

CHAPTER 2

Writing Research from a Cognitive Perspective

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Systematic research on the cognitive processes involved in writing began in the late 1970s when Hayes and Flower (1980) set out to apply the methods of cognitive psychology to the study of expertise in writing. Cognitive psychology, or the broader area of cognitive science, had taken off as a major research field in the 1950s as the theoretical and methodological limitations of behavioral psychology had become increasingly evident. Two seminal publications that appeared in 1956 provide an introduction to some of the key ideas that have occupied cognitive psychology.

In 1956, Miller published a paper called “The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information.” He reviewed a wide range of research showing that humans’ capacity for making sensory discriminations (e.g., pitches of sound, phonemes), estimating quantities of objects, and remembering items (e.g., objects, words, numbers) was limited to about seven items. Below seven, most individuals performed quite well; above seven, performance declined dramatically. This general finding suggested a fundamental limitation in the architecture of the human mind, in particular in short-term memory. To remember more things or to process more complex information, additional cognitive processing or learn-

ing was needed. Theories about the mental structures underlying memory—short-term memory, working memory, and long-term memory—continue to interest cognitive psychologists, including those who study writing. Theories about memory processes are important to understanding writing performance, development and learning, and individual differences.

Also in 1956, Bruner and his colleagues (Bruner, Goodnow, & Austin, 1956) published an influential book, *A Study of Thinking*, which focused on learners as active problem solvers. The research targeted traditional psychological tasks involving concept formation. For example, using a set of geometric figures of varying color, shape, and size, the experimenter would target a concept (e.g., small red squares). Participants would be shown one card at a time, asked whether it was a member of the targeted concept, and told whether they were correct. The goal was to figure out the targeted concept. The methodological and theoretical innovation was to ask participants to describe their thinking processes as they worked on the problem and to focus the analysis on identifying the cognitive strategies used by participants. Subsequently, a great deal of research was conducted on problem solving, using think-aloud methods to understand the conscious problem-solving

strategies of participants in a range of areas including math, physics, logic puzzles, and chess (see, e.g., Newell & Simon, 1972). It is this method that Hayes and Flower (1980) used in their seminal research on writing as a problem-solving process.

These two early publications illustrate two of the issues that have engaged cognitive researchers and that have been applied in understanding writing. Research has ranged from questions about conscious problem solving to questions about underlying unconscious processes like short-term memory. The overall aim of cognitive research is to contribute to an understanding of human performance, learning and development, and individual differences by analyzing thinking or cognitive processes. To understand thinking, cognitive researchers posit mental representations and theoretical models that connect those representations. These abstract mental representations and theories are tested through rigorous empirical research with the commitment to finding replicable and generalizable results. The goal is to develop models that explain empirical findings about performance, learning, and individual differences and that, therefore, are useful in understanding performance and guiding learning.

Cognitive researchers understand that people think, learn, and develop in social contexts using socially developed tools, including language itself. Writing is situated in social contexts that provide purposes for writing, genre, content, and audience, as well as resources to support writing (see Bazerman, Chapter 1, this volume). Within those social contexts, writers apply their knowledge of context and content, their skills, and strategic problem solving to the difficult task of making meaning. Cognitive writing researchers have included social processes in their research. Flower (1994) developed a social-cognitive theory of writing and applied it to study instruction and development, and Hayes (1996) expanded the role of social factors in his later model. Research on instruction necessarily involves social interaction (e.g., modeling, collaboration), and research on motivation also involves social perceptions and influences (see Bruning & Kauffman, Chapter 11, this volume). However, cognitive researchers tend to focus on the effects of social context and interac-

tion on learning and cognition. Over time, more work is needed to integrate cognitive and sociocultural theories and research.

The first systematic program of cognitive research on writing was the seminal work of Hayes and Flower beginning in the late 1970s (Hayes & Flower, 1980). Hayes, from cognitive psychology, and Flower, from rhetoric, set out to apply the methods of problem-solving research to understand expertise in writing, in particular the method of think-aloud, or verbal, protocol analysis, in which participants think aloud as they work on problem-solving tasks. These think-aloud protocols are then coded inductively and analyzed for evidence of problem-solving processes or strategies. The approach was productive because writing is a complex intentional problem solving activity with much conscious problem solving. The model that Hayes and Flower developed will be discussed later in this chapter.

However, the think-aloud method is limited to the study of conscious cognitive processes and to writers old enough to simultaneously compose and think aloud. For example, Hayes and Flower learned little about the process of sentence generation because writers are generally unaware of their thought processes at that level. Other research methods were needed to get at basic cognitive processes such as working memory, sequential processing, language generation, and transcription skills. Fortunately, the broader field of cognitive psychology had been studying similar processes for some time using theory-guided experimentation.

This chapter is organized as follows: In the next section, we explain five theoretical models of writing. Hayes and Flower's (1980) seminal model of writing as a problem-solving process remains influential in writing research. Hayes's revised and expanded model (1996) incorporated a wider range of psychological constructs and evidence about cognition. Bereiter and Scardamalia (1987) accounted for development of writing by proposing contrasting models of developing and proficient composing. A model by Zimmerman and Risemberg (1997) focused on self-regulation and its development. Finally, we discuss a model of domain learning applied to writing (Alexander, 1998). The remainder of the chapter

discusses four key aspects of cognition for writing that continue to engage cognitive researchers: working memory, transcription, self-regulation including planning and evaluation, and motivation.

