved in learning how to read and write alphabetic texts. Most cognitive psychological and learning sciences research on literacy has focused on this traditional conception of literacy. Still, we hope that scholars who have extended the scope of reference to these other forms of literacy may find this research useful as well.

Writing can be defined as a one-to-one correspondence between text and speech (Woods, 2010a). This distinction is particularly helpful in drawing a distinction between writing and new definitions of literacy that describe nonverbal representational forms (cf. Mayer, 2008a). Kress (2003) and others have attempted to identify the features of visual representations that are generated with the intention of representing particular authorial intent, but the ambiguity of images does not allow for the same direct correspondence between image and speech as does written text, and generating such images would not be considered to be "writing" under our definition. A written script's use of characters and grammar represents the boundary between prehistory and history (Woods, 2010a); after the development of orthographic writing systems, people were able to document the present and past and thus provide a record of the evolution of their society.

Societal expectations of literacy have increased over time. Before the effort to promote universal literacy through formal education got underway, *adults* were deemed literate when they could indicate their signature with an "X" (Reay, 1991). In the 21st

century, the Common Core Standards require that *children in kindergarten* "Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book (e.g., *My favorite book is...*)" (National Governors Association, 2012). This ratcheting up of literacy expectations demonstrates that definitions of literacy change across time, as do the standards that should apply to students at different ages of development and schooling.

Three Types of Literate Knowledge

Geary (2005) distinguishes between biologically primary cognitive abilities (those that evolved through natural selection) and biologically secondary cognitive abilities (those that are developed through cultural practice). The primary abilities are part of everyone's genetic architecture; the secondary abilities are learned through engagement with the physical world and with others (cf. Vygotsky's [1934/1987] notion of lower and higher mental functions), and these capacities vary across cultures and groups. Literacy is a secondary cognitive ability. Most cultures teach literacy through formal educational institutions (Gardner, 1991), and literacy is a prerequisite to teaching most school subjects. (There are a few exceptions to this general pattern: Scribner and Cole (1981) have documented that in some cultures, people learn scripts outside the formal confines of school that embody particular forms of cultural knowledge, with these scripts serving more local than abstract social purposes.)

Smagorinsky and Smith (1992) argue that researchers have focused, broadly speaking, on three types of knowledge. First, knowledge can be *general*, such as the ability to decode words or engage in drafting and revision. One could conceivably engage

in these practices regardless of what is being read or written. Second, knowledge can be *task-specific*: learning to read a novel and learning to read a recipe require different declarative and procedural knowledge, the first relying on the ability to recognize a narrative perspective and determine its reliability, and the second requiring a reader to follow or adapt specific instructions. Third, knowledge can be *community-specific*, in which people who are members of a community bring specialized forms of knowledge to bear on their literate actions. In this case, people from different communities might approach a given text using different cognitive and interpretive frameworks. For example, a fundamentalist Christian might first learn to read the Bible as a text embodying an indisputable truth and then adapt that stance to other readings, even when a more interpretive approach is cued by the textual codes and the context of reading (Heath, 1983).

Literacy researchers have studied all three types of literacy knowledge. Each research approach produces different insights, and together they provide a comprehensive picture of what literacy learning involves.

1. General Knowledge in Learning to Read and Write

Learning scientists have studied how people learn to read a printed word, comprehend a prose passage, write an essay, and engage in other literacy practices. These studies are examples of how researchers have applied the general science of learning to specific educational issues (Mayer, 2008b, 2011), particularly to learning of subject matter (Mayer, 2004). The psychology of subject matter—which investigates how people learn and think in subject matter areas—represents an important advance in the learning sciences away from general theories of learning that dominated in the first half of the 20th

century (Mayer, 2004, 2008b; also see the other chapters in Part 5 of this handbook). In this section, we summarize exemplary research on the cognitive science of general knowledge in literacy learning in reading fluency, reading comprehension, and writing, as summarized in Table 1.

_____

Place Table 1 about Here

_____

Reading Fluency

Consider the cognitive processes involved in reading a printed word, such as CAT. Helping students develop this seeming simple ability to read printed words is perhaps the single most important task of schooling in the primary grades, and understanding how students learn to read fluently falls squarely within the domain of the learning sciences. Huey (1908) articulated an important challenge for the learning sciences: "[T]o completely analyze what we do when we read would almost be the acme of a psychologist's achievements, for it would be to describe very many of the most intricate workings of the human mind, as well as to unravel the tangled story of the most remarkable specific performance that civilization has learned in all its history" (p. 6). Since Huey's challenge, researchers have made remarkable progress in understanding the cognitive processes that unfold when a person is reading (Rayner, Polllatsek, Ashby, & Clifton, 2011). As shown in Table 2, Mayer (2008b) has analyzed the process of word reading in alphabetic orthographies into four component cognitive skills: recognizing phonemes, decoding words, decoding words fluently, and accessing word meaning.

_____

Place Table 2 about Here

_____

Recognizing phonemes. Phonemes are the smallest sound units of a language. In English there are approximately 42 phonemes, such as /c/ and /a/ and /t/ that are combined to form the word CAT. Phonological awareness is the ability to recognize and produce each of the sound units of one's language. Reading researchers have produced strong evidence that phonological awareness is a readiness skill for learning to read. Being able to segment a spoken word into phonemes and being able to combine phonemes into a spoken word represent the first step in learning to read in alphabetic languages, even though it does not involve printed words at all. English language readers must form cognitive categories for each of the 42 sounds of English.

