Cognitive Modes and Strategies
for Writing

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Abstract

Since the advent of the process approach in writing research, composition theorists and cognitive psychologists have been trying to develop cognitive models that describe how people write. But they have run up against a major obstacle. Adults use such a wide variety of strategies that no single model can describe them all. In this paper we present a new view of adult writing strategies. We argue that adults use different modes of thought as they write. Each cognitive mode involves a different constellation of cognitive processes, products, goals, and constraints. Writers combine these cognitive modes into different writing strategies.

Viewing writing strategies as combinations of cognitive modes opens up two lines of research on writing. We can observe writers in naturalistic settings to find out what modes they use and how they combine them. And we can use more traditional experimental methods to describe the cognitive processes that specific cognitive modes entail. Research on cognitive modes would enable us to develop computer writing tools that support the modes used by successful adult writers and that ease the transitions among these modes.

Cognitive Modes for Writing:

Toward an Integrated Theory of Composition

Ask your colleagues how they write. The variety of strategies is mind boggling. Some create outlines first, and then follow their outlines as they write. Others stew about their papers for weeks or even months, then finally dash out the whole thing at a single sitting. Still others begin by pouring out "spew drafts" just to get their thoughts down on paper, then revise again and again, completely transforming the original version. How can any single framework encompass all these diverse strategies?

In this paper, we introduce a new way of talking about writing, one that we believe provides a framework for discussing the variety of strategies used by adult writers. The basic idea is that writers pass through a series of different *modes* of thinking as they compose their texts. They break the writing task down into subtasks, and these subtasks require different modes of thought. Not all writers use the same modes or combine them in the same way. But the concept of mode provides a way to analyze the differences between writers and a way to look for commonalities beneath these differences.

What do we mean by a *mode of thinking*? Perhaps it's best to illustrate with a couple of examples. *Exploration* is a name we have given to a mode of thinking commonly used by writers as they begin to write. During exploration, writers search their memories and their source materials for ideas they may want to include in their papers and jot down lists of words or phrases or sentences. *Global editing* is another very different mode of thinking, one which occurs toward the end of the writing process. During global editing, writers read or skim their papers quickly, focusing on global structure. The goal is to verify that the structure makes sense and to change it if necessary. Exploration and global editing have different goals and result in different types of products.

In the remainder of this paper, we further elaborate the concept of modes of thinking. We begin by situating the modes framework within the recent literature on writing. We then present our ideas on modes in greater detail. To illustrate, we discuss the modes we ourselves use and the strategies by which we combine them. Finally, we talk about how the idea of modes could be applied to research on writing and to the development of tools for writers.

Background

Those of us who were in school during the 50's and 60's received very little instruction in how to write. Our teachers showed us what good writing looked like and lectured us on grammar and spelling, but they did not try to teach the actual process of writing. In retrospect, composition theorists have called this teaching method the "product approach," since the focus was on the written product rather that the writing process; but the old method probably would not have been dignified by the term "approach" except to contrast it with the "process approach," which followed it (Hairston, 1982; Young, 1978).

During the era of the process approach, composition theorists moved their attention from the *products* of writing to the writing *process*. Janet Emig (1971) seems to have spawned the movement by observing the writing processes of eight twelfth graders, one in detail. A number of other educational researchers followed suit by doing detailed observations of student writers (Mischel, 1974; Pianko, 1979; Stallard, 1974). Emig and her followers succeeded in bringing composition theorists into contact with the realities of the writing process. They pointed out, for example, how little time high school and college students spent planning and revising.

Starting about in the late 70s, researchers from the relatively new field of cognitive psychology joined with composition theorists in their study of the cognitive processes used by

writers (Collins & Gentner, 1980; Hayes & Flower, 1980). The psychologists brought with them new methods of doing research. Emig and her followers had done close observations of individual student writers, often in naturalistic settings. The standard practice in cognitive psychology was to use laboratory studies to develop abstract models that describe human cognition in general. Thus, the models developed by cognitive psychologists looked quite different from the contextualized descriptions that had previously typified the process movement. The best-known of these models are those of Hayes and Flower (1980) and Bereiter and Scardamalia (1987).

Adopting methods that had previously been used to study problem solving, Hayes and Flower brought writers into the lab and asked them to think-aloud as they wrote on an assigned topic. Their protocols provided the basis for a series of insightful observations on the nature writing (Flower, 1979; Flower & Hayes, 1980a, 1980b, 1981b, 1984) as well as a formal model of writing (Hayes & Flower, 1980), which employed the formalisms of flow charts and production systems that are the stock in trade of cognitive psychologists.

Essential to their formal model was the fact that Hayes and Flower classified each statement in their protocols as planning, translating plans into text, or revising. (Planning was further broken down into generation and organization of ideas.) Unlike Emig, Hayes and Flower observed planning and revision in both student and non-student writers. But they noticed that the basic processes - planning, translating, and revision - did not always occur in the previously expected order. That is, planning did not always precede translating, nor did revising always follow it. Rather, the processes were used recursively. One process "called up" another, just as one subroutine calls up another in a computer program. For example, writers might notice as they translated their ideas into text that those ideas were incomplete, causing them to revert to the planning process. The idea of recursion enabled Hayes and Flower to handle within their formal model an unlimited variety of alternations among the basic processes.

According to Hayes and Flower's formal model, the important difference between one writer's strategy and another's is that the two writers use the basic writing processes in a different order, e.g., one writer completes her planning before she begins to translate her plans into text, another alternates between planning and translating. Thus, the success of the Hayes and Flower model depends on the categorization scheme, i.e., on the fact that the distinctions among the basic processes - planning (including generation and organization), translating, and revising - are all important.

We believe that the distinction between planning, translating, and revising fails to capture important characteristics of adult writing strategies. Consider, for example, variations in the way different writers plan. Selzer (1983) described an engineer who spent the initial 80% of his writing time generating an elaborate outline. Once the outline was complete, he wrote the paper very quickly with little revision. By contrast, a colleague of ours spends weeks thinking about a paper before she begins to write, but during this phase she writes nothing down. Within their formal model, Hayes and Flower offer no way to distinguish between the very different planning processes of these two writers. We would say that the two writers use different *modes* of thinking to plan their papers - that they use different cognitive *processes* to create different types of *products*. In classifying the cognitive processes of writing as planning, translating, and revision, Hayes and Flower seem to have glossed over several crucial distinctions.

