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Introduction: What Is an Ecology of Composition?

The real lesson to be learned from the principle of complementarity, a lesson that can perhaps be transferred to other fields of knowledge, consists in emphasizing the wealth of reality, which overflows any single language, any single logical structure. Each language can express only part of reality. Music, for example, has not been exhausted by any of its realizations, by any style of composition, from Bach to Schönberg.

—Ilya Prigogine and Isabelle Stengers,
Order Out of Chaos: Man's New Dialogue with Nature

Introduction

- In 1929, Charles Reznikoff, the objectivist poet, published *Family Chronicle*, which included a story of his mother's life, his father's life, and his own life in New York's garment district. In 1932, he published an autobiographical novel, *By the Waters of Manhattan*. In 1962, he published an autobiographical poem, "Early History of a Writer." Who wrote these texts?
- In 1989, three college students collaborated to write a single essay in a first-year writing course at a prestigious university. In spite of clear instructions, an intelligent and well-organized composition textbook, good advice from fellow students, ample opportunities for revising, and conferences with the instructor, the essay was disappointing. Why?
- In 1991, a collegial group of social scientists sharing ideas in a computer forum became embroiled in a bitter conflict about the Gulf War, a conflict that threatened to destroy long-standing research partnerships and nearly terminated the group. Three months later, members of the same group enthusiastically contributed to a conversation about refrigerator doors as family communication centers, which ultimately formed the chapter of a book. How?
- In spite of a vast body of research dating back at least to 1890, in

spite of the best intentions of talented instructors, in spite of large-scale institutional commitments to composition programs, and in spite of an unprecedented publishing boom for composition textbooks, manuals, style guides, and anthologies, there is no evidence that students are writing, reading, or thinking better than at any time in the past. What are we missing?

This book is an attempt to address these questions by taking a new look at composition with three questions in mind:

- Why are our present accounts of composing inadequate to answer the questions above?
- How might we develop a richer, more comprehensive theory of composing?
- On what grounds could we argue that such a theory has greater explanatory power than existing accounts?

To address these questions, we will need to consider a different unit of analysis in our studies of writers, texts, and audiences: an ecology of composition. To support and develop this approach, this study draws on current research in fields as diverse as biology, physics, communications, cognitive science, philosophy, and economics; and it suggests how theories developed in these fields might enlarge our understanding of composing. Much of this research focuses on a set of concepts that are generally grouped under the working term *complexity* or *complex systems*.¹ This interdisciplinary effort could be very productive for composition studies: biologist Henri Atlan argues that interaction between seemingly disparate disciplines, with different classification schemes, theories, and methods is crucial in developing new knowledge: “[T]he frontiers of knowledge are found not only, as is often believed, in the very small or the infinitely large, but in the articulations between levels of organization of the real that correspond to different fields of knowledge whose techniques and discourses do not overlap” (qtd. in Paulson 109).

This introduction will define an ecological system as composed of numerous interrelated complex systems, introduce some central principles emerging in studies of complex systems, and explain generally how these principles might be applied to situations involving writers, texts, and readers. This study represents an initial, exploratory attempt to describe what such an ecology of composition might reveal

about writers, readers, texts, their environments, and the dynamic process of composing.

The case studies in the chapters that follow analyze in greater depth three specific examples of actual writers and composing situations, including a well-known objectivist poet composing an autobiographical poem, a group of objectivist college students working on a collaborative essay, and a computer forum of social scientists conducting research on learning and development. These cases will allow us to explore the potential for applying theories of complex systems in rhetoric and composition studies, and to suggest their generalizability across diverse composing situations.

What exactly do we mean by *ecology*? And what is a *complex system*? Although these two terms are often used interchangeably by researchers, I would suggest that an ecology is a set of interrelated and interdependent complex systems; and on this basis, we first need to understand what a complex system is in order to define an ecology.

Complex systems have been proposed as an explanation for a wide range of puzzling phenomena, from the human immune system to the economics of the stock market to the rise and fall of a pre-Columbian city-state in the American Southwest, phenomena which share some surprising features. These systems have attracted serious research interest ranging across disciplines, from Nobel laureates (Murray Gell-Mann, Ilya Prigogine, and Philip Anderson in physics; Kenneth Arrow in economics) to graduate students. In a complex system, a network of independent agents—people, atoms, neurons, or molecules, for instance—act and interact in parallel with each other, simultaneously reacting to and co-constructing their own environment. Waldrop explains that in complex systems, the richness of these interactions allows the system as a whole to generate spontaneous self-organization:

Thus, people trying to satisfy their material needs unconsciously organize themselves into an economy through myriad individual acts of buying and selling; it happens without anyone being in charge or consciously planning it [on a global scale]. The genes in a developing embryo organize themselves in one way to make a liver cell and in another way to make a muscle cell. . . . Atoms search for a minimum energy state by forming chemical bonds with each other, thereby organizing themselves into structures known as molecules. In every case, groups of agents seeking mutual accommodation and self-consistency somehow manage to

transcend themselves, acquiring collective properties such as life, thought, and purpose that they might never have possessed individually. (11)

Complex systems are also adaptive, Waldrop points out, in that they do not respond to events passively, “the way a rock might roll around in an earthquake.” Rather, “they actively try to turn whatever happens to their advantage. . . . Species evolve for better survival in a changing environment—and so do corporations and industries” (11).

Finally, complex systems are dynamic, more unpredictable, spontaneous, and disorderly than a machine, more structured, coherent, and purposeful than utter chaos. “Instead,” Waldrop argues,

all these complex systems have somehow acquired the ability to bring order and chaos into a special kind of balance. This balance point—often called the edge of chaos—is where the components of a system never quite lock into place, and yet never quite dissolve into turbulence, either. The edge of chaos is where life has enough stability to sustain itself and enough creativity to deserve the name of life. (12)

There are examples of complex systems at every level of scale, from neurons in the brain to large-scale cultural and social systems such as academic disciplines or nations.