What is the evidence for the role of phonological awareness in learning to read? Bradley and Bryant (1985) tested children on phonological awareness at age 4 or 5 (e.g., being able to say "call" when asked to change the first sound in the spoken word "ball" to a hard /c/ sound) and then tested them on reading comprehension 3 years later (e.g., being able to answer questions about a passage they read). The correlation was $r = 0.5$, which indicates a strong positive relation between phonological awareness upon entering school and success in learning to read after 3 years of instruction. Juel, Griffin, and Gough (1986) found similar effects in which phonological awareness at the start of the first grade correlated strongly with children's ability to pronounce a printed word ($r = 0.5$) or write a spoken word ($r = 0.6$) at the end of the second grade. Longitudinal studies provide promising correlational evidence for the role of phonological awareness in reading (Wagner & Torgesen, 1987) by showing that students who enter school with weak skills

in phonological awareness are less successful in learning to read than those who enter school with strong skill in phonological awareness. However, it is not possible to draw causal conclusions based on correlational findings. For example, it might be the case that general intellectual ability is responsible for both phonological awareness and reading skill.

Experimental studies, where learners are randomly assigned to different instructional conditions, offer a way of testing causal claims about the role of phonological awareness. For example, Bradley and Bryant (1983) provided 40 10-minute sessions of direct instruction in phonological awareness to 5 and 6 year olds (such as selecting which of 4 pictures started with a different sound than the others). On subsequent tests performed 2 years later, the students who had this training outscored control students on standardized reading tests. In a related study, Fuchs et al. (2001) found that providing 15 hours of whole-class activities aimed at improving phonological awareness created large improvements on later tests of phonological awareness and reading comprehension as compared to a providing no special instruction in phonological awareness. Overall, reviews of training studies such as these provide strong and consistent support for the claim that phonological awareness is a first step in causing improvements in learning to read (Bus & van Ijzendoorn, 1999; Ehri et al., 2001a; Goswami & Bryant, 1990; Spector, 1995).

Decoding words. The cognitive skill of decoding refers to the process of pronouncing a printed word. Decoding skill can be assessed through *word identification tasks* (i.e., pronouncing words), such as saying "cat" when reading the printed word CAT; and *word attack tasks* (i.e., pronouncing non-words), such as saying "blood" when

reading the printed pseudoword BLUD. A major issue concerns whether people acquire decoding skill mainly by learning to translate whole words into sounds (called the *whole-word approach*) or by learning to translate individual letters into phonemes that are blended together to form a word (called the *phonics approach*). Of course, in idiographic languages, learning to read involves the whole-word approach, because each idiograph corresponds to one word. In cultures with alphabetic writing systems, the whole-word approach has been criticized on the grounds that it is more efficient to learn the pairings between letters (or letter groups) and 42 individual phonemes than to learn thousands of words.

However, the phonics approach can be criticized on the grounds that phonics rules are somewhat inconsistent, at least in English (Clymer, 1963), so some words are best learned by the whole-word approach, such as "the" (and of course, this approach is necessary with idiographic orthographies). But with alphabetic orthographies, the preponderance of evidence shows that phonics instruction is indispensable in learning to read, and yields better decoding performance than all forms of conventional instruction including whole-word on word identification tasks and word attack tasks, according to a review by Ehri et al. (2001b). For example, Blachman et al. (2004) found that providing 100 sessions of systematic phonics training to at-risk students resulted in greater improvement than conventional instruction on word identification tasks and word attack tasks as well as on tests of reading comprehension, even when the tests were given a year later. Overall, there is a strong research base showing that phonics instruction greatly improves students' decoding skill.

Decoding words fluently. Decoding through a phonics approach can initially be a cognitively demanding task in which phonemes must be sounded out and blended together to form a word, so an important step in becoming literate is to automatize the process of decoding words. Automaticity of skills is a central topic in the learning sciences, and automaticity in decoding refers to being able to read words without using conscious mental effort. When readers automatize their decoding process, limited cognitive resources in working memory are freed up to be used for reading comprehension (Perfetti & Hogaboam, 1975).

Automaticity of decoding can be assessed by *decoding fluency*, which refers to being able to read words quickly and without error. Classic research by Bryan and Harter (1897) on the development of decoding fluency in telegraphic operators shows that decoding becomes faster over 36 weeks of practice as operators move from decoding one letter at a time, to one syllable at a time, to one word at a time, to entire clauses at a time. More recently, researchers have shown that reading fluency can be increased through the method of repeated readings in which students read aloud a short passage over and over until they reach a high reading rate and low error rate, and then move on to another passage (Dowhower, 1994; Kuhn & Stahl, 2003; Samuels, 1979). Overall, there is strong evidence that decoding automaticity can be achieved through systematic practice in repeated reading.

Accessing word meaning. Readers must not only be able to decode words, they must also determine the meaning of words, an ability that can be ascertained when a reader is asked to give a definition or use a word in a sentence. To access a word's meaning, a reader has to search for the meaning of the printed word in his or her long-

term memory, so an important aspect of becoming literate is to develop a large and accessible vocabulary. Students are expected to acquire at least 1,000 to 2,000 words per year, but direct instruction in vocabulary words is woefully inadequate to reach this goal (Joshi, 2005; Nagy & Scott, 2000). Therefore, the majority of one's vocabulary is learned from context, that is, from being exposed to a literate environment in which students listen to spoken language, read printed language, speak, and write. For example, Brabham and Lynch-Brown (2002) found that elementary school students learned more new vocabulary words when their teacher read books aloud and engaged them in discussion before, during, and after the reading than when the teacher simply read the book without class discussion. Research is needed to better pinpoint the mechanism by which exposure to spoken and printed language influences vocabulary growth.

Reading Comprehension

Once a learner has acquired the cognitive skills needed for reading, which can be called *learning to read*, the learner is ready to engage in reading comprehension, which can be called *reading to learn.* This transition to reading comprehension can occur in the third and fourth grades, and is epitomized by being able to make sense of a short text passage (e.g., to be able to answer comprehension questions). Reading comprehension has long been recognized as a creative act of structure building (Bartlett, 1932; Gernsbacher, 1990) in which the reader selects relevant information, mentally organizes it into a coherent structure, and integrates it with relevant prior knowledge activated from long-term memory (Mayer, 2011). As shown in Table 3, some of the cognitive processes involved in reading comprehension are: using prior knowledge, using prose structure, making inferences, and using metacognitive knowledge.