Models of the Writing Process

Hayes and Flower (1980) Model

As noted earlier, during the 1970s, Hayes and Flower (1980) began studying the mental processes college students employed as they solved a writing problem, utilizing a technique referred to as protocol analysis, asking research participants to make their thoughts visible by “thinking aloud” while tackling a writing task. The resulting verbal protocol was analyzed for cues to identify mental operations used by the writer, providing a window into the cognitive and psychological processes involved in writing. Their analyses of the resulting protocols led to the development of what is arguably the most influential cognitive model of writing to this point in time, providing a relatively simple but elegant model of the writing process.

Hayes and Flower’s 1980 model included three basic components. One component, *task environment*, involves everything outside the writer that influences task performance. These external factors include the writing assignment (e.g., topic, audience, and motivating cues) and the text produced so far. Another component, *cognitive processes*, provides a description of the mental operations writers employ while composing. These include planning what to say and how to say it, translating plans into written text, and reviewing to improve existing text. Planning is broken down into three mental operations: setting goals, generating ideas, and organizing ideas into a writing plan. Reviewing, in turn, involves reading and editing text. The use of these cognitive processes is under the writer’s direct control (managed by a control process referred to as the Monitor), and they can be applied flexibly, as virtually any subprocess can interrupt or incorporate any other subprocess during writing. For instance, a writer might combine translation and reviewing, generating a section and then revising it, then generating and revising a second section, and

so on. Somewhat similarly, planning might interrupt reviewing, if a writer identifies an additional writing goal while reviewing and editing text. The third component, *writer’s long-term memory*, includes the author’s knowledge about the topic, the intended audience, and general plans or schemas for accomplishing various writing tasks.

Hayes and Flower’s (1980) analysis of verbal protocols showed that composing is a goal-directed process. For example, skilled writers typically establish their main writing goals (e.g., be convincing, funny, and succinct) early in the process and commonly establish subgoals for meeting these main goals (e.g., use strong arguments and refute counterarguments to convince the reader). They also made it clear that skilled writing is a conscious, demanding, and self-directed activity, involving the coordination of a variety of mental operations in order to satisfy the writer’s goals. A skilled writer must deal with many demands at once, much like a busy switchboard operator, trying to juggle simultaneously a number of demands on attention. This includes making plans, drawing ideas from memory, developing concepts, creating an image of the reader, testing ideas and text against that image, and so forth. As another cognitive researcher noted, writing does “not simply unfold automatically and effortlessly in the manner of a well learned motor skill . . . writing anything but the most routine and brief pieces is the mental equivalent of digging ditches” (Kellogg, 1993, p. 17).

The Hayes and Flower (1980) model not only fixed much of the vocabulary that people use when talking about the process of composing, but it also served as a catalyst for most of the subsequent research on the cognitive nature of writing and the architecture of the writing process (Alamargot & Chanquoy, 2001). For instance, Kellogg (1986) indexed the cognitive effort involved in each of the three major cognitive processes in the Hayes and Flower model by measuring interference from a secondary task. In a series of studies, Kellogg examined the pattern of attentional allocation of cognitive processes by college students as they wrote (Kellogg, 1987, 1996). Moreover, Rijlaarsdam and his colleagues (Breetvelt, van den Bergh, & Rijlaarsdam, 1994, 1996; van den Bergh & Rijlaarsdam, 1996) extended Kel-

logg's work by doing an even more detailed analysis of how writers employ the mental operations identified by Hayes and Flower (see also van den Bergh, Rijlaarsdam, & van Steendam, Chapter 4, this volume, for a summary of more recent research in this area).

Hayes (1996) Model

In a 1996 book chapter, Hayes presented a revised version of the 1980 Hayes and Flower model. The new model reorganized and expanded the previous framework so that it captured and integrated the ensuing 16 years of writing research as well as related cognitive research from areas such as reading, memory, and motivation. For instance, the *task environment* component was expanded to include social (e.g., audience, other texts read while writing, and collaborators) and physical components (e.g., text read so far, writing medium). He further modified the relationship between the *task environment* and *cognitive processes*, indicating a much more reciprocal relation between the two.

The *cognitive processes* component of the old model underwent considerable modification, as Hayes proposed that writers rely on general problem-solving (including planning) and decision-making skills to devise a sequence of steps to reach their writing goals, drawing inferences about audience, possible writing content, and so forth as they engage in these reflective processes. Cues from the writer's plan or text produced so far act to guide the retrieval of possible ideas for text. A suitable idea(s) is then held in working memory, as the writer expresses it vocally or subvocally as sentence parts, evaluating what to keep and modify as text is produced. Throughout the writing process, the writer engages in reading to define the writing task, obtain writing content, or evaluate text produced so far. For each of these tasks, the writer forms an internal representation of the text that can then be acted upon. For example, revising text produced so far includes critically reading it, problem solving to determine how to fix an identified problem, and implementing the change.

Hayes also expanded the 1980 model by including a *motivation/affect* component, indicating that cognitive and affective factors such as goals, predispositions, beliefs,

and attitudes influence the writing process. He further upgraded the *long-term memory component* of the old model from accessing knowledge of the audience, writing topic, and stored writing plans to include linguistic and genre knowledge as well as task schemas that specify how to carry out specific writing tasks. Finally, a *working memory* component was added to the new model. This component provides a limited place for holding information and ideas for writing as well as carrying out cognitive processes that require conscious attention, while at the same time providing an interface between *cognitive processes*, *motivation/affect*, and *long-term memory*.