Like Hayes and Flower, Bereiter and Scardamalia used laboratory studies to investigate writing. But their focus was on how the writing process changed with age. They concluded that no single model of writing could describe both children and adults (Bereiter and Scardamalia, 1987). Children use what Bereiter and Scardamalia call a "knowledge-telling" strategy. They spill out all the ideas that occur to them on their chosen topic and then stop, as they might if they were talking to a friend. Adults have the option of using a more sophisticated strategy, a strategy Bereiter and Scardamalia call "knowledge transformation." Unlike children, adults who use the knowledge transformation strategy acknowledge the rhetorical problem. They consider the effect the written text will have on the reader. The knowledge-transformer thus deals with a host of

questions that can be ignored by the knowledge-teller - e.g., Which material should be included and which omitted? In what order should the ideas be presented? What is the most effective way to word the sentences?

A schematic diagram of Bereiter and Scardamalia's knowledge-transformation strategy is shown in Figure 1. The diagram indicates that writers are considering rhetorical questions by the arrows connecting the "content problem space" and "rhetorical problem space." Unfortunately, Bereiter and Scardamalia are rather vague on exactly what these arrows mean. What activities go on when adult writers consider content and rhetorical problems jointly? Since Bereiter and Scardamalia were mainly concerned with developmental issues, these questions were not central to their discussion. But they are central to those of us who are interested in adult writing strategies.

For our purposes, Bereiter and Scardamalia's most valuable contribution was to point out the huge differences between the writing task as conceived by children and the writing task as conceived by experienced adults. For adults, the writing processes is non-homogeneous. As we see it, adults have learned to use different modes of thought to attack different aspects of the task. No single flow chart can describe adult writing strategies in general, because adults are too different from one another. Bereiter and Scardamalia were forced to settle for arrows between the content and rhetorical problem spaces because they ran up against the problem of diversity. They said, in effect, "Something very complicated is going on here." With the modes approach, we claim to have found a way to talk about that "something very complicated." And a way to get down underneath the diversity and talk about the commonalities within different modes of thought.

Before we describe the modes approach more fully, we should mention another strand in recent research on writing. To some composition theorists, the formal models and laboratory experiments imported from cognitive psychology are the wrong way to study writing. These critics see laboratory studies as too remote from the real world of the writer. They refer to researchers who use traditional experimental methods as "positivists," an epithet intended to evoke everything they hate about laboratory research: the operationalization of inherently fuzzy concepts; the use of statistical tests to measure differences between groups; the controlled environment of the laboratory itself.

Critics of the experimental approach argue that it's impossible to learn how real writers write real texts by asking experimental subjects to write on assigned topics in the laboratory. Their most persistent complaint is that the experimenters pay too little attention to *context* (Bartholomae, 1985; Bizzell, 1982; Calkins, 1985; Nystrand, 1986). The experimenters ignore the fact that adult writers write for a particular discourse community which determines not only what rhetorical style will be acceptable but what world view is assumed. And they ignore the specific factors that motivate a particular writer to write a particular text.

As an alternative to laboratory experiments, some researchers have adopted ethnographic methods for studying writers in their natural settings. They have entered particular writing communities to observe the underlying structure of the social system so that they can understand individual communication acts. The focus has often been on schools (e.g., Graves, 1981). But there have also been a number of observational studies of adult writers in their places of work.

Perhaps the purest example of an ethnographic study of writing is that by Latour and Woolgar, a French anthropologist/philosopher and an English sociologist (Latour & Woolgar, 1979). Latour (the anthropologist/philosopher) spent twenty-one months as a technician in the Salk Laboratory in La Jolla, California. During that period he participated fully in that research community as he observed it both informally and in interviews with his colleagues. Although he did not originally intend to focus on writing, it soon became apparent to him that while the acknowledged work of the lab was biological research, what the lab *actually* did was produce documents. One group, the technicians, produced primary inscriptions, derived from computers, laboratory notebooks, and other forms of scientific data-gathering. The other group spent most of their time producing secondary texts, based on the primary inscriptions, that were eventually sent
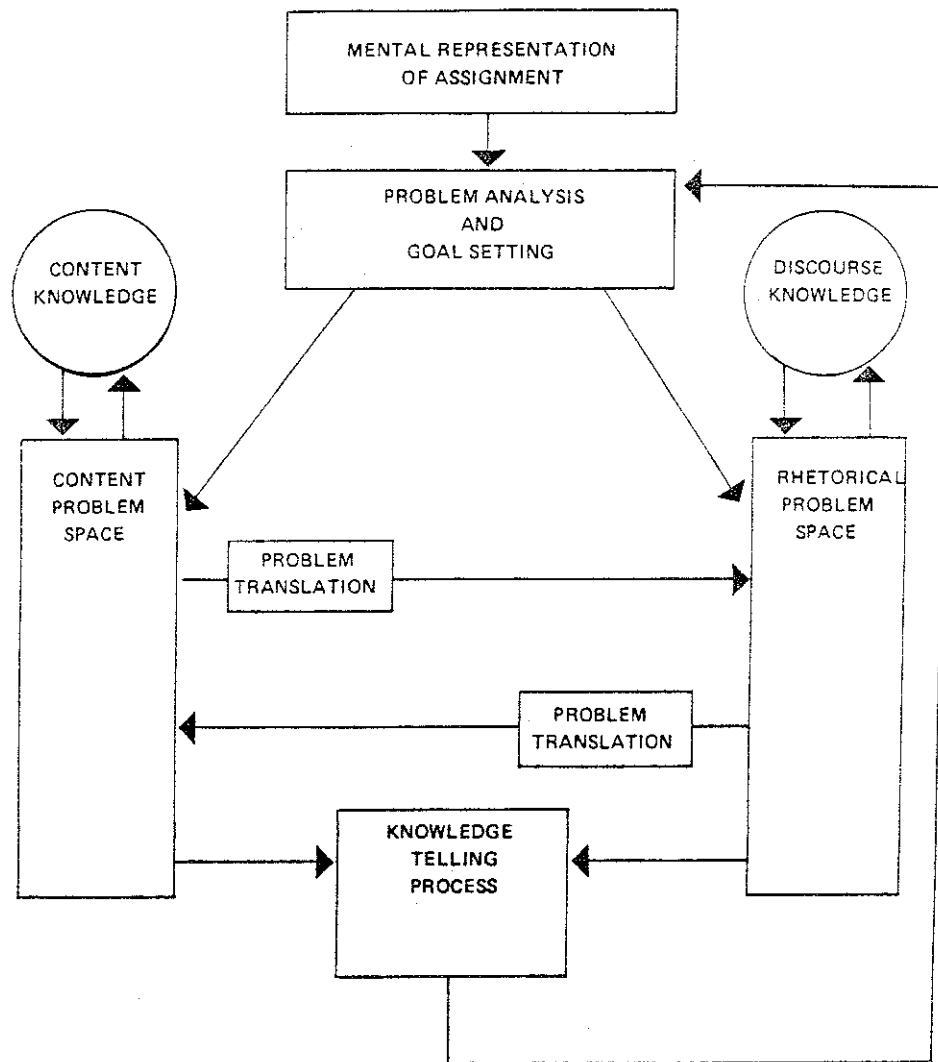
Figure 1. The knowledge-transformation model of Bereiter & Scardamalia (1987).