———————————————

Place Table 3 about Here

———————————————

Using prior knowledge. Skilled readers use their prior knowledge to guide how they select, organize, and integrate incoming information. Bartlett (1932) proposed that prose comprehension is a constructive activity in which learners assimilate incoming information to an existing schema. Modern research supports the role of prior knowledge in prose comprehension by showing that learners perform better on reading comprehension tests when they have relevant prior knowledge than when they do not (Bransford & Johnson, 1972; Pearson, Hansen, & Gordon, 1979) and they better remember material that fits with their existing knowledge (Lipson, 1983; Pichert & Anderson, 1977). Beck et al. (1991) have shown that students perform much better on comprehension tests when a history text is rewritten to explicitly prime relevant schemas. For example, if the text is about the causes of a war over territory, students comprehend that text better when it is rewritten to evoke a common childhood schema, two children both wanting the same object and fighting over who gets to play with it.

Using prose structure. Skilled readers are able to mentally outline a passage and use the outline to help them determine what is most important. For example, Brown and Smiley (1977) asked students to rate each idea unit in a passage on a scale from 1 (least important) to 4 (most important). They observed a developmental trend: third graders gave the same average rating to important and unimportant idea units, whereas college students gave much higher ratings to important than unimportant idea units. Many studies have confirmed this finding that more skilled readers are better at identifying important

information. For example, more skilled readers are more likely to recall important material from a lesson than unimportant material, whereas less skilled readers tend to recall both important and unimportant material at similar rates (Taylor, 1980). When learners practice summarizing passages, which requires recognizing important material, they score better on comprehension test performance after reading text passages (Bean & Steenwyk, 1984; Taylor & Beach, 1984).

Making inferences. Skilled readers make inferences as they read to help make sense of the passage. For example, Paris and Lindaeur (1976) read a list of sentences (such as, "Our neighbor unlocked the door.") to students, and then gave them a cued recall test with *explicit cues*—words that had appeared in the text (e.g., "door") or *implicit cues*—words that had not appeared in the text but that were implied (e.g., "key"). Kindergarteners performed much better with explicit cues, indicating they did not infer that a key was used to unlock the door, whereas fourth graders performed just as well with implicit cues as with explicit cues, indicating they did make inferences while listening to the sentences. Inspired by this finding, Hansen and Pearson (1983) examined whether inference-making training could enhance comprehension. When they administered the training to fourth graders, it improved comprehension test performance for poor readers but not good readers. One possible explanation for this finding is that the good readers already knew how to make inferences while reading.

Using metacognitive knowledge. Skilled readers monitor how well they understand what they are reading, that is, they engage in *comprehension monitoring* (also see Azevedo and Winne, this volume, on metacognition). For example, Markman (1979) found that children in grades 3 through 6 generally were not able to recognize implicit

inconsistencies in a passage (e.g., seeing a mismatch between saying there is absolutely no light at the bottom of the ocean and saying fish can see the color of plants at the bottom of the ocean) and recognized explicit inconsistencies (e.g., seeing a mismatch between saying fish can't see anything at the bottom of the ocean and saying fish can see the color of plants at the bottom of the ocean) only about 50% to 60% of the time. Even in adult readers, those who have larger working memory capacity were more likely to engage in comprehension monitoring than those with low working memory capacity (Linderholm & van den Broek, 2002). Rubman and Waters (2000) were able to improve 3rd and 6th grade students' recognition of inconsistencies in a passage by asking them to place cutouts on a magnetic board to visually represent the passage. Explicit instruction in how to recognize inconsistencies, along with examples, also improved comprehension-monitoring skill in 8- and 10-year olds (Markman & Gorin, 1981).

Writing

Finally, consider the cognitive processes involved in writing an essay. In an analysis of think aloud protocols of student writers, Hayes and Flower (1980; Hayes, 1996) identified three cognitive processes in writing: *planning, translating,* and *reviewing.* These three processes, summarized in Table 4, occur iteratively throughout the process of writing an essay rather than in precise linear order.

_____

Place Table 4 about Here

_____

Planning. Planning includes generating (i.e., retrieving relevant information from long-term memory), organizing (i.e., selecting the most important information and

structuring it into a writing plan), and goal setting (i.e., establishing criteria concerning how to communicate with the audience). Gould (1980) found that writers tended to engage in abundant local planning (e.g., pausing after each clause or sentence to plan the next) but not to engage in much global planning (indicated by not pausing before starting to write). When students are instructed to create an outline before they write an essay, the quality of the essay is better than when they are not asked to generate an outline (Kellogg, 1994).

Translating. Translating involves putting words on the page, such as through typing or handwriting. Nystrand (1982) noted that that the process of translating is subject to low-level constraints such as graphic constraints (e.g., the words must be legible) and syntactic constraints (e.g., the sentences must be grammatically correct and the words must be spelled correctly), as well as high-level constraints such as semantic constraints (e.g., the sentences must convey the intended meaning) and contextual constraints (e.g., the tone must be appropriate for the audience). Working memory capacity is limited, so if writers focus too much on low-level constraints, their essays may fail to satisfy high-level constraints, and vice-versa.

For example, when students are given training in handwriting, their handwriting becomes more legible. But somewhat surprisingly, the handwriting training also results in an increase in the quality of their essays. This finding has been interpreted as evidence that once they have automated their handwriting skill, they can use their working memory mainly for addressing the high-level semantic and contextual constraints that are essential to well-composed essays (Jones & Christianson, 1999). In a related study, Glynn, Britton, Muth, and Dogan (1982) asked students to write an essay by first producing a rough draft

that did not need correct sentence structure and spelling, or by first producing a polished draft that had proper grammar and spelling. The rough draft group wound up producing higher quality final drafts. This finding is best explained using the working memory interpretation: the rough draft group could devote more working memory capacity to addressing higher-level constraints as they wrote the first draft.