As I have mentioned, complex systems that function this way are the subject of a great deal of current research in a wide variety of disciplines.² The term has a specific technical meaning for these theorists; William Paulson, in *The Noise of Culture*, distinguishes complex systems from simple systems and complicated systems:

It is not hard to conceive of simple systems: a pendulum, a piston, a single logical operator at the level of bits in a microprocessor. We can understand fully the operation of such systems. Complicated systems, such as a clock, a car engine, or a home computer, can be fully understood as the interaction of their component parts, so that whereas knowing them requires much more of one’s time and patience, in principle nothing prevents us from explaining their operation just as fully as we can explain that of the simple systems of which they are made up. What distinguishes the complex system, on the other hand, is a discontinuity in knowledge between the parts and the whole. (108)

In other words, because such a system is self-organizing, adaptive, and dynamic, it is not possible to predict its behavior simply by understanding its parts and their relationship to each other; a complex system defies any attempt at a strictly mechanistic explanation.

I would argue that writers, readers, and texts form just such a complex system of self-organizing, adaptive, and dynamic interactions. But even beyond this level of complexity, they are actually situated in an ecology, a larger system that includes environmental structures, such as pens, paper, computers, books, telephones, fax machines, photocopiers, printing presses, and other natural and human-constructed features, as well as other complex systems operating at various levels of scale, such as families, global economies, publishing systems, theoretical frames, academic disciplines, and language itself. For my purposes, then, an ecology is a kind of meta-complex system composed of interrelated and interdependent complex systems and their environmental structures and processes. And my principal question is this: Can the concepts currently emerging in diverse fields on the nature of complex systems provide us with a new understanding of composing as an ecological system?

John Holland, a professor of psychology and computer science and a leading theorist of complex systems, uses the term *complex adaptive systems* to describe what I have termed an *ecological system* (Holland, “Complex”). That is, according to Holland, complex adaptive systems involve “great numbers of parts undergoing a kaleidoscopic array of simultaneous interactions.” Further, all of these systems involve a characteristically “evolving structure”: “these systems change and reorganize their component parts to adapt themselves to the problems posed by their surroundings” (18). According to Holland, complex adaptive systems share three characteristics: evolution, aggregate behavior, and anticipation. We say they evolve because, as time passes, the parts of the system attempt to improve the ability of their kind to survive in their interactions with the surrounding parts. The systems exhibit aggregate behavior that is not simply derived from the separate actions of its parts, but represents a globally coherent pattern that emerges from the interaction of the parts. And such systems also anticipate changing circumstances in order to predict what adaptations will be required. As Holland argues,

Because the individual parts of a complex adaptive system are continually revising their (“conditioned”) rules for interaction, each part is embedded in perpetually novel surroundings (the changing behavior of the other parts). As a result, the aggregate behavior of the system is usually far from optimal, if indeed optimality can even be defined for the system as a whole. For this reason, standard theories in physics, economics, and elsewhere [I might add composition studies], are of little help because

they concentrate on optimal end points, whereas complex adaptive systems “never get there.” They continue to evolve, and they steadily exhibit new forms of emergent behavior. History and context play a critical role, further complicating the task for theory and experiment. Though some parts of the system may settle down temporarily at a local optimum, they are usually “dead” or uninteresting if they remain at that equilibrium for an extended period. It is the process of becoming, rather than the never-reached end points, that we must study if we are to gain insight. (20)

In “Learning in the Cultural Process,” Edwin Hutchins and Brian Hazlehurst put it another way:

One of the central problems faced by biological and artificial systems is the development and maintenance of coordination between structure inside the system and structure outside the system. That is, the production of useful behavior requires internal structures that respond in appropriate ways to structure in the environment. The processes that give rise to this coordination are generally considered adaptive.

Biological evolution, individual learning, and cultural evolution can all be seen as ways to discover and save solutions to frequently encountered problems; that is, they are processes that generate coordination between internal and external structure. (689)

Let’s consider a prototypical example of composing: someone writing a book to explain a set of theories, such as this one. We think of this writing situation as involving a writer, an unfolding text, and a potential audience, a reader. The writer transfers “ideas” into written language, the actual text appears on a page, and the audience reads the text and receives the writer’s “ideas.” This, of course, is an extremely limited and partial view of the composing situation. In considering an ecology of composing, we would try to take into account the complex interrelationships in which the writing is embedded: the people and texts that form a larger conversation in which the writer, text, and reader participate and from which the “ideas” emerge to take written shape. We would consider the writer’s interaction with the environment, including the technologies for writing, the memory aids, the tools and instruments that help shape and support the writing. We would consider how the text takes shape as it emerges, how the writer interacts dialogically with the text not only through acting upon it but by responding to it and to its potential readers. We would situate the composing of the text in a nexus of complex social structures, ranging from the personal (the writer’s relationship to an editor,

a critic, or an academic colleague, for example) to the institutional (the system of publication for tenure, a corporate hierarchy, or a government funding agency, for example) and even global (a genre or an international computer network of scholars in a particular field, for example). We would also attempt to situate the writing in a historical complex, not only as an unfolding process marked by events such as first drafts, revisions, and so on, but within a larger discourse that is historically situated, and involving historically situated technologies, social relations, cultural influences, and disciplinary practices.

Further, we would take a similar approach to the co-construction of the writing process by readers, who are not merely passive recipients of the text in this ecology of composition but active constituents of it: situated, like writers and texts, in a physical, psychological, social, temporal, and spatial network of relations. Even in this extremely abbreviated overview, we can readily admit that such a view of the composing situation is indeed complex.

But it is not enough to simply stipulate that a system is complex. What features distinguish such systems? Recent work by Hutchins, as well as by Varela, Thompson, and Rosch, has provided a theoretical framework for this analysis of composing as an ecological system. I suggest here four attributes of ecological systems often overlooked by current composition theories: distribution, emergence, embodiment, and enaction. These attributes are currently gaining strength in theories of complex systems, such as cognitive processing.

Distribution

In complex systems, processes—including cognitive processes—are distributed, that is, both divided and shared among agents and structures in the environment. As Holland puts it:

A complex adaptive system has no single governing equation, or rule, that controls the system. Instead, it has many distributed, interacting parts, with little or nothing in the way of central control. Each of the parts is governed by its own rules. Each of these rules may participate in influencing an outcome, and each may influence the actions of other parts. (21)

Complex systems are also distributed across space and time in an ensemble of interrelated activities. Hutchins describes a classic example

in his ethnographic study of a navy navigation team (*Cognition*), an example that provides intriguing insights into composing situations.