out as journal articles or conference presentations. Thus, Latour concluded, much to the annoyance of the other members of the lab, that he had been observing a "paper factory."

Other studies have used less formal ethnographic methods, but have also produced insights into the function of writing within the adult workplace. For example, Odell and Goswami (1982) studied administrators and caseworkers in a social service agency; Rymer (1988) studied biochemists known to be good writers; Selzer (1983) studied an engineer; Berkenkotter (1983) studied Donald Murray, a well-know writer on writing. These studies, taken together, have shown just how rich and varied adult writing practices are.

Unfortunately, the observers and the experimenters have not been very tolerant of one another. The experimenters may grant the importance of observing writing as it occurs in the field, but they argue that the ultimate aim of research is to develop testable theories and that the proper method for testing theories is to do controlled experiments. The observers argue that there is absolutely nothing to be gained by controlled experiments. Context is all important in determining the writing process. In spite of appeals for a rapprochement between the two camps (e.g., Flower, 1989), the antagonism continues.

We suggest that the debate between the experimenters and the observers confounds two issues. The issue that has been most vigorously (and venomously) discussed is the issue of context. The issue that has not been discussed is the issue of scale: at what level of detail shall we study the writing process? To clarify the concept of "level" we draw an analogy between the study of reading and the study of writing.

We can ask different types of questions about how people read. At one level are global questions about broad reading practices. Suppose, for example, we were interested in how college professors read the literature in their fields. We might ask: How much time to they spend reading? What strategies do they use? What do they skim and what do they read carefully? When do they take notes? Do they review what they have read? Context is crucial in answering these questions. Naturalistic observations or interviews would be appropriate to answer them. Asking professors to read assigned material in the lab would not tell us how they read the books and articles in their fields. And what we found out about college professors reading professional literature would not generalize to factory workers reading newspapers.

But laboratory experiments have been very useful in answering a different set of questions about reading - questions about how people comprehend individual sentences (e.g., Just & Carpenter, 1987). In their laboratory experiments on reading, cognitive psychologists have focused on questions like the following: How do readers discover which of several meanings a word has in a particular sentence? How do they determine the functional relationships between the words in the sentence? How do they draw the inferences necessary to link the sentence to previous sentences? Cognitive psychologists have assumed, rightly we believe, that the answers to these questions are relatively independent of global context. The answers apply to literate adults, whether they are college professors reading academic articles or factory workers reading newspapers.

A similar distinction can be made between two kinds of questions about writing. At a global level, we might ask how college professors write scientific articles. How much time do they spend writing? What strategies do they use? What kind of planning do they do? Do they use outlines or lists or freewriting? How do they revise - do they focus on individual sentences or on global structure or on both? These questions can be translated into questions about what modes of thought professors use as they write and what strategies they use to guide them through the various modes. The answers are highly context dependent. Different individuals use different modes. Their strategies vary depending on what they are writing. The questions cannot be answered through laboratory experiments, since laboratory conditions distort modal strategies. Critics of the experimental approach are correct in pointing out that laboratory studies are maladapted for the study of global questions about writing strategies.

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But in writing, as in reading, there are questions that can be addressed using laboratory methods. These questions concern how writers process information when they are working *within a given cognitive mode*. For example, given that writers are composing sentences, we might ask: Do they generate the structure for a sentence before they come up with specific words? What variables determine the choice of specific words? How much of the sentence do they generate and store in short-term memory before they begin to write? So far very little research has been done on this kind on question.

We argue that the modes framework highlights the distinction between questions that can be addressed through naturalistic, observational methods and questions that can be addressed through controlled laboratory studies. At the global level are broad questions about writing strategies - about what modes of thought writers use and how they combine them. For these questions, context is crucial. Thus, observational methods are appropriate. At a local level are questions about the interplay of memory, linguistic knowledge, and text as the writer operates within a given mode of thought. The answers to these questions may be less context dependent and, therefore, more amenable to controlled laboratory studies.

In the following section, we discuss the concept of cognitive mode in more detail.

Cognitive Modes

Concept

Intuitively, a cognitive mode is a particular way of thinking. Writers engage different modes in order to accomplish different parts of the overall writing task. We'll use *exploration* again as an example. Writers often engage this mode of thinking early in the writing process. The goal is not to produce a draft of the document or even an organizational plan, but rather to externalize ideas and to consider various relations among them. Consequently, this way of thinking often carries with it a relaxed mood, open to different possibilities, perhaps even playful. These goals and the accompanying relaxation of constraints are inherent in the mode - part of what makes exploratory thinking exploratory rather than organizational or some other form. Similarly, certain kinds of informational products tend to be produced during exploration while others are not. For example, writers tend to jot down words or phrases or very rough sentences to represent ideas. To produce these preliminary working products, writers emphasize particular cognitive processes, but not others. For example, recall from memory, representation, clustering, associating, and noting simple superordinate/subordinate relations are favored during exploration; sustained linguistic encoding, building large abstract plans, and close analysis of text are not.