Reviewing. Reviewing refers to detecting and correcting problems in the written text, including both syntactic problems and semantic problems. Gould (1980) found that adult writers seldom engage in reviewing of short letters, and Bartlett (1982) found that young writers tend to miss most errors in their own writing and are able to correct fewer than half the errors they find. (Note that these studies were conducted before computer software began providing cues, like automatic spell checking, so might require 21st century modification.) Explicit training in specific strategies for detecting and correcting errors can be successful in improving essay quality (De La Paz, Swanson, & Graham, 1998; Saddler & Graham, 2005).

Overall, understanding how people learn to read and write contributes to the science of learning, by extending the learning sciences to authentic learning tasks. In contrast to classic learning theories that focused on general principles of learning, learning in subject areas such as reading and writing requires domain-specific knowledge and skills and is shaped by working-memory limitations. This phenomenon is central to the task-specific and community-specific orientations that readers and writers take when working within genres and discourse communities that pose expectations for the understanding and use of specialized conventions. These factors are addressed in the next two sections.

2. Task-Specific Knowledge in Reading and Writing

Knowledge about how to read and write particular genres of texts involves specific as well as general knowledge. For instance, in the previous section, we summarized research on writing the "essay" genre, which found that composing a well-written essay involves the processes of *planning, translating,* and *reviewing.* But one cannot necessarily conclude that all writing involves these processes. It depends on whether one accepts essay writing as embodying the processes and qualities that go into any successful writing effort, and the degree to which one believes that additional knowledge would be critical in order for one to write effectively in other genres or tasks (Hillocks, 1995; Smagorinsky, Johannessen, Kahn, & McCann, 2011; Smagorinsky & Smith, 1992).

A number of researchers have adopted the position that general knowledge is necessary but not sufficient as people's writing skills mature and they begin to differentiate genres of written expression and begin to read an increasing variety of texts. These researchers have found that when people engage with various types of reading tasks, they use different declarative and procedural knowledge. This perspective has ancient roots; the Ancient Greeks identified four classical forms of discourse: exposition, argumentation, description, and narration. Instruction in these forms presumes that each has a distinct set of traits that can be learned.

Hillocks (1982, 1986) and his students and colleagues (e.g., Hillocks, Kahn, & Johannessen, 1983; McCann, 1989; Smagorinsky, 1991, Smith, 1989) have been among the strongest proponents of the idea that writing and reading knowledge become differentiated by genre or task. Hillocks et al. (1983), for instance, describe certain

"enabling strategies" (p. 276) for compositions involving the definition of abstract

concepts: "1) to circumscribe the problem generally, 2) to compare examples in order to

generate criteria that discriminate between the target concept and related but essentially

different concepts, and 3) to generate examples which clarify the distinctions" (p. 276).

These strategies are unique to the task of defining abstract concepts; one would not

employ them in writing a personal narrative, although, quite remarkably, Hillocks (2002)

has found that in some high stakes writing tests, the same rubric is used for very different

writing tasks. For example, both narrative essays and persuasive essays are graded on a

rubric that says they must have an introductory paragraph, three body paragraphs, and a

concluding paragraph. These assessment criteria suggest that the test developers

implicitly subscribe to the general knowledge position. In contrast, scholars like Hillocks

have argued that because narrative essays and persuasive essays enlist very different

cognitive skills and abilities, the two genres call for very different production and

evaluative criteria.

       In addition to the debate about rubrics and assessment, the task-specific

knowledge position has implications for school instruction. Specifically, instruction in

text composition should focus on the particular demands of individual tasks. This

position is opposed to the general knowledge position that a writer can approach a poem

and a memo in the same way and with the same procedures (e.g., Murray, 1980). The

task-specific position suggests further that even different types of poems—a sonnet, a

free verse poem, a limerick, or virtually any other poetic type—would require unique

knowledge, with each variation (e.g., different types of sonnets) requiring yet more

specialized knowledge. The implication is that designing an effective learning

environment for these different writing tasks requires a task analysis of the particular knowledge required for each type of composition, and explicit instruction in the appropriate set of procedures identified by the task analysis.

In parallel with research on cognitive variation in writing tasks, researchers have also documented that unique skills are required to read particular types of texts. Rabinowitz (1987), for instance, argued that reading literature "is not even a logical consequence of knowledge of the linguistic system and its written signs. It is, rather, a separately learned, conventional activity" (p. 27). Smith (1989) found that giving students direct instruction in the interpretive strategies that readers use to understand irony (Booth, 1974) significantly improved students' ability to understand ironic poetry, as measured by performance on an objective test and by responses to interview questions. Booth (1974) argued that authors alert readers to the presence of irony through five types of clues, and that, once cued, readers employ particular strategies to reconstruct ironic meanings.

In Smith's 1989 study, students were taught the clues and strategies through the use of songs, short poems, and excerpts of poems before applying them independently to longer and more difficult poems. In addition to increasing students' understanding of ironic poetry, Hillocks (1989) found that such an approach resulted in substantially higher levels of engagement in classroom discussions than did a more traditional approach to teaching poetry. Smith (1991) argued that giving students direct instruction in the conventions of irony may help them become more active interpreters of meaning when irony is employed.

3. Community-Specific Knowledge in Reading and Writing

In addition to general knowledge used in literate activities and task-specific knowledge used in particular genres, different communities of practice (Lave & Wenger, 1991) require further specificity in the kinds of knowledge they employ when their members read and write, because of the demands and customs of the particular social and discourse communities in which they participate. The shift toward conceiving literacy practices as differentiated by community comprises the "social turn" taken by many writing researchers since the 1990s (Smagorinsky, 2006).