In this study, Hutchins describes a navy navigation team guiding a ship into San Diego Harbor. On each side of the ship, seamen using an optical instrument called a *pelorus* are positioned to spot landmarks and determine their position relative to the ship. Their readings are recorded in a bearing record log by a third seaman and then relayed by telephone to the navigator, who places a one-armed protractor on a chart, indicating the ship's position relative to the landmark. A series of three bearings is taken, and the navigator inscribes a line on the chart for each one, producing a small triangle that signifies the ship's location. The navigator then calculates the projected path of the ship at its present rate and direction of travel and issues instructions for the time and landmarks for the next reading. This process is repeated at least every three minutes until the ship is safely at anchor or secured to a pier.

This example presents interesting challenges to our understanding of composing. For instance, which individual on this team is really doing the "writing?" Which individual "knows" the ship's position best? Whose knowledge is being represented in the writing? It is clear that in this example, the knowledge involved in "writing," inscribing the marks upon the chart, depends on activities and communication shared in interactions not only among people but also interactions between people and various structures in the environment, from physical landmarks to technological instruments to graphical representations. Composition researchers, by this analogy, have tended to focus their attention on the person inscribing the lines on the page, or on the nature or quality of the lines themselves, or on the activity of inscribing. Our theories of composing have been somewhat atomistic, focusing on individual writers, individual texts, isolated acts, processes, or artifacts.

Recent work in distributed and situated cognition by researchers such as Edwin Hutchins, Jean Lave, Charles and Marjorie Goodwin, Lucy Suchman, and Bruno Latour demonstrates the degree to which cognitive processes are not only dependent on social interactions but also determined by activities situated in specific environments. Situations such as scientific laboratories, ship navigation crews, courtrooms, and classrooms are complex cognitive systems, in which knowledge and practices must be coordinated among groups of people in a way that cannot be defined as contained in any individual mind; further, such knowledge and practices are dependent upon structures and pro-

cesses in the environment (including, for example, architecture, technological instruments and other cognitive artifacts, texts, institutions, and language itself) that are not merely the tools of cognition, but constitutive of it. Cognitive scientists have termed the operation of such ensembles *distributed* or *situated* cognition, and their work with these concepts has important applications in composition studies. *Distributed cognition* refers to the way cognitive processes are shared, that is, both divided and coordinated among people and structures in the environment. *Situated cognition* refers to the fact that cognitive processes are always embedded in specific social, cultural, and physical-material situations, which determine not only how cognitive processes unfold but also the meanings they have for participants. These two concepts, distributed cognition and situated cognition, are thus closely related and interreferential.

By privileging the individual writer composing in isolation, we have slighted or ignored compelling evidence that writing, like other cognitive processes, occurs in ecological systems involving not only social but also environmental structures that both powerfully constrain and also enable what writers are able to think, feel, and write. Some of these structures are naturally occurring: weather, animals, oceans, mountains, and forests, for example. Others are human constructions: buildings, computer keyboards, monitors, modems, software environments, notebooks, pens, desks, chairs, and so on. For example, teachers recognize the importance of the physical arrangement of a classroom. There is a difference between a room set up theater style, with all seats facing the teacher, and a room set up seminar style, with chairs arranged around a large conference table, or a room with smaller tables and clusters of chairs, and this difference alters the teaching and learning environment in nontrivial ways. Literary biographies abound with explicit and implicit references to the importance of the physical environment for writers: Ernest Hemingway liked to write standing up, pounding the keys of an old Remington portable typewriter; Robert Coover uses a computer equipped with a hypertext program called StorySpace to create new kinds of fiction; some writers insist on a certain pen, a specific kind of paper, a set of bound composition books, a particular arrangement of objects on their desks, and so on. They themselves provide much of the physical structure in their own environment: annotations in books, notes on scraps of paper, lists of sources, files of ideas and correspondence, computer files, phone numbers of colleagues, and tools, such as tape, staplers, rulers, scissors, and so on. Away from this familiar supportive envi-

ronment, writers think and write differently; when writing while on vacation or at a conference, for example, they may feel either stripped and helpless or liberated and refreshed.

The distribution of cognition in the chart room of a ship, a scientific laboratory, or a classroom is not simply a question of the spatial arrangement of people and environmental structures in a static field, however. Since the process of cognition, and composing, is a dynamic one, we must also consider how these complex processes emerge.

Emergence

In spite of its variety and complexity at almost every level, composition is not an entirely chaotic activity; neither is it a stable, perfectly ordered and predictable one. From a vast ocean of words, phrases, and ideas, writers continue to bring forth texts that organize themselves into more or less coherent and recognizable forms at every level of scale: metaphors, sentences, introductory chapters, lab reports, dissertations, detective novels, and so on. From an incredible range of writers producing mountains of texts, a few writers emerge as influential: the texts they produce not only provoke attention or interest among readers but generate a kind of following. Writers respond with new texts that reflect the influence; and when a certain threshold is passed, a literary movement, a genre, or a style develops genuine force and momentum through the more or less coherent activities of a large number of writers and readers. Or a new term gains widespread currency (*catch-22*, *Kafkaesque*, *antihero*), a character joins our cultural stock of types (Pollyanna, Don Quixote, Romeo, Scarlett O'Hara, Walter Mitty), an event becomes "historic" ("What are Caesar's battles but Caesar's prose?" asks Lyn Hejinian). These phenomena are examples of emergence.

The question that drove scientific research on emergence was a simple and familiar one: Why is there something instead of nothing? According to the second law of thermodynamics, in a closed system, entropy will increase to a maximum; over time, the system's ability to produce energy will steadily diminish. Yet through evolution, increasingly complex species have evolved; in nations, increasingly complex and global economic systems have evolved; and on pages and computer screens, texts continue to emerge. How can this apparent contradiction be explained? In their investigations of this puzzling mystery, researchers have theorized that complex systems display a kind

of energy for self-organization that seems to defy laws of entropy; they argue that such systems exhibit emergent properties.

Emergence refers to the self-organization arising globally in networks of simple components connected to each other and operating locally. Emergent properties have been proposed as the counter effect to entropy: they are tendencies toward self-organization, order, and structure that emerge from simple components that might be expected to exhibit either random, chaotic behavior or stable, predictable behavior—but that in fact, do neither. Yet, this order is not created or determined by a single, central master "executive" or "brain."