Thus, a cognitive mode is a particular way of thinking that writers engage in order to accomplish a particular *goal*, that will be realized by producing a particular kind of *product*, drawing on particular cognitive *processes*, in accord with a particular set of *constraints*.

Products. Different cognitive modes encourage different forms of representation - words, phrases, notes, diagrams, outlines, continuous prose, etc. Some products eventually become part of the final written document. Some do not. Those that do not are considered intermediate products and serve as stepping stones on the path from early, inchoate thinking to the final, refined document. In some cases, the product of a mode is intangible (as it is for our colleague who plans her papers in her head without benefit of notes), but more often writers feel the need to make a physical record of their thinking in order to aid their fragile memories.

Processes. In different modes, writers favor different cognitive processes. For example, in exploration mode, the major cognitive processes are retrieval of ideas from long-term memory and representation of those ideas in physical form. In another mode, the major cognitive processes involve constructing integrated hierarchical structures composed of many subordinate/superordinate relations. In still another, a linguistic encoding process might transform words or phrases that represent ideas into sentences that express them. Thus, different cognitive

processes operate on different cognitive products to generate them or to transform them from one kind of product to another.

Goals. The goals for a mode represent the writer's intentions in adopting a particular way of thinking. For example, the goals for exploration are to externalize ideas and to consider various possible relations among small groups of ideas. Writers realize their goals by producing particular products - words, phrases, relational structures, etc. - using the particular cognitive processes favored in the mode.

Constraints. The constraints for a mode are the ground rules writers go by while engaged in that mode. For example, during exploration, writers avoid evaluating the ideas they generate in order to foster spontaneity and flexibility and to increase the pool of potential ideas. During organization, writers often insist that the set of relationships they generate take a hierarchical form. As writers transform an organizational plan into continuous prose, they engage the full set of rules and conventions associated with connected prose. During freewriting, writers require themselves to write continuously without editing the sentences they produce.

Although we have discussed products, processes, goals, and constraints individually, writers experience them *whole*. When writers enter a particular mode of thinking, they do so in order to achieve a particular goal, that will be realized by producing one or more products of a particular kind, using specific cognitive processes, in accord with a particular set of constraints. Thus, each mode determines the kinds of objects that can be conceptualized, the kinds of relations that can be formulated, and the form of the final conceptual construct that can be produced in that mode of thought. It is the particular, interdependent combination of these constituents that give specific modes their particular quality - change the *combination* and the mode changes, along with its utility for accomplishing a particular goal.

Experienced writers use the various modes in accord with global strategies. But they also switch modes for tactical reasons that arise during the course of the work. By global strategy, we mean the writer's overall plan to engage a certain sequence of modes in a specific order. By tactics, we refer to the fact that the writer shifts from one mode to another in response to specific problems that occur or to changing conditions in the writing context. For example, as Hayes and Flower noted, writers may return to exploration mode when they realize during writing that their plans are inadequate. Thus, modes help writers focus their attention on one set of activities at a time, while strategies provide them with an overall sense of direction as well as the means to resolve problems that arise during the process.

When writers use cognitive modes in accord with a global strategy, they are likely to produce a series of related intermediate products. For example, during exploration some writers represent concepts externally, cluster them, and then link them into a loose network of associations. During organization, they transform that loose network of ideas into a coherent structure for the document. During writing, the individual concepts and relations in the organizational plan are transformed into continuous prose, graphic images, or other developed forms. During editing, they refine the structure and expression of the draft document. Thus, writers produce a *flow* of intermediate products in which the output of one mode becomes the input for another.

However, this flow of products is not one-way and continuous. Rather, as writers shift modes iteratively and recursively to solve problems, the flow of intermediate products goes back and forth, as well. For example, writers may find while organizing that they do not have critical information needed for a particular section. Rather than interrupt their thinking to get that information, they may elect to continue but leave the section undeveloped. Later, when the missing information is available, they may interrupt their writing, revert to organization or perhaps even exploration mode, and build the missing portion of the document's structure. When the missing piece has been filled in, they resume writing.

Analogy

In the preceding section, we described cognitive modes and strategies in the abstract. Here, we offer an analogy to give the reader a more concrete feel for them.

Think of a mode as a room where you go to work on a project. Since you have multiple modes, you have multiple workrooms. Each room is set-up to help you work on a particular part of a project - planing, cutting out the pieces, assembling them, finishing them, etc. Thus, you enter each room for a purpose - the *goal* - which is to take the work-in-progress one step further toward completion. Each room is equipped with particular tools appropriate for the kind of work done in that room - these are the cognitive *processes* associated with the mode. The materials you use those tools to work on are the (intermediate) *products* associated with the room. The material may be contained within the room or you may bring an unfinished product into the room in order to make the kinds of changes to it that are best done there. While each room offers a context and a set of specialized resources, at the same time each room also limits your possibilities. It is suited for some purposes but not others. These limits are the *constraints*. Thus, each room/mode is associated with a particular purpose/goal, each includes a particular set of tools/processes that can be used to build or to make changes in a particular kind of object/product, and each limits/constrains the type of work that can be done there.

Now think about how and why you change rooms. Sometimes you leave one room and go to another because you have finished that portion of the task; you've finished making the particular kind of changes to the work-in-progress for which the room is intended The room you go to next is determined by your overall sense of the steps in the larger task you are working on. This kind of change is *strategic*.

Sometimes you change rooms to solve problems that come up. For example, suppose some part of the object/product you designed and built earlier proves at this stage of the project not to work. You go back to the room where you first constructed that piece. Or perhaps you didn't have the raw materials earlier to build the piece you now need. You leave what you are doing to go and build the missing piece. These kinds of changes are *tactical*.

In the following section, we describe two of the many global strategies writers use.