Researchers working from this position find that the process of argumentation, to give one of many possible examples, is not practiced the same by all cultural groups. All cultural groups are likely to employ features of the general outline of argumentative practices identified by Toulmin (1958), but in different degrees and with additional requirements to suit their cultural practices. Although Toulmin acknowledged that different situations bring out nuances in the particular argumentative strategy, his widely-accepted model stipulates that arguments include the following elements:

1. *Claim*: the points or generalizations emphasized in the argument

2. *Grounds:* reasons or supporting examples used to support the claim.

3. *Warrant:* the principle, provision or chain of reasoning that serves to substantiate the grounds as evidence in service of the claim.

4. *Backing*: support, justification, reasons to verify the warrant.

5. *Rebuttal/Reservation:* the identification of counter-arguments and response in terms of the argument's driving logic.

6. *Qualification*: acknowledgment of the limits to the claims, grounds, warrants, and backing and conditionality thereof.

These elements, however, do not appear in the same degree in all discourse communities, and various cultural groups often have additional elements and requirements. Kochman (1981), for instance, found that in public settings, Black and White participants foregrounded different aspects of argumentation in their exchanges, and distrusted the argumentative practices employed by the other cultural group. White participants in public discussions of neighborhood issues in Chicago tended to rely on logical arguments founded in appropriately grounded claims, yet did so with muted affect, relying instead on the weight of their logic. Black participants meanwhile relied on passionate expression of needs and ideas. To White participants, the Black contributors lacked analytic grounding for their opinions, and thus were suspect. To the Black participants, the White contributors lacked passion and thus commitment to their ideas, and thus were suspect.

With less volatile consequences, others have found that professional and disciplinary communities of practice foreground different aspects of argumentation. Fahnestock and Secor (1991) argue that literary criticism is a unique form of argumentative discourse, one that a Toulminesque purist might find deficient in terms of its implementation of argumentative structure. A literary critic's effectiveness "depends not just on what is said but on the vehicle of its saying" (Fahnestock & Secor, 1991, p. 91), with *metaphor* serving as "the very vehicle by which the argument is framed in language" (p. 92). Literary argument also relies on special conventions, such as the use of paradox, which "may both serve the intellectual content of the argument and be an aesthetic end in itself, demonstrating the cleverness of the critic" (p. 88). Literary

criticism, then, must itself include literary elements in order to persuade the literati of its merit.

If argumentation were task-specific only, without being adapted to discourse communities' specialized values, literary criticism would not have such particular requirements and expectations. However, when read independent of its intended context, literary criticism might come across as insufficient as argumentation, because "literary arguments often do not make explicit certain structurally predictable elements—the definitions, causal linkages, comparisons which derive from the stases and common topoi of classical rhetoric" (Fahnestock & Secor, 1991, p. 84). Yet the special conventions of literary critics "invoke the shared assumptions of the community of literary scholars, and at the same time create that community" (p. 84).

Stratman (1990), in contrast, analyzed legal brief writing (1990) and found that "legal writing is a distinct, unique kind of writing skill [that] can be taught" (p. 196). Stratman's findings contradict to the widely held view of law schools that general practice in critical reasoning will result in good legal writing. Stratman (1990) contests this approach, arguing that "What differentiates legal reasoning and argument from ordinary reasoning and argument are the unique rhetorical demands that structure the appellant-appellee (petitioner-respondent) relationships and the way courts may reconstitute opposing arguments in the context of this relationship" (p. 185). Appellate brief writers need to be able to make inferences about certain enduring dispositions common to both judges and their opposing lawyers, should be able to anticipate the ways in which judges and opponents frame and interpret their contentions. In the setting of the courtroom, the metaphorical expression of the literary critic would undoubtedly come across as

distracting and confusing. The expectations of a knowledgeable audience suggest which aspects of argumentation are most salient.

Implications for Learning Sciences

Our review of the research on how people learn to be literate suggests the following implications for the learning sciences in general:

1. Learning a complex cognitive skill, such as reading and writing, requires a multifaceted array of cognitive components, from decoding letters as a fundamental skill to composing and interpreting texts in a variety of genres in accordance with the expectations of particular communities of practice. This complexity is likely to be found in other complex cognitive skills, including those that are presumed by many to lack such demands. Rose (2005), for instance, has documented how waitresses must develop strategies to aid memory of a routinely changing set of customers in a chaotic environment, requiring the recall of the basic sequences and etiquette (greeting the customer, asking for drink orders, bringing the salad before the main course, and so on as performance schema) as well as more task-specific knowledge, such as the different conventions for serving wine and serving water, and more community-specific knowledge, such as the expectations for serving wine in a roadside diner and serving wine in a five-star restaurant. The general, task-specific, and community-specific knowledge categories appear to structure performances in diverse areas of endeavor.

2. It is not possible to learn the higher-level cognitive skill (understanding a genre like argumentation) without first mastering the lower-level cognitive skills of letter and word decoding; and the automatization of lower level skills is necessary

before higher level skills can be learned due to limitations in working memory.
Just as a reader or writer could not undertake an argument without knowing how
to form words from letters, a soccer player could not attack different types of
defenses without first knowing how to kick, pass, and receive a soccer ball at the
most basic level.

3. Communities of practice play a substantial role in defining expert cognitive
performance in literate domains. As learners mature within fields of endeavor and
belief systems that differentiate schools of thought within fields, they must learn
the conventions for acceptable communication and action so that they can adapt to
local expectations. In diverse areas of cognition and performance, metacognitive
awareness helps to enable the adaptation of one's knowledge to new situations in
which local conventions require recognition and adjustment for optimal
communication and action.