Hendriks-Jansen suggests that the concept of emergence has three different senses. The first, he writes, "amounts to a thesis about the hierarchical organization of entities and processes. It maintains that the properties at higher levels of organization are not predictable from properties at lower levels." In other words, complex systems cannot be adequately described simply by analyzing their simpler components. The second sense of emergence is historical: "This draws attention to the fact that simple traits and forms of organization give rise, in the course of evolution, to more complex and irreducibly novel traits and structures." Finally, Hendriks-Jansen suggests a third sense of emergence, which he calls "interactive emergence."

I shall argue on empirical and conceptual grounds that all behavior is situated activity, and all situated activity results from interactive emergence. Behavior cannot be adequately described in terms of events that take place inside a creature's head. It cannot be explained by rules that formalize neural activity or mental activity, for it comes into existence only when the creature interacts with its species-typical environment. (30)

This third sense of emergence incorporates the first two senses, and it is in this sense that the term will be used in this study.

Meaning, genre, irony, style, authority, credibility—these are all emergent properties in texts. So is the influence of a particular text or writer in a social, historical, or cultural situation. Emergent properties suggest that all of our classification systems are actually open-ended, explanatory theories rather than closed, deterministic containers. Novels explode into hypertexts, which begin to organize themselves into new genres: cyberpunk novels, literary interpretive webs, multi-authored fiction, and so on. However, the concept of emergence is not in opposition to entropy: it includes it. As new forms or agents emerge, others fall away, break up, dwindle down, rust, decay, or decompose

into either chaotic or stable states from which new forms emerge. What deconstruction breaks apart comes together again as elements of new texts—for example, journal articles by literary theorists. The “exhaustion” of postmodernism itself affords novelty.

Embodiment

Writers, readers, and texts have physical bodies and consequently not only the content but the process of their interaction is dependent on, and reflective of, physical experience. In *Reading Minds*, for example, Mark Turner makes the point that the physiological fact that humans are bilaterally symmetrical determines many of our fundamental concepts, causing us to perceive and interpret the world in terms of bilateral balance, binary oppositions, and other forms of symmetrical relations. Thus, we “naturally” construct argument as a battle between two opposing forces that seek a “common ground.” Mark Johnson and George Lakoff have also argued that our conceptual schemas and metaphors are grounded in our physical experiences. Since we are bounded by our skins, for instance, and experience the rest of the world as outside of us, we have developed a broadly deployed schema: “Each of us is a container, with a bounding surface and an in-out orientation. We project our own in-out orientation onto other physical objects that are bounded by surfaces. Thus we also view them as containers with an inside and an outside” (Lakoff and Johnson 29). The container metaphor is extended not only to physical space but to events, actions, activities, states, and other abstract entities, including writing situations.

The fact that humans share, to a large extent, similar experiences as a result of their physical being makes both language itself and its content comprehensible. But embodiment does not refer only to our conceptual structures and cognitive activities. Neither writing nor reading can be accomplished without physical activity: clasping a book, moving the eyes across a line of text, using the muscles of the hand, arm, and fingers to handle a pen or keyboard. The nature of that activity may vary: blind people read a text through touch rather than sight, a writer may use voice to dictate a text rather than manipulate a pen or a keyboard by hand. Still, such atypical activities only foreground the inherently physical interaction between writers, readers, and texts. One of the salient features of academic life is the massive suppression of awareness of this physical relationship. (Yet it is tacitly acknowledged in children’s books such as *Pat the Bunny* and its suc-

cessors, as well as in the kinesthetic pop-up books.) Feminist scholars have begun drawing attention to gendered constructions of writers and readers, but this research represents only one aspect of embodiment. The work with metaphors and schemas by Lakoff and Johnson and by Turner provide another piece of the puzzle. Philip Lieberman connects the evolution of language to biological adaptations of the tongue, mouth, and brain. Embodiment grounds our conceptual structures, our interactions with each other and with the environment, our perceptions, and our actions. Just recognizing that readers, writers, and texts are physically embodied, both in their structures and in their interactions is an important step, but it is not enough. To get a comprehensive understanding of composition, we need to understand how distribution, emergence, and embodiment are enacted through activities and practices in composing situations.

Enaction

Enaction is the principle that knowledge is the result of an ongoing interpretation that emerges through *activities* and *experiences* situated in specific environments. Lucy Suchman explains,

The *situated* nature of learning, remembering, and understanding is a central fact. It may appear obvious that human minds develop in social situations, and that they use tools and representational media that culture provides to support, extend, and reorganize mental functioning. But cognitive theories of knowledge representation and educational practice, in school and in the workplace, have not been sufficiently responsive to questions about these relationships. And the need for responsiveness has become salient as computational media radically reshape the frontiers of individual and social action, and as educational achievement fails to translate into the effective use of knowledge. (xiii)

Jean Lave, Michael Murtaugh, and Olivia de la Rocha have studied the activity of “supermarket shopping,” for instance, as an example of cognition in context; William G. Chase has studied how taxi drivers organize their knowledge of a city through their daily activities; Bruno Latour (*Science*) has studied scientific activity in laboratories. These are among many recent studies of situated activity, focusing on how cognition proceeds via the activities of participants in particular settings. But the concept of enaction goes beyond the notion of situated activity: Maturana and Varela define enaction as the principle that “every act of knowing brings forth a world” and “all

knowing is doing" (*Autopoiesis* 26). In our perceptions, thoughts, and actions, we are constantly engaged in "bringing forth a world." What exactly does this mean? Two examples might help demonstrate this underlying basis for the concept of enaction. The first example looks at visual perception, and the second example expands on the first to look at special cases of "seeing."

While we might argue about the correlation between language and "reality out there" or about different classification schemes for what we perceive, we generally believe that visual perception itself is unproblematic: in our commonsense model of "seeing," our visual apparatus passively receives the sensory information already existing in a pregiven world. Anyone who happened to be standing in the same place would see the same things because that person would be receiving the same input (in the form of light waves) from the "real world."