Hayes's (1996) newer model provides a much more sophisticated and complicated view of skilled writing. The inclusion of motivation and working memory as part of the writing equation was an especially important addition (Graham, 2006). However, one limitation of both models is that they do not account for development or provide substantial insight into how novice and competent writers differ.

Bereiter and Scardamalia (1987) Models

Based on their study of children's writing, Scardamalia and Bereiter (1986) proposed that beginning or novice writers use a greatly simplified version of the idea generation process included in the 1980 Hayes and Flower model. In essence, novice writers convert the writing task into simply telling what is known about the topic (i.e., writing-as-remembering or writing-by-pattern). The architecture of this *knowledge-telling* model involves three components: (1) forming a mental representation of the assignment by defining the topic and the type of text to be produced; (2) drawing topic and discourse knowledge from long-term memory to complete the writing assignment; and (3) the knowledge-telling process itself, which includes the writer's search for topic or discourse knowledge, which if appropriate is transcribed as text and serves as a stimulus for conducting the next search of long-term memory.

Scardamalia and Bereiter (1987) also proposed a *knowledge-transforming* model of writing to describe more skilled writing. This model involves planning text content

in accordance with rhetorical, communicative, and pragmatic constraints. Once the writer develops a mental representation of the assignment, problem analysis and goal setting are undertaken to determine what to say (content planning) as well as how to say it and who to say it to (rhetorical planning). These two types of planning are carried out in separate spaces, but operate in close interaction through a problem translation component, where topic knowledge can be transformed by taking into account content goals as well as rhetorical and pragmatic constraints. Similarly, rhetorical and pragmatic dimensions can be altered by content constraints. The resulting plans are elaborated in writing through the knowledge-telling process described above. The resulting text can be fed back into the content and rhetorical planning spaces, providing the writer with an additional opportunity to transform ideas and content.

The movement from knowledge telling to knowledge transforming likely involves a series of intermediate stages (see Hayes, 2011). Although the knowledge-telling model appears to provide a reasonably sound description of how inexperienced writers compose (e.g., Olinghouse, Graham, & Gillespie, in press), and has served as a focal point for much instructional research (see Graham & Harris, 2003), the validity of the knowledge-transforming model is less certain and its impact more limited. In addition, none of the models so far have addressed how novice writers become more competent.

The Zimmerman and Risemberg (1997) Model

A model developed by Zimmerman and Risemberg (1997), focusing on self-regulation in writing (see also Santangelo, Harris, & Graham, Chapter 12, this volume), specified mechanisms through which writers learn and grow, at least in terms of their use of self-regulation procedures and self-efficacy. According to this model, self-regulation in writing occurs when writers use personal (or self-) processes to strategically regulate their writing behavior or the environment. They propose that writers manage the composing process by bringing into play three general classes of self-regulatory behaviors: strate-

gies for controlling their actions, the writing environment, and their internal thoughts and processes. As they employ these strategies, writers monitor, evaluate, and react to their use of them, allowing them to learn from the consequences of their actions. Strategies that are viewed as successful are more likely to be retained, whereas those that are viewed as unsuccessful are more likely to be abandoned. A writer's sense of efficacy, in turn, may be enhanced or diminished depending on the perceived success of the strategies, whereas self-efficacy influences intrinsic motivation for writing, the use of self-regulatory processes during writing, and eventual literary attainment.

It is important to note that learning in the Zimmerman and Risemberg (1997) social cognitive model is not determined just by personal processes put into play by the writer. The use of personal processes is influenced by behavioral and environmental events in a reciprocal fashion. For instance, regulating the writing environment by arranging a quiet place to compose involves intervening behavioral actions, such as turning off the radio and closing the door. However, the continued use of these environmental regulation strategies depends on the writer's perceptions of their effectiveness in facilitating writing.

The model proposed by Zimmerman and Risemberg (1997) is somewhat narrow, as it focuses primarily on the role of self-regulation in writing. It does, however, offer an explicit explanation of how (1) writers exert deliberate control over the act of writing, (2) their beliefs about competence influence and in turn are influenced by their self-regulatory actions and subsequent performance, and (3) writers acquire new self-regulatory behaviors.

Model of Domain Learning Applied to Writing

The issue about how a person progresses from being a novice to a skilled writer has also been addressed through application of the model of domain learning (Alexander, 1998). According to this model, development within a specific domain, such as writing, is fueled by changes in a writer's self-regulatory or strategic behaviors, knowledge, and motivation. It is assumed that learning arises from a continual interplay between these

cognitive and affective factors, but that progress toward competence in a domain is catapulted forward by the force of any one of these components (Alexander, 2004).

Graham (2006) examined the proposition that strategies, knowledge, and motivational factors contribute to writing development. He reasoned that a factor such as knowledge shapes writing development if the following tenets are supported by empirical evidence: (1) skilled writers possess more of the attribute (e.g., knowledge about writing) than less skilled writers, (2) developing writers increasingly possess the attribute with age and schooling, (3) individual differences in the attribute predict writing performance, and (4) instruction designed to increase the attribute improves writing performance.