Conclusion

In this chapter we have confined our discussion of literacy practices to those
concerned with learning to read and write print-based texts. In doing so we do not dismiss
the abundant field of multimodal textuality that has become of great scholarly and
practical interest following the recent proliferation of digital devices that enable
combinations of sign systems for communication. These new forms of textuality are
increasingly driving research that extends the above findings in new ways.

The body of research reviewed here will continue to form an important base for
all forms of multimodal textuality, because in many of them, printed text is a core
element used to convey meaning. Even when they do not contain printed text, they

typically involve composing and interpreting complex sequences and configurations of symbols, and as such are likely to be based in the same underlying cognitive abilities that we have reviewed here.

Our outline of general, task-specific, and community-specific knowledge provides a useful organizing framework for a large body of research. Roughly speaking, the three types of knowledge follow a developmental curricular path, with general knowledge of how to read and write being the province of younger children and their education, task-specific knowledge available when curricula begin to differentiate in middle and high school into subject areas and their preferred genres, and community-specific knowledge primarily of importance when one enters more intensive concentration on a profession or discipline such that adhering to local conventions is necessary in order to communicate and succeed within genres.

This chronological approach does include exceptions, such as McCarthey and Raphael's (1992) finding that even young readers are oriented to the expectations and codification of disciplinary texts, and thus to the demands of particular discourse communities; and Hayes and Flower's (1980) reliance on populations of college students in an engineering school engaged in problem-solving tasks to produce general models of composing knowledge. At the same time, this curricular progression maps well onto the finding from the learning sciences that knowledge proceeds from general understandings to those requiring more specific forms of knowledge. The learning sequence governing reading and writing development, then, appears to share fundamental processes involved in learning across the cognitive spectrum.

References

Bartlett, E. J. 1982). Learning to revise: Some component processes. In M.

    Nystrand (Ed.), *What writers know: The language, process, and the structure of*

    written discourse (pp. 345-363). New York: Academic Press.

Bartlett, F. C. (1932). *Remembering*. New York: Cambridge University Press.

Bean, T. W., & Stenwyck, F. L. (1984). The effect of three forms of summarization

    instruction on sixth graders' summary writing and comprehension. *Journal of*

    Reading Behavior, 16, 297-306.

Beck, I. L., McKeown, M., Sinatra, G. M., & Loxterman, J. A. (1991). Revising social

    studies text from a text-processing perspective: Evidence of improved

    comprehensibility. *Reading Research Quarterly, 26,* 251-276.

Blachman, B. A., Schatschneider, C., Fletcher, J. M., Francis, D. J., Clonan, S. M.,

    Shaywitz, B. A., & Shaywitz, S. E. (2004). Effects of intensive reading

    remediation for second and third graders and a 1 year follow-up. *Journal of*

    Educational Psychology, 96, 444-461.

Booth, W. (1974). *A rhetoric of irony*. Chicago: University of Chicago Press.

Brabham, E. G., & Lynch-Brown, C. (2002). Effects of teachers' reading aloud styles on

    vocabulary acquisition and comprehension of students in the early elementary

    grades. *Journal of Educational Psychology, 94*, 465-473.

Bradley, L., & Bryant, P. (1983). Categorizing sounds and learning to read—a causal

    connection. *Nature, 301,* 419-421.

Bradley, L., & Bryant, P. (1985). *Rhyme and reason in reading and spelling*. Ann Arbor:

    University of Michigan Press.

Bransford, J. D., & Johnson, M. K. (1972). Contextual requisites for understanding: Some investigations of comprehension and recall. *Journal of Verbal Learning and Verbal Behavior, 11,* 717-726.

Brown, A. L., & Smiley, S. S. (1977). Rating the importance of structural units of prose passages: A problem of metacognitive development. *Child Development, 48*, 1-8.

Bryan, W. L., & Harter, N. (1897). Studies in the physiology and psychology of telegraphic language. *Psychological Review, 4*, 27-53.

Bus, A. G., & van Ijzendoorn, M. H. (1999). Phonological awareness and early reading: A meta-analysis of experimental studies. *Journal of Educational Psychology, 91,* 403-414.

Clymer, T. (1963). The utility of phonic generalizations in the primary grades. *The Reading Teacher, 16,* 252-258.

National Governors Association. (2012). *Common Core State Standards Initiative: Preparing America's students for college & career, Kindergarten-Grade 12*. Washington, D.C.: Author. Available at http://www.corestandards.org/ELA-Literacy/W/K

De La Paz, S., Swanson, N., & Graham, S. (1998). The contribution of executive control to the revising by students with writing and learning difficulties. *Journal of Educational Psychology, 90*. 448-460.

Dowhower, S. L. (1994). Repeated reading revisited: Research into practice. *Reading & Writing Quarterly, 19,* 343-358.

Ehri, L. C., Nunes, S. R., Simone, R., Willows, D. M., Schuster, B. V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn

to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly, 36*, 250-287.

Ehri, L. C., Nunes, S. R., Stahl, S. A., & Willows, D. M. (2001). Systematic phonics instruction helps students learn to read: Evidence from the National Reading Panel's meta-analysis. *Review of Educational Research, 71,* 393-447.

Elleström, L. (Ed.) (2010). *Media borders, multimodality and intermediality*. New York: Palgrave Macmillan.

Fahnestock, J., & Secor, M. (1991). The rhetoric of literary criticism. In C. Bazerman & J. Paradis (Eds.), *Textual dynamics of the professions: Historical and contemporary studies of writing in professional communities* (pp. 74-96). Madison: University of Wisconsin Press.

Fuchs, D., Fuchs, L. S., Thompson, A., Al Otaiba, S., Yen, L., Yang, N. J., Braun, M., & O'Connor, R. E. (2001). Is reading important in reading-readiness programs? A randomized field trial with teachers as program implementers. *Journal of Educational Psychology, 93*, 251-267.