In a fascinating study that challenges this model of vision, Oliver Sacks wrote about a man who had his sight restored through an operation at the age of fifty after having been blind since very early childhood. He had functioned well as a blind man, working as a masseur at a YMCA, living independently in an apartment, and getting along capably in the world. We might expect that the restoration of his sight would provide him with wonderful experiences in which the world in all its visual splendor would be instantly and miraculously revealed to him. However, this was not the case. In fact, seeing became a devastating burden for him. In the first place, he found that he had to "learn" how to see, even though his sight was fully restored in the physical sense. The world was a confusing mass of colors, light and shadow, and motion, which he was utterly unable to interpret. He could not establish edges and boundaries, so he had to learn, painstakingly, for each object, to distinguish unities: a chair, a cat, a tree. (We take this kind of "figure-ground" perception quite for granted.) A set of stairs represented an incomprehensible jumble of intersecting colors and lines; he had to be assisted in climbing them, not just the first time, but over and over again. He had no sense of depth or distance; when he entered a room, the furniture seemed to be rushing toward him at a frightening rate, and he couldn't navigate his way through it. Paintings in perspective or a football game on television were visually incomprehensible to him. He could not tell the difference between his cat and his dog except by closing his eyes and feeling them. Further, the projection of perspective was impossible for him; at every change

of viewpoint, for example, a chair seemed an entirely different object. The cognitive effort of seeing exhausted him. Even worse were the expectations of his coworkers and friends; they assumed that he was fully functional "now that he could see." His work, once a source of deep satisfaction, now repulsed him as he became aware of the freckles, colors, and imperfections on the bodies of his clients.

This case demonstrates the remarkable degree of cognitive coordination we bring to the seemingly "natural" activity of seeing, and it reveals a great deal about our social and cultural expectations and assumptions about the nature of sight. Since much of this coordination is developed in infancy and very early childhood, we are unaware of the cognitive activity that is required simply to "see." It is not merely our interpretations of what we are seeing that are cognitively coordinated but the activity of seeing itself, as well as what is "seen." Vision is *enacted*—what we see is brought forth (*emerges*) through the coordination of our physical structure and our cognitive and physical activity.

Our vision is also socially and culturally coordinated, as Goodwin and Goodwin demonstrate in another example of enaction in visual perception. In "Professional Vision," they detail how novice archaeologists are socialized into their profession through activities in the field under the guidance of an experienced archaeologist. An important part of this process is learning how to "see like an archaeologist": to distinguish subtle differences in the color and texture of dirt, to discriminate changes in layers of dirt in an excavation, and to associate meanings with these distinctions. Goodwin and Goodwin refer to this process as establishing a "domain of scrutiny," which becomes the field of physical and social activities that creates a "disciplined way of seeing on the landscape they are investigating." They note,

Through systematic discursive procedures encompassing talk, tools, and writing practices [archaeologists] are able to transform events in that landscape into the distinctive objects of knowledge that become the insignia of their profession: the theories, artifacts and bodies of expertise that are its special domain of competence and set it apart from other groups. The same is true for lawyers, doctors, and linguists, all of whom transform the events that become the objects of their concern into the forms of knowledge that animate the discourse of their profession. (2)

This transformation is not entirely unproblematic, however; in the same report, Goodwin and Goodwin describe how jurors in the first

Rodney King trial were socialized into a particular kind of “professional vision” through the meticulous efforts of police “experts,” in which weapons became “tools” and an elaborate coding scheme for potential “aggression” justified police “escalation” or “de-escalation” of force. Millions of people saw the videotape of the incident, which was replayed many times on television, so theoretically they all “saw the same thing.” Yet jurors in the case came to *see* the tape very differently as a result of this careful instruction in “expert vision.” This example further refutes the simplistic model of vision as passive reception of a sensory stimulus and supports the argument that vision is a classic example of the principle of enaction. Although we are unaware of much of this activity, we are constantly and actively co-constructing our own sensory experiences in the world.

Now we must ask: What are the implications of enaction for our understanding of textual ecologies? Varela, Thompson, and Rosch suggest a possibility when they argue that cognitive capacities are “inextricably linked to histories that are *lived*, much like paths that exist only as they are laid down in walking.”

Yet another way to express this idea would be to say that cognition as embodied action is always about or directed toward something that is missing: on the one hand, there is always a next step for the *system* in its perceptually guided action; and on the other hand, the actions of the system are always directed toward *situations* that have yet to become actual. Thus cognition as embodied action both poses the problems and specifies those paths that must be tread or laid down for their solution. (205)

Texts are also “paths laid down in walking,” and they too are always about or directed toward something that is missing (as Reznikoff’s texts were “directed toward” his grandfather’s missing poetry). In text composing we do not report on a pre-given world “out there” or “inside ourselves”; rather, we *bring forth* a textual world as we are writing it. And we dwell in that world and are defined by its creation as certainly as we dwell in the “real” world.

We might ask then: If enaction constitutes and defines ecological systems, and if we are to consider composing situations as ecological systems, what kinds of activities in composing situations are evidence of enaction? It seems to me that our present view of such activities is seriously impoverished. We conventionally posit composing situations as enacted in a very small set of practices, generally represented as “reading” and “writing.” Recent ethnographic studies have enlarged

this view to include the role of “talking.” In our journals, we have discussed at length the practices of teaching writing, almost invariably in terms of the activities of writing, reading, and talking. We have discussed as well practices related to our institutional involvements, such as job hunting, seeking tenure, and presentations at professional conferences. But we have maintained, in general, a reductionist perspective on actual writing situations. I believe we need to look not more closely, but differently, at any ecological system of composing in order to discover the range and variety of the situated activities that both constitute and define it.

Our activities and practices as readers and writers generate effects in the environment, which includes other people; and, at the same time, the same environment is affecting our activities and practices. Enaction involves “capacities that are rooted in the structures of our biological embodiment but are lived and experienced within a domain of consensual action and cultural history,” as Varela, Thompson, and Rosch put it. They add,

If we are forced to admit that cognition cannot be properly understood without common sense, and that common sense is none other than our bodily and social history, then the inevitable conclusion is that knower and known, mind and world, stand in relation to each other through mutual specification or dependent coorigination. (149–50)

We can see enaction at work as writers interpret their experiences and ideas in texts that emerge from continuing activities and experiences with their environments, on computer screens, on legal pads, with keyboards, pens, and pencils as physical devices for inscription. Composing practices such as freewriting, invention heuristics, diagramming, outlining, sketching, and marking manuscripts for revision also structure the form and content of what is written. The emerging text begins to organize itself into a body, and through the interactive process of its composing, it also specifies its writer—we are shaped by the texts we create as surely as we shape them. The reader interacts with a text through time, in which meaning emerges and organizes itself, more or less coherently, in dialogue with the reader’s mind: thus text and reader arise codependently. Sometimes, indeed, as Ornatowski has demonstrated in the writing of government contractors, readers (government officials) actually dictate the form and content of the text (contract proposals). Writers, readers, and texts develop and mutually specify each other in specific situations through

physical, social, psychological, temporal, and spatial experience and activity; for this reason, we describe composing as an enactive process. We chat on the phone with a colleague, attend a conference and listen to presentations, construct an assignment for our students, read a journal article, exchange email with a professor in another field, write some notes on a legal pad, map out an outline, open a word-processing file, and choreograph finger movements on a keyboard with a peculiar arrangement of alphabetic keys. These are all situated activities, which derive their meanings from the specific contexts in which they occur.