Graham's 2006 review of the literature was generally consistent with the proposition that strategies, knowledge, and motivation each contribute to writing development. He found that the available evidence provided support for the four tenets above when applied to writing strategies and knowledge about writing. Although the role of motivation in writing development was generally supported, it was less definitive. Skilled writers were typically more motivated than less skilled ones, but some aspects of motivation declined over time (e.g., attitude toward writing) and others like self-efficacy increased or declined depending on the study. Individual differences in motivation, however, predicted writing performance, and a small number of studies showed that efforts to enhance motivation (i.e., self-efficacy) boosted writing performance.

Summary

Since the publication of the Hayes and Flower (1980) model more than 30 years ago, increasingly sophisticated cognitive descriptions of the composing process have emerged. These models, however, are still incomplete. To illustrate, they do not take full advantage of the increasingly sophisticated body of motivational theory and research now available (Pintrich, 2000). Nor do they adequately consider the role of genetic factors or new research on the brain. The influence of a broad array of environmental, contextual, cultural, and social influences on writing and its development

remain relatively untouched in the cognitive models of writing developed to date. There is also a pressing need to create models that capture what the writing process looks like at different levels of development, extending the work of Bereiter and Scardamalia (1987) and Kellogg (1996), as well as models that explain how writing development is fostered.

Selected Research Areas

Working Memory

As Miller (1956) demonstrated, humans have a limited capacity for remembering and processing information. Long-term memory contains vast stores of knowledge and experience acquired in the past, including in the case of writing, knowledge of content, writing forms and qualities, audiences and social situations, language, writing processes and strategies, transcription skills, and many other topics. However, in order to use that knowledge, one must bring it to consciousness and hold it there while thinking about it. This capacity to hold varying amounts of information in memory while processing it is what cognitive psychologists call working memory. As noted above, Hayes (1996) gave it a central place in his revised model of writing. Working memory increases from childhood to adulthood (Case, 1985) and varies among individuals (Swanson & Zheng, 2013), so it is potentially important in understanding development of writing and individual differences in writing, especially for developing writers with disabilities. In writing, researchers have found correlations between working memory and writing fluency and quality (for a review, see McCutchen, 1996).

The most commonly cited model of working memory (Baddeley, 1986) consists of three components: the *phonological loop*, which stores and processes auditory and verbal information; the *visuo-spatial sketchpad*, which stores and processes visual and spatial information; and a *central executive* that regulates attention, retrieval from long-term memory (LTM), and other cognitive processes. Highly automated processes do not draw on working memory, but any task that requires conscious or sustained effort draws on the central executive to manage the process using appropriate processing

schema from long-term memory. Psychological research generally supports the validity of these three components of working memory (Swanson, 2008). They are further supported by neurological research showing that verbal and visual information are processed in the left and right hemispheres, respectively, and that executive functions are located primarily in the frontal lobe (for a review, see Wager & Smith, 2003).

Kellogg (1996) proposed a componential model of working memory in writing based on Baddeley's conception. According to this model, various component writing processes draw differentially on verbal and visual-spatial working memory. Planning draws on visual-spatial memory because ideas are often recalled from long-term memory as visual images and plans are often organized as spatial diagrams. Translating ideas into sentences and evaluating and revising draw more heavily on verbal working memory. All components (except transcription in proficient adults) draw on the central executive. Several studies have found that planning and translating, respectively, engage visual-spatial and verbal working memory (Olive, 2004, 2012; Olive, Kellogg, & Piolat, 2008).

More writing research has focused on the overall capacity limitations of working memory rather than separate components, particularly with regard to development and individual differences. Bereiter and Scardamalia (1987) conducted several investigations related to how working memory capacity might limit the ability of children to coordinate multiple ideas while composing. They drew on neo-Piagetian research by Case and colleagues (Case, 1985) showing developmental changes in the number of chunks of information children, adolescents, and adults can hold in memory while executing an attention-demanding process. In one series of studies (Bereiter & Scardamalia, 1987, Chapter 6), students were asked to write brief texts explaining the information in a 2×2 matrix. For example, one matrix provided information on climate (warm, cool) and crop (oranges, apples) in two states. Not until adolescence (grade 7) were most students able to write sentences that integrated all four dimensions (e.g., "In Michigan's cool climate they grow apples but with California's warm climate oranges may be grown"; Bereiter & Scardamalia, 1987,

p. 160). In another study, they analyzed children's essays looking for evidence of coordination of ideas, for example, claim and reason, claim-reason-evidence. Most children in grades 3–5 showed evidence of coordinating two ideas, with increasing numbers of children in grade 5 coordinating three ideas. For Bereiter and Scardamalia (1987), limited working memory is one reason that children follow the simpler knowledge-telling model. To our knowledge, this line of research on children's developing ability to coordinate multiple ideas in writing has not been pursued further. However, it is consistent with some later research. For example, Ferretti, MacArthur, and Dowdy (2000) gave students either general goals to persuade an audience or an elaborated goal that included responding to potential opposing positions. Sixth-grade students but not fourth-graders wrote higher-quality essays with more counterarguments in the elaborated goal condition. The results might be explained by the limited ability of the fourth-grade students to coordinate reasons on both sides without more support.