Gardner, H. (1991). *The unschooled mind: How children think and how schools should teach*. New York: BasicBooks.

Geary, D. C. (2005). *The origin of mind: Evolution of brain, cognition, and general intelligence*. Washington, DC: American Psychological Association.

Gernsbacher, M. A. (1990). *Language comprehension as structure building.* Mahwah, NJ: Erlbaum.

Glynn, S. M., Britton, B. K., Muth, D., & Dogan, N. (1982). Writing and revising

persuasive documents: Cognitive demands. *Journal of Educational Psychology,*

74, 557-567.

Gould, J. D. (1980). Experiments on composing letters: Some facts, some myths, and

some observations. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes*

in writing (pp. 97-128). Mahwah, NJ: Erlbaum.

Goswami, U., & Bryant, P. (1990). *Phonological skills and learning to read.* Mahwah,

NJ: Erlbaum.

Hansen, J., & Pearson, P. D. (1983). An instructional study: Improving the inferential

comprehension of good and poor fourth-grade readers. *Journal of Educational*

Psychology, 75, 821-829.

Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing.

In C. M. Levy & S. Ransdell (Eds.), *The science of writing* (pp. 1-28). Mahwah,

NJ: Erlbaum.

Hayes, J. R., & Flower, L. S. (1980). Identifying the organization of writing processes. In

L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30),

Mahwah, NJ: Erlbaum.

Heath, S. B. (1983). *Ways with words: Language life, and work in communities and*

classrooms. New York: Cambridge University Press.

Hillocks, G. (1986). *Research on written composition: New directions for teaching*.

Urbana, IL: ERIC, National Conference on Research in English.

Hillocks, G. (1989). Literary texts in classrooms. In P. W. Jackson & S. Haroutunian-

Gordon (Eds.), *From Socrates to software: The teacher as text and the text as*

teacher. 88th yearbook of the National Society for the Study of Education (pp. 135-158). Chicago: University of Chicago Press.

Hillocks, G. (1995). *Teaching writing as reflective practice*. New York: Teachers College Press.

Hillocks, G. (2002). *The testing trap: How state writing assessments control learning*. New York: Teachers College Press.

Hillocks, G., Kahn, E., & Johannessen, L. (1983). Teaching defining strategies as a mode on inquiry: Some effects on student writing. *Research in the Teaching of English, 17*, 275-284.

Huey, E. B. (1908/1968). *The psychology and pedagogy of reading.* Cambridge, MA: MIT Press.

Jones, D., & Christensen, C. A. (1999). Relationship between automaticity in handwriting and students' ability to generate written text. *Journal of Educational Psychology, 91*, 44-49.

Joshi, R. M. (2005). Vocabulary: A critical component of comprehension. *Reading & Writing Quarterly, 21*, 209-219.

Juel, C., Griffin, P. L., & Gough, P. B. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology, 78,* 243-255.

Kellogg, R. T. (1994). *The psychology of writing.* New York: Oxford University Press.

Kochman, T. (1981). *Black and White styles in conflict*. Chicago: University of Chicago Press.

Kress, G. (2003, May). *Reading images: Multimodality, representation and new media*. Paper presented at the International Institute for Information Design Conference, Expert Forum for Knowledge Presentation: Preparing for the Future of Knowledge Presentation, Chicago. Retrieved February 26, 2011 from http://www.knowledgepresentation.org/BuildingTheFuture/Kress2/Kress2.html

Kuhn, M. R., & Stahl, S. A. (2003). Fluency: A review of developmental and remedial practices. *Journal of Educational Psychology, 95,* 3-21.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

Linderholm, T., & van den Broek, P. (2002). The effect of reading prose and working memory capacity on the processing of expository text. *Journal of Educational Psychology, 94,* 778-784.

Lipson, M. Y. (1983). The influence of religious affiliation on children's memory for text information. *Reading Research Quarterly, 18,* 448-457.

Markman, E. (1979). Realizing that you don't understand: Elementary school children's awareness of inconsistencies. *Child Development, 50,* 643-655.

Markman, E. M., & Gorin, L. (1981). Children's ability to adjust their standards for evaluating comprehension. *Journal of Educational Psychology, 73,* 320-325.

Mayer, R. E. (2004). Teaching of subject matter. In S. T. Fiske, D. L. Shallert, & C. Zahn-Waxler (Eds.), *Annual review of psychology* (Vol. 55; pp. 715-744). Palo Alto, CA: Annual Reviews.

Mayer, R. E. (2008a). Multimedia literacy. In J. Coiro, M. Knobel, C. Lankshear, & D. J. Leu (Eds.), *Handbook of research on new literacies* (pp. 359-378). Mahwah, NJ: Erlbaum.

Mayer, R. E. (2008b). *Learning and instruction* (2nd ed). Upper Saddle River, NJ: Pearson.

Mayer, R. E. (2011). *Applying the science of learning.* Upper Saddle River, NJ: Pearson.

McCarthey, S. J., & Raphael, T. E. (1992). Alternative perspectives of reading/writing connections. In J. W. Irwin & M. Doyle (Eds.), *Reading/writing connections: Learning from research* (pp. 2-30). Newark, DE: International Reading Association.

Murray, D. (1980). Writing as process. In T. R. Donovan & V. W. McClelland (Eds.), *Eight approaches to teaching composition* (pp. 3-20). Urbana, IL: National Council of Teachers of English.

Nagy, W. E., & Scott, J. A. (2000). Vocabulary processes. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of reading research* (vol. 3; pp. 269-284). Mahwah, NJ: Erlbaum.

Nystrand, M. (1982). An analysis of errors in written communication. In M. Nystrand (Ed.), *What writers know: The language, process, and structure of written discourse* (pp. 57-74). New York: Academic Press.