I will not attempt to argue that the four attributes I have selected for discussion here—distribution, emergence, embodiment, and enaction—exhaust the possibilities for describing an ecology of composition; rather, these attributes are significant in current research across the disciplines that are engaged in studies of mind, language, and technology, and they have the potential to shed new light on our understanding of writers, readers, texts, and composing processes. But how is it that these attributes manifest themselves?

Dimensions of Complex Systems

To better understand how the attributes of distribution, emergence, embodiment, and enaction can be revealed in ecologies of composing, let's look at five analytical dimensions: physical-material, social, psychological, temporal, and spatial.

The physical-material dimension (including technology). Texts emerge through writers' and readers' physical interactions with material structures: pens, paper, computers, typewriters. Texts take physical form as print on paper in books, journals, log books, and illuminated electrons on the screens of computers. Writers and readers are physical beings, too: one of the reasons Hemingway preferred to type standing up was to relieve the pain from an old back injury. Writers physically interact with the instruments of writing in order to produce texts; readers physically interact with texts, not only through visually scanning, but by holding a book, using a keyboard or a mouse to scroll through a document, turning pages of a journal. Writers and readers stop writing or reading when they are hungry, thirsty, sleepy, or physically restless. They are sensitive to type that is too small, books that are too thick, margins that are too skimpy, screen fonts that are

too hard to read, computer monitors that are too small, rooms that are too warm or too dim, and to many other physical features of the text or the environment that shape their interactions with the "content" of the text.³

The social dimension (inter-individual). The social dimensions of composing have been the focus of a great deal of recent attention, particularly through ethnographic studies such as Barbara Walvoord and Lucille McCarthy's study of college freshmen, Geoffrey Cross's study of collaborative writing in business, and Cesar Ornatowski's studies of textual collaborations between government agencies and contractors. Literary studies have a long tradition of research dealing with social milieus of writers, texts, and readers—new historicist explications of Shakespeare, feminist studies of popular women's fiction, and new interpretations of slave narratives, for example. In this study, the social dimension is not confined to interactions between individuals (such as between the writing instructor and a student) or groups (such as a discussion on a computer forum) but also encompasses a broad range of social structures, practices, and relationships, including cultural and political movements, literary traditions, and institutions.

The psychological dimension (intra-individual). A great deal of research attention—by researchers such as Linda Flower, John Hayes, Carl Bereiter, and Marlene Scardamalia—has focused on psychological aspects of both composing and reading. Thoughts and emotions are widely accepted as the source of writing and the determinant of its reception by readers. Our folk beliefs about writing depend heavily on psychological theories, which have given us concepts such as "writer's block," "problem solving," and "decision making" for describing individual experiences of composing. In fact, this dimension has dominated discussions of composing to such an extent that our assumptions about it have become almost invisible to us. Is writing really the result of simply transferring what's inside an individual's head onto paper? Students complain that they can't *think* of a topic, that they don't *know* enough to write about their subject; writers provide a heroic narrative to explain how they came up with a plot, or they offer psychoanalytic explanations for their inability to meet a deadline; readers despair over the difficulty they have grasping the ideas in a text. Recently, there have been attempts to bridge the psychological and the social dimensions of composing (Berkenkotter;

Brandt). This rapprochement demands an entirely new perspective on research agendas, methodologies, and modes of inquiry, however, and it remains to be seen whether it can be effected. Further, such a combined approach still neglects several important dimensions of composing. For example, as a discipline we have paid little attention to current research on the neurophysiology of attention, language recognition, and text comprehension.

The spatial dimension. Text composing has some unusual spatial properties. Texts are constructed across a bounded space—words on a page or a computer screen, on a billboard or a sign, even a single word scrawled in lipstick across a mirror. Texts fill books and take up space on bookshelves, in libraries, on computer disks, in bookstores, and in warehouses. But texts also cross unbounded spaces, unimagined and unpredictable spaces between their original construction sites and their readers: they are sent out by truck, by plane, by ship, and by computer networks, and, of course, they are passed from hand to hand, to destinations far from their makers. Their writers are situated in particular spaces—a familiar kitchen, an office, a library, a laboratory, a hillside—and so too are readers, who cross the space of the text word by word, sentence by sentence, like travelers in another land. Texts allow writers to travel where they may never go, and readers to be where they've never been. We speak of them as breaking new ground, covering a subject, taking us into familiar territory, as uphill reading; readers are engrossed in another world, far away, lost in the story, struggling over the rough spots, skipping around, or halfway through. These metaphors reflect some of the spatial dimensions of the relationship between writers, readers, and texts. And, like other forms of space, textual real estate usually entails a cost: there is a generative cost (paper, pencils, computers, software), a publication cost (print runs of books or journals, computer media, networks, CD-ROM publishing), and a cost for readers, as well. Sometimes this cost is explicit (books, subscriptions to journals, online charges), and sometimes it is masked (“free” access to the Internet for academics, review copies of textbooks, advertisements, government funding). A non-trivial cost for both writers and readers is temporal: the time consumed in preparing, composing, producing, distributing, seeking, and reading texts.

The temporal dimension. Composition theorists have recently em-

braced the concept that all discourse is historically and culturally situated. Beyond programmatic assertions, however, there has been little real development of the concept itself. Indeed, such statements tend to be both theoretically oversimplified and themselves ahistorical. That is, they serve to flatten the real historical dimensions of any event, activity, state, or process.

Hutchins points out that every person, collective, piece of structure in the environment, and activity has a distinct and different historical trajectory (*Cognition*). He projects these trajectories in three-dimensional space along three temporal axes, which we might term the social, the environmental or technological, and the unfolding activity itself.