Perhaps the largest amount of research on working memory and writing has focused on competition for working memory resources between low-level processes of transcription and higher-level planning and evaluation processes. As children learn to write, much of their attention, that is, their working memory, is focused on transcription issues of spelling and handwriting, leaving less working memory available for higher-level composing concerns. As transcribing becomes more fluent and eventually automatic, writers are able to engage in more planning and evaluation as they write. The demands of transcription on working memory and the effects on composing have been studied in several ways. One way is to compare handwriting (or typing) to dictation, which removes demands on transcription. Another way is to investigate correlations between transcription skills and writing quality across ages. Finally, experimental studies have been conducted on the effects of instruction on composing. Research using all of these approaches is discussed in the next section on transcription.

Recent research on working memory has addressed some apparent limitations of earlier models. Ericsson and Kintsch (1995)

have argued that the very limited capacity in Baddeley's model cannot adequately explain complex expert performance. They proposed a model of 'long-term working memory' in which working memory contains retrieval links to long-term memory, making it possible for experts in a domain to access far more information relatively quickly. McCutchen (2000) explored the implications of this model for writing. Baddeley (2007) later added a new component to his own model, "episodic" memory, which stores experiential memories and can integrate visual and verbal information.

Others have focused increased attention on the central executive, arguing that executive functions are critical to complex processes such as writing. Vanderberg and Swanson (2007) measured the three components of working memory and found that only the executive functions predicted writing outcome measures of planning, structure, and vocabulary complexity. More complex models of the executive functions have also been applied to understanding writing and writing disabilities. For example, Altemeier, Abbott, and Berninger (2008) found that separate executive functions, such as inhibition, attention shifting, and sustaining attention, helped to explain reading and writing performance in children with and without dyslexia. For further discussion of new directions in research on working memory and writing, see Olive (2012).

Overall, theories of working memory help to explain development and individual differences in writing. Working memory capacity, both memory storage and executive function, increases from childhood to adolescence and adulthood as the brain matures. In addition, as transcription becomes more fluent and automatic, working memory is freed for greater attention to composing. Limitations on working memory help explain why children adopt a knowledge-telling strategy (Bereiter & Scardamalia, 1987), which permits sequential composing by attending to topic, discourse form, and the text just written. In addition, students with learning disabilities (LDs) may have deficits in components of working memory and problems with transcription (Altemeier et al., 2008). Proficient writers manage the limitations of working memory by using goal-directed strategies that break down the

writing process into manageable chunks. Although children do not normally do much advance planning, elementary children can learn planning strategies that enable them to manage more information and produce texts that are more complex and higher in quality (Graham, Kiuahara, McKeown, & Harris, 2012).

Transcription Skills

One issue not addressed in the cognitive models of writing presented earlier is the role of transcription skills in writing and writing development (see also Fayol, Chapter 9, this volume). Transcription involves transcribing the words the writer wants to say into written symbols on the page (Graham, 2006). This involves the use of writing skills such as handwriting, keyboarding, and spelling.

For skilled writers, transcription is mostly an unconscious, automatic task (Willingham, 1998). This is not always the case, however, as conscious attention to transcribing skills would occur in the following example situations: using a word whose spelling is unknown or deciding to write all letters as capitals when texting or emailing in order to emphasize what is being said.

For beginning writers, transcription skills require considerable effort and attention (Berninger, 1999; Graham, 1999). Until these skills become efficient and relatively automatic, they may exact a toll on both the reader and the writer. If we just consider the skill of handwriting, there are at least two ways it may constrain writing. One, text that is illegible cannot be understood by the reader (Graham, Harris, & Herbert, 2011). Somewhat similarly, text that is readable, but hard to decipher due to poor handwriting, may be devalued by the reader, as the legibility of text influences others' evaluation of its content (see Graham, Harris, & Hebert, 2011). Two, handwriting may impede beginning writers' efforts by interfering with other writing processes (Scardamalia & Bereiter, 1986). Having to switch attention during composing to thinking about how to form a particular letter, for example, may lead a child to forget writing ideas or plans being held in working memory. Likewise, they are likely to lose some writing ideas as they compose, as their handwriting is often not fast enough for them to record all of their ideas

before they start forgetting some of them. Difficulties with handwriting may also constrain young children's development as writers. McCutchen (1995) proposed that transcription skills such as handwriting are so demanding for beginning writers that they minimize the use of other writing processes, such as planning and revising, because they exert considerable processing demands as well. In addition, Berninger, Mizokawa, and Bragg (1991) found that difficulties with handwriting led children they worked with to avoid writing and develop a negative view of their writing capabilities.

Evidence demonstrating the impact of transcription skills on writers and writing development is varied and relatively conclusive. For example, eliminating transcription skills by having writers dictate their compositions has a positive impact on writing performance. A review by De La Paz and Graham (1995) found that young and old writers produced more text when they dictated versus wrote their compositions, but effects on quality of writing were found only for young children just learning to write (preschool and first grade) and older elementary-age children with poorly developed handwriting and spelling skills, not for older typical learners. However, the comparison between normal dictation and handwriting is not a fair test of the effects of removing transcription demands because dictation has the disadvantage that writers cannot see the text they have already written. Reece and Cumming (1996) conducted a series of studies comparing dictation in which students could see their text being typed on a screen to normal dictation and handwriting. In these studies, upper elementary students wrote better essays in the visible-text-dictation condition than with normal dictation or with handwriting; poor writers did better in both dictation conditions than with handwriting. This effect seems to change with older students. A study using speech recognition software (which displays the text as it is dictated) (MacArthur & Cavalier, 2004), high school students with LDs wrote higher-quality essays dictating to the computer than with handwriting, but typical students wrote equally well in both conditions.