Paris, S. G., & Lindauer, B. K. (1976). The role of inference in children's comprehension and memory for sentences. *Cognitive Psychology, 8,* 217-227.

Pearson, P. D., Hansen, J., & Gordon, C. (1979). The effect of background knowledge on

    young children's comprehension of explicit and implicit information. *Journal of*

    Reading Behavior, 11, 201-209.

Perfetti, C. A., & Hogaboam, T. (1975). The relationship between single word decoding

    and reading comprehension skill. *Journal of Educational Psychology, 67*, 461-

    469.

Pichert, J., & Anderson, R. C. (1977). Taking different perspectives on a story. *Journal of*

    Educational Psychology, 69, 309-315.

Rabinowitz, P. J. (1987). *Before reading: Narrative conventions and the politics of*

    interpretation. Ithaca, NY: Cornell University Press.

Rayner, K., Pollatsek, A., Ashby, J., & Clifton, C. (2011). *Psychology of reading* (2nd ed).

    New York: Psychology Press.

Reay, B. (1991). The context and meaning of popular literacy: Some evidence from

    nineteenth-century rural England. *Past and Present, 131*(1), 89-129.

Rose, M. (2005). *The mind at work: Valuing the intelligence of the American worker*.

    New York: Penguin.

Rubman, C. N., & Waters, H. S. (2000). A, B seeing: The role of constructive processes

    in children's comprehension monitoring. *Journal of Educational Psychology, 92*,

    503-514.

Saddler, B., & Graham, S. (2005). The effects of peer-assisted sentence-combining

    instruction on the writing performance of more of less skilled young writers.

    Journal of Educational Psychology, 97, 43-54.

Samuels, S. J. (1979). The method of repeated readings. *The Reading Teacher, 32,* 403-408.

Saxe, G. B. (2012). *Cultural development of mathematical ideas: Papua New Guinea studies*. New York: Cambridge University Press.

Scribner, S., & Cole, M. (1981). *The psychology of literacy.* Cambridge, MA: Harvard University Press.

Smagorinsky, P. (1991). The writer's knowledge and the writing process: A protocol analysis. *Research in the Teaching of English, 25*, 339-364.

Smagorinsky, P. (Editor) (2006). *Research on composition: Multiple perspectives on two decades of change*. New York: Teachers College Press and the National Conference on Research in Language and Literacy.

Smagorinsky, P., Johannessen, L. R., Kahn, E., & McCann, T. (2010). *The dynamics of writing instruction: A structured process approach for middle and high school.* Portsmouth, NH: Heinemann

Smagorinsky, P., & Smith, M. W. (1992). The nature of knowledge in composition and literary understanding: The question of specificity. *Review of Educational Research, 62*, 279-305.

Smith, M . W. (1989). Teaching the interpretation of irony in poetry. *Research in the Teaching of English, 23*, 254-272.

Spector, J. E. (1995). Phonemic awareness training: Application of principles of direct instruction. *Reading & Writing Quarterly, 11*, 37-51.

Stratman, J. (1990). The emergence of legal composition as a field of inquiry: Evaluating the prospects. *Review of Educational Research, 60*, 153-235.

Taylor, B. (1980). Children's memory for expository text after reading. *Reading Research Quarterly, 15,* 399-411.

Taylor, B., & Beach, R. W. (1984). The effects of text structure instruction on middle-grade students' comprehension and production of expository text. *Reading Research Quarterly, 19*, 134-146.

Toulmin, S . (1958). *The uses of argument*. New York: Cambridge University Press.

Tuominen, K., Savolainen, R., & Talja, S. (2005). Information literacy as sociotechnical practice. *Library Journal, 75*, 329–345.

Vygotsky, L. S. (1934/1987). Thinking and speech. In L. S. Vygotsky, *Collected works* (vol. 1, pp. 39-285) (R. Rieber & A. Carton, Eds; N. Minick, Trans.). New York: Plenum.

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101,* 192-212.

Witte, S. (1992). Context, text, intertext: Toward a constructivist semiotic of writing. *Written Communication, 9*, 237-308.

Woods, C. (Editor) (2010a). *Visible language: Inventions of writing in the ancient Middle East and beyond*. Chicago: The Oriental Institute of the University of Chicago. Retrieved February 11, 2011 from http://oi.uchicago.edu/pdf/oimp32.pdf

Woods, C. (2010b). Introduction: Visible language: The earliest writing systems. In C. Wood (Ed.), *Visible language: Inventions of writing in the ancient Middle East and beyond* (pp. 15-27). Chicago: The Oriental Institute of the University of

Chicago. Retrieved February 11, 2011 from

http://oi.uchicago.edu/pdf/oimp32.pdf

Table 1: Three Content Areas in the Cognitive Science of Literacy Learning

Name	Target task
Reading fluency	Pronouncing a printed word
Reading comprehension	Comprehending a printed passage
Writing	Producing a written essay

Table 2: Four Cognitive Processes in Reading Fluency

Name	Example task
Recognizing phonemes	Substitution of first phoneme: You hear the word, "ball" and are asked to change the /b/ sound into a /t/ sound.
Decoding words	Word identification: Pronounce the printed word, CAT. Word attack: Pronounce the printed word, BLUD.
Decoding words fluently	Read a paragraph aloud fast and without error.
Accessing word meaning	Give a definition for a word and use it in a sentence.

Table 3: Four Cognitive Processes in Reading Comprehension

Name	Example task
Using prior knowledge	Reorganizing the material to fit with an existing schema
Using prose structure	Determining what information is important in a passage
Making inferences	Attributing a motive to justify a character's action
Using metacognitive knowledge	Finding a contradiction in a passage

Table 4: Three Cognitive Processes in Writing

Name	Example task
Planning	Creating an outline before writing
Translating	Using a word processing program to compose an essay
Reviewing	Detecting and correcting problems in an essay