Specific Modes for Writing

The two authors of this paper use very different writing strategies. Smith uses a variant of the plan-write-revise strategy, which he calls the "strategic method" (J.B. Smith & C.F. Smith, 1987). Lansman, a follower of Peter Elbow, uses what she calls the "write-first method," which draws heavily on freewriting (Elbow, 1981; Lansman, 1991. See also Becker, 1986; Green & Wason, 1982; Wason, 1980.) In the following section we describe each strategy as a series of modes. The point we hope to make is that two very different strategies can both be described within the modes framework. Keep in mind that for us, as for almost everyone we know, writing a text is a messy process which seldom proceeds according to plan. We will not describe the detours and sidetrips that are inevitably involved. Rather, we outline as accurately as we can the general strategies that we use and leave to your imagination the obstacles that can arise and the tactics we use to overcome them.

Smith's Strategic Method

Exploration. Smith uses an exploration mode to gain a general sense of the material available for the document. During exploration he retrieves ideas for the text from memory and from source materials, writes them down as short phrases, clusters them and notes specific relations among them. Smith often writes phrases on "post-its" and clusters the post-its to represent the relationships between ideas. Other writers may express their ideas as rough sentences and link these sentences with arrows. The products of exploration mode are always intermediate, i.e., these products do not show up directly as part of a draft. There are no constraints on the form

of the products of exploration. Ideas need not be expressed in complete sentences nor organized hierarchically. There is, however, a constraint on the process: Smith avoids evaluating the ideas that come up during exploration; he simply records them.

Situational Analysis. Smith uses situational analysis to identify aspects of the rhetorical situation that affect the text. For many writers, situational analysis is not a separate mode, but, rather, permeates thinking throughout the writing process. But Smith prefers to devote one or more blocks of time to situational analysis as a separate activity. As was the case for exploration, there are few constraints on the products of situational analysis. These products include notes, lists, and diagrams that represent what is known or assumed about potential readers. These products are intermediate and are used to guide decisions made in other modes. During situational analysis, Smith envisions potential readers, establishes priorities among them, imagines what readers know about the subject matter and decides how he would like the text to affect them. Situational analysis allows Smith to make consideration of context a conscious conceptual process.

Organization. The goal of organization mode is to develop a single, coherent structure for the text. Smith uses the ideas and component structures produced in exploration mode as the raw materials for organization mode. He groups sets of ideas under their logical superordinate headings, generating those superordinate concepts when necessary. He breaks other ideas down into their components. He experiments with various organizational schemes to determine which one fits the rhetorical goals he has developed during situational analysis. The processes required by organization involve examining the logical relationships between ideas. The product, for Smith, is a hierarchical structure containing three to four levels of topic headings. The organizational process is constrained by the requirement that the result be a single organizational scheme which includes all the major ideas that are to appear in the text.

Writing. In writing mode, Smith translates the ideas in the organizational scheme into sentences. The product is a rough draft. Both the organizational scheme and the rules of English grammar constrain that product. While writers vary widely as to the quality of the prose they expect to produce in writing mode, Smith strives for a first draft that is grammatical and rhetorically suitable for the purposes established during situational analysis. But he anticipates making major structural and linguistic changes during the the editing phases.

Editing. Smith breaks editing down into three distinct cognitive modes. During **global editing**, he addresses the large-scale structure of the document. The purpose is to make sure that the document as a whole makes the right point, that the right parts are present, and that they are in the right order. The primary constraint is that attention be focused on the high-level, structural features of the document and that the details be ignored. During global editing, Smith evaluates large-scale relations, notes logical inconsistencies among the parts of the document, and corrects or manipulates these large, structural components. The product is a refined version of the document - one that has a sharper central focus than the original draft and one in which the large components fit together more comfortably.

During **coherence editing**, Smith shifts his attention to intermediate-sized units of the text - paragraphs and sections. The purpose is to examine the logical, sequential order of, first, the paragraphs within sections and, then, sentences within paragraphs. The primary constraint is again the focus of attention on units of a particular size. Cognitive processes include evaluating coherence relations and restructuring paragraphs to make relations clear. Some sentences may have to be transformed or rewritten to make them fit together. The product is a document in which the sentences and paragraphs have clear, logical relations to one another and advance the larger purpose of the section they comprise.

Expression editing represents still a different mode of thinking. Whereas coherence editing is concerned with sentences as discrete objects to be verified and arranged, expression editing is concerned with the insides of sentences - their clarity, directness, and appropriateness for the rhetorical purposes of the document. Thus, expression editing requires close attention to linguistic detail. The processes emphasized are reading, linguistic analysis, linguistic

transformation, and linguistic encoding. The product is a more refined document - one with crafted prose.

Lansman's Write-First Strategy

Freewriting. Lansman uses freewriting to begin a paper or section. Her freewriting mode is much different from Smith's writing mode. During freewriting, Lansman writes continuously without stopping or editing for periods of 20 minutes to an hour. The result is a very personal and informal text consisting of (fairly) grammatical, connected sentences. (Lansman does not consider grammaticality and connectedness to be conscious constraints on freewriting, only accidental by-products of the process.) Little of her freewriting is included in a finished draft. Her goal in freewriting is to find out what she wants to say in the paper. She considers freewriting to be a more useful starting point than the lists or structures produced in Smith's exploration mode.

Distillation. When she finishes freewriting, Lansman reads what she has written and underscores the major points. She then rewrites the points she has identified as individual sentences and arranges those sentences to form a meaningful sequence. As she does this, she also extracts the central point of the paper and states that point as a single sentence. The goal of distillation mode is to establish the central theme and the structure for the paper. The constraints are that the points be stated in sentences and that the order makes sense.

Sketching. Lansman sometimes uses the list of points as the basis for a fuller sketch of the paper. In the sketch, each point is elaborated into several sentences. Equally important, the transitions between the points are developed. The goal of the sketch is to show the shape of the paper.

Writing. On the basis of either the distilled list or the sketch, Lansman writes a draft. The draft is written in a rhetorical style that is appropriate for the purposes of the paper. Although few sentences from the freewriting are directly quoted, the ideas that were generated during freewriting provide a foundation for the draft. *Writing* mode is quite similar for Smith and Lansman. However, Lansman frequently interrupts *writing* to revert to *freewriting* in order to clarify her ideas and relax her style.

Cooperative Editing. As she finishes parts of the draft, Lansman reads them to her writing group for their reaction. When they miss the point, she moves back into writing and/or freewriting mode to rewrite the entire section.

Expression Editing. Expression editing is similar for Smith and Lansman.