Researchers in France (Bourdin & Fayol, 1994) have further demonstrated that the

process of transcribing ideas onto paper is more demanding for children than for adults. In their experiments, adults were equally adept at recalling information and generating sentences when responding orally or in writing, but children's performance was significantly poorer when writing. Thus, transcription processes imposed greater cost on those whose transcription skills were still developing (such skills are not fully mastered until high school; Farr, Hughes, Robbins, & Greene, 1990; Graham, Berninger, Weintraub, & Schaefer, 1998). Other studies have shown that students with less developed transcription skills are weaker writers than same grade peers with stronger transcription skills (e.g., Deno, Marsten, & Mirkin, 1982; Juel, 1989; Olinghouse & Graham, 2009)

Individual differences in transcription skills also predict how well students' write. In a review of 13 studies, Graham, Berninger, Abbott, Abbott, and Whitaker (1997) reported that handwriting fluency and spelling were moderately correlated with measures of writing achievement. In an empirical study reported in the same paper, they found that, collectively, handwriting and spelling skills accounted for 25% and 42% of the variance in writing quality at the primary and intermediate grades, and 66% and 41% of the variance in writing output at these same grade levels, respectively.

Finally, teaching text transcription skills has a positive impact on developing writers. In a meta-analysis conducted by Graham et al. (2012), text produced by primary grade students who were taught handwriting, typing, and/or spelling evidenced a half-standard deviation improvement in writing quality over children who were not taught these skills. These findings provide support for the contention that the teaching of text transcription skills needs to be part of early writing instruction. Another meta-analysis by Graham and Santangelo (2014) provides additional support for this contention in terms of spelling instruction, showing that students become better spellers when this skill is directly taught versus relying on incidental methods, such as frequent reading and writing, as a catalyst for spelling development. This review further found that spelling instruction enhanced students' reading skills.

Self-Regulation

A common point of agreement in the models of skilled writing reviewed earlier is that writing is a self-directed process (see also Santangelo et al., Chapter 12, this volume). To achieve their intentions, skilled writers employ a variety of strategies for regulating the writing process, their behavior, and the writing environment (Scardamalia & Bereiter, 1985; Zimmerman & Risemberg, 1997). These strategies include: goal setting and planning (e.g., establishing rhetorical goals and tactics to achieve them), seeking information (e.g., gathering information pertinent to the writing topic), record keeping (e.g., making notes), organizing (e.g., ordering notes or text), transforming (e.g., visualizing a character to facilitate written description), self-monitoring (e.g., checking to see if writing goals are met), reviewing records (e.g., reviewing notes or the text produced so far), self-evaluating (e.g., assessing the quality of text or proposed plans), revising (e.g., modifying text or plans for writing), self-verbalizing (e.g., saying dialogue aloud while writing or personal articulations about what needs to be done), rehearsing (e.g., trying out a scene before writing it), environmental structuring (e.g., finding a quiet place to write), time planning (e.g., estimating and budgeting time for writing), self-consequating (e.g., going to a movie as a reward for completing a writing task), seeking social assistance (e.g., asking another person to edit the paper), and self-selecting models (e.g., emulating the tactics or style of writing of a more gifted author).

In contrast, novice or beginning writers, as described in the knowledge-telling model proposed by Scardamalia and Bereiter (1987), employ an approach to writing that minimizes the role of goal setting, planning, revising, and other self-regulation strategies (McCutchen, 1988). They commonly convert the task of writing into telling what one knows, with little attention directed to what they want to accomplish, the organization of text, the needs of the reader, or even the constraints imposed by the topic. This retrieve-and-write approach to writing relies heavily on a single composing process, the generation of ideas, involving little in the way of thinking, planning, and reflecting (Graham, Harris, & McKeown, 2013).

These differences in self-regulation are evident in cross-sectional studies examining self-regulation strategies such as planning. For example, in a study by Bereiter and Scardamalia (1987), college students planned their entire composition during a scheduled preplanning period, generating multiple and abbreviated lists of ideas that were connected by lines or arrows. Conceptual planning notes, evaluative statements, and structural markers were also quite common in the plans they generated. In contrast, the planning notes produced by children in grades 4, 6, and 8 mostly involved generating complete sentences that were edited into a final draft during writing, with little attention devoted to developing other types of goals. Conversely, the planning of the writers in this study became increasingly sophisticated with age, as the number of planning notes produced between grades 4 and 6 doubled, and conceptual planning notes became more common from grades 4 to 8.

There is a relatively rich set of studies showing that the use of many of the self-regulation strategies described above is associated with better writing (see van den Bergh, Rijlaarsdam, & van Steendam, Chapter 4, this volume, as well as MacArthur, Chapter 18, this volume). For some self-regulation strategies, this may occur at a younger or older age. Consider, for example, planning and revising. In a literature review, Hayes and Nash (1996) reported that the correlations between writing quality and amount of planning ranged from 0.23 to 0.87 for students in grades 6 through college. Moreover, Graham and his colleagues (study in process) found that advanced planning made a statistically significant contribution to predicting the overall quality of persuasive text written from source with even younger students (after first controlling for variance due to gender, transcription skills, and motivational variables). In contrast, revising behavior is generally unrelated to overall writing performance until high school or later (Fitzgerald, 1987), probably because young children do not revise much and limit most of their revising efforts to proofreading and minor word changes (Graham & Harris, 2000).