Consider a routine event—in his example (*Cognition*), the navigation of a ship into a harbor. On the social axis, we might note that the career of a naval officer on a navigation team, for example, occurs typically on a scale from zero to thirty years. There will also be, at any given moment, several people on the navigation team at different loci on that scale, and the team itself has a history of interactions. Furthermore, the entire process is embedded in a cultural system, the navy, which has its own history dating back to earliest human attempts to navigate the seas. On the environmental/technological axis, we observe that some members of the team may use a piece of structure in the environment, such as a natural landmark, whose history evolves on a scale of thousands of years, but the task will also involve various man-made technological instruments and practices, some new and some older, whose usefulness spans perhaps hundreds of years. On the activity axis, people interact with these environmental structures and each other to accomplish a specific navigational task that unfolds over a few minutes or even seconds.

Many other social, technological, and environmental elements are involved, whether centrally or peripherally, in this navigation moment, each situated on its own historical trajectory. What is the historical situatedness of this complex ensemble? At any moment of observation, as Hutchins notes, we can only take a slice that captures the momentary position of participants but that cannot account for all of the dimensions of their historical relations. Such a view refutes the simplistic notion of “historical situatedness” as some sort of linear progression, an inevitable unfolding of sequences of large and small events, and argues instead for a more complex sense of a network of historical relations in dynamic interaction with each other.

This more complex sense of the historical dimensions of an activity has a direct application to the writing situation, in which relationships among writers, readers, and texts unfold over distinct historical trajectories in a landscape of historical relations—the emergence and reception of genres, styles, and topics; the politics of race, gender, and class; economic cycles; cultural trends; life cycles of writers and readers; particular writing tasks or reading episodes. For example, let's consider a writer engaged in a composing task and manipulating a piece of equipment, a personal computer, that would have been as unimaginable as a "personal space shuttle" even a few years ago and that could easily be superseded by some newer technology a few years from now. But the textual form or genre, such as a dissertation, for instance, might date back hundreds of years, to the development of the university system in Europe. The writer is a particular age—8, or 19, or 45, or 78—and this fact makes a difference not only in terms of the life experience, skills, and strategies for writing that the writer brings to the work but also in terms of how the text will be viewed by readers. The text has a certain lifetime, too: perhaps a few seconds if it is scrubbed out on the computer screen before it is printed, perhaps centuries if it is cherished and preserved. The style may become dated; the genre might fall out of fashion; universities could come to view dissertations as quaint relics of the past, or they could replace them with new forms—virtual-reality constructions, book or journal publications, or videos of candidates in action. There are intellectual and social trends as well: ethnographic studies come into favor, empirical studies fall from grace; women and minorities are celebrated, white males drop out of the spotlight; it's a good year for studies of composing in early childhood, it's a bad year for studies of college students revising; Bakhtin is in, Derrida is out. Meanwhile, the institutions in which all of this activity is embedded are themselves changing: budget crunches forcing the closure of whole departments; new disciplines emerging, gaining prestige, or falling from favor; publishers starting up or closing their doors; funding agencies shifting their priorities.

The five dimensions outlined here are not categories or classes of objects; they are five aspects of every object, process, fact, idea, concept, activity, structure, event, and so on. Thus, although we can distinguish these dimensions, they cannot be "separated out" because they are interdependently specified. As in geometry, single-dimension objects can only exist theoretically, in the imagination.

Each of the four attributes mentioned above shares the properties

of the five dimensions, so we can speak of the distribution of cognition (or text composing) across physical, social, psychological, spatial, and temporal dimensions. Further, each of the properties can be deployed across all four attributes. For example, the social dimensions of composition are distributed, embodied, emergent, and enactive (see fig. 1).

These dimensions and attributes can be observed at every level of scale, from neuronal structures and processes in the brain to population genetics, geophysics, and global economics; in composition studies, from a poet's tiny editorial correction on a draft of a poem to a global literary movement—poststructuralism, feminism, hermeneutics.

Much research in complex systems theories has used the formal language and modeling of mathematics to express and validate concepts in the field. I am not arguing for a mathematical approach to composing, but I *am* trying to get at complexities in ecological systems that have not been addressed by theorists in rhetoric and composition. This may be why so many existing theories are so unsatisfactory and partial. Typically, composition research has posited a triangle of writer, text, and audience and has tended to single out the writer, the text, or the audience as the focus of analysis. Once, rhetoric and composition theories focused on text features alone, tropes, modes, argumentation, coherence, transitions, and so on; texts were artifacts. Other than the related issues of reaching one's "audience," usually considered as a purely textual exercise, there was little theoretical consideration of the psychological, social, temporal, or physical dimensions of writing.

	Physical	Social	Psychological	Spatial	Temporal
Distribution					
Embodiment					
Emergence					
Enaction					

Fig. 1. An ecological matrix

In the 1970s, Janet Emig, Sondra Perl, Nancy Sommers, and others introduced the concept of writing as a process, foregrounding the temporal dimension in which composing unfolds not only as specific writing tasks are accomplished, but also over the longer-term developmental stages of writers. Later, in the 1980s, Linda Flower, John Hayes, and others introduced theories from psychology into composition studies, foregrounding the psychological dimension. In their cognitive models of composing processes, writers draw on long-term and short-term memory as they make plans, solve problems, and develop goals and strategies for writing and revising a text.

At about the same time, ethnographic projects by Donald Graves, Lucy McCormick Calkins, Lee Odell and Dixie Goswami, Shirley Brice Heath, and others began to illuminate the social dimension of writing, acknowledging the importance of social interactions and structures in composing, and arguing for the significance of collaborative writing. Recent ethnographic studies of classrooms and other composing situations (Chiseri-Strater; Walvoord and McCarthy), studies of co-construction of texts (Gere; Lunsford and Ede), and case studies of "real-world" writing (Doheny-Farina and Odell; Odell and Goswami; Ornatowski) have complicated the picture, introducing into the triangle an additional member, often referred to as *context* or *culture*. The construction of context or culture, in much of this research seems, however, primarily social; there is little discussion of the material or physical world as a significant component of composing activity.