We have sketched these two different writing strategies to show that the mode concept be applied to a variety of writing practices. In the section that follows, we distinguish between three concepts: a framework which provides a way of talking about writing and other productive tasks; a model, which describes a particular strategy within that framework; and a paradigm, which recommends one strategy over others.

Architectural Components, Models, and Paradigms

The concept of cognitive mode can be applied beyond the domain of writing. In a range of creative or productive activities, individuals divide tasks into subtasks, set goals and subgoals, produce intermediate objects or subassemblies, and employ different processes during different phases of the work. They do these things whether they are working with physical objects or with information objects. The modes framework specifies in a general way the *architectural components* - modes - of productive human activities. Different tasks draw on different modes, but many of them can be understood within the general framework of modes and strategies. In order to talk about cognitive modes in this more general way, it is useful to distinguish between two additional concepts.

A *model,* as we use the term, is a particular system of components and the rules that account for the relationships among those components. A model of writing based on modes would include particular modes - those that particular writers use under particular writing conditions - and the particular strategies and tactics used by those writers. The *strategic method* and the *write-first method,* described above, are examples of writing *models.* But to be complete, the strategy and tactics of the model should be expressed in rules precise enough to explain the particular conditions or factors that cause writers to shift from one mode to another.

A *paradigm* is similar to a model but carries with it the assertion that one particular system of modes and strategies is desirable and/or appropriate. Thus, when writing teachers devise and recommend a particular approach to writing, they are presenting a paradigm of the writing process - one that does not necessarily describe "natural" behavior but one that is advocated in the belief that it is better than the writer's current approach.

While the idea of a modal architecture is general, specific modes are learned and/or developed. Consequently, we should not be surprised to see different groups of writers using different sets of modes. Some sets, it can be argued, are preferable to others because they are more efficient or suit certain groups of writers better than other sets. Research is necessary to determine exactly which modes and strategies are commonly used by successful writers. In the section that follows, we will sketch such a program.

Implications for Research

The modes framework has evolved out of our research on writers' cognitive strategies and on computer tools to support them. Over the past seven years, we have built a computer system, called the Writing Environment, that supports writers not only in writing and revising text, but also in generating and organizing their ideas and in revising the structure of the text (J.B. Smith & Lansman, 1989; J.B. Smith, Weiss, Ferguson, Bolter, Lansman, & Beard, 1987). The design of the system is closely tied to Smith's Strategic Method, described above (J.B. Smith & C.F. Smith, 1987). The Writing Environment has four *system modes,* each of which supports a particular set of cognitive modes. Thus, Network Mode supports exploration, Tree Mode supports organization and global editing, Edit Mode supports writing and expression editing, and Text Mode supports coherence editing. Currently, the system does not support situational analysis, although further versions could.

The Writing Environment also records writers' activities by generating *machine-recorded protocols* that are analogous to think-aloud protocols. A number of computer-based analysis tools have been developed to analyze these protocols (J.B. Smith, D.K. Smith, & Kupstas, 1991). For example, we can replay a writing session, recreating on the computer screen the activities of the writer; we can display graphically the pattern of alternations among the system modes; and, using a grammar written as an augmented transition network, we can parse the sequence of operations employed by the writer.

We have used the Writing Environment in several studies of adult writers. In these studies, writers ranging from advanced undergraduates to experienced technical writers were brought into the lab and taught to use the Writing Environment. They were then asked to write one or more articles on assigned topics. Using their computer-generated protocols, we addressed specific questions about writing strategies (Lansman, J.B. Smith, & Weber, 1990).

Building computer systems based on a specific theory of writing and developing a formal grammar to infer writers' cognitive processes and strategies from their actions have caused us to think hard about the writing process. We have been forced to state our assumptions precisely and to test those assumptions not only against our computer-generated protocols but also against the observations made by our subjects and against our own experience as writers. In the remainder of this paper, we will describe several directions this work is now taking us.

From the beginning, we believed that writers used different modes of thinking as they wrote - that they analyzed their audience, generated ideas, organized ideas, composed sentences, revised, and so on. And we knew, based on Hayes and Flower's work as well as our own, that they did not necessarily employ these different modes of thinking in a strict plan-write-revise order. But our concept of modes of thinking was much narrower then than it is today. Over the course of our research, we came to realize that the number of modes writers use and the strategies by which they combine them is much broader than we had originally thought. While the Writing Environment fits some writers' strategies quite well, it does not support others'.

We have also realized that the strategies writers use when writing on assigned topics in the lab may be quite different from the strategies they use when they are writing as a part of their own work. Many of the subjects in our studies have complained that they would not have submitted the assignments they wrote during our experiments as finished work. They would have spent much more time working on them. Their writing strategies were distorted by the requirement that they complete their work in one afternoon. Thus, we were forced to acknowledge, to a greater degree than we had before, the impact of context on writing strategies.

Our experience developing and using the Writing Environment has led us to elaborate the modes framework. The modes framework, in turn, has led us to advocate a two-pronged approach to research. One broad research goal is to find out what modes of thinking adult writers use and how they combine them. A second broad goal is to understand the specific cognitive processes *within* individual modes of thinking. We offer an analogy to make the distinction clearer.

Describing how people write can be compared to describing how they move. Imagine trying to use empirical research to arrive at a single model that encompasses walking, jogging, swimming, bicycling, etc. The task seems impossible. But it might be approached by two very different types of research. Observations and interviews might reveal what *modes* of movement people use and what they use them for. Some jog for daily exercise, walk to work, and bicycle on week-ends. Others bicycle to work and walk to get from one place to another at work, etc. Modes of movement would vary across individuals and contexts. At a more detailed level, controlled experiments might reveal the nature of physical movement *within* individual modes of movement, e.g., how people use their muscles during jogging. Here there would also be individual differences. For example, different people put their feet down differently during jogging. But at this more detailed level of analysis there would be more opportunity for generalization. For all joggers, certain leg muscles contract during certain phases of the stride and other muscles contract during other phases.

The two-pronged approach we are recommending for the study of writing is analogous. Observational studies of adult writers would tell us what modes of thought they use during writing and how they combine these modes. For these studies it would be essential that writers be working in naturalistic settings on their own projects. On the other hand, controlled experiments could answer detailed questions about cognitive processing within modes. These studies might be done in the laboratory.