Hayes and Nash (1996) have raised the concern that the positive relations observed between self-regulation strategies such as

planning and writing performance may be due to a confounding variable, namely, time-on-task. Previously, significant correlation between planning and writing quality became statistically nonsignificant in several studies Hayes and Nash reviewed once time-on-task was held constant via the technique of partial correlations. This has not been a consistent finding in the literature, however, as statistically significant positive correlations were obtained between planning and writing performance in other studies where time-on-task was not a confounding factor (e.g., Berninger, Whitaker, Feng, Swanson, & Abbott, 1996; Troia & Graham, 2002).

In any event, a growing body of evidence shows that teaching developing writers how to regulate various aspects of the writing processes leads to better writing (see Santangelo et al., Chapter 12, this volume). For instance, a series of meta-analyses have demonstrated that teaching planning and revising strategies to students enhanced their writing performance (Graham et al., 2012, 2013; Graham & Perin, 2007; Rogers & Graham, 2008). The positive effects of such instruction have occurred as early as first grade with planning (Zumbrunn & Bruning, 2013) and fourth grade with revising (Graham & MacArthur, 1988). These findings suggest that with proper scaffolding and instruction, self-regulation strategies can shape the writing of very young children, even though influential models of early writing like knowledge telling propose that such strategies are not normally used (McCutchen, 1988).

Motivation

Writing is a demanding task that presents motivational challenges even for proficient writers. Many of the self-regulation strategies used by experienced writers and discussed in the previous section function to motivate writers to work productively. Learning to write can also be frustrating and difficult for many students, and motivation to engage in writing generally declines across the school years (Hidi & Boscolo, 2006). Motivation is influenced both by social and situational factors and by internal cognitive and affective factors.

Motivation is a complex concept that has been studied from multiple theoretic

cal perspectives (Murphy & Alexander, 2000). However, not all prominent theories of motivation have been studied with writing. For example, expectancy-value theory (Wigfield & Eccles, 2000) has seldom been studied with writing. Here we briefly discuss three motivational constructs that have been applied to understand writing motivation: self-efficacy, achievement goals, and interest.

The largest body of cognitive research on writing motivation has focused on self-efficacy. Self-efficacy is defined as individuals' judgments "of their capabilities to organize and execute the courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). People tend to engage in activities that make them feel competent and to avoid tasks that they think are beyond their ability. Self-efficacy has been found to predict engagement, persistence, affective reactions, and performance across many areas of achievement (Bandura, 1986; 1997; Pajares, 1996). In writing, self-efficacy has been shown rather consistently to predict writing performance even after controlling for prior writing achievement (for reviews, see Pajares & Valiante, 2006; Bruning & Kauffman, Chapter 11, this volume).

Self-efficacy is measured with questionnaires that ask individuals to rate their confidence that they will be able to successfully complete specific tasks. Conceptually, self-efficacy refers to specific capabilities, so individuals might vary in their self-efficacy for particular aspects of writing skills, strategies, and knowledge. Some research has found multiple separate factors of self-efficacy. For example, separate factors have been found for composing tasks (e.g., structuring an essay) and skills (e.g., grammar) (Shell, Murphy, & Bruning, 1989; Pajares, 2007). Pajares (2007) found that writing achievement was predicted best for elementary school students by self-efficacy for skills but for high school students by composing self-efficacy. One research group (Bruning, Dempsey, Kauffman, McKim, & Zumbrunn, 2013) found three separate self-efficacy factors for ideas, conventions, and self-regulation. They found that conventions self-efficacy best predicted the writing test scores of secondary students, but ideas and self-regulation were more related to liking writing.

Self-efficacy is an important motivational outcome that can influence future writing achievement and should be addressed in instruction. Self-efficacy can be influenced by mastery experiences, vicarious experience (modeling), social persuasion, and emotional reactions (e.g., anxiety) (Bandura, 1997). Research in areas other than writing has consistently found that mastery experience is the strongest source of self-efficacy beliefs, and one study that addressed writing confirmed this finding (Pajares, Johnson, & Usher, 2007). Modeling writing processes, encouraging students to believe they can be successful, and helping them control negative emotions are all parts of effective writing instruction, but unless these efforts lead to successful independent writing experience, they may not enhance self-efficacy.

Another established motivational theory that has been applied to writing is achievement goal theory (Elliot & Church, 1997; Pintrich, 2000). Current theory in this area includes three contrasting goal orientations: mastery, performance-approach, and performance-avoidance. A mastery goal orientation characterizes individuals who seek to develop knowledge and competence. Individuals with a performance goal orientation seek to demonstrate competence relative to others. Performance-avoidance goals refer to efforts to avoid unfavorable judgments by others. Research on academic achievement in multiple areas (for a review, see Senko, Hulleman, & Harackiewicz, 2011) has found that mastery goals are related to interest, persistence, deep learning strategies, positive affect, and achievement; performance-approach goals are positively related to academic achievement; and performance-avoidance goals are related to low achievement, low interest, poor study habits, and anxiety. Also, mastery and performance-approach goals are usually positively correlated.