There are hopeful signs that our discipline is growing aware of the need to enlarge its sphere of inquiry. In "The Ecology of Writing," Marilyn Cooper quotes Richard C. Lewontin, the biologist:

All organisms—but especially human beings—are not simply the results but are also the causes of their own environments. . . . While it may be true that at some instant the environment poses a problem or challenge to the organism, in the process of response to that challenge the organism alters the terms of its relation to the outer world and recreates the relevant aspects of that world. The relation between organism and environment is not simply one of interaction of internal and external factors, but of a dialectical development of organism and milieu in response to each other. (368)

In spite of the promise in Cooper's title and the Lewontin quote, however, the ecology of writing in the article is still rather sketchy and limited to social interactions via ideas, purposes, interpersonal interactions, cultural norms, and textual forms.

Until very recently, in fact (e.g., see Haas, *Writing*), there has been surprisingly little attention directed to the physical, material circumstances of writing, although Michael Davidson argues persuasively for the value of such study through, for example, research in archives on poetic drafts and manuscripts. Davidson points out that the archive "returns a quality of voice and physicality to work which may seem, in its published version, hermetic and isolated" (317). And finally, researchers such as Cynthia Selfe, Gail Hawisher, Andrea Herrmann, Paul LeBlanc, Stuart Moulthrop, George Landow, and others studying computers and composition have drawn attention to some aspects of the physical dimensions of writing using new technologies. Martin Rosenberg, Paul Taylor, William Paulson, and Katherine Hayles have for some time explored chaos and complexity theory in relation to literary theory and to some extent composing situations. But we do not yet have a comprehensive theory of composing as an ecological system of interrelated structures and processes that are at once physically or materially, socially, psychologically, temporally, and spatially emerging in codependent activities.

It seems that composition researchers, even those working with collaborative composing, are still constrained by some common cultural assumptions about mind, language, and society. Central to these assumptions is the idea of cognition as uniquely the property of individuals, as computational activity of the brain. Second is the assumption that language represents thought, which somehow precedes it. Third is the assumption that a group can be treated simply as a gathering of individuals, who make individual plans, decisions, contributions, and "moves" in enacting the group process. Fourth is the assumption that text composing can somehow be isolated from the physical and material conditions of its production and use. A collateral assumption is that we can understand composing atomistically, as distinct entities (texts, individual writers, genres, strategies, tasks, decisions, problems, and "processes"), rather than as an ecological system with a high degree of integration among its components.

This study presents a challenge to current assumptions about the nature of composing. Working with concepts developed by Ed Hutchins, Jean Lave, Bruno Latour, John Holland, Stuart Kauffman, Lucy Suchman, Francisco Varela, Evan Thompson, and Eleanor Rosch, I argue that composing, like many other human cognitive processes, is irreducibly social and inextricably embedded in specific environments that are not merely supportive of but integral to the processes of think-

ing, writing, and reading. Further, I argue that our goals for improving or even understanding reading, writing, and thinking cannot be achieved without a careful consideration of the ecological systems within which these practices occur.

Pat Churchland, a philosopher of science, has raised an interesting issue for theorists of complex systems. When asked whether it is reasonable to think of the human brain as a complex dynamical system, she replied, "It's obviously true. But so what? Then what is your research program?" (qtd. in Lewin 164). For composition theorists, this challenge presents itself as two related questions: How can we determine whether theories of complex systems are relevant to composing? And if they are relevant, what is our research program? This book suggests both the possibilities and the necessity for such research.

New technologies, while they have expanded the horizons for discourse, have also made manifest the inadequacy of our present approaches to composition. Ethnographic methods are confounded by the time and distances involved in highly interactive computer communication. Discourse analysis is tailored to conversation, but analysis of turn-taking, timing of pauses, and interruptions is impossible with email discussions. Revisions are no longer necessarily separate drafts with handwritten corrections, but fluid processes of change, including correction, deletion, and elaboration on the computer screen. Electronic manuscripts have elastic properties of font size and style, margins, footnotes, and other features that make it difficult even to establish an authoritative text for analysis. Since our present analytical approaches are inadequate to the task of understanding new technologies for composing and communication and their transformational impact on cognition and culture, our best hope of developing new analytical approaches lies in careful observation and interpretation of the discourse as people are presently using it in a wide range of applications, in classrooms and corporations, in campuses and laboratories, in government agencies, and in commercial information services.

We need to discover who and what are the agents interacting in an ecology of composition; how these agents organize themselves into a more or less coherent whole—a word, a sentence, a poem, a literary genre, a collaborative writing group, a movement such as "romanticism" or "modernism"; how they situate themselves; how they interpret their environments; and how they use their interpretations to engage in purposeful activities and interactions. And specifically, we need to gain a better understanding of how composing systems are distrib-

uted, embodied, emergent, and enactive across physical, social, psychological, temporal, and spatial dimensions.

Among the problems with attempting to enlarge the unit of analysis beyond the individual, the unit with which we are so familiar, is that such a change confronts us with a seemingly overwhelming amount of information. Ethnography presents researchers with a dramatic example of this predicament: among the vast mass of collected observations, interviews, notes, and interpretations, how does one sort out the telling details from the inconsequential? It is no use saying that all details are significant; time, space, and writers' and readers' patience are finite. As a discipline, we have not yet developed a useful method for recognizing, sorting, classifying, recording, or interpreting significant features that emerge from the complexity of the context in which they occur.⁴ Further, we have not developed a generally accepted (even within our own discipline) means of moving beyond descriptions of complex writing situations toward explanation. Until we are able to do so, our status as a discipline is open to question. Such a project is beyond the scope of a single book, of course. I can only sketch out here some of the dimensions of the task and argue for its importance and urgency.

Our view of composing has been greatly simplified as a consequence of our methodological procedures. In the process, however, we have simply dropped out some rather large and complex components that may be significant for our understanding of what is involved in actual composing situations. As contexts and technologies for writing continue to change at an ever accelerating pace, we cannot cling to our familiar, comfortable assumptions about writers, readers, and texts, or we will find ourselves increasingly irrelevant and even obstructive. We must not only develop new instruments and new tools for analysis; we must also develop entirely new disciplinary ways of seeing, thinking, and sharing knowledge. In the process of reconstructing our disciplinary thinking, there will be many failed attempts, blind alleys, wrong turns, and bloody battles, but the alternatives are worse.

In the chapters that follow, we will look more closely at the four attributes of an ecology of composition mentioned above, distribution, emergence, embodiment, and enaction, by examining specific writing situations, while keeping in mind the central question: What can we learn about readers, writers, and texts by considering composing as an ecological system?