An Observational Study of Adult Writing Strategies

Observational studies of writing take many forms (Calkins, 1985). To get an idea of the kind of observational study we have in mind, imagine the following scenario. The subjects in the study are experienced professionals writing papers, reports, or other texts as part of their work. Each writer is followed from the conception to the publication of one such text. If writers normally use computers, their computer-based activities are automatically recorded. Each time a writer "shifts gears", she presses a button on a computer or tape recorder. The machine automatically records the date and time, and then cues the writer to talk about her recent activities. In addition, writers save all handwritten products, noting the date and time they were created. The goal is to generate for each writer a detailed history of one text.

How would the data from such a study be analyzed? We have asserted that adult writers break the writing process down into a series of distinct activities, which we have called *cognitive modes*. The data would be used to assess the usefulness of the concept of cognitive mode in describing writers' strategies and to find out what specific cognitive modes writers use.

As we analyzed the data, the main challenge would be to specify what constitutes a distinct cognitive mode and to determine when mode shifts occur. Evidence for modes shifts would come from several sources: from the objective records of the writing process, from verbal reports, and from pauses and breaks. The most obvious indication that a mode shift had occurred would be that the nature of the product changed, e.g., from unconnected words and phrases to connected text. Another objective indication would be that the process changed, e.g., from creating a sequence of sentences, one following the other, to moving text around.

In addition to objective evidence of changes in product and process, verbal reports could be used to determine where mode shifts had occurred. Especially relevant would be writers' statements concerning their goals, e.g., "That's as far as I can go with the outline. Now I have to start writing."

A final source of evidence concerning mode shifts would be breaks and pauses. We would expect breaks and pauses to be more likely at shifts between modes than within a single mode.

Agreement between objective records of product and process, verbal reports, and pauses would constitute evidence for the validity of the modes framework. But even with all these sources of information, the decision as to whether a mode shift had occurred would at times be ambiguous. For example, as we write this paragraph, we shift back and forth between writing and editing. Are we shifting back and forth between two different cognitive modes, called *writing* and *expression editing*? Or is there a single mode that might be called *writing with editing*? Such dilemmas might be resolved by using a hierarchical set of modes. At the higher level of the hierarchy would be the large scale mode, writing with editing. Each writing with editing episode could then be broken down further into separate, but related, *writing* and *editing* episodes.

Having established that we could, indeed, describe individual writers' activities as a series of cognitive modes, our next task would be to look at the data across different writers. Which cognitive modes did writers share, and which were idiosyncratic? Is it possible to classify strategies into groups, e.g., *organize-first* strategies vs. *write-first* strategies (Lansman, 1991).

Studies of Cognitive Processing within Modes

The controlled studies we envision would explore in detail the cognitive processes that take place within particular modes. These studies could take many forms. To get an idea of what we have in mind, consider some possible studies of how writers compose sentences in *writing* and *freewriting* modes.

Cognitive theorists often assume that generating meaning and generating words are separate processes (Bereiter & Scardamalia, 1987; Hayes & Flower, 1980). According to these cognitive models, the writer generates an idea, and then, mindful of the constraints imposed by the particular writing task, translates that idea into words. Theorists who emphasize the importance of context disagree (Nystrand, 1986). To write is to communicate, they argue. The communicative intent, the projected audience, the meaning to be communicated, and the words that express that meaning are inseparable.

Investigating the differences between *writing* and *freewriting* modes seems a promising way to look at this issue. Under normal conditions writers spend a large fraction of their writing time pausing - 2/3 according to Gould (1980). During freewriting, on the other hand, writers try not to pause. How are the cognitive processes of writers changed when they attempt to eliminate pauses? One interesting hypothesis is that during freewriting, as compared to "normal" writing, generation of meaning, translation of meaning into words, and recording of words are merged into a single process. According to this hypothesis, writers use pauses to generate the meaning of

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subsequent text and to translate that meaning into words. Pauses allow writers to carry out these activities sequentially. When pauses are shortened or eliminated during freewriting, writers are forced to combine these processes or carry them out in parallel.

A variety of experimental techniques could be used to evaluate this hypothesis. Matsuhashi (1982) has argued that writers use pauses between writing episodes to plan their texts. She observed a different pattern of pauses when her student subject was reporting a sequence of events than when he was writing a more abstract essay. She argued that long pauses between sentences of the essay reflected reprocessing of information retrieved from memory. The shorter pauses within sentences of the report reflected syntactical decisions. How would the pauses of freewriters differ from those of writers? We can assume that freewriters' pauses would be less frequent and/or shorter. But would the pattern of pauses be the same as for writers using more conventional techniques? An initial study of the patterns of pauses within *writing* and *freewriting* modes would be a starting point in comparing the cognitive processes of writers and freewriters.

Using Kellogg's (1987) probe technique, we might present a tone during randomly chosen pauses. At the tone, writers and freewriters would be instructed to report what they were doing during that pause: rereading previously written text, thinking about the topic in general, thinking about what they wanted to say next, generating the words they were about to write, or something else. We would again ask whether the pattern of responses was different for writers and freewriters.

Bereiter and Scardamalia (1987) discuss a study done by Bereiter, Fine, & Gartshore (1979) in which children were interrupted in the middle of writing sentences and asked to report any words they had generated and were about to write. The children reported an average of 4-5 words. Similar techniques could be used with writers engaged in *writing* and *freewriting* modes. If pauses are used to generate the text the writer is about to record, then freewriters, who presumably pause less than others, may report fewer planned words than writers using more conventional techniques.

In Bereiter et al's study, there was also a slight tendency for the words children actually generated to be more formal in style than the words they reported they were about to write. Bereiter and Scardamalia speculated that the changes might be due to an internal Monitor that operated "at the point of utterance." One of the avowed aims of freewriting is to suppress this kind of monitor (Elbow, 1981). Thus we might expect fewer differences in the direction of increased formality for the freewriters than the writers.