Research on goal orientation in writing has been conducted by researchers in combination with self-efficacy (Kauffman et al., 2010; MacArthur, Philippakos, & Graham, in press; Pajares, Britner, & Valiante, 2000; Pajares & Cheong, 2003). All four studies found positive correlations between mastery goals and self-efficacy and negative correlations between performance-avoidance goals and self-efficacy. Kauffman and colleagues

(2010) reported positive correlations with grades for both mastery and performance goals. Interestingly, a study with basic (remedial) college writers (MacArthur et al., in press) did not find any positive correlations among self-efficacy, mastery and performance goals, and writing achievement. However, they did find negative correlations of performance-avoidance goals with self-efficacy and with five measures of reading and writing achievement, suggesting that for this population negative motivational goals may be highly influential. This interpretation is supported by a qualitative study (Cox, 2009); in interviews with students from six community college composition classes, 80% of students mentioned experiences of prior failure with writing or fear of failure, and many reported counterproductive effects consistent with performance-avoidance goals, such as dropping classes, avoiding speaking in class, and not submitting papers.

The third motivational construct that has often been studied for writing is interest. Unlike the cognitive concepts of self-efficacy and goal orientation, interest includes both affect and cognition. Experiencing interest involves an affective reaction that is integrated with cognition. Interest theory distinguishes between situational and individual interest (Hidi & Boscolo, 2006). Situational interest is an affective response to something in the environment that focuses attention and that may or may not have a lasting impact. In writing, interesting topics or assignments can evoke such situational interest. Individual interest is “a relatively enduring predisposition to attend to events and objects, as well as to reengage in activities” (Hidi & Boscolo, 2006, p. 146). Individual interest develops over time and is associated with increased knowledge and value.

Both situational and individual interest have been shown to be related to academic performance, attention, and levels of learning (Hidi & Renninger, 2006). In writing, much of the research has focused on interest in content topics. Topic interest and knowledge are often related. Together, knowledge and interest affect the quality of writing, but knowledge has more influence (Hidi & Boscolo, 2006). Some research has also focused on development of individual interest in writing as an activity. Hidi and Ren-

ninger (2006) have proposed a four-phase model of development from situational interest to stable individual interest. This development may include movement from situational interest in topics to interest in writing itself.

Developing positive motivation toward writing is an important outcome of instruction. Teachers can help students develop a sense of competence and self-efficacy by designing instruction to ensure success on writing tasks along with a belief that success was due to one's own effort and learning. It is also important to provide writing tasks that are interesting and challenging and that students see as meaningful. When students perceive writing as useful for learning and communication, they are more likely to adopt mastery goals focused on learning rather than performance goals. Self-efficacy and interest are likely to reinforce each other since people tend to be interested in things they are good at and to develop skill based on their interests. Both also support mastery goals making it possible for students to see writing as a challenging but attainable goal.

Final Thoughts

From a cognitive perspective, proficient writing is a complex goal-directed problem-solving process that makes substantial demands on writers' knowledge, strategies, language, skills, and motivational resources. Beginning with often ill-defined goals established by the social contexts and purposes, writers analyze problems to set specific goals and subgoals, generate content, organize their ideas, craft sentences and choose appropriate words, and produce text, all the while evaluating everything against their communicative goals. The need to maintain focus while switching attention among ideas and processes places heavy demands on self-regulation and motivation.

The writing processes of young, developing writers are much simpler. Having made the basic discovery that language can be represented by marks on paper, children focus primarily on generating ideas and getting them on paper. Much development and learning occurs on the way to proficient writing. Through instruction and practice, children develop increasing skill and fluency

in the transcription processes of spelling and handwriting. Language proficiency develops, aided greatly by experiences learning to read. Also through reading and writing experiences, individuals gain knowledge about written genres and the characteristics of good writing. Cognitive maturation increases working memory, including executive control as well as verbal and visual storage, thus increasing capacity for integrating ideas and balancing content and rhetorical demands. Capacity for planning and self-regulation also grows, and students develop increasingly sophisticated strategies for planning and revising. Development varies among individuals based on differences in cognitive capacities as well as experience and instruction. In particular, students with learning disabilities that affect phonological processing, memory, or executive function may have particular problems with aspects of writing.

All of these aspects of development can be enhanced through well-designed instruction. Reading instruction that emphasizes both decoding and comprehension is fundamental for supporting development of writing. Instruction to develop fluent handwriting and spelling facilitates writing by freeing capacity for more complex processes. Teaching genre features can enhance both reading comprehension and writing. Instruction in strategies for planning and revising can enhance knowledge of writing and writing achievement from early elementary through college and adult education. Furthermore, teaching self-regulation strategies, such as goal-setting, monitoring, evaluation, and managing the environment, enhances the effect of strategy instruction. Writing instruction can also increase reading comprehension and learning in content areas of science and history. Experiences with meaningful writing activities that promote content learning and communication enhance students' understanding of writing purposes and forms and motivate interest in writing. Motivation is also critically dependent on instruction that provides mastery experiences to develop self-efficacy.

Overall, cognitive research has made, and continues to make, substantial contributions to understanding writing performance, learning and development, individual differences, and instruction. Ultimately, a com-

prehensive understanding of writing and its development will require research with greater integration of social and cognitive perspectives.

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