Critics of an experimental approach will argue that nothing can be learned from the studies outlined above if writers who participate are taken out of the contexts in which they normally write. Ideally, experimenters would descend on a writer who was engaged in writing or freewriting as part of her ordinary writing routine and enlist her help in an experiment. They would record pauses, present probes, and use other experimental techniques right there in the writer's office or study while the writer continued to use her accustomed materials and tools. Such an ideal is unlikely to be fully realized. But we can approximate it as closely as possible and hope that deviations will have only small effects.

Computer Support for Modes

Commercially available word processors provide only a single *system mode*. They support a single representation of the text and a single set of operations on that representation. These programs support several of the cognitive modes discussed above: writing, coherence editing, expression editing, and freewriting. An additional feature, an outliner, has been added to some commercial word processing system. The outliner, by allowing the writer to generate outline headings and attach text to those headings, is supposed to help writers structure their texts. But even with outliners, word processors do nothing to facilitate many kinds of thinking that writers

use. Consequently, many writers go back and forth between paper and pencil and their word processors as they write.

In an effort to improve on the conventional word processor, we developed the Writing Environment. The most important difference between the Writing Environment and the typical word processor is that the Writing Environment offers four distinct system modes. The four system modes are represented by four separate windows on the computer screen. Each one allows the writer to work with a different representation of the text. Thus in the design of the Writing Environment, we explicitly acknowledged the fact that writers engage in distinct modes of thought as they write, and that these modes of thought involve different processes, products, goals and constraints.

The Writing Environment by no means exhausts the capabilities of the computer to support the cognitive modes writers use. We can imagine, for example, a computer writing tool that would be much more compatible with Lansman's Write-first strategy. Using this tool, the writer could begin by freewriting in a system mode that looked very much like the conventional word processor. As she read through her freewriting, she could bracket important blocks of text and summarize these blocks in a series of single sentences - the basic points to be covered the the text. The sentences would reside in a separate system mode, but would be linked back to the blocks of freewriting that inspired them. In this second mode, the sentences could be moved around freely, much as nodes are moved in the network mode of the Writing Environment. Having decided on a good order for the sentences, the writer could then write a structured draft based on the sentences, drawing when appropriate upon the blocks of freewriting to which they were linked.

The theory of modes gives us a way to think about the relationship between writers' strategies and the computer tools that support them. In designing a new computer program for writers, we need to ask what modes of thought that program will support and how it will support them. What cognitive processes are tied to what system functions? How are the products of those processes represented? How does the program constrain the user? How are intermediate products that are developed in one mode moved to another mode for further work? We believe that designers should give explicit thought to the relationship between cognitive modes and system modes. Ideally, research will reveal which cognitive modes are most often used by successful writers, and computer tools will be developed which support all those modes.

A crucial issue in the design of such computer tools would be the design of the transitions between system modes. In MS-WORD, the two system modes - outliner and word processor - appear in the same geographical location on the computer screen. To switch between them, the user simply turns the outlining function on or off. In the Writing Environment, the different system modes are represented in separate locations on the screen. There are advantages and disadvantages to both systems. In the network mode of the Writing Environment, *nodes* representing ideas or topics can be moved freely around the screen, but finally must be copied out of network mode into tree mode to create a neat hierarchical structure. In the outliner, there are limitations on the movement of topic headings, but the user is saved the inconvenience of copying. Research might show us which transitions are crucial and how best to facilitate them.

Another issue is representation. To us, it seemed important that writers be able to move ideas around in the two dimensional space of the screen in order to explore the relationships among them. Participants in our experiments agreed. On the other hand, no computer program that we know about has succeeded in giving the user as good a "feel" for the totality of a text as a stack of printed pages.

Conclusion

Since the advent of the process approach in the study of writing, researchers have been striving toward a model of the writing process (Flower & Hayes, 1981; Faigley, 1986). But we have had a hard time figuring out what such a model should look like. Our ideas about cognitive

models have been strongly influenced by the information processing tradition in cognitive psychology. Within this tradition, the analogy between the human information processor and the computer is very powerful. The person is seen as receiving *input* from the environment, processing the information in that input, and generating an *output* in the form of a response. The input and output can take many forms. The input may be a paragraph and the response a summary; or the input may be a problem and the response a solution. But for almost all the experimental tasks used by cognitive psychologists, it is possible to specify clearly the beginning point (input) and the end point (output) of the task, and it is possible to interpret the activities of the experimental subject as a series of processing steps leading from one point to the other. Furthermore it is possible to argue that these steps would be roughly the same whether the subjects were carrying them out in the experimental laboratory or in a more naturalistic setting.

Writing is simply not this kind of task. In writing, the end points are not well-defined. It is impossible to identify the specific input for the task of writing a text. Is it the writer's domain knowledge, the conditions for professional advancement, the need for self-expression? We can define the output as the final text, but that output is infinitely variable and difficult to measure or classify. Most important, it is impossible to specify the processing steps that the writer goes through in writing the text. The process varies between contexts and between individuals. We cannot assume that adults writing on an assigned topic in the laboratory will follow the same procedure as those same adults writing papers in their own fields of expertise. And we cannot assume that one writer's strategy is similar to another's.

We need another paradigm for the study of writing. In this paper, we have suggested the idea of cognitive modes as an alternative to the more standard information processing analogy. We have argued that experienced writers use a series of different modes of thought as they write. Each mode has its own set of cognitive *processes, products, goals,* and *constraints.* Although the particular sequence of modes that an individual writer may use is infinitely variable, within a mode there may be identifiable similarities between writers. Thus, we suggest a two-pronged approach to research on writing. At a macroscopic level, observational research might reveal what modes are commonly used by experienced writers and how they are combined. At the microscopic level, experimental research might reveal the cognitive processes engaged by writers within individual modes.

The type of research we have described would lead to a more complete theory of cognitive modes in writing. The development of the modes concept could benefit the field of composition studies at both a theoretical and a practical level. At the theoretical level, the history of composition theory is often described as a series of "approaches" - the "product approach," the "product approach," and, most recently, the emphasis on context. The concept of cognitive modes suggests a way to integrate these approaches. *Process* and *product,* in combination with *goals* and *constraints,* are integral pieces of the modes concept. *Context* is a critical determinant of the sequence of modes that will be used by a writer. At a practical level, the modes concept could lead to theory-based computer systems to support writers.

Acknowledgments

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